Preservation Rhinoplasty Third Edition Editors and Authors…

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Acknowledgement:

We started our book project, *Preservation Rhinoplasty*, in February, 2018. Our desire was to complete the book in the shortest possible time to help early adopters minimize potential complications. The task was completed over a 9 month gestation followed by self-publication to ensure its availability at the Preservation Rhinoplasty Meeting in Istanbul, November, 2018.The book was an immediate success and the original 1,000 copies quickly sold-out. It was necessary to provide an up-dated and expanded Second Edition for Dr. Saban's meeting in Nice in February, 2019. The current Third Edition reflects the dramatic advances that have occurred in the past two years, particularly as regards dorsal modification procedures, complete alar preservation, and the role of cone beam scans. Also, the Editors wanted more emphasis on patient selection and decision making throughout the text as well as information on revisions and managing complications. As the past 3 years have demonstrated convincingly, *Preservation Rhinoplasty* has confirmed its original definition - a series of evolving surgical techniques as well as a fundamental approach and philosophy for the entire rhinoplasty operation

In addition, other tasks have been superbly executed by our team members that include the following:

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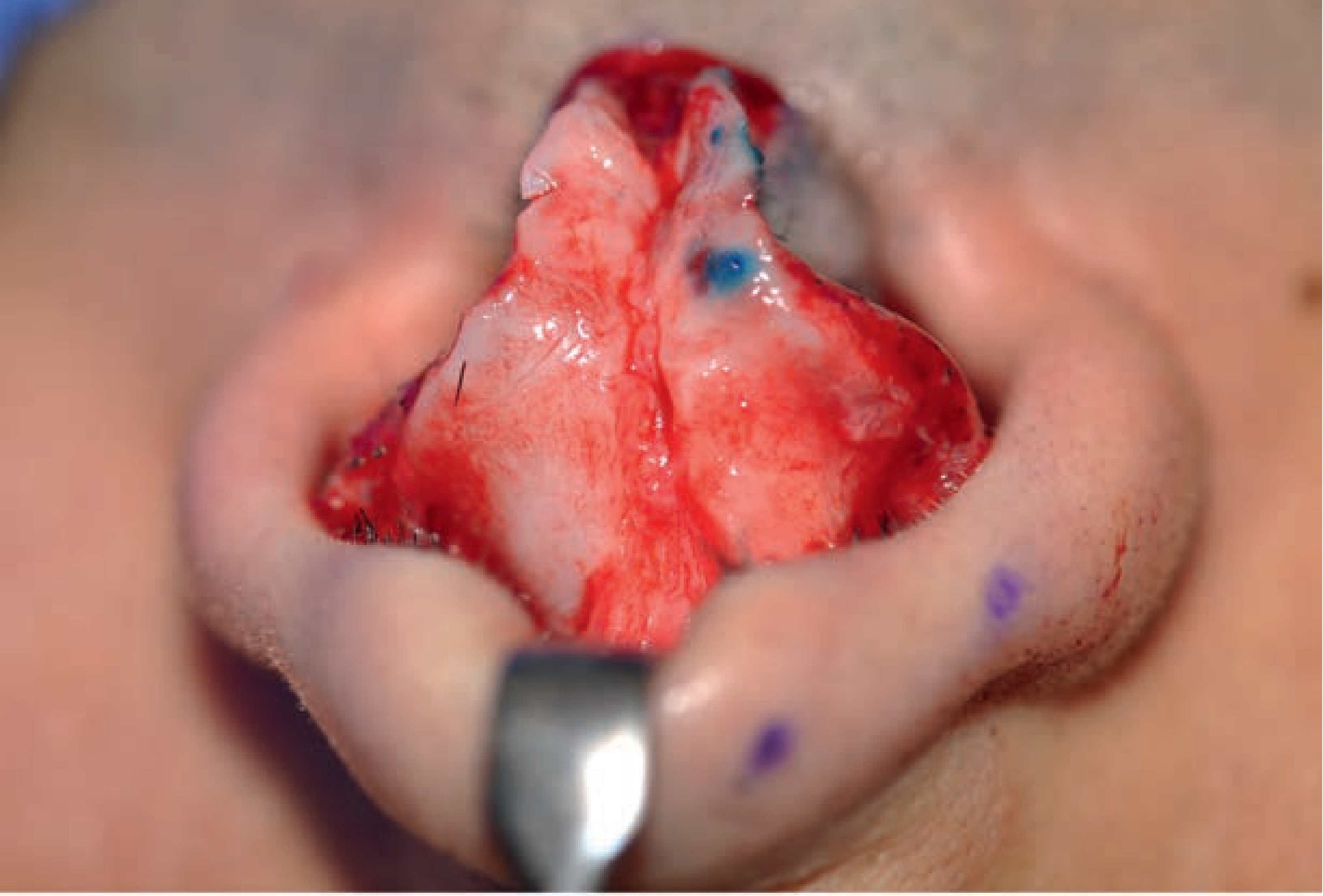
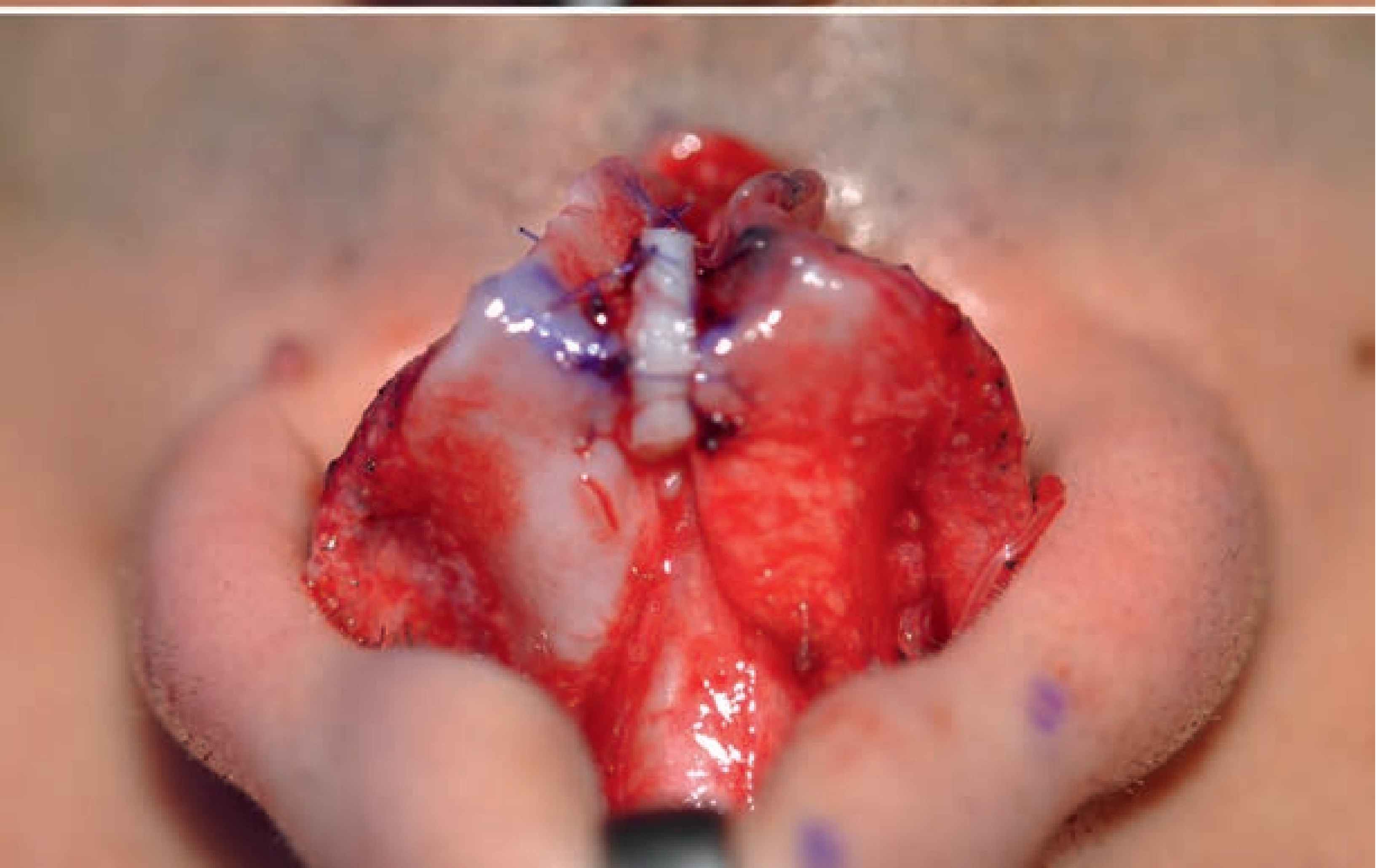
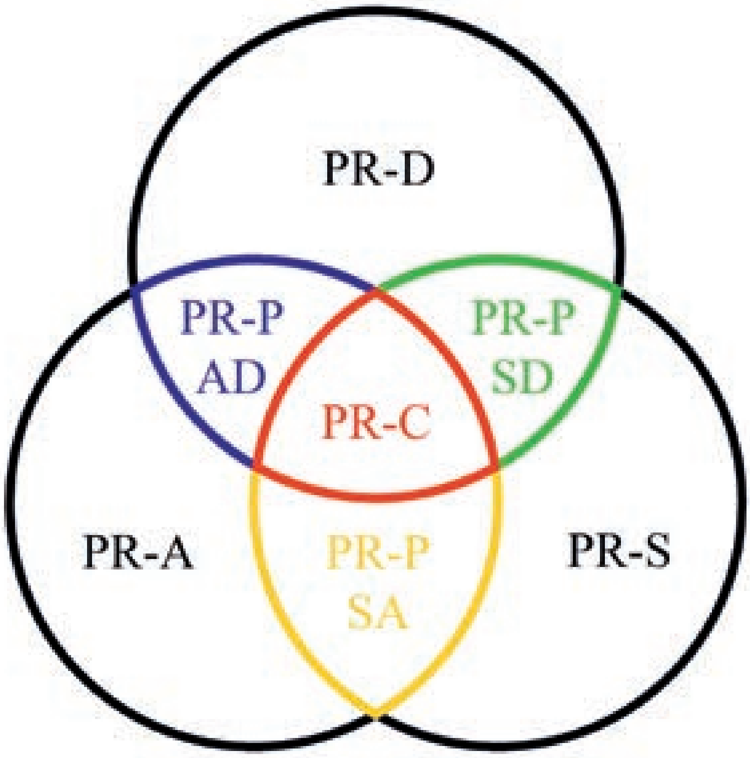






Preservation Rhinoplasty - Rationale & Overview

Rollin K Daniel

Based on my experience with over 6,000 rhinoplasties, I concluded that surgeons need to fundamentally change how we perform primary rhinoplasty surgery in order to minimize the need for complex secondary rib reconstructions. The three basic principles are preservation of the skin sleeve, dorsum, and alar cartilages. The goal is to replace resection with preservation, excision with manipulation, and secondary rib reconstruction with minimal revisions. On reflection, this new approach marks a distinct change from both “resection rhinoplasty” and “structural rhinoplasty,” thus leading to new terminology – “Preservation Rhinoplasty.” This fundamental advance was summarized in an Editorial entitled “The Preservation Rhinoplasty – The Next Rhinoplasty Revolution” (Daniel 2018). Shortly after its publication, Dr. Cakir asked if his next meeting could be entitled Preservation Rhinoplasty. I thought it was a brilliant idea because surgeons should learn new procedures from teachers experienced with this procedure. In addition, I emphasized that the proceedings of the meeting should be summarized in advance and published as a text book to further assist surgeons in learning these new techniques. Our collective goal was to shorten the learning curve for other surgeons and to minimize postoperative problems which could lead to revisions. During the past year, it has become obvious to me that Preservation Rhinoplasty is not just a series of surgical techniques, but rather a *fundamental approach and philosophy* for the entire rhinoplasty operation. This current Third Edition of Preservation Rhinoplasty will emphasize the fundamental principles and how surgical techniques continue to evolve.

PRINCIPLES

Preservation Rhinoplasty (hereinafter PR) is composed of the following 3 parts:

1) elevating the skin sleeve in a subperichondrial – subperiosteal dissection plane,
2) preserving the natural dorsum with optional modification but avoiding an open roof, and
3) maintaining the alar cartilages with minimal excision while achieving the desired shape using sutures.

Skin Sleeve

For decades, surgeons have elevated the skin sleeve in the sub-SMAS plane which has led to significant postoperative swelling, numbness, prolonged scar remodeling, and long-term thinning of the soft tissue envelope (hereinafter STE). In contrast, elevation of the STE in a deeper plane results in minimal swelling, near normal sensation, minimal scar remodeling, and avoidance of long-term thinning of the soft tissue envelope.

Dorsum

In the majority of rhinoplasties, removing the dorsal hump has been done by resection which leads to creation of an "open roof" that in turn requires midvault reconstruction using either spreader grafts or spreader flaps. In contrast, dorsal preservation (hereinafter DP) maintains the dorsal structures while eliminating the dorsal hump using septal resection followed by osteotomies to reduce the height of the dorsal line. Essentially, one divides the dual goal of dorsal resection – eliminating the dorsal hump and lowering the dorsal profile line – into separate steps. Thus, one is able to modify the dorsum dramatically without destroying its normal anatomy and aesthetic lines while eliminating the need for midvault reconstruction. Note: Preservation Rhinoplasty (PR) is composed of 3 parts, one of which is Dorsal Preservation (DP) – the two terms should not be used interchangeably.

Alar Cartilages

Traditionally, surgeons achieved the desired tip shape using a combination of excision, incision, grafting, and suturing techniques. Although the results were often good to excellent initially, a significant percentage of cases degraded over time. With the rise of tip suturing and structural support using various columellar or septal extension grafts, intermediate term results have improved dramatically with maintenance of projection and fewer tip deformities. PR advances tip surgery even further by preserving virtually the entire alar cartilage which enhances function, reduces potential problems, and makes any future revision simpler. These techniques of preserving the alar cartilages represents as great an advance in tip surgery as the introduction of structural techniques, and may well make many of the structural steps unnecessary as distortion forces and scarring are minimized thereby reducing the need for support.

CLASSIFICATION

PR consists of 3 components (see introduction diagram): intact skin envelope elevation (S), dorsal preservation (D), and alar cartilage preservation (A). Obviously, all 3 will be done in some cases (complete: PR-C) and in other cases only partially (partial: PR-P). Thus, partial cases can be subdivided into which of the 3 components was done. For example, a common technique will be a case with dorsal and alar preservation which would be designated as PR-P (D, A). For the compulsive surgeon, one could further subdivide S into subperichondrial over the alar cartilages as Sa and over the osseocartilaginous vault as Sd.

OPERATIVE SEQUENCE

As a general rule, surgeons should integrate new techniques into their standard operative procedure rather than replace them completely. For example, the majority of surgeons currently use the open approach and a limited sub-SMAS elevation of the STE. In contrast to certain experts who use a closed approach, the majority of surgeons should continue to use the open approach for PR as it facilitates visualization of what can initially be technically difficult steps in the dorsal preservation procedure. Although some surgeons prefer a total exposure of the bony dorsum for insertion of piezo electric saws, the majority of surgeons will continue to use a limited exposure and osteotomes for PR. As one becomes more experienced, changes will be made in the operative technique.

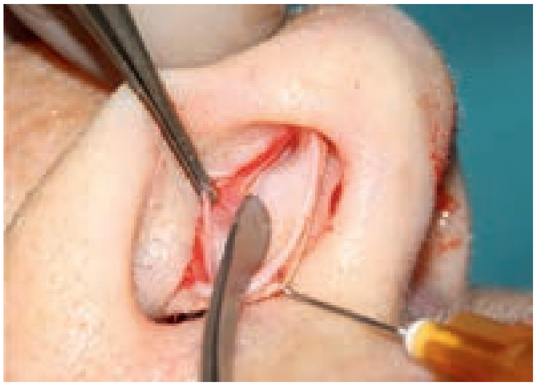
ANESTHESIA

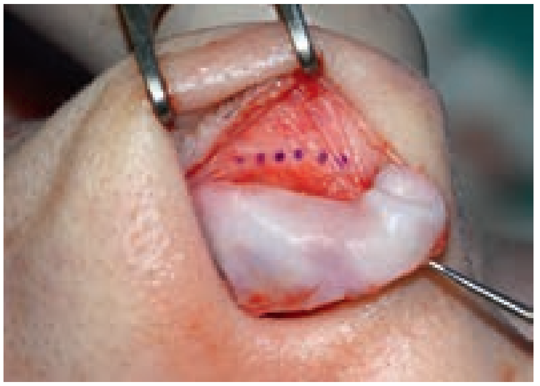
Virtually all patients are done under general anesthesia with supplemental local anesthesia. It should be noted that the majority of authors in this text use *hypotensive general anesthesia* with the systolic blood pressure below 90mmHg (see Anesthesia chapter). Often, the technique of injecting the local anesthesia can be divided into the following 3 stages: 1) standard nasal, 2) supplemental nasal for PR, and 3) extended paranasal anesthesia if a deep plane total bony exposure is planned. The standard injection for an aesthetic septorhinoplasty can be done with 6-8 cc of local anesthesia inserted in small amounts at the incision sites and along the dissection planes of the nose and septum.). Most surgeons also do a “field block” of the nasal vascular supply including the infraorbital, dorsal, and nasal arteries via the perialar base region. Supplemental injections specifically for the PR procedure include additional infiltration deep in the keystone area. Local anesthesia for extended deep plane dissection with total exposure of the bony vault is supplemented with a dilute tumescent solution.

EXPOSURE

The skin sleeve is elevated in a single sheet via a continuous subperichondrial-subperiosteal plane (hereinafter SSP). The surgeon can use either an open or a closed approach. For the majority of experienced surgeons who prefer the open approach, this step may require switching from the more superficial sub-SMAS plane to the deeper subperichondrial plane. Although many surgeons think they are dissecting “subperichondrially,” they are not. One can see in the figures below a typical sub-SMAS dissection over the nasal cartilages. The alar cartilage appears clean in the medial half, but one sees SMAS remnants on the lateral half. Visually, the true subperichondrial plane dissection over the cartilaginous dorsum reveals a clean white cartilage surface. (Left) A sub-SMAS dissection, (Right) a Subperichondrial dissection.

In contrast, a true subperichondrial dissection as performed by Dr. Cakir leaves the perichondrium intact and exposes the clean alar cartilage without any SMAS attachments. (Dots indicate the sesamoid cartilages within the longitudinal scroll ligament).





Dorsal exposure can be discussed in terms of plane and extent. Although some surgeons prefer the standard sub-SMAS plane (Saban), the true goal of PR is to raise the entire STE intact with no disruptions. Therefore, we prefer the continuous SSP of dissection. The extent of dissection will depend in part on preference or surgical instrumentation – limited extent (osteotomes) or wide dissection (Piezo instruments). The true dorsum is exposed to allow any minor modifications and to insure smooth skin redraping. Saban feels that skin undermining is critical to release any restraining connections and allow redraping onto the newly positioned dorsum in contrast to Gola who preserves the overlying skin attachment. Since Saban utilizes conventional osteotomes, he prefers a limited dissection for dorsal exposure usually stopping at the lateral extent of the nasal bones (approximately 1 cm on either side of the dorsal midline). In contrast, surgeons who prefer to use Piezo instrumentation do a wide dissection with total degloving of the osseocartilaginous vault. Virtually all surgeons who use a wide exposure combined with dorsal preservation have been impressed with the minimal postoperative swelling and rapid recovery of the patients. This counterintuitive finding may be due to multiple factors: 1) the SSP dissection with preservation of the STE results in minimal vascular disruption, or 2) the intact dorsum acts as a “blocker” to prevent bleeding from the septal area extending upward (Kosins).

SEPTAL SURGERY

Without question, the most significant change in technique for PR is the approach to septal surgery / dorsal preservation. Conceptually, one has to balance resection with preservation and straightening with support. The following 5 differences between standard septal surgery for aesthetic rhinoplasty and septal surgery in PR are as follows: 1) a more limited subperichondrial exposure; 2) high septal strip resection for elimination of the dorsal hump and dorsal profile reduction, 3) greater septal mobilization to release fixation of the deviated septum, 4) an emphasis on septal relocation rather than septal resection, and 5) less septal harvest for graft material.

Obviously, there is a range in the amount of septal exposure and septal resection from the least amount possible (Saban) to the standard exposure (East, Kosins) to extensive (Juliano Paris).

As advocated by Saban, a high osseocartilaginous septal strip excision is an intrinsic part of the operation and must be incorporated into any preoperative plan (Saban et al. 2018). Obviously, a contraindication for the operation could be extensive prior nasal trauma or septal surgery. Since PR eliminates the need for midvault reconstruction and reduces the frequency of alar rim grafts, less graft material will be required, and more septum can be maintained for septal support.

DORSAL PRESERVATION (DP)

The type of osteotomies and method of mobilization will vary depending upon the amount of dorsal reduction and the surgeon's preference. The 3 major steps in DP are the following:

Step # 1 – Septal Strip Resection

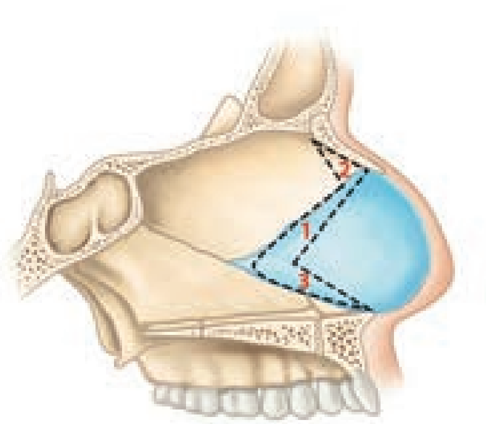
The septal strip excision must accomplish 2 things – eliminate the convexity of the dorsum and provide room for lowering the dorsal profile. Essentially, the keystone area is an osseocartilaginous "*joint*" which is supported by the underlying septum. Once this support is excised, the hump can be reduced, eliminated, or even pushed toward concavity. The amount of septal strip excision will often correlate with the amount of dorsal reduction – a 6mm septal resection allows for a 6mm reduction in the dorsal profile. How and where is the septal strip resected? At this point, one should compare the method of septal resection in Cottle's classic Push Down procedure (Cottle et al. 1958) with the Saban septal strip resection. Essentially, Cottle's classic septal surgery consists of the following 3-part resection (see below on the left):

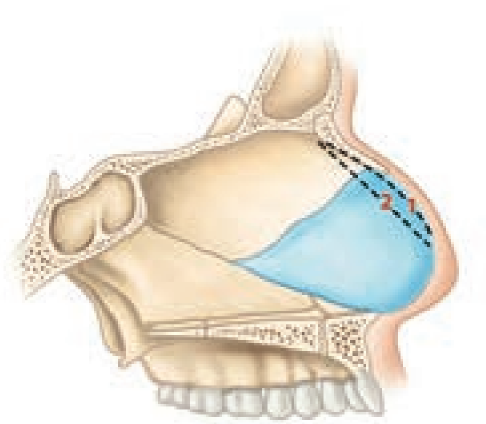
1) a vertical 4mm wide resection at the bony –cartilaginous junction of quadrangular cartilage and ethmoid bone running from the keystone area down to the vomer,
2) a longitudinal triangular resection of ethmoid bone beneath the nasal bones, and
3) a longitudinal strip excision from the inferior surface of the quadrangular cartilage comparable to the amount of anticipated dorsal lowering.

In contrast, Saban's high longitudinal septal strip excision accomplishes the same objectives in a simpler two cut single resection (see below on the right):

1) Under direct or endoscopic visualization, the cartilaginous resection starts just below the level of the upper lateral cartilages septal junction (W-point) approximately 10mm cephalic to the anterior septal angle (hereinafter ASA). Using a V tip sharp scissor, the incision proceeds directly under the dorsal vault until there is bony contact at the perpendicular plate of the ethmoid beneath the bony cap.
2) Then, a second incision is made parallel to the first at a lower level.

The amount and shape of the intervening septum to be excised depends upon the preoperative planning. Using the tip of a Joseph elevator, a disarticulation between the cartilage and the bone is performed and the cartilaginous strip is removed. Next, a Blakesley straight endonasal forceps 4 mm in width is introduced into the freed septal space just below the dorsal vault and a portion of the ethmoid bone is removed. This resection can be done safely as this site is far from the lamina cribriformis and the skull base. When first starting out, the amount of excision should be done *incrementally* to avoid excessive excision. For recent advances in the modified Cottle technique, see the SPQR chapter by Finocchi.

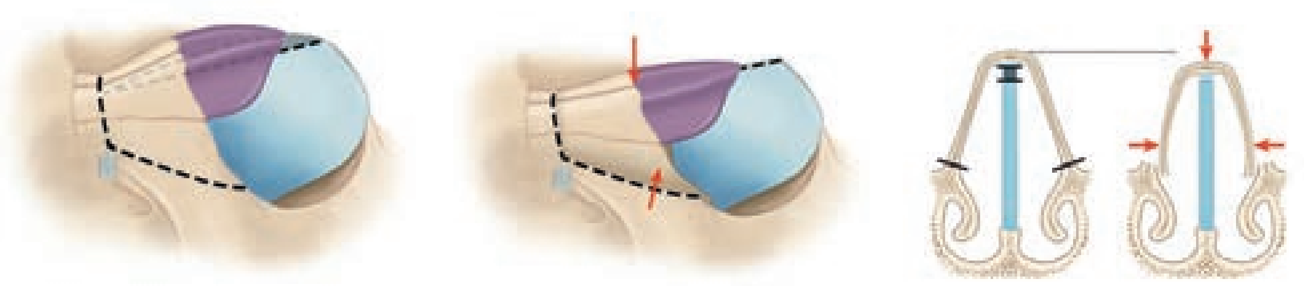




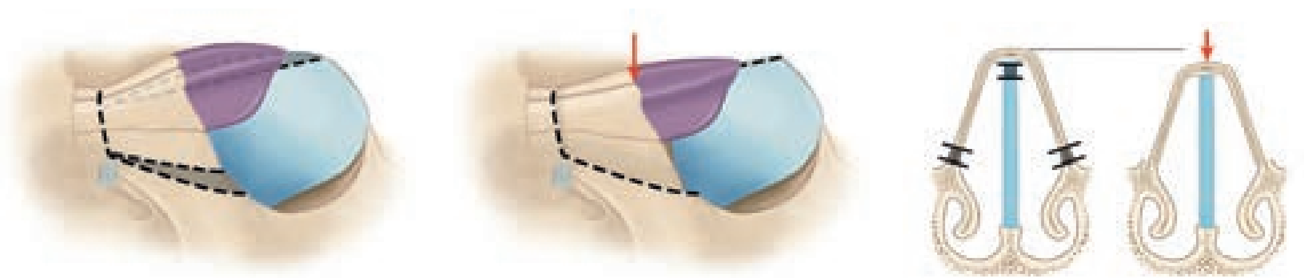
Step # 2 – Bony Pyramid Mobilization

One can arbitrarily divide the bony mobilization into complete osteotomies with *push down* for small humps and complete osteotomies with lateral wedge resection to *let down* for larger humps. In all cases, *the entire bony vault is mobilized "en bloc" with separation of the nasal bony pyramid from the frontal processes of the maxillary bones and the nasal spine of the frontal bone*. This maneuver requires complete lateral and transverse osteotomies. A clear understanding of the difference between a Push Down (hereinafter PD) and a Let Down (hereinafter LD) operation is essential and can be seen below.

Push Down



Let Down



In case of small humps and/or minimal reduction, we prefer the Push Down with complete lateral osteotomies performed percutaneously. For the lateral osteotomy, the tip of the osteotome must be perpendicular to the lateral bony wall. A sagittal cut is important as it allows a better sliding of the bony surfaces and facilitates the push down maneuver while reducing the risk of excessive narrowing of the base. Next, a percutaneous perpendicular transection of the nasal spine of the frontal bone is done. A 2mm osteotome is pushed through the skin at the *nasion* and a transverse root osteotomy of the nose is completed. Additional transverse cuts can be made from the cephalic termination of the lateral osteotomy upward towards the *nasion*. The result must be a *totally mobilized nasal pyramid* allowing for transverse movement.

If a more extensive lowering of the nasal pyramid (more than 4 mm) is required, then a Let Down is usually preferred by performing a triangular bony wedge resection of the frontal processes of the maxilla. This excision must be done very low laterally, in the nasofacial groove in order to avoid any palpable or visible step. An endonasal approach is used beginning with undermining on the deep aspect of the maxillary process followed by external subperiosteal undermining up to the anterior insertion of the medial canthal tendon. Then, *triangular bony wedges of the frontal processes of maxilla* are resected on both the left and right sides at the level of the facial plane. This lateral basal resection can be done either by precise osteotomies under direct vision or using bone rongeur forceps, or even Piezoelectric instruments. Once the bony wedges are resected, then the bony pyramid can descend freely until it rests on the maxillary bone.

Step # 3 – Lowering the Dorsum

At this point in the operation, the septal strip excision has been completed followed by the bony vault osteotomies - the entire nasal pyramid is totally mobilized. The bony-cartilaginous dorsum can now be lowered or impacted in between the frontal process of the maxilla using the following three steps:

1) transverse mobilization of the whole nose,
2) pinching the bony sides of the nasal vault symmetrically, and
3) performing a downwards movement of the nasal bony pyramid into the nasal fossa.

With the Push Down, the lateral nasal walls slide inside the frontal processes of the maxilla, while the dorsal bony cartilaginous vault goes down onto the remaining septum. When performing a Let Down, the nasal pyramid rests on the midline septal central pillar while laterally the bony lateral walls and rest on the frontal process of the maxilla.

Thus, the new height of the nose is determined by the level of the septum which acts as the central pillar of the nasal framework. If further lowering is required, another strip of cartilaginous septum can be incrementally resected until the desired result is achieved. At this point, it is important to check the upper septum just below the K-area, in order to avoid a rocker effect. If this occurs, further resection of the subdorsal septum is done under direct vision to control the final shape of the dorsum. We prefer a slight overcorrection near the keystone area, but always avoid an excess of cartilage resection in the supratip area which can lead to a saddle deformity. The resected cartilaginous strips can be reserved as a graft for subsequent use often as a columellar strut or alar rim grafts.

The dorsum is fixated to the underlying septum near the ASA with one or two Vicryl® 4/0 sutures on a round needle. If necessary, a percutaneous nylon suture can be placed through the ULCs and the septum maintaining the desired position and stitched externally on a “bourdonnet” dressing; or a small hole can be drilled through the nasal bones on both sides and a transosseous suture inserted. The treatment of the tip is done later, according to the necessity. Since impaction of the dorsum will change tip position and rotation, it is always better to start the rhinoplasty with modification of the bony vault. In patients with a high convex dorsum, the lowering of the vault will open the K-area leading to a longer dorsum following simple mathematic rules. In these cases, it is mandatory to excise part of the new anterior septal angle to allow for rotation of the tip.

TIP MODIFICATION

PR represents a dramatic shift in how surgeons approach tip surgery for the following 3 reasons:

1) the vast majority of the alar cartilages are maintained, and cartilage resection is minimized,
2) the tip ligaments are preserved with minimal need for suture reconstitution, and
3) the subperichondrial exposure minimizes long term scar distortion and thinning of both the STE and the alar cartilages.

The importance of the subperichondrial dissection over the alar cartilages cannot be overemphasized, both for its short-term and long-term consequences. Elevating the perichondrium off the alar cartilages renders the cartilages much more malleable and easily shaped with sutures. Experienced surgeons will find a significant difference and even a challenge in how the now more malleable cartilages respond to sutures. Most surgeons use a 6-0 PDS suture on a round needle after a sub-perichondrial dissection as opposed to a 5-0 PDS suture on a cutting needle after a sub-SMAS dissection. The subperichondrial approach also allows one to preserve the various tip ligaments. Since the subperichondrial dissection results in less scarring, there should be minimal bossa formation and a cleaner access for any possible revision. Equally, as there was no actual dissection in the STE and no damage to the SMAS layer, then thinning of the STE over the long-term should be limited to the effects of aging and not surgical damage.

Obviously, tip surgery is extremely complex and highly variable depending upon the patient's anatomy and aesthetic desires. However, preservation of the alar cartilages represents a dramatic shift in tip surgery which should result in a more natural tip with fewer and simpler revisions. The contributions of Gruber, Ozmen, Cakir, Davis, and Kosins have been monumental. Perhaps the best example of this conceptual and technical change is in our approach to alar malposition. Currently, the primary cause of alar malposition is purported to be cephalic orientation where the lateral crus is perceived to be oriented towards the medial canthus. Toriumi has defined it as an angulation of the lateral crus from the midline measuring less than 30 degrees with an ideal angle being about 45 degrees (Toriumi & Asher, 2015). He has advocated repositioning of the lateral crus to treat a large number of tip deformities in both primary and secondary cases. Yet for many surgeons who have performed a full lateral crural transposition, there is a moment when they wish they had never done it. Total elevation of the lateral and middle crus followed by repositioning results in disorientation of tip landmarks and requires complete remodeling of the tip. In other words, the primary goal was to fix the lateral crus, but the nightmare becomes the secondary need to create an aesthetic tip which might have been acceptable to very good before the transposition. Ultimately, surgeons began to ask the question - do the lateral crura need to be transposed? Cakir and Davis came to the same conclusion independently that transposition is not necessary – simple suture tensioning of the lateral crus medially will correct the problem. There is no need to transpose the lateral crus provided there is no cephalic lateral crus resection and that traction is placed medially to a strut. Davis (Davis 2015) has emphasized the functional benefit of lateral wall tensioning using fixation of the domes to a septal extension graft. As will be noted in the following case history, major aesthetic changes can be achieved by repositioning the totally preserved alar cartilages.

ADVANATAGES

The ultimate goal is to approach all rhinoplasties from a *preservation perspective* and apply the appropriate technique for the individual patient. Yes, there may be specific cases with limited applicability to specific parts of PR rather than the whole entity. For example, there may be cases where one cannot do a DP, but one still preserves an intact skin envelope and alar cartilages. Ultimately, one is trying to keep the skin envelope intact with all of its ligaments and neurovascular structures intact which reduces both short- and long-term morbidity. Maintaining the dorsum results in a more natural appearance, eliminates the need for midvault reconstruction thereby reducing the number of grafts and the amount of septal harvest. Minimizing alar resection and transposition produces fewer tip deformities that require complex revisions. When structures are preserved, any revisions should be relatively simple. For example, the most common revision following a DP is a simple rasping under local anesthesia and not a 5-7 hours secondary rib graft reconstruction.

DISADVANTAGES

The primary disadvantage of PR is the need for the surgeon to modify existing routine techniques and thus the primary challenges are technical. It must be stated that the surgeon should use whichever approach they have more experience with – closed or open – your choice. Another example of how existing methods have to be modified is the subperichondrial dissection which renders the alar and upper lateral cartilages to be more malleable and to respond differently to suturing techniques. As a result, tip sutures need to be inserted more carefully and not tied as tight. In addition, different suture techniques and sequences may be required. The approach to and extent of septal surgery is different. The standard septal method of wide mucosal undermining, maximum septal harvest, and retention of a 10mm wide L-shape strut must be approached with greater care. Exposure is more limited, a smaller more localized resection is done, and a more rigid strut is retained.

ADVANTAGES of PR	DISADVANATAGES of PR
subperichondrial dissection	subperichondrial dissection (alars)
intact skin sleeve - reduces morbidity	increases alar malleability
nasal ligaments preserved	septal surgery more demanding
dead space can be closed	multiple, major osteotomies
more natural dorsum (intact)	total mobilization of bony vault
no need for midvault reconstruction	
fewer grafts required – more septum	
simpler operation	mastery of new techniques
fewer steps so faster	limited application
more rapid recovery	
easier revisions – no rib reconstruction	

CASE #1

A 25-year-old man of Hispanic descent requested a rhinoplasty. He wanted a significant change to eliminate the hanging tip and wide, visible nostrils. The key to analysis is the three-crus concept. Anatomically the alar cartilages are normal, but they are rotated downward to create a *snarl tip*. The most startling aspect of the deformity is the apex of the nostril rim above the tip angle on lateral view. As will be seen, no excision or incision of the alar cartilages is needed; instead, each of the three crura are rearranged and repositioned to their anatomical / aesthetic ideal.

Step #1 – Tip analysis Transfer of the surface aesthetics to the underlying anatomy reveals that the c′ is 3 mm below the nostril apex. The columellar inclination is 80°. The operation would be to verticalize the footplates and advance the columellar segment of the medial crus upward.

Step #2 – Medial crus A modified tongue-in-groove (TIG) was done to raise the footplates onto the caudal septum and to correct the columellar inclination. In addition, c′ was elevated to the ASA to correlate with the top of the nostril.

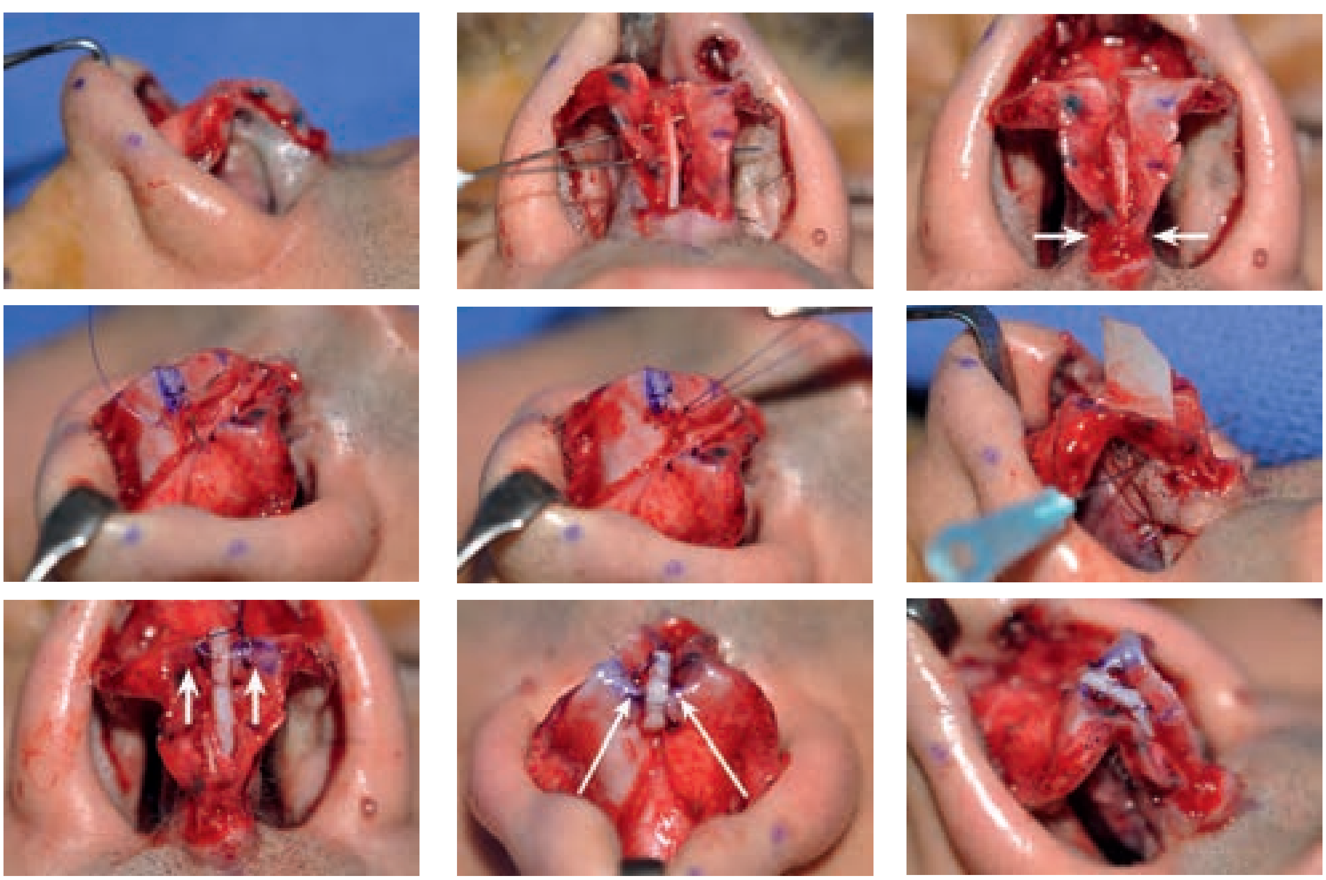
Step #3 – Dome creation Simple cephalic dome sutures (CDS) were inserted at the anatomical domes. This was not a lateral steal, as it correlated with the natural junction between the domal notch and lateral crus.

Step #4 – Septocolumellar graft A 30mm × 8mm septocolumellar graft was sutured to the caudal septum and the medial crus. This was not a septal extension graft as there was no extension.

Step # 5 – Lateral crus tensioning Sutures were placed from the domal segment to the septocolumellar graft. This medialization also flattened the lateral crus–accessory cartilage junction and maintained the vestibular valve.

Step #6 – Base modification At this point, a 3mm nostril sill cinch procedure was done to reduce the width of the nostril sill, followed by the insertion of alar rim grafts.

Note: there is no abnormal anatomy, just abnormally located normal anatomy that needs to be placed and structurally supported in its normal position. Total mobilization of the crus and transposition was not necessary. Also, the natural dorsum was preserved, and a small radix graft was added.



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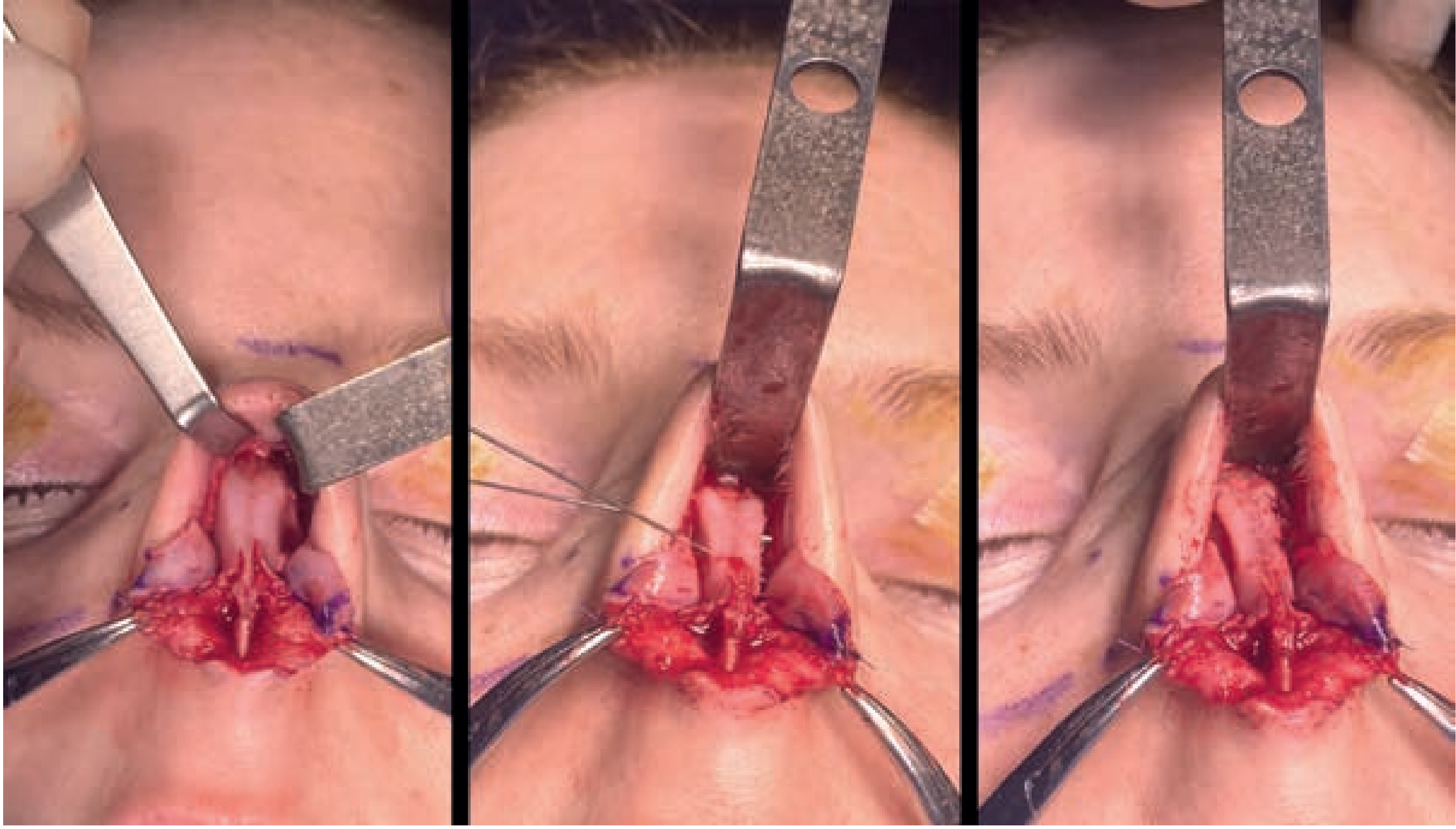
The first Push Down Dorsal Preservation, Goodale, 1898

The first Let Down Dorsal Preservation, Lothrop, 1914



History of Preservation Rhinoplasty

Eugene Kern, Rollin K Daniel

For many surgeons, the concept of Preservation Rhinoplasty and especially Dorsal Preservation surgery is new. Many consider it to be a radical departure from conventional reduction rhinoplasty and worry that it is both risky and unproven. Yet, the operation was first done in 1898 and there is an extensive literature confirming its efficacy and validity. What is new is the recent awareness and interest in the operation by the majority of rhinoplasty surgeons throughout the world. Thus, the Editors of this text consider it appropriate to ask Eugene Kern to summarize his 50 years experience with Dorsal Preservation surgery. We will then review the history of Preservation Rhinoplasty including the dorsum, soft tissue envelope, and alar cartilages in their historical order.

PERSONAL EVOLUTION

The following interview of Dr. Eugene Kern was conducted by Dr. Rollin Daniel at the Advanced Aesthetic Rhinoplasty Meeting in St Petersburg, Russia on October 26, 2019.

Q. I'm sure the first questions readers would ask is for you to tell us about your training in Otorhinolaryngology and how you came to specialize in Nasal Surgery.

A. I had the privilege of being a Resident in ENT-ORL at the Mayo Clinic in Rochester, Minnesota from July 1964 to October 1968. At that time, nasal surgery was divided between two departments. Plastic Surgery did the cosmetic cases and Otorhinolaryngology did the sinus and functional breathing cases. Dr. John Erich was the Chairman of the Plastic Surgery Department and all the ENT-ORL residents rotated through Plastic Surgery as part of our education. I had the marvelous advantage of being Dr. Erich's assistant for 3 months. Also, as part of residency, I benefited from working for 3 months with both Drs. Clifford Lake and Pat Barelli. Both of these surgeons served as teachers at the national "Cottle Courses" performing and teaching the "Push Down" operation. Those experiences were my introduction to cosmetic and functional nasal surgery during my Mayo Clinic years. I also had the opportunity to attend Dr. Cottle's week long nasal surgery course in Chicago in 1967 and Dr. Irving Goldman's rhinoplasty course in New York City in 1968. I was distinctly and indelibly influenced by the "magic" of the rhinoplasty operation with its interplay of structure (anatomy), function (physiology), and esthetics along with the mighty pull of a charismatic cast of inspiring personalities in the field, including "Cottle the Colossal". From then on, almost all themes rhinologic arrived as a fury.

Q. What was the status of Rhinoplasty Surgery in the mid-1960s? Was it the classic Joseph technique with the saws or had it changed?

A. In the mid-1960s, the status, prestige, and importance of rhinoplasty surgery was not as significant or important as the head and neck cancer surgery we saw or the otologic procedures. The marvel of hearing restoration stapes surgery was at its zenith as well as the spectacle of acoustic neuroma surgery often combined with the neurosurgeons. Rhinoplasty was strikingly down the totem pole of rank and esteem at the institution. Regarding the classic Joseph technique, I vaguely recall Dr. John Erich using saws. I also remember Dr. Irving Goldman in 1968, using saws for "hump" reduction and often for lateral osteotomies. At the first Cottle course I attended in the fall of 1967, Dr. Cottle plus the other course surgeons, performing live surgery, were using saws to begin the lateral osteotomy along the ascending process of the maxilla, forming a groove followed by the chisel to complete the osteotomy. During my residency, both Dr. Lake and Dr. Barelli were performing the Cottle "Push Down" technique exclusively rather than the Joseph dorsal "hump" resection rhinoplasty. Cottle had published his article on the "Push Down" operation in 1954 and both Drs. Lake and Barelli adopted that technique. Both became teachers at the "Cottle Courses" in addition to performing and teaching the procedure to their residents.

Q. Let's diverge here for just a moment and talk about Dr. Maurice Cottle who popularized the "Push Down" operation. Since you knew him both professionally and personally, perhaps you could just reminisce about him and how he came to devise the "Push Down" procedure.

A. First, some personal brief reminisces. Dr. Maurice Cottle was my respected mentor. He was a most creative and innovative surgeon demanding a self-imposed rigorous devotion to detail. Using his authority and charisma, he insisted that all of the teachers agree on using his nomenclature so we could speak to each other unambiguously and additionally so as not to confuse the students with differing terminology. He regularly required that surgical maneuvers be performed in a very systematize manner because he observed that surgeons often encountered problems because they did not follow or understand the rationale for a standard surgical sequencing. His dogmatic and doctrinaire nature notwithstanding, Dr. Cottle's noble primary drive was preserving or improving nasal breathing function. "Preservation of normal physiologic function" was his mantra and his essential obsession. He had come to this point because as a rhinologist many of the patients he saw had nasal breathing problems subsequent to a previous rhinoplasty performed throughout the 1950s, 1960s and 1970s. When I was a young Mayo staff surgeon in the early 1970's, I visited Dr. Cottle at his Chicago office and personally observed him making measurements of nasal air flow and pressure differences (rhinomanometry). He could calculate breathing resistance as a method of evaluating nasal breathing function. He was a fundamentalist in the best sense of the word and continuously researched the fundamentals of physiology and nasal airway function. His emphasis was on nasal breathing and respiratory function, not cosmetic appearance. Now, I will discuss the origin of the "Push Down" operation. Dr. Cottle directly told me almost a half century ago, that the concept of the "Push Down" operation occurred to him directly from a middle age male patient that he had been following for sinus issues. One day, the patient came in for a follow up appointment and Dr. Cottle noticed that the patients previously "humped" nose was now straight. Curious as always, he inquired as to what had happened. The patient said that he had been in an automobile accident and struck his face on the windshield. So, it was this "windshield" incident that Dr. Cottle instinctively correlated to rhinoplasty, and presto the "Push Down" operation was conceived.

Q. What about the role of the Cottle Courses for dissemination of his concepts? I remember going to one of the very last courses given in 1980. We sat in the dark for 2 days learning anatomy and physiology of the nose, before we were allowed to touch the formaldehyde-fixed cadaver on the 3rd day.

A. In the 60s and 70s he had a large following in both United States and Europe as he founded the American Rhinologic Society and the International Rhinologic Society. He was also influential and regularly established rhinologic surgical courses (the "Cottle Courses") at academic institutions here and abroad. He clearly believed in teaching the future teachers. He profoundly influenced rhinologic thinking and surgery for more than generation in Canada, the United States, Mexico as well as parts of South America, Europe and the Middle East. Dr. Cottle was extremely interested in the nasal valve and its role in nasal breathing function. Following his birth in England and early life in France, he had a fluency in multiple languages coupled with an old-world sensitivity and sensibility. He garnered a wide circle of European friends among a number of Continental surgeons. He knew about the Dutch surgeon and anatomist Mink and his contribution to understanding the nasal valve and its importance to nasal breathing. He incorporated lectures considering the nasal valve in all of his courses. He felt that a patient's breathing function needed to be studied frequently, and repeatedly declared, "never sacrifice breathing function to make a pretty nose."

Q. Currently, 98% of surgeons have never done nor have any awareness of the Cottle operation. Rather, they have their routine rhinoplasty operation which can make learning new procedures difficult. You taught the “Push Down” operation to Residents for many years. What did you find the challenges to be? Was it different having residents with a clean slate for whom this was their first rhinoplasty operation?

A. At first, our Mayo residents saw only the “Push Down” operation performed by Drs. Clifford Lake, George Facer, Pat Barelli and myself so it was just what we did. The residents learned the Cottle standardized approach for the septo-rhinoplasty. Since septal surgery was a fundamental and integral aspect of learning rhinologic surgery, the “Push Down” which required septal surgery was conceptually understandable once you understood the role of the septum in mobilizing the external nasal pyramid. The primary challenge was teaching the residents how to totally disassemble the septum when indicated. Total exposure of the septum was often indicated in the many previously operated revision case which required reconstruction. Our trans-septal pituitary cases, in conjunction with the Department of Neurological surgery, was a superb opportunity for our residents to learn the tenets of septal surgery in general and specifically total nasal septal reconstruction. As to the challenges of teaching residents, our residents would usually rotate with a nose surgeon for 3 months, we were proselytizing and filling their clean slates with daily nasal patients and they were cheerfully absorbing. In addition, beginning in 1971 on alternate years our staff provided a 10-day “Rhinofest” with lectures and dissecting sessions with fresh frozen cadavers for developing and expanding their newly acquired surgical skills.

Q. You were at the Mayo Clinic doing Cottle procedures every week. Then all of a sudden it is 1975-80, you have the rise of the Open Approach and to a certain degree the sub specialization of Facial Plastic Surgery. Why do you think that the Cottle rhinoplasty did not maintain its popularity?

A. It is my opinion that for many surgeons, the Cottle procedure was associated with preventing or correcting nasal breathing problems whereas the Open Approach was synonymous with a purely cosmetic operation and by extension an integral part of Facial Plastic Surgery. Also, surgeons who practiced the septorhinoplasty principles of the “Cottle School” were also sinus surgeons. They often considered primary rhinoplasty a much less challenging surgical exercise when equated to problematic complex secondary revision cases with distorted anatomy, disrupted physiology and a patient with a disturbed psyche. In addition, these surgeons were often practicing general otorhinolaryngologist and the diverse scope of surgery in the field often including, otology, laryngology and sinus surgery. They were not concentrating primarily on rhinoplasty or any other aspects of facial plastic surgery. In otorhinolaryngology, the American Academy of Facial Plastic and Reconstructive surgery (AAFPRS) became the organization that promoted and popularized the Open Approach for rhinoplasty championing improved exposure for teaching while employing the traditional Joseph dorsal resection approach. Truth is as you see it and as I saw it, principally that many of the leaders in AAFPRS rejected Cottle’s authoritarian “cult of personality” approach. Equally, they had their own charismatic teachers, numerous courses, workshops, extensive video library, annual scientific meetings, and official fellowship training programs. Ultimately, the AAFPRS became the dominant educational and political organization to a generation of surgeons throughout the world. The AAFPRS became officially recognized as a National Medical Specialty Society holding seats at the AMA House of delegates and at the American College of Surgeons board of governors. In the United States, the Cottle septorhinoplasty methods were eclipsed by the AAFPRS training program teachers who pragmatically applied and coupled the freshly fashioned Open Approach with the traditional Joseph dorsal resection. Over time, many of the Cottle course teachers just aged, becoming emeriti, without replacement.

Q. When one reads the papers by Cottle and Drumheller, one realizes that Cottle was an extremely innovative surgeon. He is described as having used 34 different types and combination of osteotomies and that he did a Let Down procedure much more than his original Push Down.

A. Well, in my personal experience of watching Dr. Cottle operate I never remember him performing a “Let Down” procedure. It was Bert Huizing of the Netherlands who published removing a triangular wedge out of the ascending process of the maxilla for the “Let Down” operation. I actually observed and learned that technique from Dr. Vernon Grey of Los Angeles California who, to my knowledge, was the first to title it the “Let Down” procedure. Fausto Lopez Infante, my surgical colleague and close personal friend from Mexico City did the “Let Down” procedure using a rongeur to remove the triangular wedge of bone from the frontal process of the maxilla rather than excision of bone by means of chisels. After completing my residency in 1968, I principally practiced the “Push Down” operation until I learned the “Let Down” from Vernon Grey and Fausto Lopez Infante which was sometime in the late 70’s.

Q. For almost 50 years, you have been an unrepentant Dorsal Preservationist! Your virtual total rejection of the Joseph Resection Rhinoplasty had to be based on treating the sequelae of that operation.

A. Yes, I have no regrets about being a dorsal preservationist or for that matter, I have no regrets either about being a rhinometrician. Many patients came to the Mayo Clinic because of a previous rhinoplasty. They complained of difficulty breathing often revealing an associated inverted V deformity, dorsal irregularities, and breathing disturbances. As we had an active rhinomanometry laboratory, many of those patients found their way to our department for assessment and treatment. With my experience of seeing patients as a result of failed rhinoplasty along with my training in the “Cottle School,” I was particularly anxious about performing a classic Joseph “hump” removal procedure. For one thing, I didn’t think I could accurately chisel the bony dorsum without leaving telltale sequelae, primarily in thin skin patients. In my hands, I thought it was esthetically and functionally more conservative with less risk to perform the “Push Down” and later the “Let Down” procedure thereby maintaining an intact dorsum rather than electively chiseling the nasal dorsum. Ultimately, you ask yourself the following question. Why resect the dorsum only to be required to reconstruct it with spreader grafts or spreader flaps. Certainly, the term Dorsal Preservation is excellent because it goes beyond the sheer technical surgical methodology of the “Push Down” while emphasizing the goal of maintaining the nasal dorsum intact. I think Dr. Cottle would welcome and venerate the term Dorsal Preservation and the entire concept of Preservation Rhinoplasty.

HISTORY OF DORSAL PRESERVATION

Origins

Historical reviews of the evolution of Rhinoplasty Surgery correctly begin in 1887 with John Orlando Roe, MD, of Rochester, New York (below on the left) who reported the first aesthetic tip operation. In 1891, he published a cosmetic correction of angular dorsal deformities using bone scissors for dorsal reduction without septal surgery or osteotomies for 3 patients (below on the right).



In most texts, the next moment of historical importance is Jacques Joseph's first reduction rhinoplasty done in February 1898 (Joseph, 1899). The case study of a dramatic hump reduction with preop and 3 months postop photographs was published the following year. Most discussion of Joseph's techniques are based on subsequent articles and his encyclopedic text on nasal surgery.



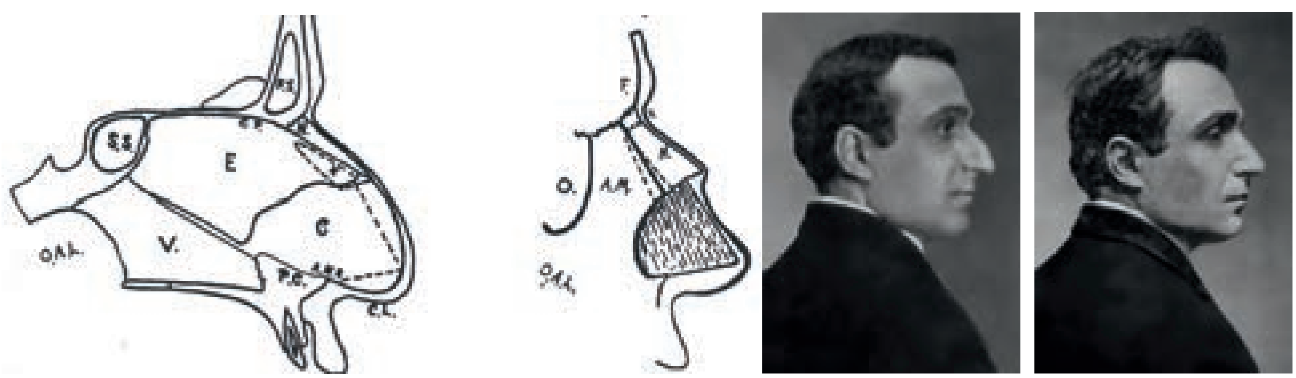
Yet, research into the origins of dorsal preservation by the junior author (RKD) revealed a more fascinating parallel development. In Fomon's classic text, he describes surgical techniques to "correct the deformity without attacking the hump itself" and he references Goodale, but who was he? Goodale was an assistant physician for diseases of the throat at the Massachusetts General Hospital and the Boston Children's Hospital. He corrected an "exaggerated Roman nose" on a 13-year-old girl on June 21, 1898. Goodale's procedure was conceptually and surgically the first "push down" operation. Several points are worth emphasizing (Goodale, 1899). First, he had perfected his techniques in cadavers before attempting a clinical case. Second, he divided the operation into a septal and bony vault phase. The septal portion utilized two scissor cuts. First a curved scissors with the convex side uppermost just beneath and following the dorsal contour. Then a lower cut with a straight scissor to achieve the desired dorsal height. Both cuts were transmucosal as septal flaps were not raised. The bony portion of the operation consisted of the following 3 steps to "depress the bony bridge": 1) a saw cut through the nasal bone / ascending portion of maxilla suture line, 2) a fracture through the frontal articulation of the nasal bones, and 3) fracture of the ascending portion of the maxillary bone inward. After 40 minutes of surgery, he stated, "with depression of the nasal bones, the bridge of the nose assumed a straight line..." Photographic documentation was cited in the article but was actually printed elsewhere in the Journal requiring additional sleuthing. The postoperative result was indeed impressive.



In 1901, Goodale reported on 22 additional cases, including photographs, of dorsal preservation surgery (Goodale, 1901). Essentially, a "push over" technique was done to straighten the nose (see below). Thus, there can be little question that Goodale is the father of the "Push Down" operation and all of Dorsal Preservation surgery.


Yet, two issues must be discussed. First, how did Joseph's and Goodale's operations compare. It should be noted that Joseph did a *direct inverted-Y skin excision* to gain access for dorsal reduction and excess skin excision – thus a radical open approach. It would be 6 years before Joseph adopted the endonasal approach used by Goodale and Roe. The second issue is why didn't Goodale's operation become the standard rhinoplasty operation as it was clearly superior to Joseph's original procedure. During subsequent years, Goodale moved towards research in allergies and started the first Allergy Clinic in the United States at the Massachusetts General Hospital. He did not write any more papers on rhinoplasty. Essentially, Goodale's contribution as the originator of the "push down" operation has remained in obscurity for over a hundred years until now.

In 1914, O.A. Lothrop of the Massachusetts General Hospital, published an article with preop and postop photographs entitled "An Operation for Correcting the Aquiline Nasal Deformity: the Use of a New Instrument" (Lothrop, 1914). He described the operation in-detail. "The muco-perichondrium is then elevated on both sides of the septum close under the nose bridge up to and under the nasal bones. The free border of the cartilage forming the bridge is now shaved down to the line desired for the reconstructed bridge. A piece of the perpendicular plate of the ethmoid close under the nasal bones is now removed, relieving all support at that point. The step in the operation consists in making an incision within the nostril along the free border of the nasal bone and ascending process of the superior maxilla. This incision cuts the mucous membrane and underlying tissues adherent to the free border of the bones and brings the operator beneath the periosteum covering the external surface of the nasal bone and ascending process. The periosteum elevator now raises all the periosteum over the nasal bone and ascending process of that side. The above technic is now repeated on the other side. A triangular or V-shaped piece of bone is next removed subperiosteally from either side of the nose. This section includes a little of the nasal bone and some of the ascending process and has its acute angle near the fronto-nasal suture. In order to remove this section cleanly, symmetrically and quickly, a new bone punch was devised for this operation." Thus, there can be little doubt that Lothrop was the father of the "Let Down Procedure".



Although both Goodale and Lothrop were attached to the Massachusetts General Hospital, Lothrop neither mentioned nor referenced the work of Goodale in the bibliography of his 1914 paper. Interestingly, Lothrop left that hospital and went into private practice, never publishing another paper on rhinoplasty surgery. His work and operative illustrations would be cited by both Eitner (Eitner, 1932) and Fomon (Fomon, 1939).

In 1926, Pierre Sebileau and his father-in-law Leon Durfourmentel published their technique entitled “Surgical Correction of Congenital and Acquired Deformities of the Nasal Pyramid” (Correction Chirurgicale Des Difformites Congenitales et Acquises De La Pyramide Nasale. Sebileau, 1926). These surgeons from the University of Paris illustrated the details of the “let down” procedure. They resected a portion of the frontal process of the maxilla and removed an “inferior strip” of septal cartilage to reduce the dorsal profile line while preserving the “K-area” and maintaining the osseocartilaginous dorsum intact. The next French contributor was Maurel (Maurel, 1940) who devised a push down technique consisting of a bony and cartilaginous component. The bone phase incorporated a low-to-low lateral osteotomy followed by a transverse osteotomy thereby mobilizing the nasal dorsum (“canopy,” according to Maurel). The cartilage phase included a subdorsal septal resection under the bony bridge with resection of the nasal spine of the frontal bone allowing the displacement of the osseocartilaginous nasal dorsum into the nose thereby “improving” the profile. Obviously, these publications and advances in aesthetic surgery would be on hiatus during World War II. As seen below, one can compare the techniques of Joseph, Sebileau, and Maurel.

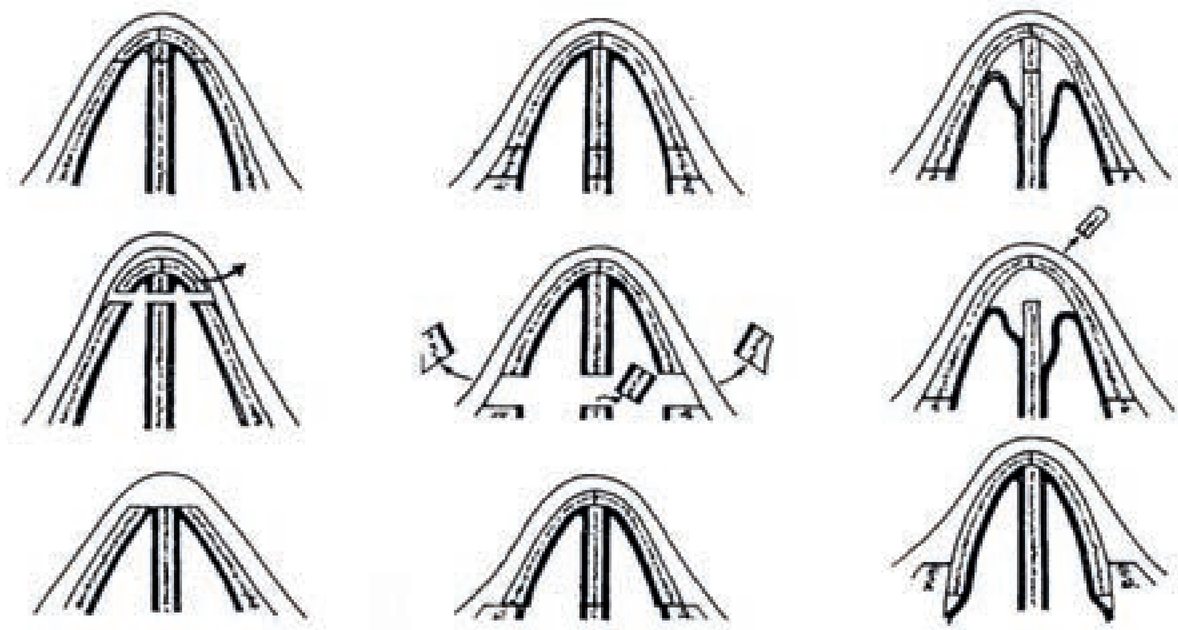


Fig. 1. — Procédé de Joseph (1898) avec « toit ouvrant ».

Fig. 2. — Procédé de Sebileau et Dufourmentel (1927) : résection basale.

Fig. 3. — Procédé de Maurel (1940) : section basale latérale et résection septale supérieure.

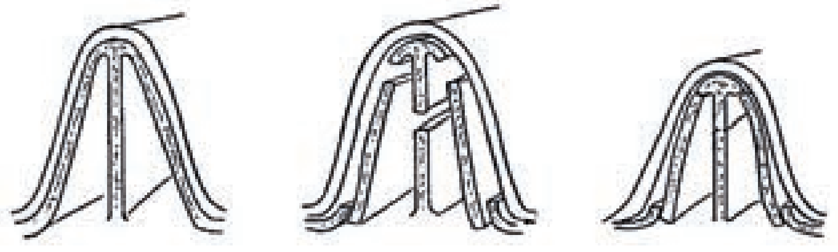
Fig. 1. — Joseph's technique (1898) with an open roof.

Fig. 2. — Sebileau and Dufourmental's technique (1927) : basal resection.

Fig. 3. — Maurel's technique (1940) : lateral basal section and superior septal resection.

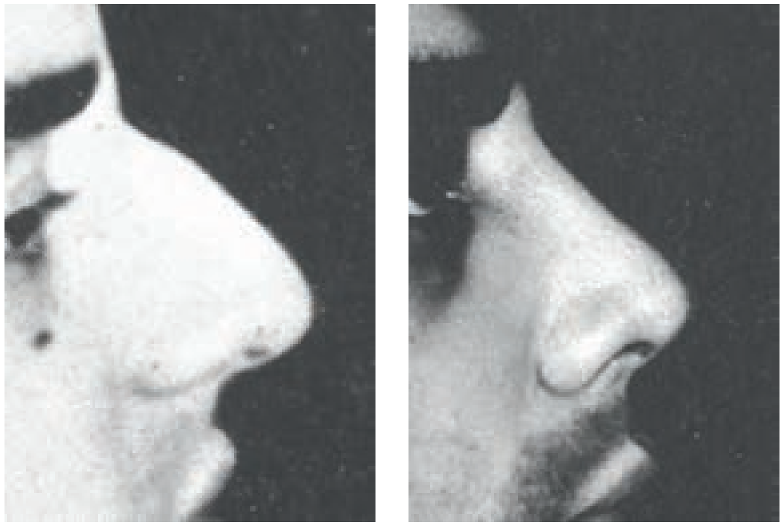
Cottle era

The publication of Cottle's paper in 1954 entitled "Nasal Roof Repair and Hump Removal" was considered monumental (Cottle, 1954). The technique was succinctly summarized in the following sentence: "To eliminate the hump without removal of the roof tissue entails a mobilization of the whole nasal pyramid and the pushing down of the pyramid into the nose." Cottle stated that the operation had 4 components: 1) appropriate septal exposure and septal surgery, 2) lateral osteotomies, 3) infracture of the lateral nasal walls, and 4) total bony vault mobilization followed by push downward into the nose. Note: "if the previous septal correction did not already allow enough moving of the dorsum, a strip of septal cartilage and bone, corresponding roughly to the desired lowering of the nasal roof, would be removed, usually from the anterior border." It should be noted that Cottle did not cite the work of Goodale, Lothrop, and Eitner nor the "let down" of Sebileau and the "push down" of Maurel.

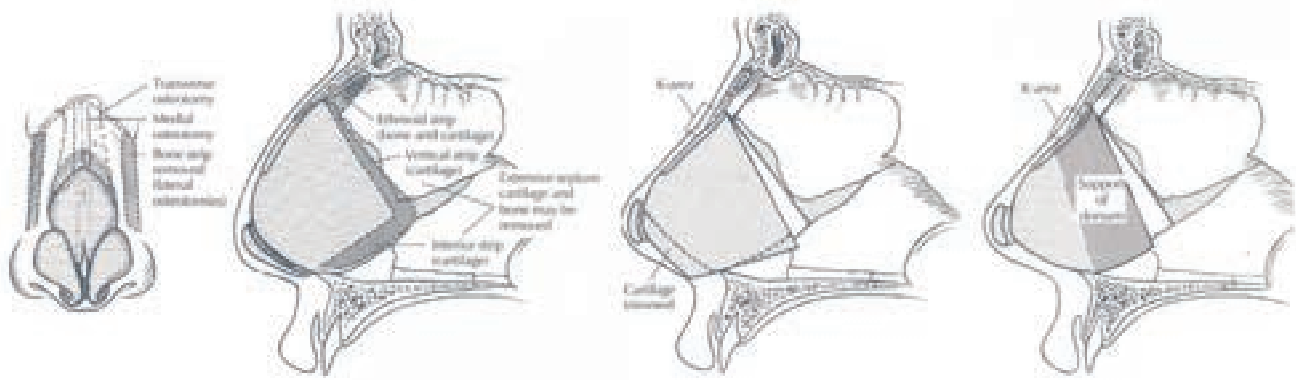


Thus, the question becomes why, how, and when did Cottle come to the push down operation? Cottle was an Otolaryngologist who specialized in Rhinology with a deep interest in nasal function and rhinomanometry. He was particularly concerned about "vasomotor disturbances" which occurred following rhinoplasty. He coined the term "open roof" to describe the etiology of these functional problems. How Cottle came to the push down concept is summarized in the following conversation between the senior author (EK) and Cottle. While examining an old patient for a sinus issue, Dr. Cottle noted that the patient's nose was straighter, the "hump" was gone. Since he had seen the patient on several occasions previously, he was curious as to what had happened. The patient denied having surgery, but admitted to being in a motor vehicle accident. The patient had broken his nose against the windshield, before seat belts, and noticed the change as had Cottle. Thus, the "aha" moment occurred and the genesis of hump reduction without hump resection. Once Cottle published his monumental paper, surgeons wanted to learn the technique and numerous "Cottle Courses" were given throughout the world sponsored by the American Rhinologic Society.

In reviewing the literature on Cottle's work, two findings are important. Although there were no preop and postop photos in his original paper, Cottle did publish an article in 1964 with "extensive conjoined septum and pyramidal procedures" (Cottle, 1964). As seen in the photos below, the patient had a concomitant septoplasty and aesthetic rhinoplasty.



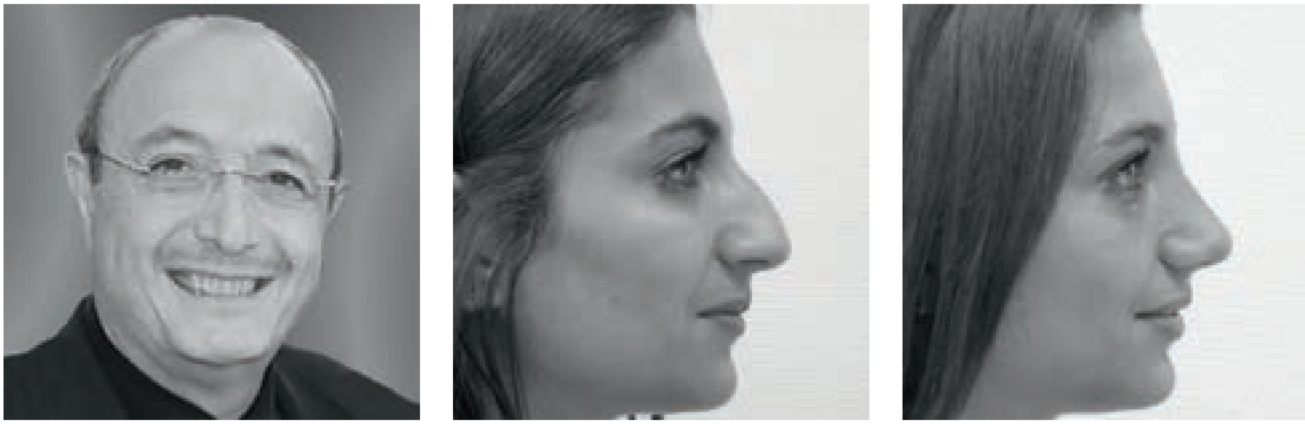
The second point is that Cottle treated a wide range of deformities using numerous variations of his basic technique, few of which he reported. It was left to Drumheller (Drumheller 1993,1995) to provide a clear description of Cottle's technique which had evolved from his original 1954 operation. The standard procedure is shown below.



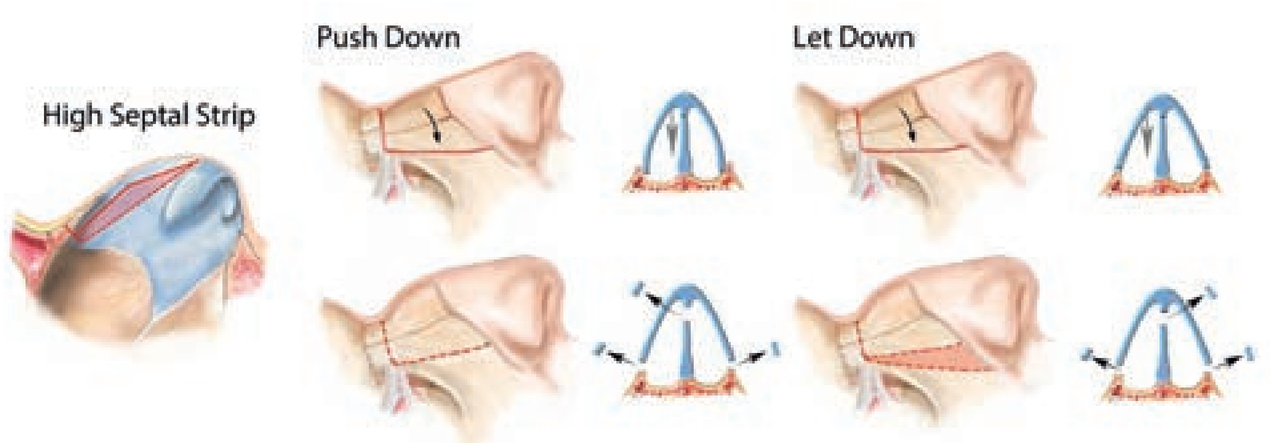
Although the S-shape septal excision was a fundamental component, the bony vault procedures were highly variable. According to Drumheller, Cottle did both the push down and let down technique as well as multiple asymmetric osteotomy / ostectomy combinations for the crooked nose. Because Cottle was operating on a wide variety of noses that are comparable to current deformities, he had to adapt and modify his operation to correct those problems. Drumheller describes some of Cottle's 33 variations of the osteotomies used to treat asymmetric, tilted and twisted noses which renders the variations of the pushdown unlimited (Drumheller, 1995). 75 years later, surgeons are only now rediscovering what Cottle had already proven. Numerous papers and books added to the dorsal preservation literature including the contributions of Gola (France – 1989, 2004), Huizing (The Netherlands – 1975), Willemont et al (Belgium – 1967), Wayoff and Perrin (France – 1968), Hinderer (United States – 1971), Sulsenti (Italy – 1972), Barelli (United States – 1975), Pirsig and Konigs (Germany – 1988), Pinto (Brazil – 1997), Kienstra (United States -1999), Dewes (Brazil – 2003). Many of these surgeons would develop centers of excellence and teaching centers. While Rhinologist were focused on function, the majority of Plastic Surgeons were performing the Joseph resection / reduction operation. Further accelerating the demise of the Cottle procedure was the open approach. Specifically, visualization facilitated the teaching of residents and shortening the learning curve for beginners. The extent of this demise was the virtual elimination of the Cottle procedure from the program of scientific congresses throughout the world, especially in the US.

Current Renaissance

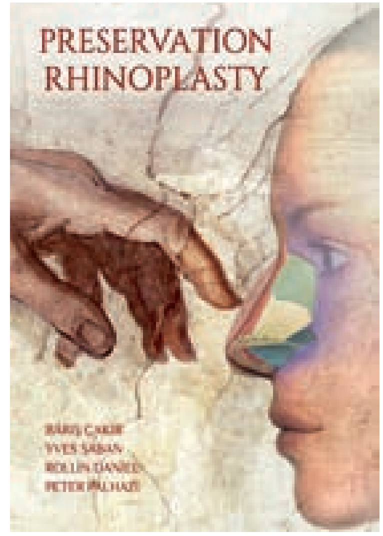
Although there were pockets of interest in the push down procedure (Brazil, France, Mexico), it was Saban et al publication in 2018 (Saban, 2018) entitled “Dorsal preservation: the push down technique reassessed” that reignited interest in dorsal preservation techniques.



The paper was important for the following 3 reasons: 1) it provided a detail historical review demonstrating that the technique had been done for over 100 years with well documented and extensive literature, 2) a clear description of both the anatomical basis and surgical techniques of DP, and 3) a clinical series of 740 cases with a minimum 2 year follow-up and an acceptable 3.4% dorsal revision rate.



Subsequently, world-wide dissemination was accelerated by Cakir’s Meeting in Istanbul in November, 2018 entitled “Preservation Rhinoplasty” that was attended by over 700 surgeons. Simultaneous publication of the text, Preservation Rhinoplasty, allowed surgeons to shorten the learning curve and reduce the complication rate associated with introduction of new surgical techniques. In addition, explosive growth would occur through social media with over 1,400 surgeons on one site devoted solely to Preservation Rhinoplasty.

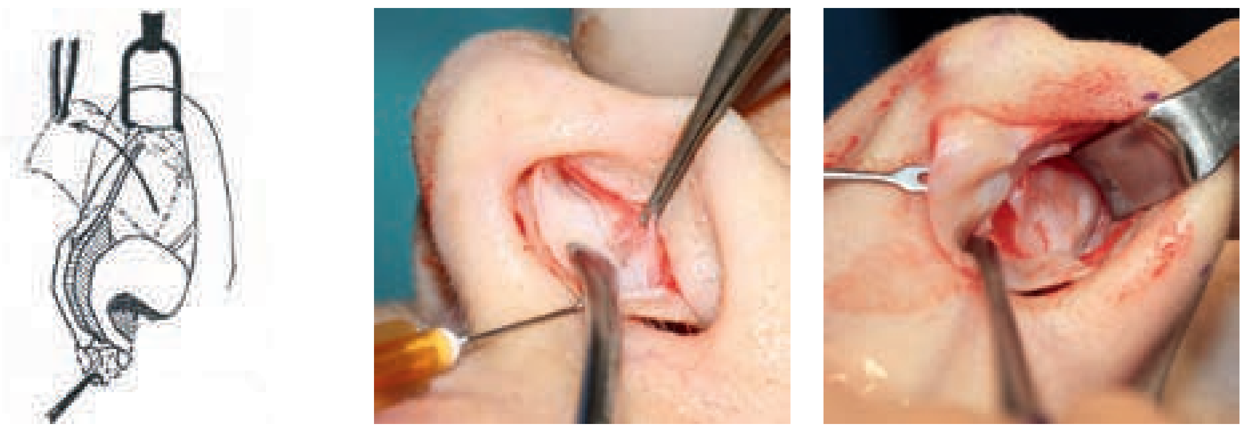


Multiple trends in dorsal preservation have begun to emerge. First, the Saban technique of a high septal strip excision followed by total nasal mobilization plus either a push down or let down maneuver is the current gold standard. Second, Finnochi's SPQR operation (Finnochi, 2020) has updated the Cottle procedure with its inferior strip excision. Multiple surgeons have validated the role of the modified Cottle operation for severely deviated noses with complex septal deformities. Third, *dorsal modification* procedures have extended the indications and the number of patients who can benefit from dorsal preservation surgery. Luiz Carlos Ishida (Ishida, 2020) has modified his father's concept of removing the bony hump following lowering of the cartilaginous hump subsequent to excision of an intermediate septal strip (Ishida, 1999). The modified technique retains a triangular portion of the dorsal bony cap thus maintaining the integrity and smoothness of the keystone area. The Spare Roof Technique of Ferreira (Ferreira, 2018) is another method of dorsal modification and consists of the following: 1) a longitudinal septal strip excision for dorsal reduction, 2) contouring of the bony cap to set the ideal profile line, 3) suturing the cartilage vault down to the underlying septum, and 4) routine lateral and medial osteotomies as indicated. As documented in Ferreira's chapter, this procedure is an ideal technique for surgeons wishing to learn dorsal preservation. As noted by Kosins (Kosins, 2020), these techniques are most useful for patients with dorsal humps 4mm or less. In summary, Dorsal Preservation surgery is currently evolving and expanding with dramatic aesthetic change and functional preservation.

HISTORY OF SOFT TISSUE ENVELOPE PRESERVATION

Elevation of the Soft Tissue Envelope

Elevation of the soft tissue envelope (STE) for surgical exposure is the determining factor for its post-surgical preservation. One only needs to see the long-term sequelae post rhinoplasty of skin thinning, cartilage distortions, and dorsal irregularities to appreciate the disastrous consequences of damaging the STE. If one begins with the Joseph rhinoplasty operation, elevation of the STE was done with a double edge knife inserted in the intercartilaginous incisions and passing blindly in "close contact with the cartilaginous vault" to above the caudal edge of the nasal bones. Then, an incision was made against the bone and a Joseph elevator was used to elevate the periosteum prior to en bloc hump removal. Next, Padovan (Padovan, 1975) introduced the concept of a subcutaneous dissection followed by creation of a subperichondrial-subperiosteal flap (see figure below on the left). An incision was made on one side of the dorsum, next the flap was elevated followed by lowering the dorsum, and then the flap sutured back in place. We shall designate this as "subPP" as an abbreviation for subperichondrial-subperiosteal dissection.



The use of a subperichondrial plane over the alar cartilage was done by multiple surgeons. However, Cakir (Cakir, 2012) was the first to publish on the subject of "A Complete Subperichondrial Dissection Technique for Rhinoplasty with Management of the Nasal Ligaments". He described this *total subPP* approach as consisting of 3 steps: 1) dissecting over the osseocartilaginous vault, 2) a subperichondrial dissection over the alar cartilages from either an open or endonasal approach, and 3) joining the two pockets together in one continuous subPP plane as seen in the photos above. He felt that there was a lower incidence of bruising, edema, and numbness compared to the sub-SMAS approach. Kosins (Kosins, 2017) has shown with sonogram studies that the structure of the STE is minimally disrupted following a subPP dissection as compared to the disruption seen in the STE of patients having a sub-SMAS dissection. Patron (see Patron's chapter) has found histologically that a subperichondrial dissection does not generate fibrosis or devascularization, but instead activates the chondrogenic activity of chondroblasts resulting in cartilage production. It is anticipated that one will not see the progressive thinning and distortions of the STE that often occur over a 10 year period following sub-SMAS dissections.

No Elevation of the Soft Tissue Envelope

Another option is to *not* to elevate the STE over the dorsum at all, a technique recommended by Gola (2000, 2002). In over 1000 cases, Gola demonstrated excellent results following dorsal preservation procedures without any skin undermining. This technique has been confirmed by other authors (Finocchi) as well.

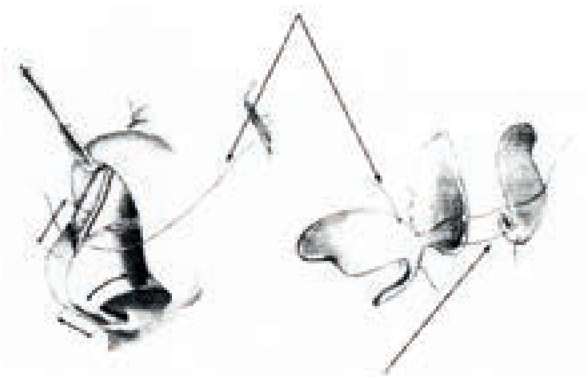
Ligament Preservation

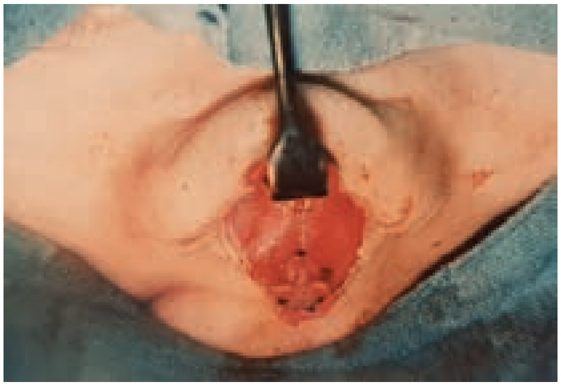
The anatomical study of nasal ligaments was often a minor footnote in most rhinoplasty texts despite Janeke and Wright's (Janeke, 1971) monumental publication. In their now classic study on the support of the nasal tip, they found the following 4 areas of anatomical support: 1) scroll junction between upper lateral and lower lateral cartilages, 2) a lateral sesamoid cartilage complex, 3) the junction between medial crura and caudal septum, and 4) the interdomal sling. They concluded that routine surgical techniques destroyed these ligaments and led to a loss of tip projection. They advocated several modifications in surgical technique: 1) high septal strip incision / excision rather than disruption of the membranous septum, 2) minimal resection of cephalic lateral crus with maintenance of the alar ring, and 3) retention of the medial crus / septal relationship. Many of their recommendations would be ignored. Over a multi decade period, Saban performed incredibly detailed anatomical studies of the nose which was presented first in his Monograph (Saban, 2002) and then he summarized his dissections in a stunning Atlas (Saban, 2009). He advanced his concepts with the paper entitled "An Anatomical Study of the Superficial Musculoaponeurotic System" (Saban 2008). Thus, he extended the original description of the nasal SMAS by Letourneau and Daniel (Letournneau, 1988). The critical findings were the following: 1) the nasal SMAS was a continuous sheet from radix to alar rim, 2) "extensions" occurred both laterally to the internal nasal valve and inferiorly into the membranous septum, and 3) a distinct adherence to the ULC perichondrium at the internal nasal valve.

In 2018, Daniel and Palhazi (Daniel 2018) discussed in detail the anatomical and surgical relevance of 7 nasal ligaments. Once again, it was Cakir who pioneered the surgical importance of ligament preservation (Cakir, 2012, 2018). He emphasized preservation of Pitanguy's ligament as it enhanced tip projection, compressed the infralobule, and accentuated supratip break. In addition, the scroll ligament complex was elevated with the STE and then reattached to improve both function and aesthetics. The trans septal incision retained the integrity of the membranous septum which preserved both the deep Pitanguy and intercrural ligaments. Almost 50 years later, the recommendations of Janeke and Wright would become surgical realities.

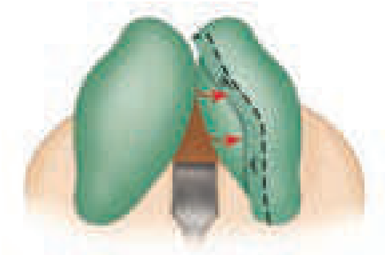
HISTORY OF ALAR CARTILAGE PRESERVATION

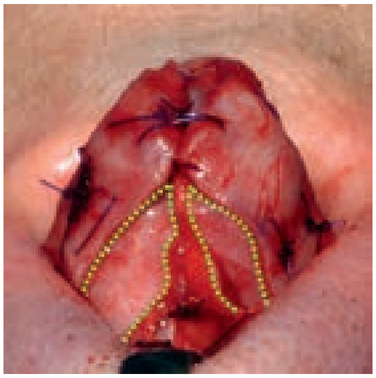
For decades, excisions and incisions of the alar cartilages were used to achieve tip definition. Widespread adoption of the open approach led to new tip sequence of excision of cephalic lateral crura, insertion of a columellar strut, and tip suturing. Next, septal extension grafts and transposing of the lateral crura were added. Excision of a portion of the cephalic lateral crus was done almost routinely, but why? The argument was that the excision reduced tip volume, rotated the tip, and made the alar more malleable for tip suturing. During this period of change, several surgeons were adopting a more conservative approach to managing the lateral crus. One of the first proponents of a preservation approach was Arturo Reglado-Briz whose landmark paper was entitled “Aesthetic Rhinoplasty with Maximum Preservation of Alar Cartilages: Experience with 52 Consecutive Cases” (Reglado-Briz, 1998). He summarized his tip suturing technique as follows – “In preserving the cephalic portion of the lateral crus, the goal was to obtain a structural tetrapod as a unified tip complex. Excision of the cephalic portion of the lateral crus involves normal tissue and increases the risk of presenting some degree of the typical postrhinoplasty stigmata” (alar rim retraction, pinched tip, external valve collapse). The only caveat was that small paradomal cephalic lateral crus excisions (fingernail clipping size) were done routinely. He argued strongly against alar excision as it leads to scar formation, structural distortion, and functional sequelae.

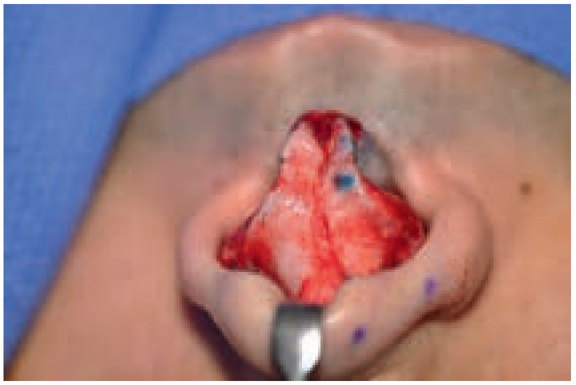




When it is not possible to do a complete alar preservation, one can perform an *incise and slide* procedure based on Ozmen’s technique (Ozmen, 2009). The procedure consists of the following steps: 1) a transverse incision through the lateral crus at approximately 8mm parallel to the caudal rim, 2) undermining of the caudal portion of the lateral crus, 3) suturing of the cephalic island under the remaining lateral crus without disrupting the longitudinal scroll ligament, and 4) reattachment of the vertical scroll ligament.







Kosins (Kosins, 2020) introduced a tip shaping technique with no alar cartilage excision or incisions – a truly *complete alar preservation*. The technique consists of the following important steps: 1) attachment of a septal extension graft to the caudal septum either end to end or side to side, 2) domal creation sutures to create tip definition, and 3) lateral crural steal that shortens and tensions the lateral crus. These 3 steps create a rigid tip complex tensioned at all 3 legs of the tripod. Note: there is no excision of alar cartilages, either cephalically nor paradomal, nor are there any transections in the middle crus as frequently done by others. In his analysis of 100 primary patients undergoing preservation rhinoplasty, Kosins (Kosins, 2020) performed 54% complete alar preservation, 36% had an incise and slide technique, 7% had a small cephalic trim due to strong cartilages, and the remaining 3% had assorted grafts for asymmetries. Essentially, he was able to perform an alar preservation technique in 90% of patients compared to the almost 100% cephalic alar excision performed in routine resection rhinoplasty.

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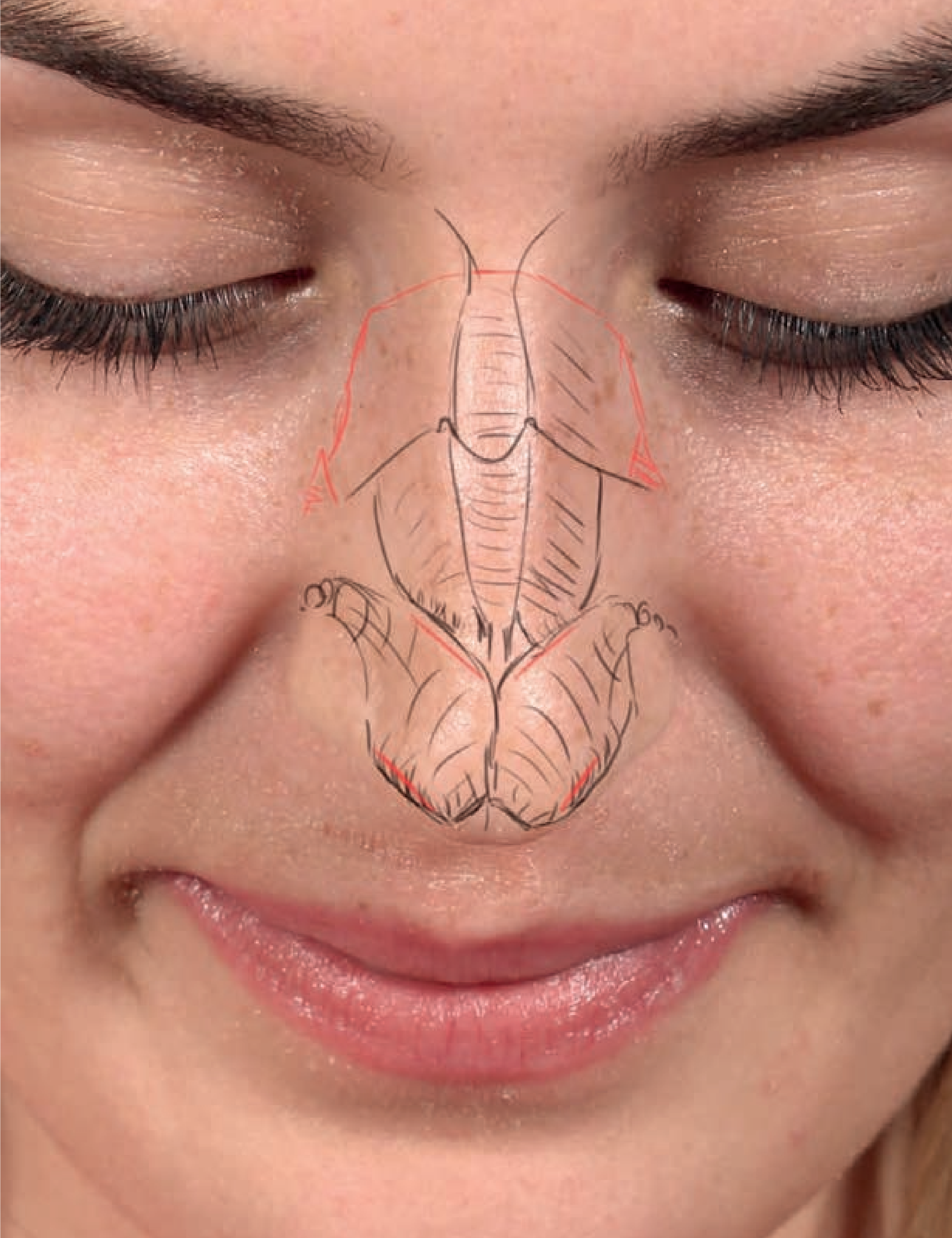
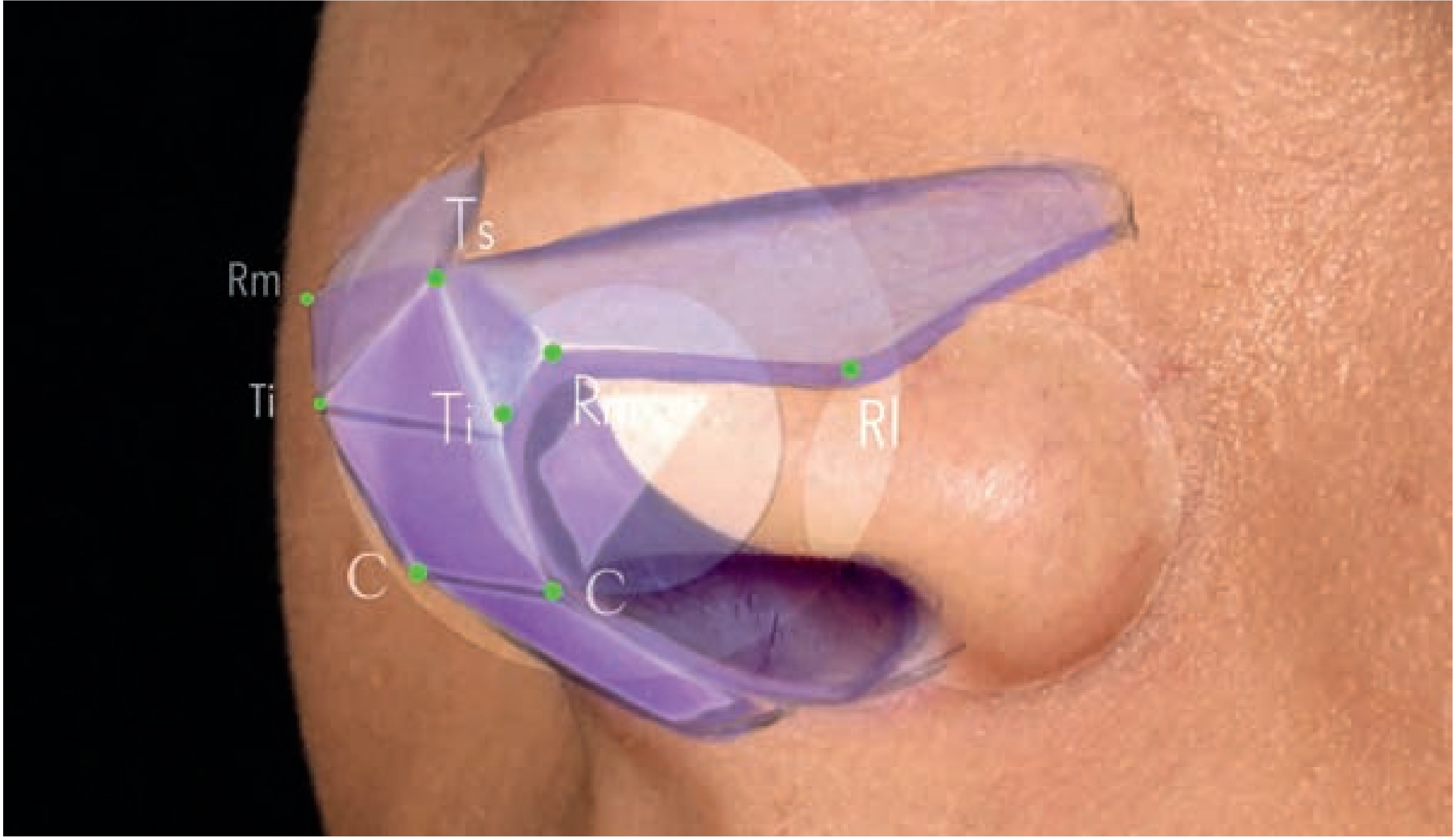




Analysis & Surgical Planning

Barış Çakır

Most patients and surgeons focus on what they don't like about the nose and how to eliminate it. Often, there is little understanding of what the "ideals" should be and how to achieve them. Therefore, we begin with a careful analysis of the patient's nasal aesthetics using the polygon concept, from radix area to tip. A great deal of time is spent with the patient discussing their objectives and how much change they want in their nose. For example, dorsal preservation techniques allow the surgeon to achieve a range of results from preserving a small hump to a straight dorsum to a curved dorsum – the patient gets to choose. The dorsal aesthetic line, as originally proposed by Sheen, are not parallel, but rather *trapezoid* being narrow at the radix, then wider at the keystone, before narrowing again in the supratip. During the last decade, Toriumi's concept of the nasal tip contour consisting of *surface highlights and shadows* has predominated. Although conceptually important, the linkage to the underlying anatomy is often lost as numerous non-anatomical grafts are inserted between the underlying structures and the overlying skin. In contrast, the *polygon* concept focuses on creating an anatomy that directly translates to the skin surface without the use of grafts. In addition, the preservation of the skin envelope and its associated ligaments ensures long-term results. This chapter will focus on analysis and operative planning linked to both the patient's presenting anatomy and objectives as well as the surgeon's aesthetic ideals.

SKIN

I classify skin as thin, medium thickness and thick. It is essential to explain to the patient that skin type directly affects tip definition. If the skin is very sebaceous, a dermatologist may be asked for help. The patient below used oral Vitamin A before her surgery. When the sebaceous glands of the skin get smaller, redraping is easier.

Preserving the Pitanguy's ligament prevents loss of tip definition and projection. We preserve the Pitanguy's ligament in 80-90% of the patients. It is necessary to cut the Pitanguy's ligament in patients with high definition and projection. It is easy to estimate this pre-operatively. In patients with thick skin, Pitanguy's ligament is dissected to a lesser extent, resulting in greater supratip skin control.

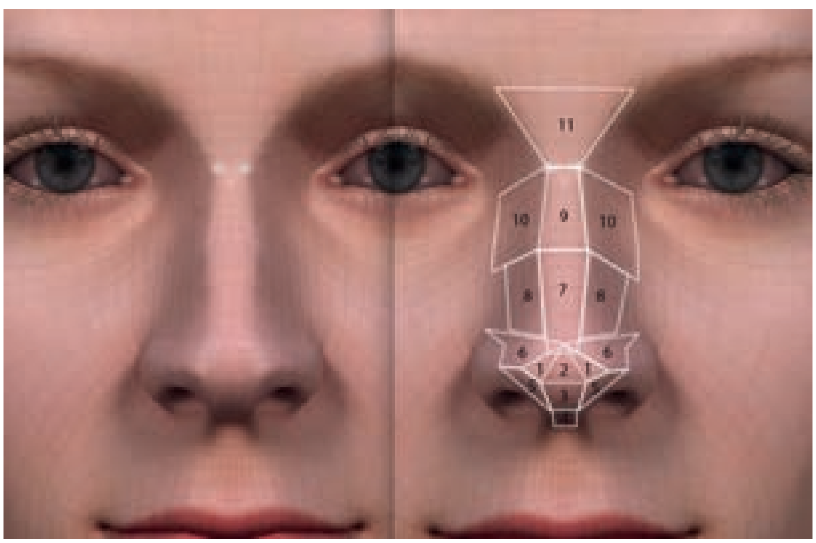
DORSUM

The results of dorsal preservation technique are different from the results of conventional hump rasping techniques. Even though I like parabolic dorsal aesthetic lines, the patients are habituated to straight and soft dorsal lines obtained with conventional techniques. In my first six months of performing the let down procedure (LDO), patients complained of a persistent small hump following surgery. They would say that they did not want any hump, but would like their dorsum to be straight. However, I now see I have patients telling me they want a natural dorsum with a small hump. Patients learn; they choose and then request specific characteristics. In other words, it needs to be discussed with the patient what dorsal preservation technique is.

Yves Saban asks his patients to self-examine their nasal hump during the medical exam. Moreover, he asks the patient to touch the nasal dorsum before looking at the mirror after the surgery. I can frankly say that I have many patients who prefer to keep their hump anatomy. I definitely prefer to perform a let-down in a patient with a nose that looks good in the front view. I deliberately tell the patient that there may be a slight residual hump after the surgery. Dorsal straightening may not be sufficient in patients with excessively convex humps and in the elderly. This subject will be discussed in depth.

POLYGON ANALYSIS

We took pictures of people with beautiful noses between 2008 and 2012. We worked with sculptors and painters to analyze beautiful noses. We examined the contour lines, light reflections and shadows of these noses. We prepared nasal models with 3D Max. We analyzed organic models with cubic forms. determining their forms by taking the underlying anatomy into consideration. We could obtain the most natural-looking nasal model by using the polygon mesh tool. Therefore, we defined the sections formed by cartilages over skin with polygons and named them accordingly. Not only the mass, but also the spaces between them should be observed for aesthetics.



We are trying to simulate the model explained in detail with the help of polygons in tip surgery. Below, each polygon is referred to by the number on the drawing.

1. *Domal trigons:* Trigons formed by the points Ti, Ts and Rm. Two in number. The domal trigons should be facing forward.
2. *Interdomal polygon:* The trigon between the points Ts, Ti and Ti'. This polygon faces forward, like the interdomal and domal polygons. The apical angle of the interdomal trigon is 80 in men and 100 in women. Never obliterate the interdomal polygon, particularly with sutures.
3. *Infralobular polygon:* The tetragon between the points Ti and C. Dr. Rollin Daniel has given this polygon its name. The infralobular polygon faces downward at an angle of 45 degrees. It is a space polygon. The superficial layer of SMAS fills this space and turns it into a section. Strut grafts are also placed in this polygon. If the strut graft is placed close to the caudal edge of the medial crura, the infralobular polygon becomes round. The infralobular polygon is formed by the weakest part of the lower lateral cartilages - that is the middle crura. After dissection this area weakens, and contour grafts may be necessary to strengthen it.

4. *Columellar polygon:* The space tetragon between the C points and footplates. The columellar tetragon faces downward. The space between the caudal edges of the medial crura should be preserved. A common mistake is over-grafting this area or excessive approximation of the caudal edges. Over-grafting widens the columellar tetragon. Excessive suturing of the caudal edge narrows the columellar polygon. However, the columellar polygon is clearly distinguished in a natural and beautiful nose. A slight groove is not bothersome, but natural.
5. *Facet polygon:* The tetragon between the points Ti, Rm, Rl and C. It faces downward and laterally at 45 degrees. One of my main objections is in this area. This polygon is not a triangle. There is an edge of 2-3 mm between the points Ti and Rm. The facet polygon is not a space to be filled. It is clearly distinguishable in a beautiful nose. A thin-skinned nose without a facet polygon is an explicitly surgical nose. It has a "tent-like" anatomy. It lies between the middle and lateral crura.
6. *Lateral crural polygon:* It is a mass polygon and formed by the body of the lateral crus. The caudal edge of the lateral crus is anterior to its cephalic edge. This position forms an obvious section polygon and "scroll" line on the skin. Lateral crural resting angle is the angle between the surface of the lateral crus and upper lateral cartilage. This angle should be around 100 degrees. Surgical techniques damaging the nasal tip also distort the lateral crural resting angle. The angle between the lateral crus and upper lateral cartilages start to exceed 100 degrees. The resting angle is a subject on which I will put particular emphasis. If this angle is proper, the need for rim grafts decreases dramatically. As the resting angle widens, the nose becomes a pinch nose. If the resting angle is 100 degrees, the facet polygon forms pleasantly. We will discuss how the resting angle can be corrected with a cephalic dome suture in the Techniques chapter.
7. *Dorsal cartilage polygon:* The area from the tip to the keystone area. It is a clearly anteriorly facing section in thin-skinned patients. There is a groove that gets deeper towards the keystone in the middle of the cartilage roof. This groove is 1-2 mm deep and filled by the dorsal perichondrium. The thickness of the Pitanguy ligament that lies over the dorsal cartilage increases as it gets closer to the tip. The dorsal cartilage ends up forming the septal angle after it enters between the lateral crura. Study the case below where the dorsum is preserved with the let-down technique.
8. *Upper lateral cartilage polygons:* The area formed by the upper lateral cartilage. It faces laterally, anteriorly and inferiorly. As the upper lateral cartilages are very thin, they rarely present topographic problems. If the dorsal cartilage polygon is shaped properly, this polygon will not cause any headaches. When the height of the upper lateral cartilage polygon is excessive, resection from the upper lateral cartilages is also performed as the hump is resected. Another problem that we emphasize enough is the long upper lateral cartilage. The nasal tip rotation in droopy noses is usually achieved with septal caudal resection and lateral crural cephalic resection. However, cephalic resection should be made to an extent so as to allow lateral crural cephalic dome suture. This is usually 1-4 mm. If this is not sufficient for rotation, caudal resection from the upper lateral cartilages should be performed. In this way, the upper lateral cartilage polygon can be shortened, and a higher scroll line can be formed.
9. *Dorsal bone polygon:* The area between the keystone and nasal radix. The dorsal bone polygon has more rounded contours compared to the dorsal cartilage polygon. It does not reveal lights as sharp as the dorsal cartilage polygon. It is wider in the keystone area and narrow at the nasal radix. It is shorter in men and longer in women. That is, the keystone area is located more superiorly in men when compared to women. If the roof is completely closed with osteotomy, the dorsal bone polygon becomes too narrow. When spreader grafts or flaps are used for dorsal lights, a controlled open roof is obtained. If the bone is wide and the shape of the cartilage is good, the cartilage can be pushed down and the bony roof opened.

I learned this technique from Dr. Hüseyin Güner and Dr. Mehmet Bayramiçli. The dorsal cartilage is separated from the ULCs, then a cartilage strip is removed and pushed down. The bony hump is opened with bone scissors and the roof closed with osteotomies. As the mucosa is left attached to the dorsal cartilage flap, there is no need for suturing.

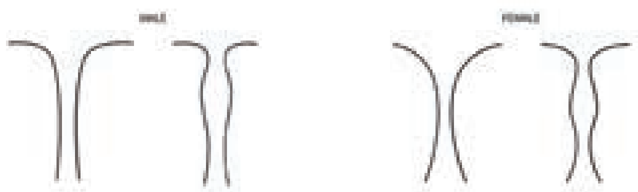
10. *Lateral bone polygons:* Formed by bones. They face laterally, superiorly and anteriorly. Asymmetries of bones are very frequent. Wide dissection allows rasping bony convexities. The frequently encountered axis deviations can be corrected with an asymmetric let-down. A dorsal preservation example is shown below.

DORSAL AESTHETIC LINES

We must develop a concept of dorsal aesthetic lines that conforms to the underlying anatomy. Incorrect concepts lead to usage of surgical techniques in incorrect doses. We must better understand the dorsal anatomy and use more anatomical techniques. In summary, dorsal aesthetic lines are as follows:

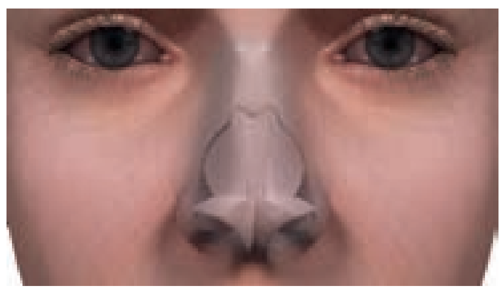
- Dorsal aesthetic lines are not straight.
- Dorsal aesthetic lines are narrow at the supratip area, wide at the keystone and narrow again at the radix.
- Differences between men and women are the width and location of the keystone area.
- The keystone is narrow and located at the middle of the nasal dorsum in women.
- The keystone is wider and closer to the radix in men. It is 3-4 mm more superiorly located when compared to women.
- While the nasal radix in men is at the level of the supratarsal fold, it is at the level of the eyelashes or pupil in women.

The left side below shows dorsal aesthetic lines for men, the right side for women. On the left side of each group, one can see the conventional dorsal aesthetic lines, while on the right side of each group, one can see my description. So far, I achieved the most natural nasal dorsum with the dorsal preservation techniques. For more information on the dorsal aesthetic lines please read our paper (Cakir et al. 2013).

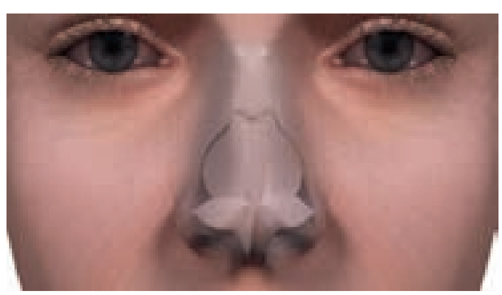


LATERAL CRURAL WIDTH

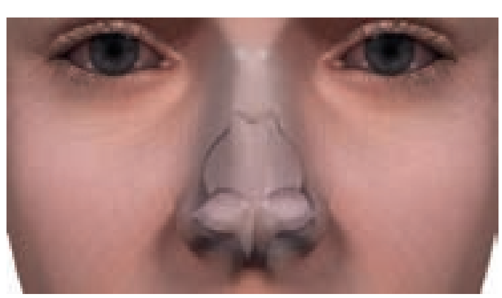
Lateral crural width is an important subject. A wide lateral crus is usually treated with cephalic resection only. However, resections of more than 4 mm may result in alar retraction. We use the rim flap technique in patients with caudal lateral crural excess. Please pay attention to the relationship between the lateral crus and the nostril in the case below. The shadow facet between the nostril, dome and lateral crus is the facet polygon.



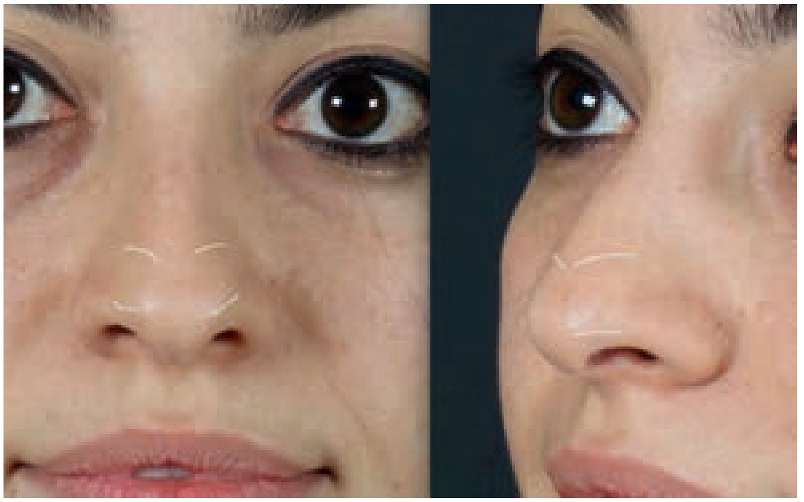
The facet shadow is not large enough when the lateral crus is closer than normal to the nostril. Such patients are said to have lateral crural caudal excess.



In the drawing below, both cephalic and caudal excess can be seen. Narrowing the lateral crus with cephalic resection causes serious side effects. Caudal excess is treated with the autorim flap. With this technique, a resection of more than 4 mm is not necessary even in the most bulbous noses.

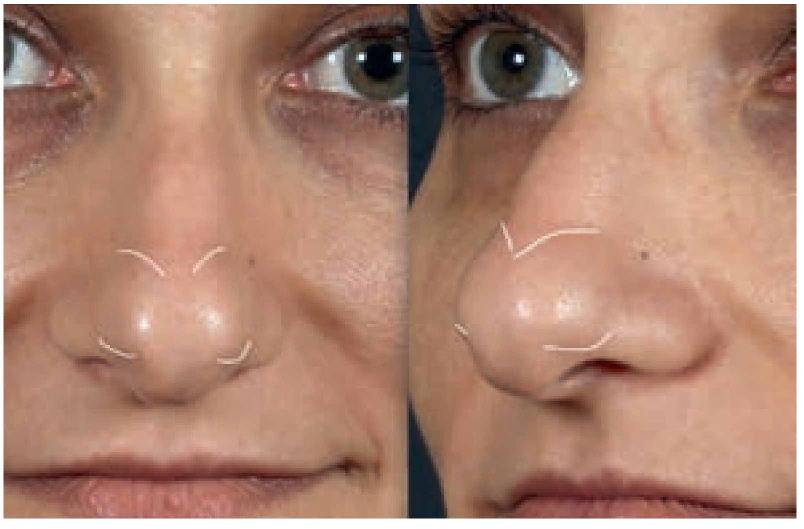


LATERAL CRURA: normal width



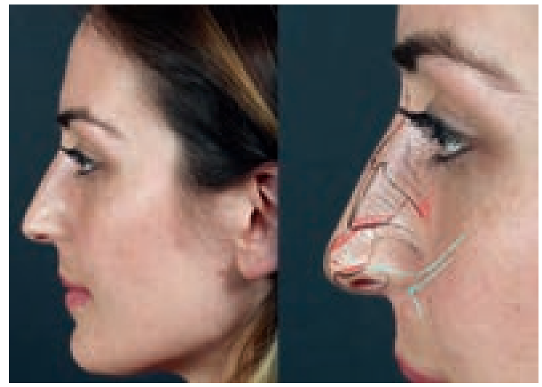
LATERAL CRURA: cephalic excess

LATERAL CRURA: cephalic & caudal excess

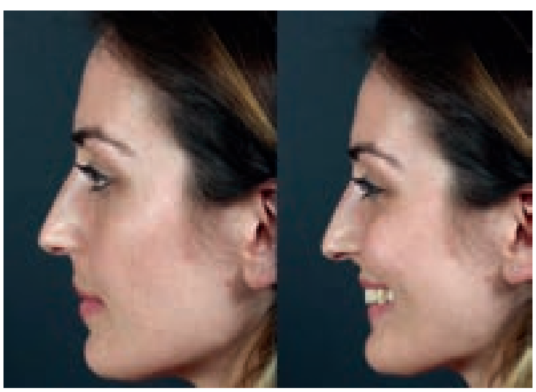


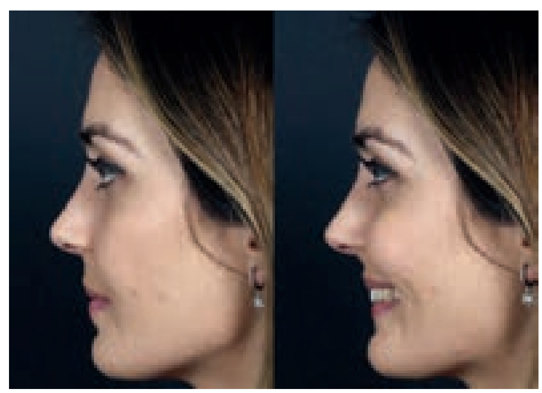
SURGICAL PLANNING

Here I will illustrate my planning procedure by performing surface aesthetic analysis on a patient. I have chosen a thin-skinned patient, since the cartilages are more visible. The dorsal nasal width is very good. I have performed these drawings with Photoshop® and a Wacom® tablet. Drawing the cartilages on the pictures can be a useful exercise. Lobular projection is insufficient. The facet polygon is too small.

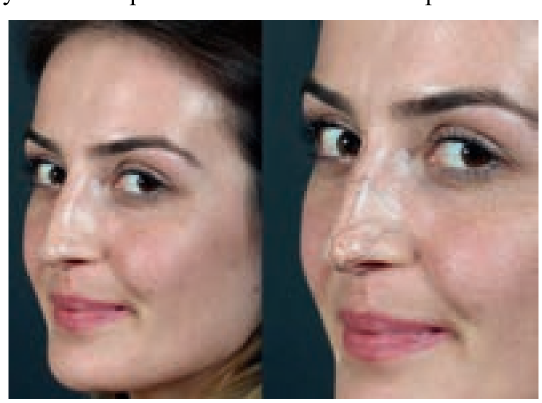


When the patient smiles, the nasal tip moves too much. The body of the depressor muscle is visible (see figures on the left). Even deprojection only decreases depressor activity. In my opinion, muscle resection or incision is rarely necessary (see figures on the right).



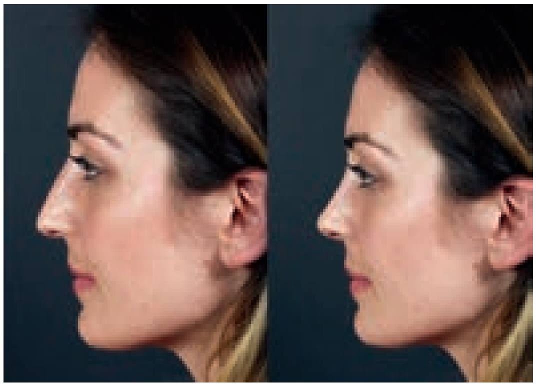


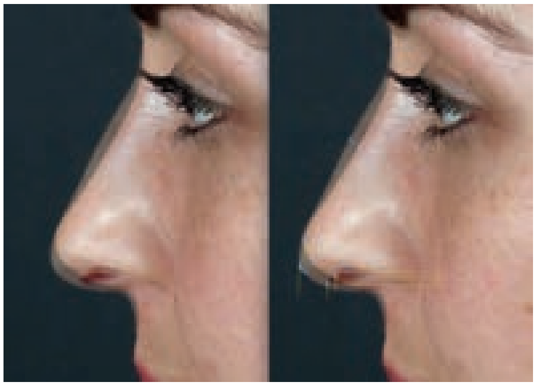
The patient has isolated lateral crural caudal excess. The lateral supratip breaking point shows the scroll line. The scroll line is very close to the nasal tip. This is how we understand that lateral crural cephalic excess is very limited. The lateral crural caudal edge is very close to the nostril edge. Therefore, the facet shadow is small. The lateral crural width of this patient should be treated caudally. We have planned a 2 mm autorim flap and 1-2 mm lateral crural caudal resection.



PHOTOSHOP EXERCISE

Tip projection decreases by 2 mm. Nostril apex projection decreases by 4 mm. Lobule projection increases. The changes in projection can be seen in the superimposed pictures.





OPERATIVE NOTE

Closed approach under general anesthesia was performed. The caudal septum was exposed with a low septal transfixion incision. Caudal 1 mm of the septum was left attached to the Pitanguy ligament as a posterior strut. The dorsum was dissected in the subperichondrial and subperiosteal plane. The domes were delivered with an infracartilaginous incision leaving the caudal 2 mm of the lateral crura as an autorim flap. An additional caudal 2 mm of the lateral crus was trimmed. Subperichondrial dissection of the septum was carried out, and the excess in the septal floor was excised. A resection of 4 mm was made from the caudal septum. A lateral crural cephalic trim of 3 mm was made. Lateral crural steal of 3 mm was performed bilaterally. The lateral crural resting angle was corrected with a cephalic dome suture. A strut graft was placed. A resection of 2 mm was made from the caudal upper lateral cartilages for rotation. A strip of 3 mm cartilage and bone was resected from under the dorsum. Transverse and radix osteotomies were performed with a hand saw. A bony wedge of 3-4 mm was excised from the aperture. The nasal body was mobilized with lateral osteotomies. The 1 mm wide cartilage attached to the Pitanguy ligament was sutured to the septum. The scroll ligaments were sutured to the caudal part of the upper lateral cartilages. Camouflage grafts were placed over the radix osteotomy. The low-septal and rim incisions were repaired. Thermal dorsal splints and internal nasal splints were applied.

Surgical plan in the cephalic view.

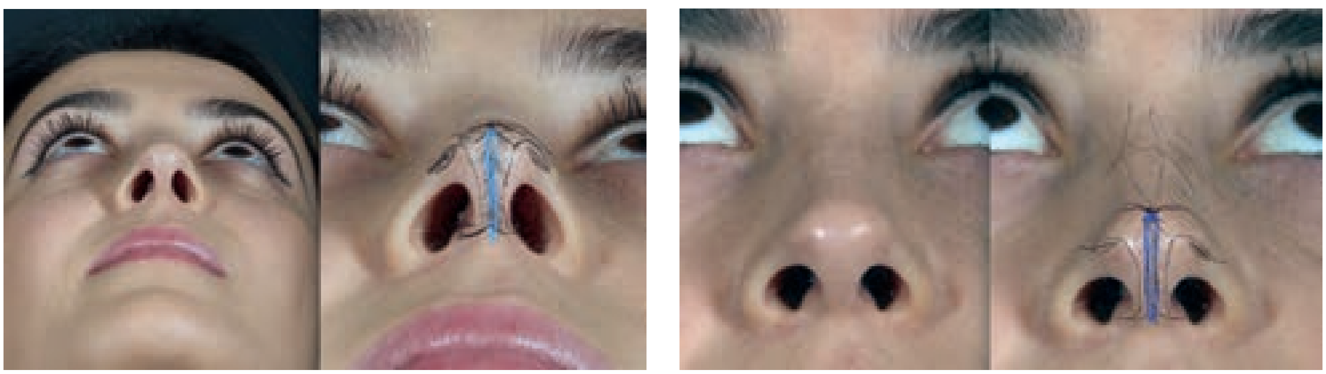
43 days postoperatively. The facet polygons have enlarged. No droopiness when smiling.

Lateral view. The smiling problem has disappeared.

The facet polygon is best seen in oblique view. On the right one can see the helicopter view.

Postoperative cartilage drawings. Pay attention to the position of the autorim flap.

The autorim flap provides the triangle in basal view.



CONCLUSIONS

Ultimately, it is the surgeon's obligation to understand the linkage between surface aesthetics - nasal anatomy - surgical techniques. The ability to "see through" the skin is an important skill to develop. As seen in the photos above, one should do pencil drawing overlays, both preop and postop, to analyze the anatomical deformity and surgical changes. Early in one's practice, pencil drawings and photoshop exercises should be done for every consultation whether the patient has surgery or not. The surgeon must train their eye to the critical details and learn how to link analysis to surgical technique.

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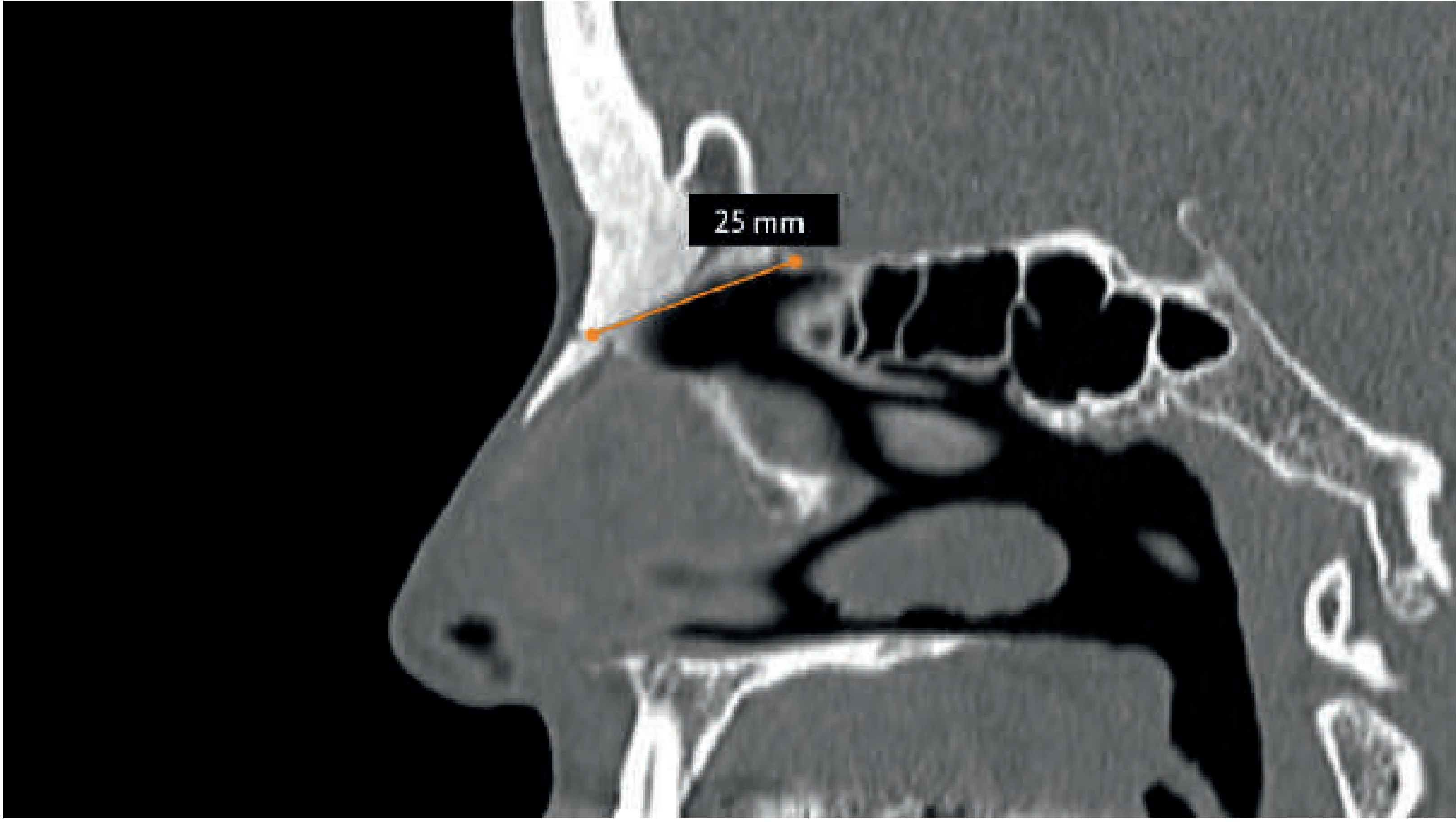


Cone Beam CT Analysis for Dorsal Preservation Surgery

Charles East, Lydia Badia, Yves Saban

Dorsal Preservation (DP) has many advantages in primary rhinoplasty. This concept preserves the patient's natural dorsum including at least part of the bony cap and the continuity of the cartilaginous vault, thereby minimizing the risks associated with monobloc hump reduction, consequent middle third collapse and airway dysfunction. DP invariably involves a reduction in the height of the nasal septum either cartilaginous and /or bony. In both the high and low septal strip excision procedure, a release has to be made underneath the dorsal vault. The lateral bony pyramid is separated from the maxilla and then combined with transverse and radix cuts to free the osseocartilaginous vault as a whole. Alternatively, the bony cap can be removed and the cartilaginous vault pushed down combined with faded paramedian and lateral osteotomies to medialize the bony walls. Complete impaction DP consists of two principle technique: the dorsal Push Down and the Let Down. A subdorsal septal excision is a common component of many DP techniques. It involves excision of a strip of cartilaginous septum and often a portion of the perpendicular plate of ethmoid. These maneuvers potentially may be hazardous particularly with regards to fracture propagation into the cribriform plate and ultimately a cerebrospinal fluid leak.

TERMINOLOGY, ANATOMY, ANALYSIS

An important point to understand is that with DP, the more cartilaginous the bridge, the easier it is to flex and to push or let down. One difficult area to control is the radix or Nasion point (N). In many instances the question has to be asked - should the radix be dropped down towards the face or maintained. Dropping the radix is achieved with a complete radix/transverse osteotomy resulting in a disarticulation between the skull and the bony vault. In contrast, radix height can be maintained with a hinge effect allowing the more caudal dorsum to lower while maintaining the radix (N, nasion) height. Too much resection under the radix potentially will allow the dorsum to drop excessively resulting in infantilization of the nose with a low radix and a step deformity.

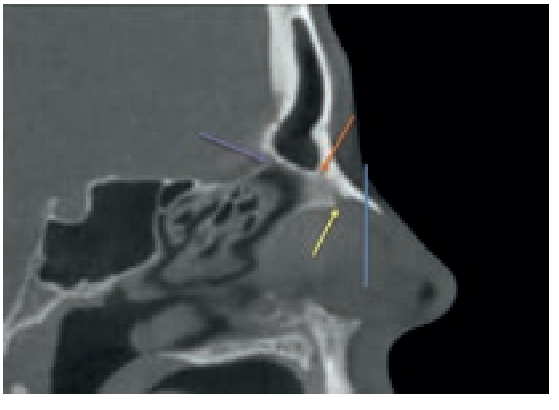
Understanding the anatomy of the subdorsal septum is therefore crucial and in particular the position of the quadrilateral cartilage/perpendicular plate junction. In many instances where the radix needs to be preserved, it's postulated that perpendicular plate (PPE) resection is not required-merely a cut to release it. Therefore, it is important to understand the structures that make up the bone of the nasion and bony cap. CT images with triplanar views of the midline bony vault illustrate the anatomical relations of the dorsal septum and key structures of the anterior cranial base.

CONE BEAM CT ANALYSIS

We utilize cone beam CT (CBCT) or spiral CT studies with 1mm slices performed for preoperative rhinoplasty planning. The images are exported for analysis using a commercially available triplanar DICOM reader software (Cavendish Imaging). The following points were identified:

- Radix line **(Trans Radix Osteotomy Point or TROP - blue line**). The radix is the soft tissue centre-point of transition from the glabella to the nasal dorsum. The nasion (N) is the deepest bony depression at the root of the nose.
- Thickness of Nasal bone/frontal spine at the radix.
- Antero-caudal frontal sinus (orange arrow) – The most anterior and caudal point of the frontal sinus.
- O-point – the most anterior part of the cribriform plate (purple arrow).
- E-point – the junction between the bony and cartilaginous septum at its most cranial aspect (yellow arrow).

The coronal plane view of each image is inspected to identify the midline using a vertical marker. The corresponding sagittal image is then used and a vertical line drawn mimicking the transverse radix osteotomy plane (TROP Blue line). From the TROP the following measurements are taken: a positive value indicating that the point is in front of the TROP, a negative value demonstrating the point is posterior to the TROP: 1) Nasal bony cap thickness (Nasal bone, spine of the frontal bone), 2) TROP to frontal sinus, 3) TROP to O-point, and 4) TROP to E-point.



CBCT STUDY

We evaluated CBCT of 64 patients with a mean age of 33.5 years (range 2 – 62). The study cohort was evenly split with regards to gender (51.5% female, 48.5% male). The findings were as follows.

Nasal Bone Thickness

The mean nasal bone thickness was 2.59mm (range 0.8 to 4.56mm). Dependent on the length of the spine of the frontal bone, there was considerable variation in the thickness of bone at the radix osteotomy point- in some patients there was only the thin nasal bone while in others the spine contributed to the width. At the site of the transverse osteotomy, the nasal bone is on average *2.59mm thick*. Contrary to what was previously thought, there was no significant correlation between nasal bone thickness and age in our study.

Distance from Transverse Radix Osteotomy Plane (TROP) to Frontal Sinus

The mean distance from the TROP to the frontal sinus was 13.58mm (range 7.7 to 21.2mm) across the entire cohort. The frontal sinus is on average *13.58mm posterior* to the osteotomy plane. Therefore, it is unlikely for a fracture line to propagate into the sinus with careful technique. When the frontal sinus has been opened inadvertently as occurred with the two senior authors due to its pneumatization caudal into the radix there were no adverse sequelae. This distance seems to increase with skeletal maturity into the second to 4th decades of adult life and then decreases with advancing age. This is consistent with facial bony resorption with advancing age.

Distance Transverse Radix Osteotomy Plane (TROP) to O-point

The mean distance from the TROP to the O point was 28.67mm (range 7.7 to 21.2mm) across the entire cohort. We defined the cribriform plate as the O point. Our study demonstrated that the cribriform plate is a mean of *28.67mm posterior* to the transverse radix osteotomy plane. This finding should prove reassuring for surgeons performing DP surgery. The clinical advice is to minimize the risk of a radiating fracture to the skull base by avoiding any twisting actions with rongeurs on the PPE. Direct cuts with a narrow bladed double action scissor, piezo, or the use of a 2mm narrow bladed rongeur to nibble small pieces of the thin bone will reduce the risk of inadvertent damage.

Distance from Transverse Radix Osteotomy Plane (TROP) to E-point

The mean distance from TROP to E-point was -7.25mm (range -19.2 to 5.22mm) across the entire cohort. The junction between the PPE and quadrangular cartilage is denoted as the E-point. A negative value denotes that the subdorsal septal junction between quadrangular cartilage and PPE (E-point) is located posterior to the TROP. A positive value indicates the E-point is located anterior to the TROP. There were only 5 adult patients where the E-point was anterior to the TROP. In all the pediatric studies and the remainder of the adults, the junction was behind the TROP; i.e. the septum was cartilaginous below where the radix osteotomy would be made. There is frequently a tongue of cartilage extending cranially underneath the bone cap, and this junction point (E-point) was seen to be on average *7.25mm posterior* to the transverse radix osteotomy plane.

Dorsal preservation rhinoplasty has meant a reappraisal of the structures making up the radix, and a review of the biomechanics of how the movement of a preserved dorsum can change a patient's profile. In an impaction dorsal preservation, there are transverse bone cuts connecting a low lateral and a radix osteotomy instead of paramedian osteotomies and an in-fracture. Therefore, it is important to understand the anatomy at the radix.

Very often, 3 bones comprise the radix–the nasal bones which are often quite thin but fused on top of the spine of the frontal bone (a type of joint that can be opened completely with a radix osteotomy). Underneath these, there is either a cranial extension of the cartilaginous septum or the thin perpendicular plate of the ethmoid. The dorsal septum determines the support of a new dorsum in preservation rhinoplasty. By lowering the septal height, flexion occurs at the central keystone producing a flatter bridge from a previously convex shape. A scan can show the thickness and caudal extent of the bony cap and therefore help determine if the area will flex or if the bone cap should be removed to create a cartilaginous dorsum.

In determining the ideal profile, the surgeon has to judge where the starting point of the nose will be (Nasion point or Radix) and whether it needs to be setback, maintained or augmented. Clinical photographs and the sagittal scan (or lateral cephalogram) are helpful in preoperative planning.

The more subdorsal tissue is resected, particularly in the cranial part of the septum, the greater the probability of the radix dropping which will both deepen and lower the starting point of the nose.

SEPTAL RESECTION – SELECTING THE RIGHT TECHNIQUE

Management of the PPE is critical in deviated noses and those being treated by low strip DP techniques. Fracture propagation into the cribriform plate is possible during rhinoplasty and is a concern with manipulations of the upper PPE. We defined the cribriform plate as the O-point. Our study demonstrated that is was a mean of 28.67mm behind the transverse radix osteotomy plane. Again, this distance gradually increased into the 2nd and 3rd decade of life before decreasing, although this change was not significant. This finding should prove reassuring for surgeons and the clinical advice is to minimize the risk of a radiating fracture to the skull base by avoiding any twisting actions with rongeurs on the perpendicular plate. Direct cuts with a narrow bladed double action scissor, piezo, or the use of a 2mm narrow bladed rongeur to nibble small pieces of the thin bone with reduce the risk inadvertent damage by first protecting the skull base *before* making an osteotomy at the radix.

TRANSVERSE RADIX OSTEOTOMY

This cut must be planned to be made either perpendicular to the bone of the dorsum or obliquely at a higher level than the lateral wall cuts. The shape of the radix correlates with the embryological development where the nose starts entirely as a cartilaginous capsule and then ossification extends from the skull base downwards over the cartilage, progressing with age. This progression has significant implications for flexion at the K area as the movement between the bone and the underlying cartilaginous vault is easier to achieve when the nasal bone is short, or the hump/bridge is entirely cartilaginous. Therefore, in an older patient with a relatively ossified nasal pyramid and septum, DP to flex the K area may not be as easily achieved. Removing the bone cap first is usually indicated. It is important preoperatively to *integrate* all the findings from clinical photograph, sagittal section of the CBCT scan, and patient morphing into the operative plan. From this decision process, the location and type of the radix osteotomy is determined (perpendicular to the dorsum or oblique), plus the degree of resection of the subdorsal septal cartilage /bone to achieve a hinge or a drop of the radix.

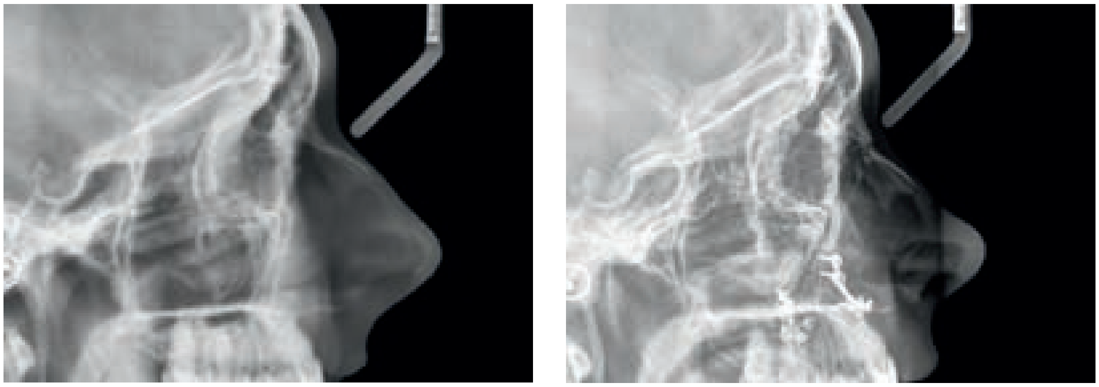
In choosing whether to drop the radix or to hinge it, keeping the radix (Nasion) position is the key determinants of the amount of subdorsal septum that needs resecting and the obliquity of the radix cut. From this study, in the majority of patients it is *not* necessary for high resection of the perpendicular plate. Rather, a simple cut through the PPE is sufficient to allow overlap if a hinge is required, or resection with a narrow rongeur if it is felt the radix needs to drop. Moving the transverse radix osteotomy 4-5mm cranial to the *transverse cuts* results in an oblique cut from superior to inferior allowing a slide or a hinge of bone on bone.

The authors preference is to use a 2mm percutaneous osteotomy. This is performed immediately after the subdorsal septal release and before any transverse bone cuts. In this manner, sudden collapse of the radix can be avoided.

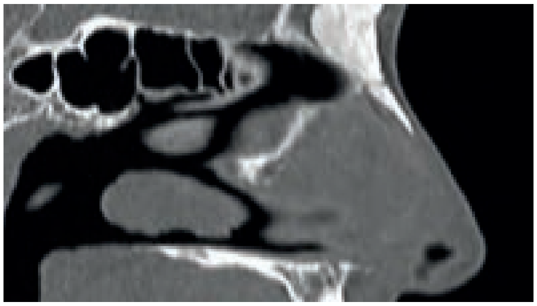
Osteotomy sequence: 1) resection of Webster's triangle (red dots); 2) sagittal lateral osteotomy (black solid line); 3) oblique radix osteotomy - percutaneous (blue solid line); 4) transverse lateral percutaneous osteotomy (black dots).

Radix drop by transverse radix osteotomy.

Lateral cephalogram showing radix drop.

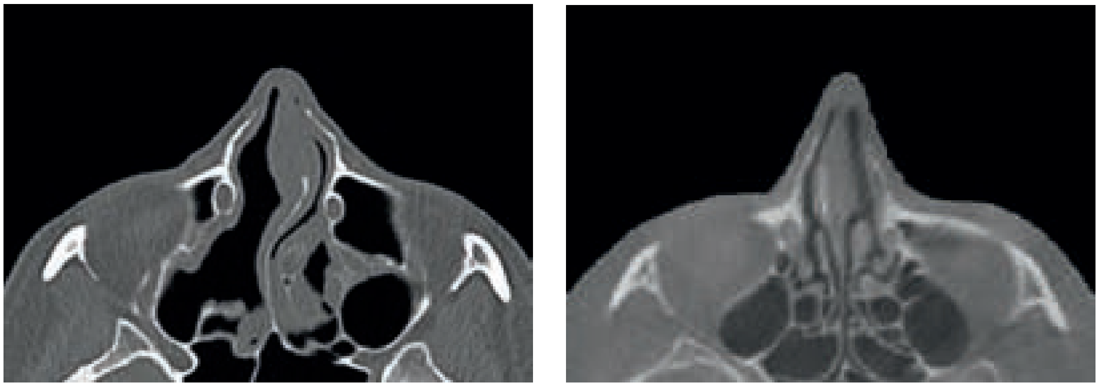


CBCT showing a ‘hinged radix’- there is no step at the radix.

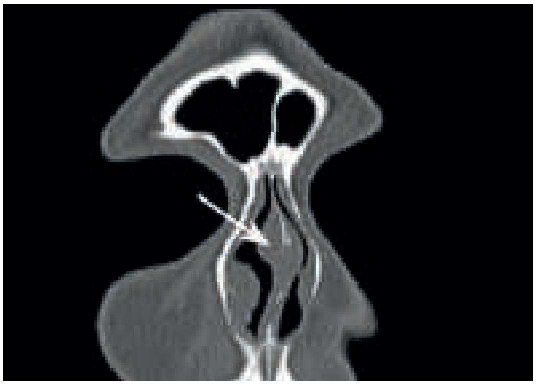


Crooked nose. A sagittal right osteotomy with impaction of frontal process of maxilla inside the pyriform aperture. Left lateral osteotomy is cut transversely to allow hinge and therefore rotation of the nasal pyramid to the right.

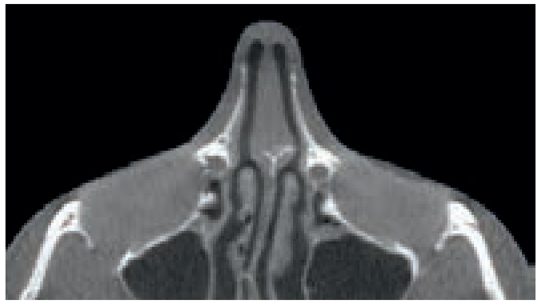
2 examples of deformities of Perpendicular Plate causing airway narrowing.



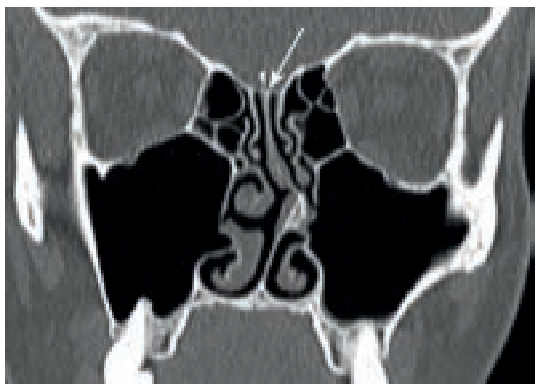
Coronal section showing PPE deviation, septal Tuberculum (arrow), a thickening of the muco-perichondrium.



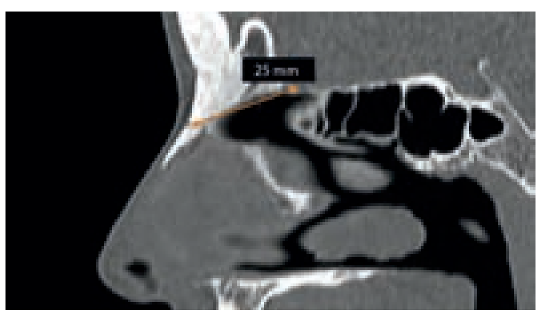
Narrow pyriform aperture. Any pushdown procedure or medialization of the bony base is likely to compromise the nasal valve. Therefore, resection of the lower pyriform with a let-down would be the preferred technique.



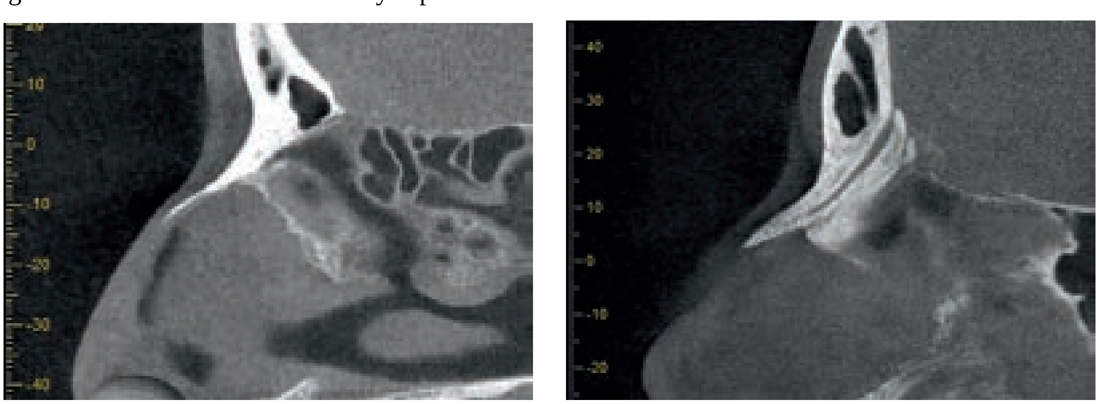
The PPE attaches to the skull base at the thin cribriform plate. It is essential that no twisting or pulling of the bone occurs during resection of the ethmo-vomerine spur. Arrow marks the location where there is high risk of CSF leak.



Distance of the radix cut from the cribriform plate, meaning low risk of skull base damage with radix osteotomy.

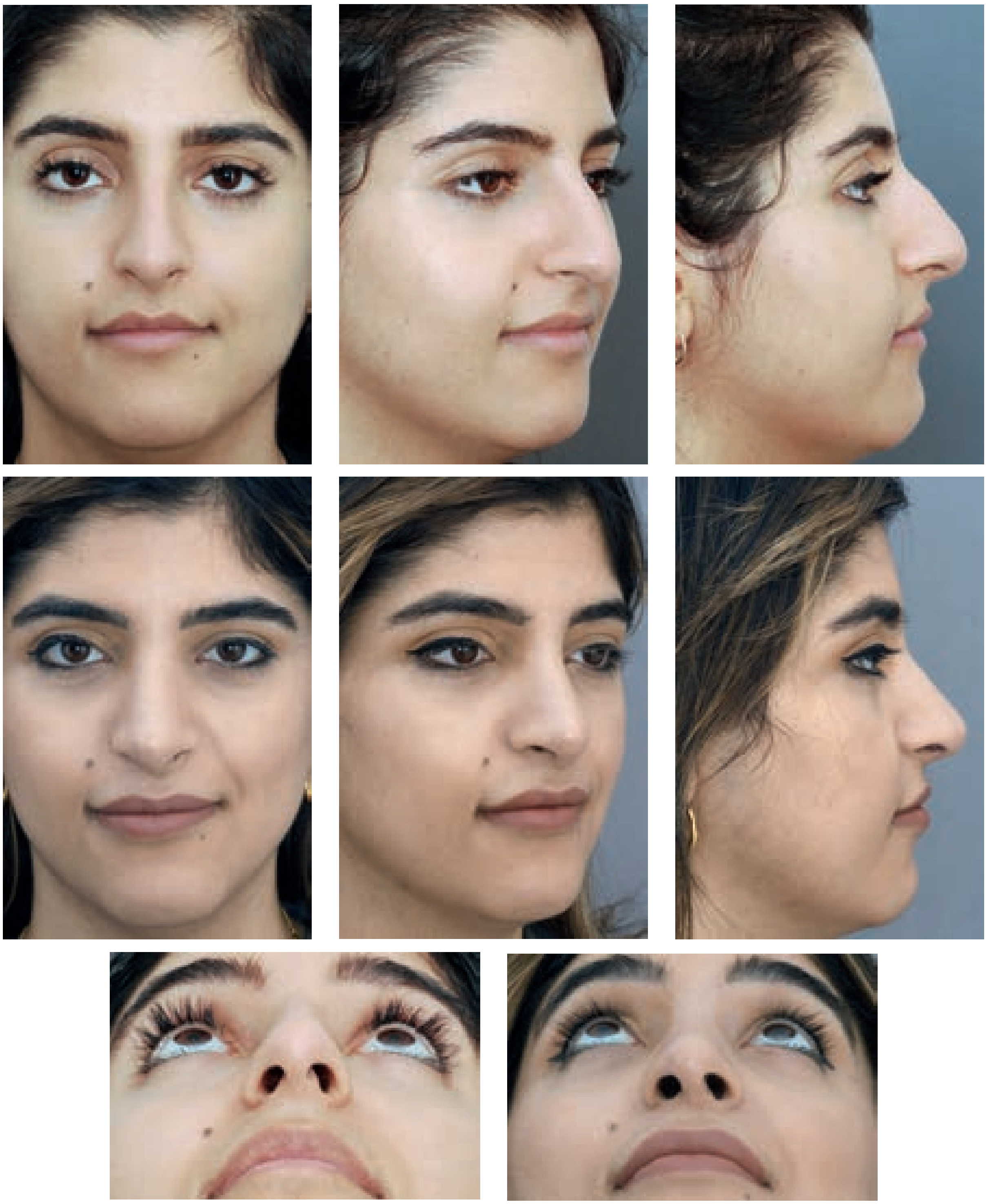


Variations in the thickness and form of the nasal *bony cap*. The right sided scan shows a fibrosed nasofrontal tract from the sagittal sinus into in a thickened bony cap.



CASE #1 – Radix Hinge (Preserve the Nasion)

23 years old female wishing to retain her ethnicity and have a smaller nose without over reduction of her profile. Open approach with marking and section of Pitanguy's midline ligament with subsequent repair, LKA release, piezo reduction of bony cap. Webster's triangle resection, sagittal lateral osteotomies, high radix cut with 2 mm percutaneous osteotomy, then sagittal piezo transverse osteotomies. 6 mm subdorsal septal resection, crisscross suture fixation and W-point fixation. Posterior tongue-in-groove, contouring strut and cranial dome sutures.



CASE #2 – Radix Disarticulation (Deepen the Nasion)

24 years old having previous septal surgery, but wanting a more feminine nose, with lower dorsum and lifted tip. Low columella open approach, Webster triangle resection, LKA release and division of Pyriform ligament, 3 mm subdorsal resection of septum up to frontal spine, transverse and lateral sagittal cut osteotomies with piezo. Radix cut with piezo perpendicular to dorsum and drop of the radix. Lateral crural steal 2 mm, cranial dome sutures, strut graft, Pitanguy sling stitch and scroll repair.

CASE #3 – Asymmetric osteotomies and septal correction

Open approach, subperichondrial-subperiosteal dissection, ligaments preserved. Complete septal dissection, low septal strip modified Cottle with excision of subdorsal cartilage above the vertical cut 3 mm. Excision of vomerian spur. Saggital lateral osteotomies with piezo and elevation of medial pyriform mucosa for left side impaction inside pyriform aperture. Transverse and radix cut at same level with rotaion of the dorsum. Lower septum advanced and fixed to the spine with 3-0 PDS, causing differential pushdown of the dorsum. Strut graft and cranial dome sutures, repair of scroll and Pitanguy ligaments, type 2 alar base repair (sill and flare), premaxilla augmentation of Rt alar with diced cartilage.

CONCLUSIONS

Cone beam CT (CBCT) is now inexpensive and readily available to virtually all surgeons. We would recommend its routine use in rhinoplasty surgery. Nasal sidewall anatomy, pyriform aperture dimensions, dorsal and septal anatomy are all readily assessed as well as any disease more posteriorly involving the turbinates and paranasal sinuses.

This study confirms previous cadaver reports on the anatomy of the osseocartilaginous vault and gives guidelines for different Dorsal Preservation procedures.

Cone beam CT can readily elucidate the nasal dorsal, septal and sidewall anatomy and is helpful to the surgeon in planning the most appropriate modification of the dorsum in modern rhinoplasty. The diagnostic value of a scan cannot be underestimated, and it should reassure the surgeon particularly with respect to the skull base. The need for routine resection of the perpendicular plate in preservation rhinoplasty may not be necessary.

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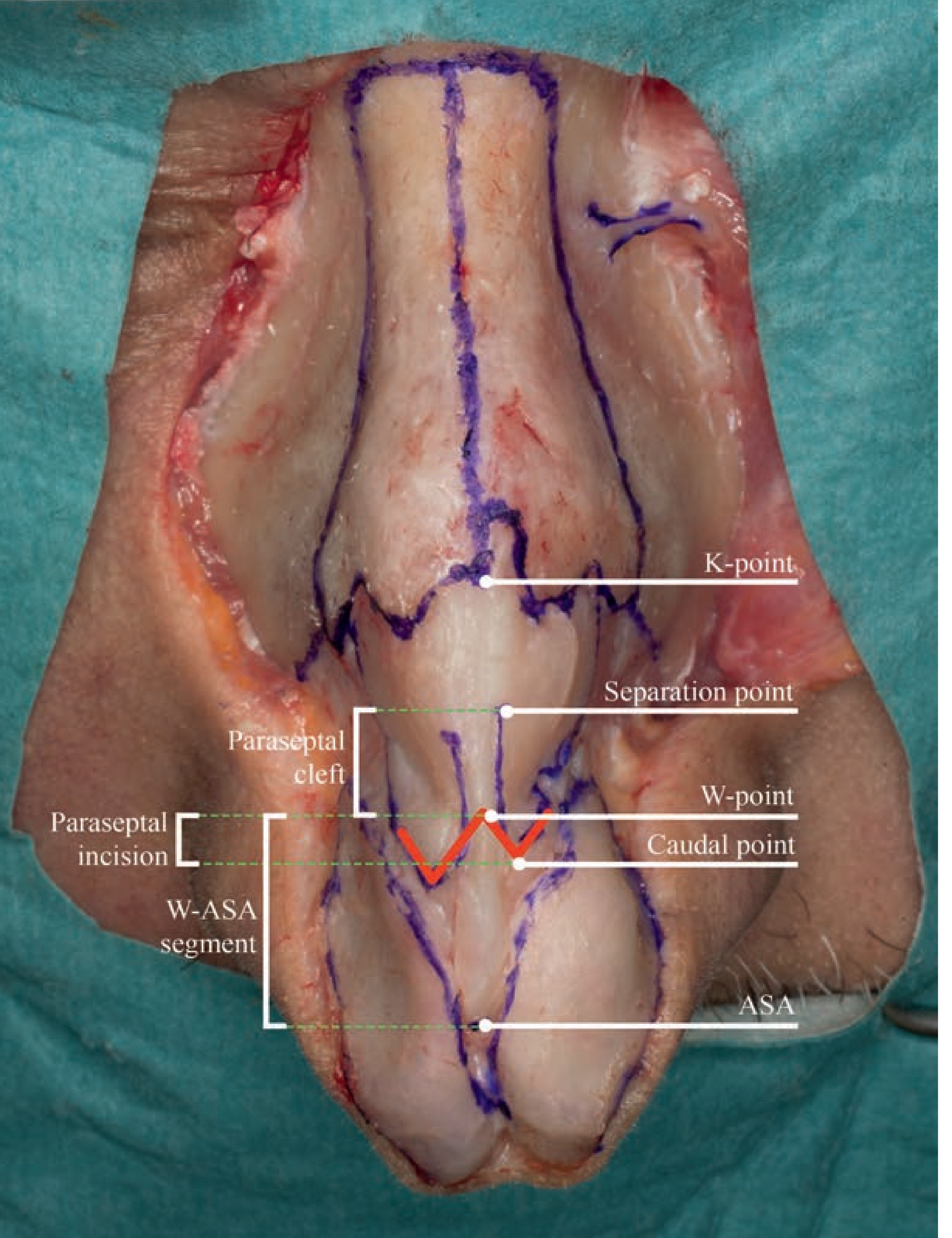
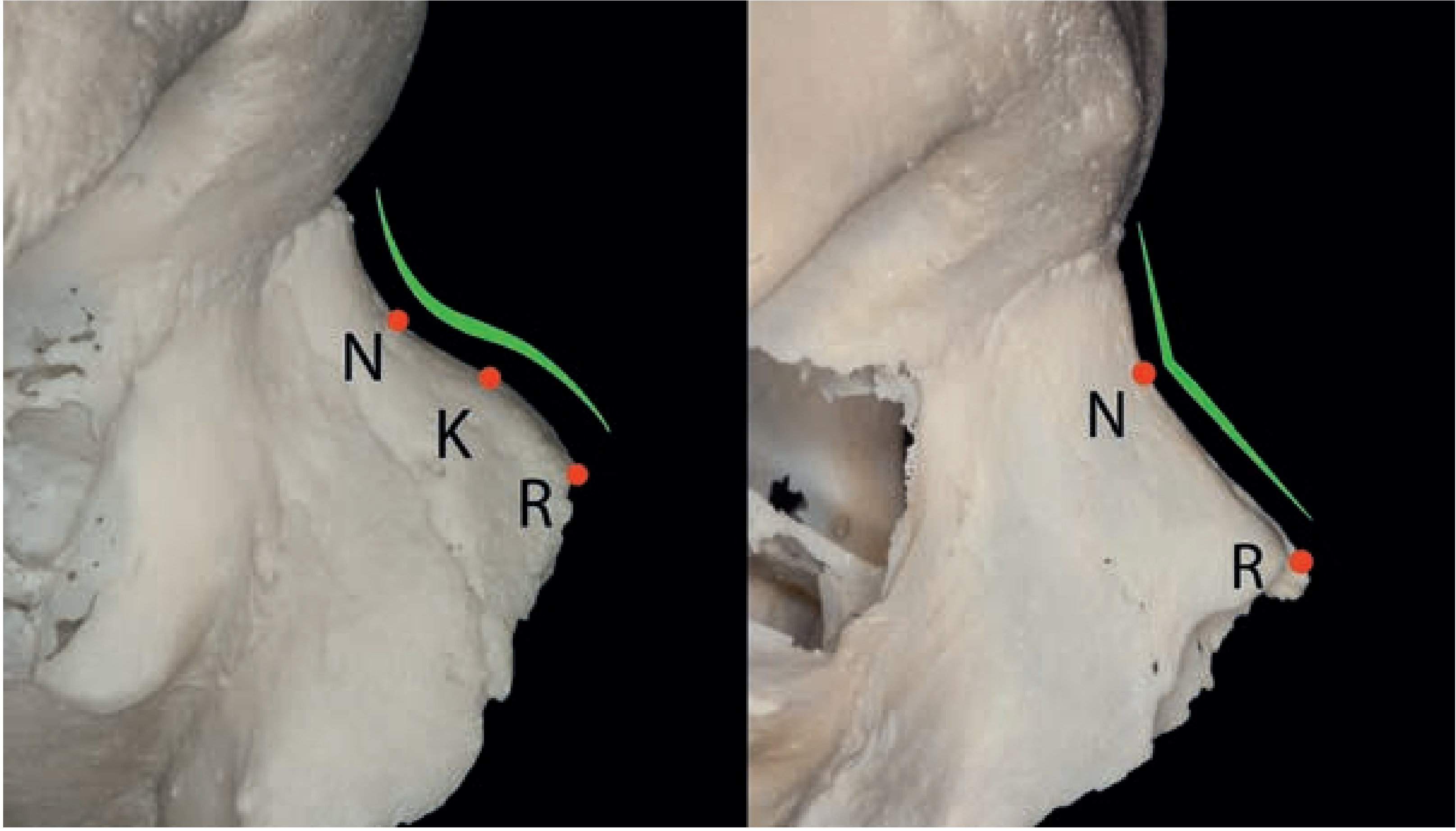

K-point
Separation point
Paraseptal cleft
W-point
Paraseptal incision
Caudal point
W-ASA segment
ASA



Operative Anatomy for Preservation Rhinoplasty

Peter Palhazi, Rollin K Daniel

As with all surgery, Preservation Rhinoplasty (PR) requires an in-depth knowledge of anatomy in order to understand and perform the essential operative steps. A detailed knowledge of surgical anatomy is crucial for PR for two reasons. First, there has been a dramatic expansion in our understanding of nasal anatomy over the past decade (Daniel, Palhazi, 2018). Second, surgical techniques have evolved based on this new anatomical knowledge. For example, the current techniques for Dorsal Preservation are based on the concept of the osseocartilaginous junction being a semi-flexible chondro-osseous joint which can be changed from convex to straight while retaining a natural dorsum. Another example is the elevation of an intact soft tissue envelope in a continuous subperichondrial-subperiosteal plane. To elevate the skin envelope without damaging it requires advanced technical skills as well as a sophisticated understanding of the nasal anatomy, especially tissue planes and nasal ligaments. The present chapter will discuss and illustrate both the essential anatomy and surgical techniques required for Preservation Rhinoplasty in a step-by-step fashion.

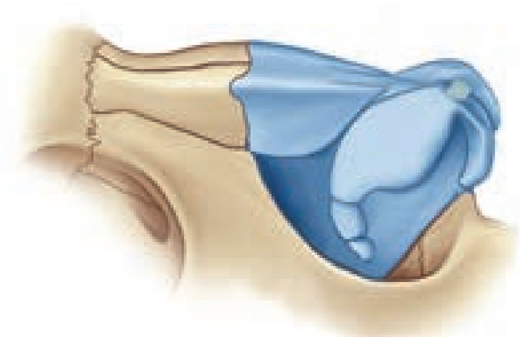
ANATOMICAL CONCEPTS OF THE SOFT TISSUE ENVELOPE FOR PR

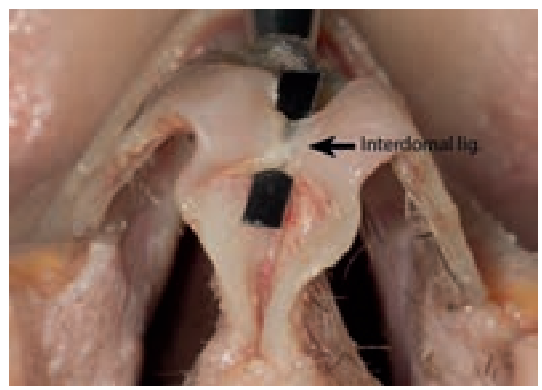
The majority of rhinoplasty surgeons have familiarity with nasal anatomy and a relatively routine surgical technique for most noses. However, the transition to Preservation Rhinoplasty requires greater in-depth knowledge of nasal anatomy and new surgical approaches based on that anatomy. In this section, we will emphasize the anatomy of the nasal ligaments and their importance in the surgical techniques for elevating an intact soft tissue envelope.

Interdomal Ligament

The interdomal ligament connects the two middle crura at the cephalic junction of the infralobular segment. Technically, the ligament does not run between the domes, but rather between the middle crura in a more posterior and cephalic location. It is easily found in all noses and is often quite rigid.

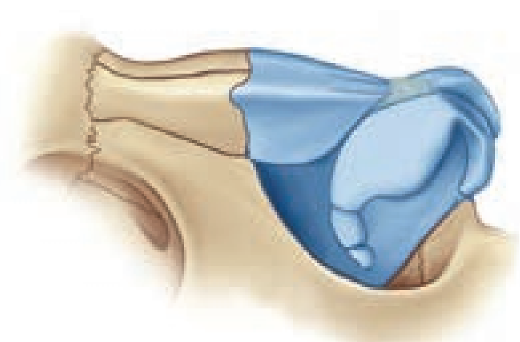
Although many surgeons cut the interdomal ligament during insertion of a columellar strut, the interdomal ligament can easily be preserved due to its cephalic position away from the caudal border of the middle crura. Obviously, this preservation is not possible if a tip split procedure is performed. Many surgeons routinely insert an interdomal suture to narrow the interdomal distance, which in reality merely represents reestablishment of the previously cut interdomal ligament.

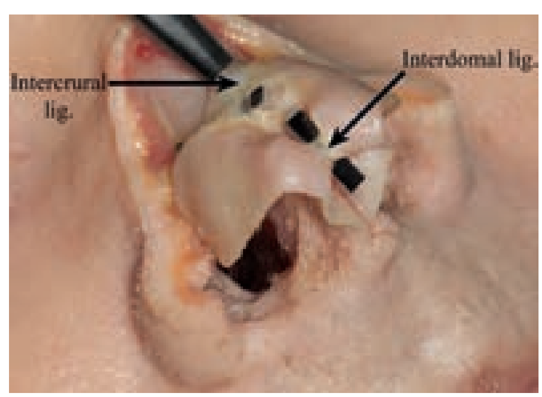




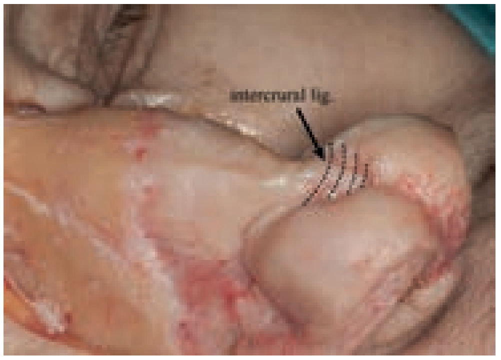
Intercrural Ligament

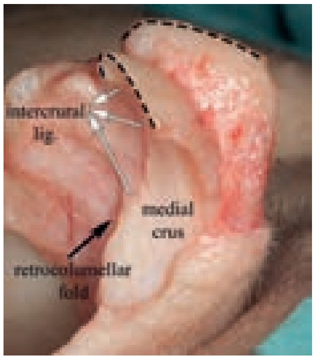
The intercrural ligament connects the cephalic border of the entire alar cartilages, including the lateral, middle, and medial crura. It passes just above the mucosa and holds the alar cartilages together.





In its cephalic portion along the lateral crus, it acts as the suspensory ligament of Converse passing just above the anterior septal angle. In its mid-portion, it is posterior to both the interdomal ligament and the deep portion of Pitanguy's midline ligament. Its caudal component effectively restrains the medial crus and footplate, pulling them towards the caudal septum. The intercrural ligament unifies the two alar cartilages and acts as a suspensory sling over the anterior septum.

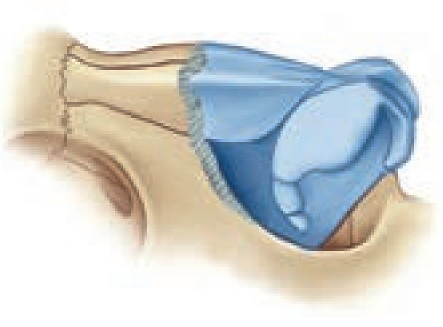


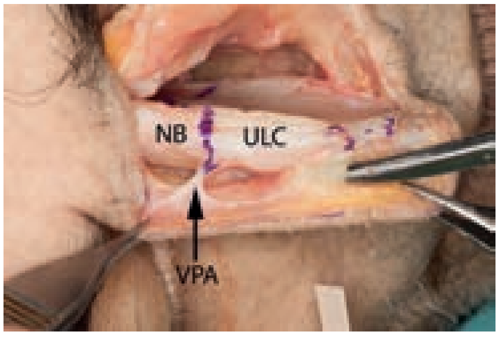


During rhinoplasty surgery, this ligament can either be preserved or disrupted. In an open approach, a “tip split” procedure will divide the ligament and require the surgeon to restore support, usually with a columellar strut. However, downward traction on the alar cartilage followed by a “dorsal split” allows one to maintain the intercrural ligament. A bilateral transfixion incision through the membranous septum will disrupt the intercrural ligament support between the footplates. Alternatively, one can perform a low septal transfixion incision. Essentially. one makes the transfixion incision through the caudal septum approximately 2-3 mm back from the caudal border, thereby ensuring total preservation of this ligament.

Vertical Pyriform Attachments

Saban noted distinct superior and inferior lateral nasal ligaments along the pyriform aperture, which he designated ligamentum laterale superius and inferius nasi. We have found these ligaments to be inconsistent as distinct entities, but have detected a consistent vertical attachment between the entire pyriform aperture and the overlying soft tissue envelope, which we have designated as the Vertical Pyriform Attachments (VPA). It is particularly dense at the keystone area and on occasion along the lateral border. Release of this VPA becomes important in the total dorsal exposure associated with complete lateral osteotomies done with a piezo-electric saw.

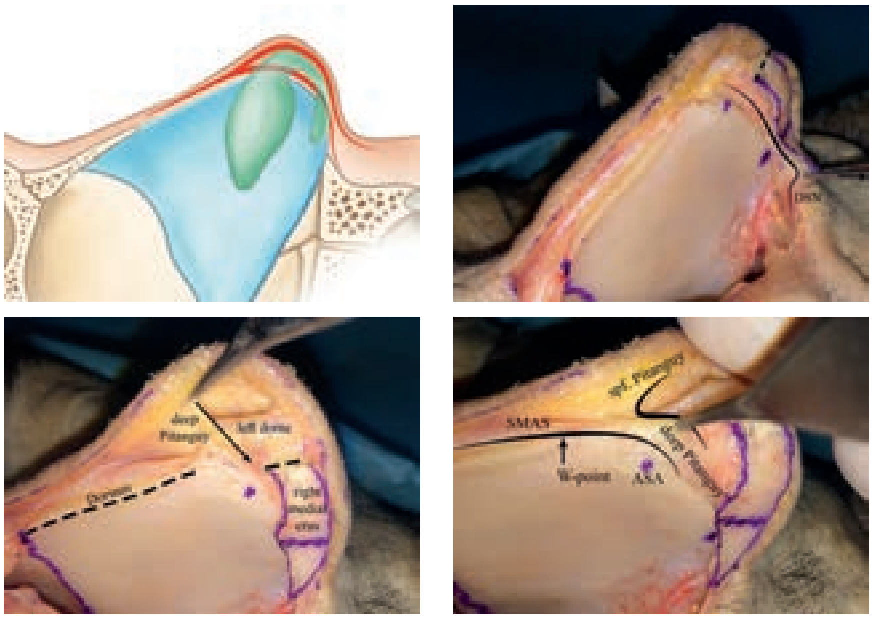




Pitanguy’s Midline Ligament

Pitanguy described a ligament originating on the undersurface of the dermis and running tangentially down to and in between the alar cartilages. He reported a connection between this ligament and the depressor septi nasi (DSN), which was later confirmed by de Souza Pinto. Recently, Saban has demonstrated that the medial SMAS at the level of the internal nasal valve divides into a superficial and a deep layer. The superficial medial layer runs caudally below the interdomal fat pad, but *above* the interdomal ligament into the columella. The deep medial layer of the SMAS runs *beneath* the interdomal ligament, but above the anterior septal angle into the membranous septum and then downward toward the anterior nasal spine. Saban concluded that the deep medial SMAS could correspond to Pitanguy’s ligament.

Based on the accepted five-layer laminate concept of the nasal soft tissue envelope, Pitanguy's ligament cannot be a true dermocartilaginous ligament, as it would have to run tangentially from the dermis across and through the SMAS to reach the cartilaginous structures in the tip. We have modified the original terminology and advocate the use of the term "Pitanguy's midline ligament," which reflects its origin as part of the midline SMAS layer. (Daniel, Palhazi, 2018)

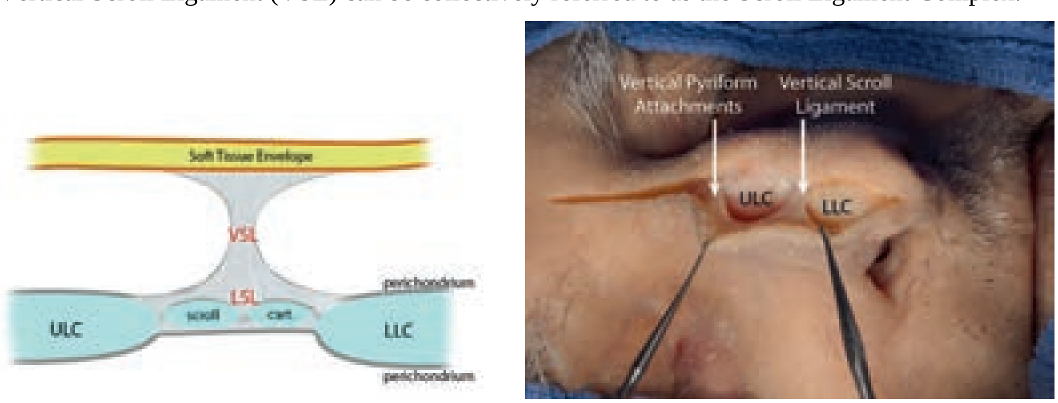


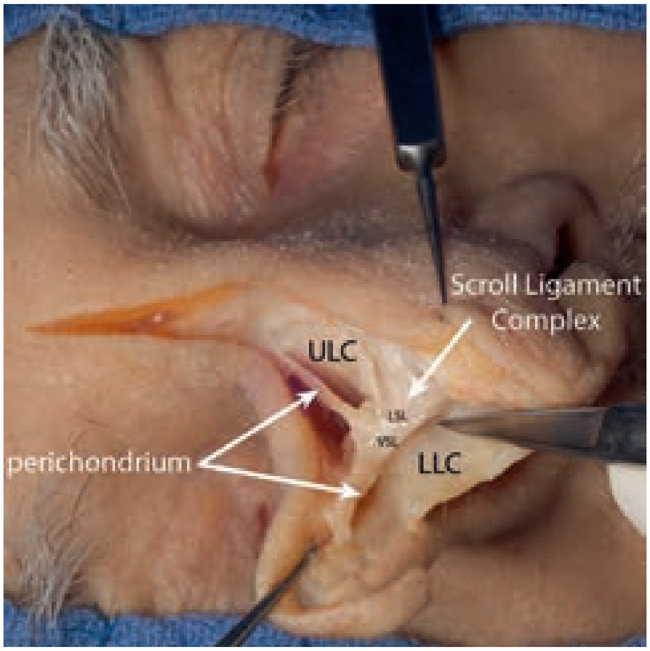
We emphasize that Pitanguy's midline ligament divides into a *superficial portion* which passes above the interdomal ligament and becomes continuous with the superficial orbicularis oris muscle (SOON) and a *deep portion* which passes below the interdomal ligament and becomes continuous with the depressor superficial nasalis muscle (DSN).

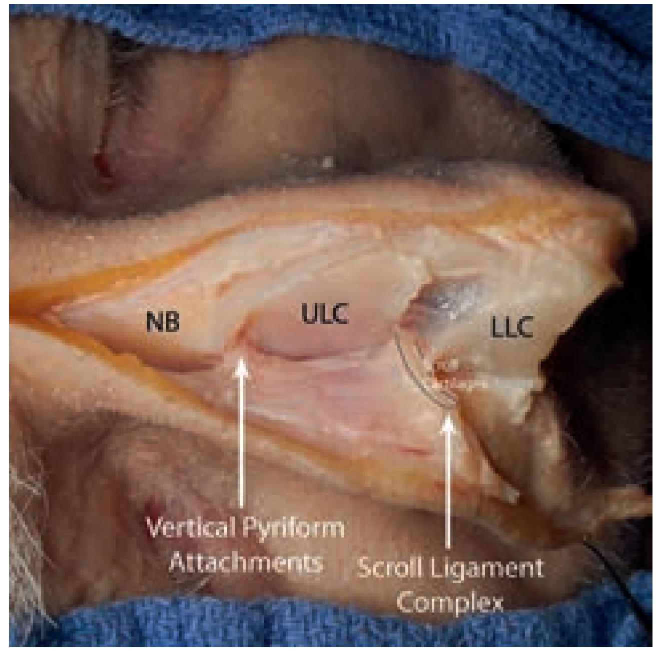
Surgically, division and repair of Pitanguy's midline ligament has become an important method of supporting the nasal tip. Utilizing a closed approach, Çakır identifies the ligament and preserves it in approximately 90% of cases. Surgeons using an open approach often mark, divide, and then repair Pitanguy's midline ligament at the end of the case.

Scroll Ligament Complex (SLC): Vertical & Longitudinal Scroll Ligament

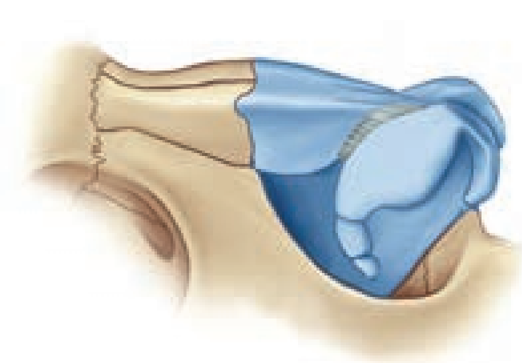
A longitudinal fibrous attachment has long been recognized in the scroll area between the cephalic border of the lower lateral cartilages (LLC) and the caudal border of the upper lateral cartilages (ULC). Recently, Saban has identified a distinct fibrous attachment from the undersurface of the transversalis muscles to the scroll junction. Thus, a Longitudinal (LSL) and a Vertical Scroll Ligament (VSL) can be collectively referred to as the Scroll Ligament Complex.

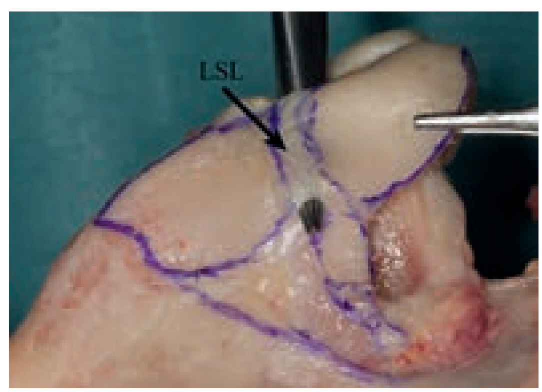


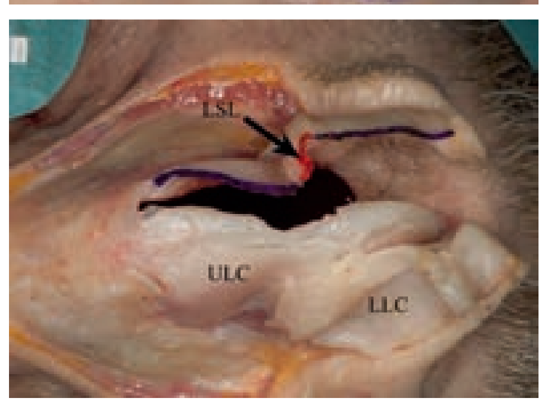




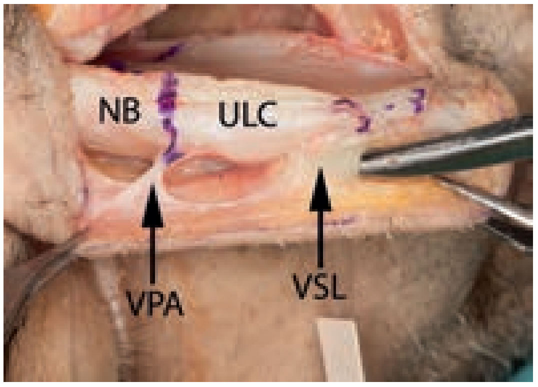
The *Longitudinal Scroll Ligament* (LSL) occurs at the junction between the LLC and ULC. It is basically a perichondrium-derived fibrous tissue in the scroll area that contains multiple interspersed sesamoid (scroll) cartilages. On the mucosal surface, it is the internal valve area. It acts like a swinging door. This ligament is a strong connection between the cartilages, whose lateral counterpart is the pyriform ligament (Rohrich et al. 2006).

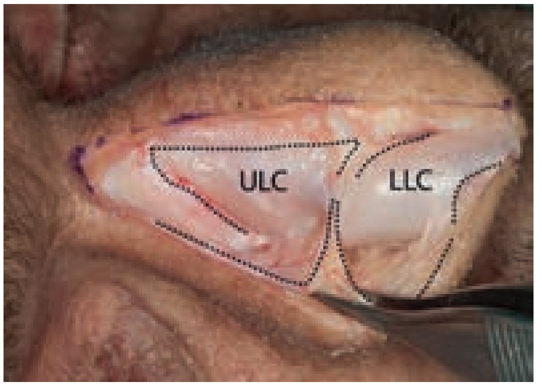




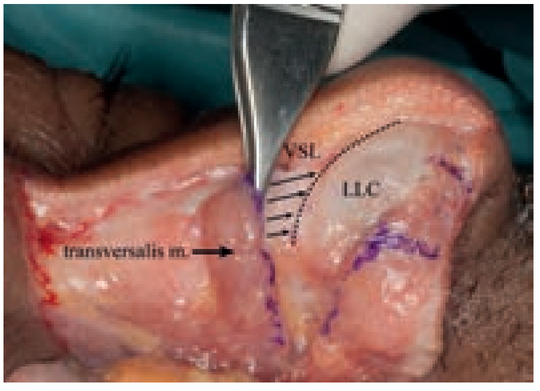


Saban introduced the concept of a *Vertical Scroll Ligament* (VSL) that emerges from the undersurface of the deep SMAS layer and inserts into the internal nasal valve area. These vertically oriented ligaments are always problematic to understand, because they are not as distinct as the longitudinal ones between the cartilages. The VSL is actually a line of adherence along the scroll area, between the overlying soft tissue envelope (SMAS) and the underlying LSL as seen below.



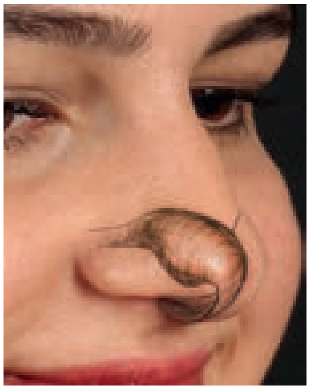


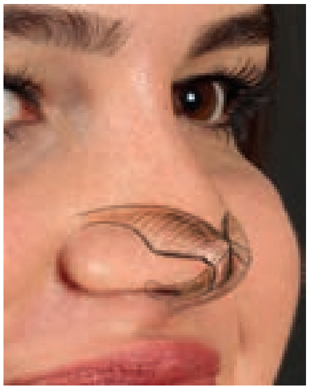
One can clearly see in the following figure the SMAS and scroll area connections. The VSL appears from the caudal edge of the perimysium of the transversalis muscle, thus transmitting the muscle contraction onto the scroll area and finally onto the internal valve. However, the transversalis muscle is a paradoxical muscle. During inspiration, it contracts to narrow the airway, exaggerates the internal valve, and hence redirects the airflow towards the upper meatuses.



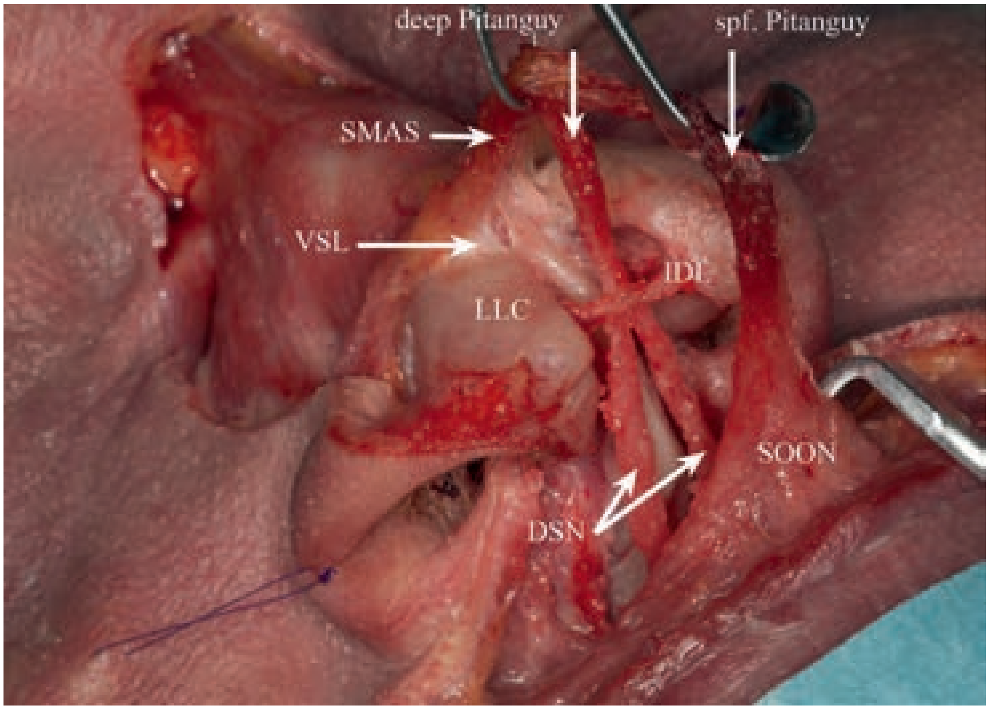
The scroll ligament complex (SLC) has become extremely important in PR and demonstrates the linkage between surface aesthetics-anatomy-surgical technique. New analysis and terminology of this area are now required. As seen in the photograph below, it is important that the surface aesthetics of this area be carefully analyzed pre-operatively.

The classic term “*alar groove*” often denoted a C-shape line which arises in the alar crease, runs vertically through the “alar dimple” before turning toward the alar rim along the caudal border of the lateral crus, and ending at the turning point (TP). However, we now conceptualize the alar groove as splitting at the A-1/lateral crus junction point into a scroll line and a lobular line. The line along the cephalic border of the lateral crus is called *the scroll line*. It is significant as it is both the cephalic border of the lateral crus polygon and the location of the resting angle, both important aesthetic considerations. The *lobular line* overlies the caudal border of the lateral crus and terminates at the turning point, thereby separating the tip lobule from the alar base. These concepts have a dramatic impact on surgical technique as demonstrated in the patient below, treated by Dr. Çakır. As seen in the pre-operative photo on the left, the alar groove is very pronounced, and the scroll line is angulated upward and far from the rim. Surgically, one can elevate the scroll ligament complex intact and then reattach it closer to the alar rim, thereby creating a more aesthetic tip, as seen post-operatively.





In conclusion, this photograph shows the relationship of all of the important ligaments in the lower third.



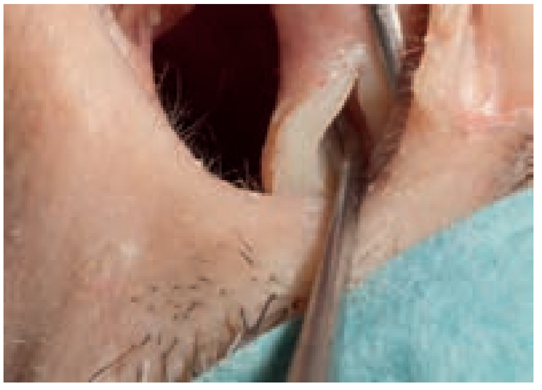
SOFT TISSUE ELEVATION OVER THE OSSEOCARTILAGINOUS VAULT

Elevation of the entire soft tissue envelope (STE) in a continuous subperichondrial -subperiosteal plane (SSP) is a critical first step in performing a complete PR.

Step #1 – A Low Septal Transfixion Incision

The first incision is a low septal transfixion incision. Most surgeons are familiar with the transmucosal transfixion incision with its half- and full-length extent, plus unilateral or bilateral configurations. Essentially, the columellar is separated from the caudal septum via an incision through the membranous septum.

The disadvantage of these incisions is that they cut many of the nasal ligaments including the deep layer of the Pitanguy ligament, and it disrupts many of the attachments of the alar cartilages, including the intercrural ligaments. In contrast, the low unilateral septal transfixion incision placed 2 mm cephalic to the caudal border of the septum preserves all of these ligaments while providing access to the septum. The cartilage retained in the columellar complex is called the posterior strut by Çakır, in contrast to the columellar struts utilized for tip shaping.

Step #2 – Intercartilaginous Incisions

The intercartilaginous incision is placed at the junction between the upper (ULC) and lower lateral (LLC) cartilages. After infiltration with local anesthesia, a 10-15 mm long incision is made, just penetrating the mucosa. The incision passes from lateral to medial where it joins with the septal transfixion incision bilaterally.

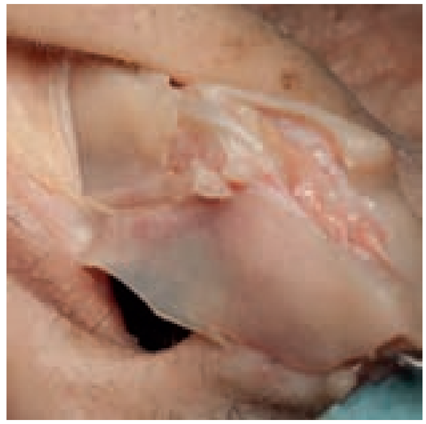
Step #3 – Subperichondrial Dissection over the Cartilaginous Vault

Sharp pointed scissors are then used to expose the upper lateral cartilages along their caudal border. Technically, it is important to facilitate clear demonstration of the dissection planes.

The perichondrium is easily swept off the dorsal aspect of the cartilaginous vault in a lateral to medial direction and then progressing upward to the bony cartilaginous junction. The Daniel-Çakır elevator is particularly useful for this maneuver. Resistance will be encountered as one approaches the cartilaginous-bony junction.

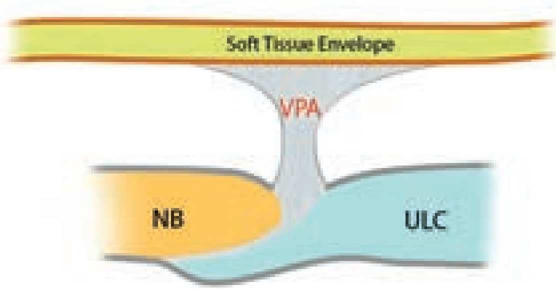
In the photos below, one can see the central and lateral subperichondrial dissection over the cartilaginous vault.





Step #4 – Division of the Vertical Pyriform Attachments

Significant resistance is encountered as one passes from the cartilage vault to the bony vault, due to the vertical pyriform attachments (VPA) which are vertical attachments between the pyriform aperture and the overlying soft tissue envelope. These may provide significant resistance and require sharp dissection to enter the subperiosteal plane.



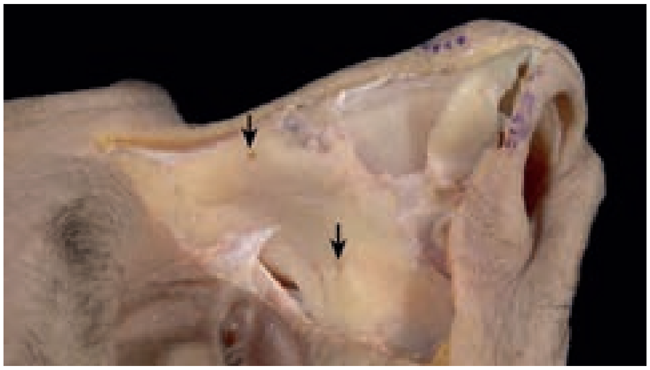
Step #5 – Lateral Dissection into the Subperiosteal Plane

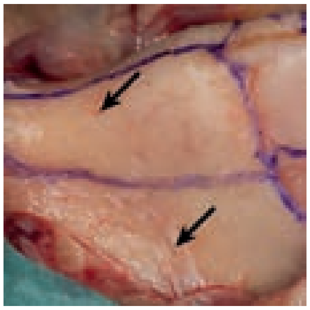
It may be necessary to use a #15 blade to scratch along the caudal border of the nasal bone in order to enter the subperiosteal plane. It is often best to find the plane laterally over the nasal bones and then connect medially over the dorsum.

However, once this plane is entered, the dissection is easily done with an elevator. The extent of the subperiosteal dissection cephalically and laterally will depend upon the surgeon's preferred method of osteotomies. For conventional osteotomes or hand saws, the dissection cephalically will extend to the radix area and laterally midway down the lateral bony wall. For those surgeons using power or piezo-electric instruments, a total degloving of the bony vault is preferred.


Step #6 – Lateral Dissection and Bleeding Points

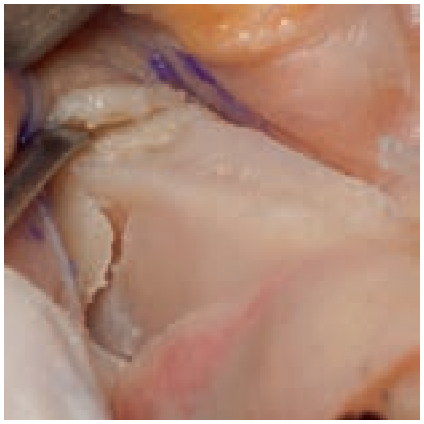
As the lateral dissection continues cephalically in a subperiosteal plane, one tends to encounter several bleeding points at consistent locations. One group of perforating vessels are usually slightly caudal to the sellion, in the radix area. The bleeding is due to severing the small communicating vessels. These vessels are small (< 0.5 mm) branches from the anterior ethmoidal vessels below the bone, which pass through holes to reach the angular vessels. Cauterization is usually sufficient to achieve hemostasis, but bone wax can be applied in cases of persistent bleeding. A second group of vessels are found in a more lateral location at the cephalic end of the nasofacial groove. There are also bleeding vessels through the mucosal space (see figure on the right). These vessels are usually 0.5-1.0 mm in diameter and consist of communicating vessels between the external and intranasal vessels. They are usually damaged when a lateral osteotomy is done or an incision made through the mucosa internally.





Step #7 – Medial Dissection: Central Subperichondrial/Subperiosteal Fusion Area

Dissection in the central area to unite the upper subperiosteal and lower subperichondrial pocket can be difficult.



The reason for this challenging dissection is based on embryology. During fetal development, the nose is made up of a cartilaginous capsule which is covered with perichondrium. Then the nasal bones with their periosteum are laid down on top, which results in an overlapping fusion of perichondrium and periosteum. In some ways, this challenging dissection is similar to dividing the conjoined fibers between the anterior and posterior pockets of the septum. Again, judicious scraping with the #15 blade may be of value.

SOFT TISSUE ELEVATION OVER THE LOBULE

Soft tissue elevation over the lobule via a subperichondrial-subperiosteal plane (SSP) is a demanding technique that must be mastered.

Step #1 – Auto-Rim Flaps and Entering Subperichondrial Plane at the Turning Point

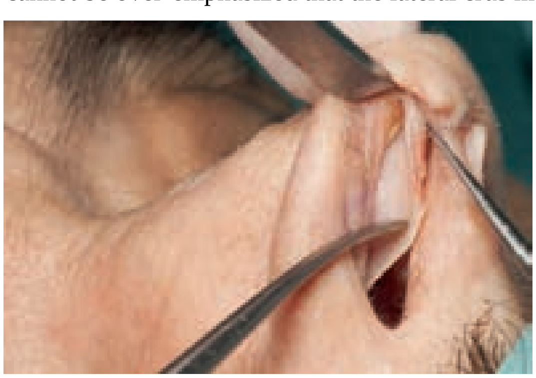
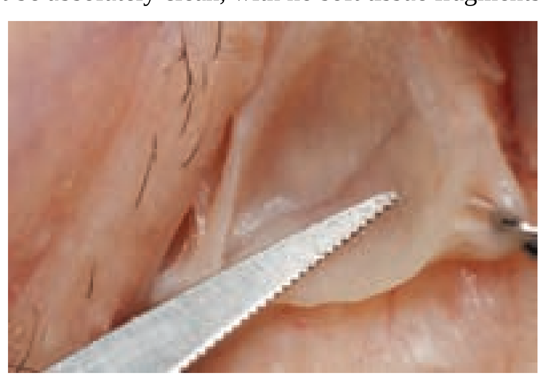
As advocated by Çakır (Çakır et al., 2015), an auto-rim flap is an important method for achieving the desired alar highlight line advocated by Toriumi, as well as for preventing alar rim retraction. In addition, it minimizes the need to add alar rim contour grafts at the end of the case. The figures below show a closed approach.

After careful palpation of the caudal border of the lower lateral cartilage, an intracartilaginous incision is made 2-3 mm back from the caudal margin. It begins at the lateral genu of the domal notch or 2-3 mm lateral to the dome, and then passes laterally to the turning point (TP) of the lateral crus, where it ends. This long narrow sliver of cartilage is retained within the skin sleeve.

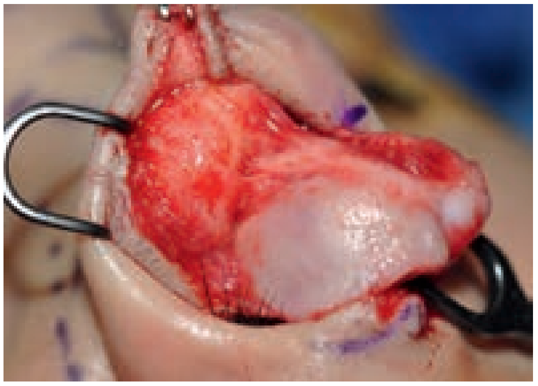
It is easiest to begin the subperichondrial dissection laterally using a #15 blade held vertically and then scarping along the cartilage. The lateral crus is held under tension with a fine hook pulling the lateral crus downward, while a narrow ribbon retractor pulls the skin upward to increase exposure.


Step #2 – Develop a Full Subperichondrial Plane over the Lateral Crus

It cannot be over-emphasized that the lateral crus must be absolutely clean, with no soft tissue fragments.

As seen in the clinical photographs below, the vast majority of surgeons who think they are dissecting subperichondrially are not in the correct plane. If one sees muscles or bleeding points on the elevated skin, then the dissection is sub-SMAS, no matter how "clean" the cartilage appears. Gaining access to this plane is the most tedious and technically challenging aspect of this operation. On the left side below, one can see a clean dissection over the cartilage, but it is sub-SMAS as the muscles and bleeding soft tissues are obvious. On the right side, one can see a true subperichondrial dissection with visible perichondrial fibers on the elevated soft tissue, while the dots indicate the scroll ligament complex.




Step #3 – Continue Dissection over the Dome, Down the Middle Crus, and onto the Medial Crus

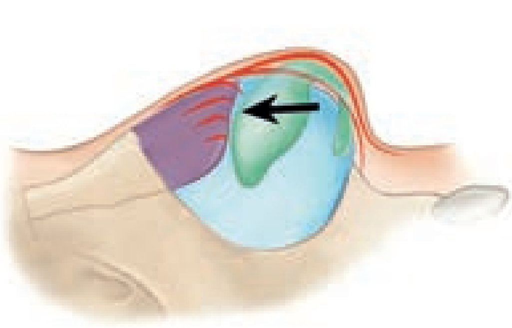
Once the lateral crus has been exposed, the dissection continues over the dome, then down the middle crus and onto the medial crus below the columellar breakpoint. The goal of this dissection is to achieve sufficient mobility of the crus to allow delivery of them into one nostril. It is essential that the alars be sufficiently mobile to be in approximation without tension when delivered through one nostril, thus allowing accurate suturing. In the figures below one can see a closed approach on the left, an open approach on the right.

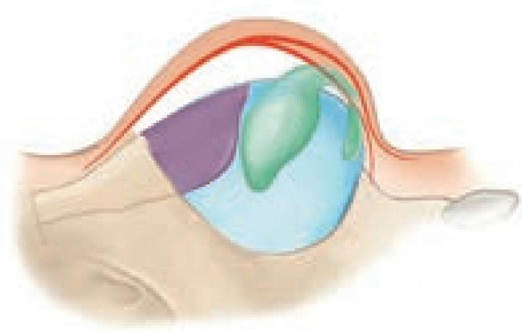

Step #4 Release of the Interdomal Ligament

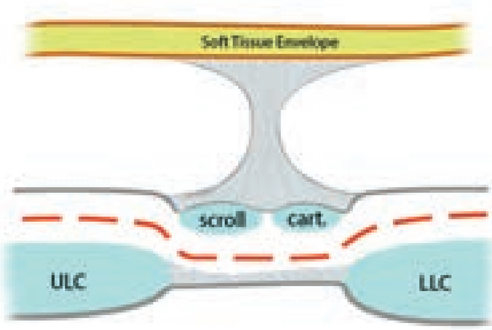
At this point, additional mobilization is achieved by releasing the interdomal ligament. Again, the dissection must be meticulous, and the ligament released from the posterior border of the middle crus. Note that the appositional approximation of the interdomal ligament is restored with sutures, including various "loop sutures" between the interdomal soft tissues and cephalic border of the middle crura.

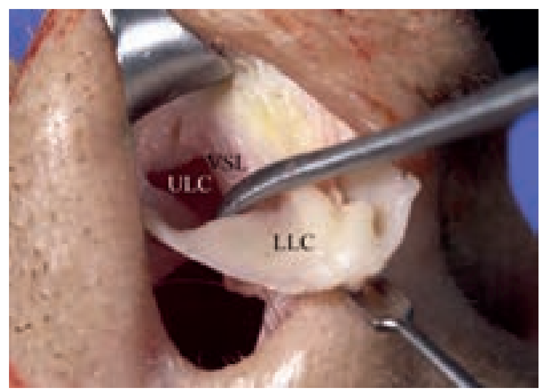
Step #6 – Cephalic Dissection across the Scroll Junction pushing up the Scroll Cartilages and the Vertical Scroll Ligament

Although conceptually simple, this step is ultimately the joining of two preexisting subperichondrial pockets: one over the lateral crus, and the other over the cartilaginous vault (see figure below). Connecting the pockets starts at the dorsum and progresses laterally.

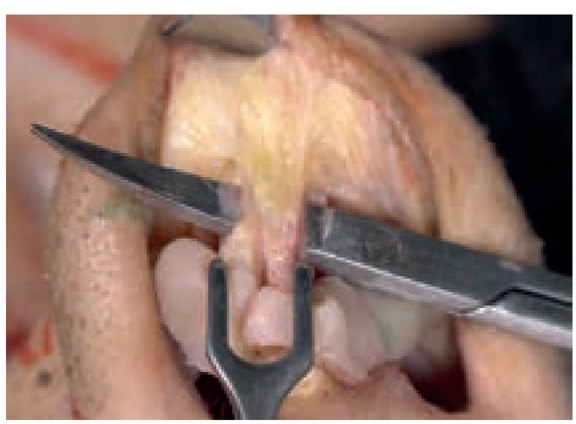




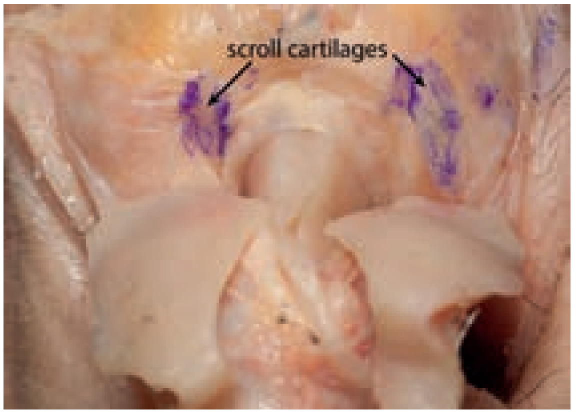




The figure below demonstrates the preservation of the Pitanguy's ligament. Note: The transcolumellar incision was done to show the deep Pitanguy's ligament.

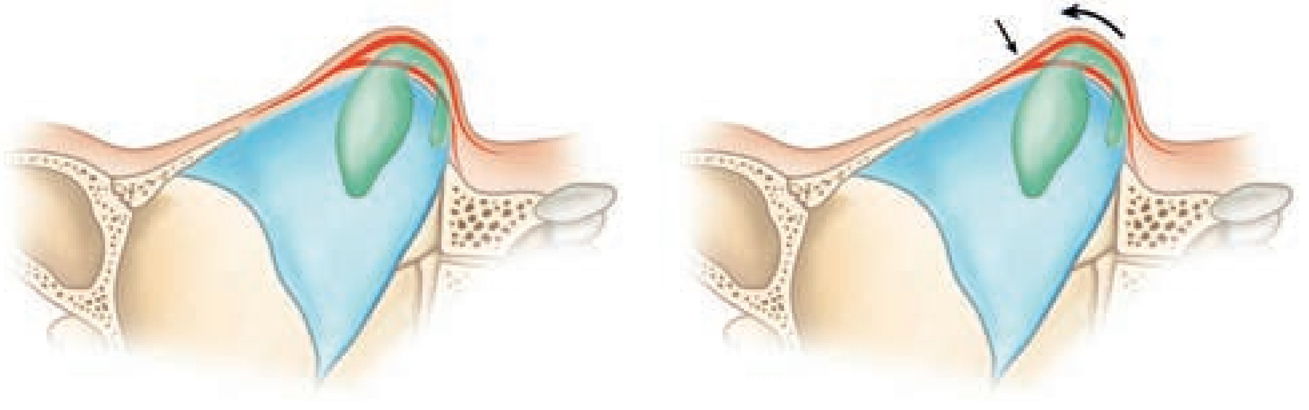


Success is noted by visualization of the white sesamoid cartilages in the overlying soft tissue envelope (see figure below; note: dissection was performed to show the scroll cartilages in the perichondrium/VSL—the Pitanguy's ligament is not preserved).



Dividing Pitanguy's ligament, with the option of suturing it back together, gives greater access to the dorsum, if there is a need for any dorsal modification. In most cases Pitanguy's ligament is kept intact. The obvious question is: "Why bother to preserve the ligament?" There are 3 reasons to keep it intact:

1) it elevates the tip,
2) it compresses the infralobular curve, and
3) it pulls the soft tissue envelope downward, thereby accentuating the supratip break.



Cutting Pitanguy's ligament has three negative consequences:

1) derotation of the tip with loss of projection,
2) it lengthens the infralobule and causes it to round out, and
3) it creates a soft tissue poly-beak. *Preservation leads to predictability*.

Why is this step so important? Functionally, it means that the scroll ligament complex between the longitudinal and vertical components is maintained and neither disrupted nor scarred. In many ways, it is the equivalent of preserving the internal valve angle by doing submucosal tunnels. Aesthetically, the suture reattachment of the sesamoid area to the ULC will set the aesthetic scroll line on the surface and define the upper border of the lateral crus polygon.

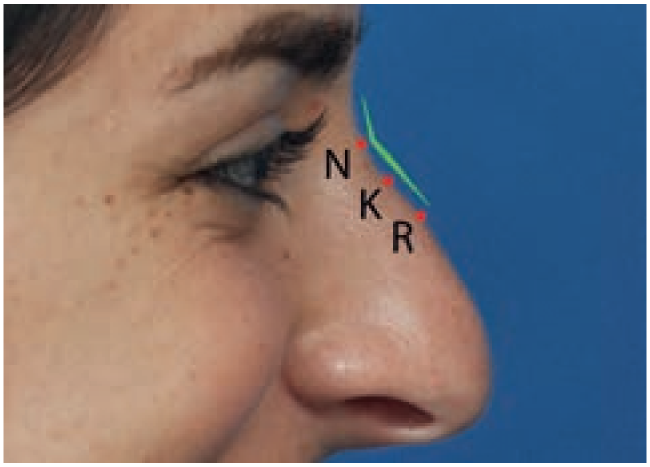
ANATOMICAL CONCEPTS OF DORSAL PRESERVATION

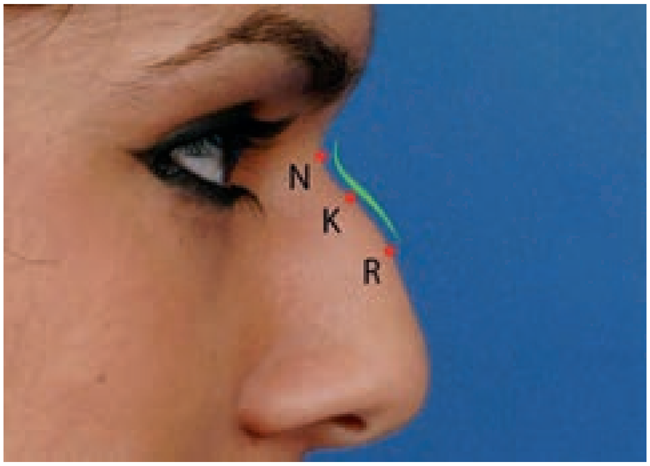
Preserving the osseocartilaginous dorsum is a major advance in rhinoplasty surgery. Instead of excising the dorsum, one lowers it by removing a subdorsal septal strip, followed by lateral, transverse, and radix osteotomies.

Step #1 – Understanding the Aesthetic Points of the Dorsal Profile (N-K-R)

Very few surgeons analyze the nasal hump. Rather, they connect the dots between the nasion (N) and ideal tip projection to set the ideal dorsal line and thereby determine the amount of reduction. In PR, it is important to recognize the three aesthetic points: N, K, R.

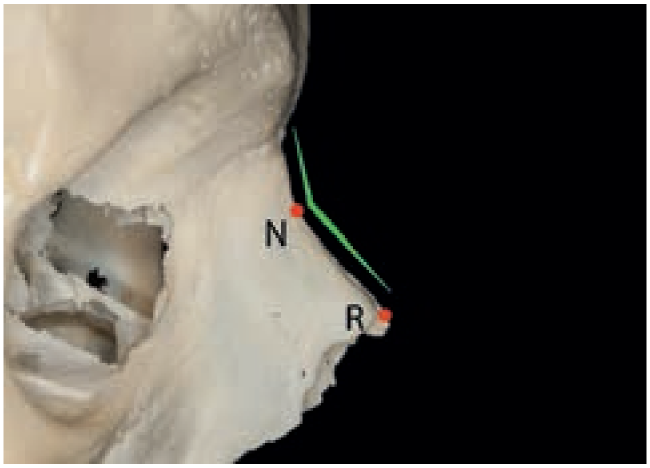
The clinical *Nasion (N)*, as opposed to the anthropometric nasion, is the deepest point in the radix area on profile view, which is usually the deepest point on the nasal bones. The *Kyphion (K)* is the most prominent point on the nasal dorsum. The *Rhinion (R)* is most caudal point of the paired nasal bone and marks the midline junction between the bony and cartilaginous vaults. One needs to realize that the rhinion denotes the keystone junction (do not confuse K & R).

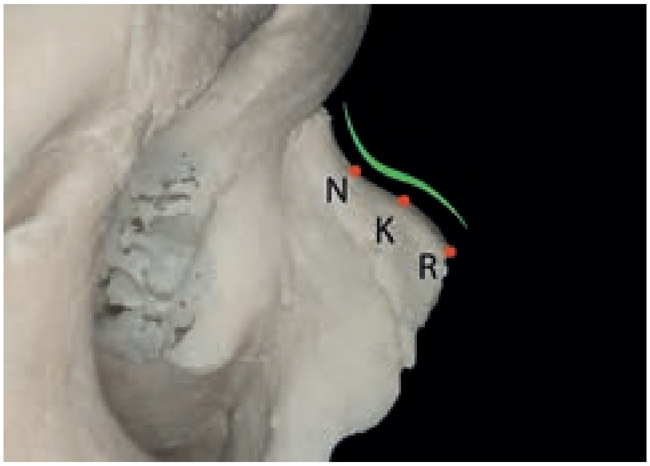




Step #2 – Anatomy of Humps and Nasal Bones

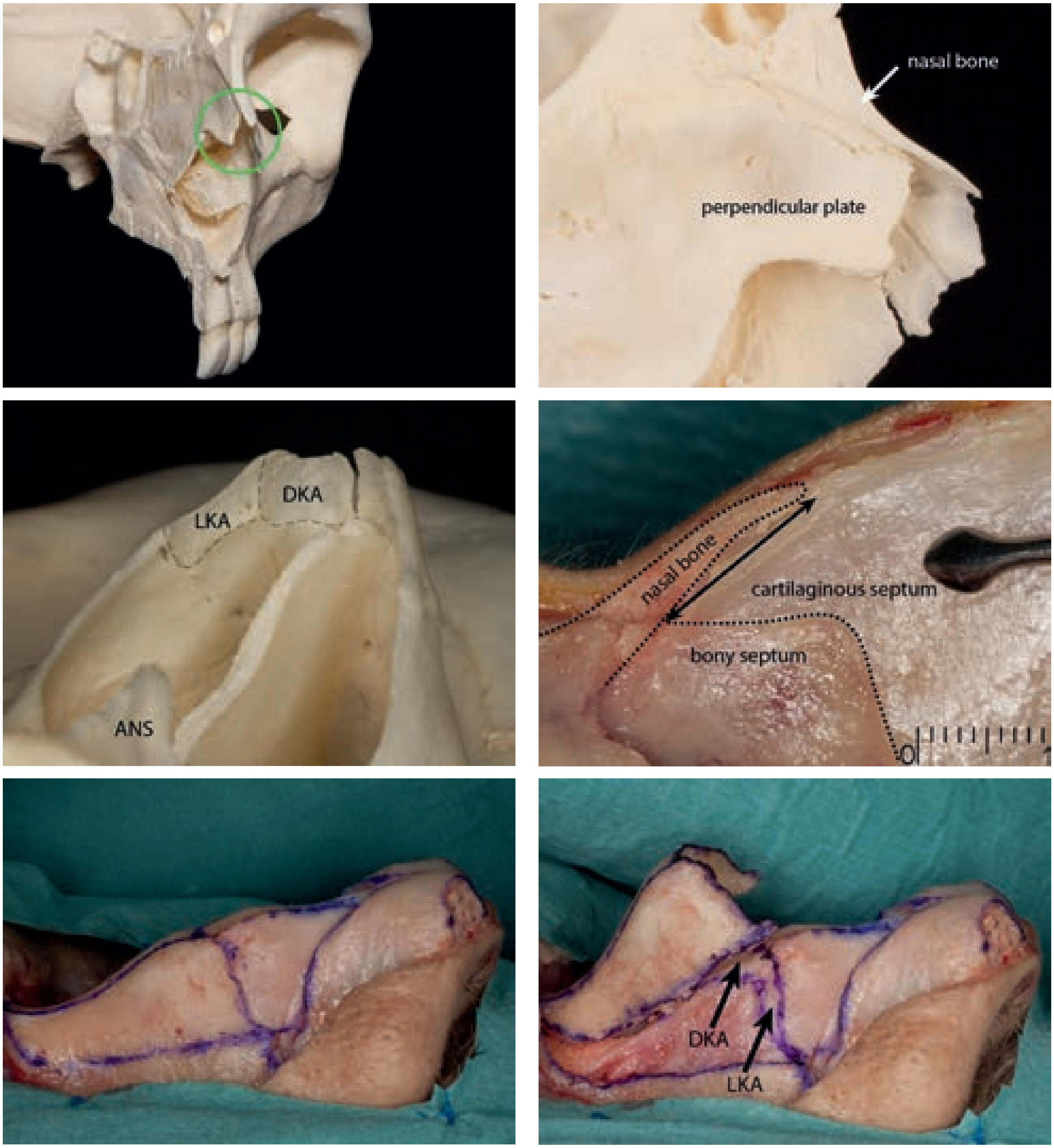
After marking these three points, one can classify dorsal humps into V- and S-shape (Lazovic et al. 2015). The V-shape dorsum has a straight-line configuration from Nasion to Rhinion, with one point of angulation. The S-shape dorsum has a distinct angulation from Nasion to Kyphion and then a plateau from Kyphion to Rhinion. In PR, the more severe the S-shape kyphotic dorsum, the more difficult it is to flatten.





Step #3 – The Keystone Area

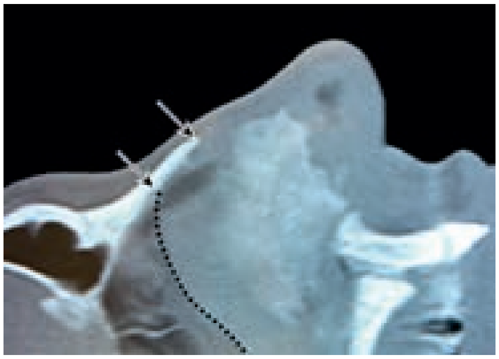
It is important to define the keystone area as that portion of the nose where the bony vault overlaps the cartilaginous vault both dorsally (dorsal keystone area—DKA) and laterally (lateral keystone area—LKA).

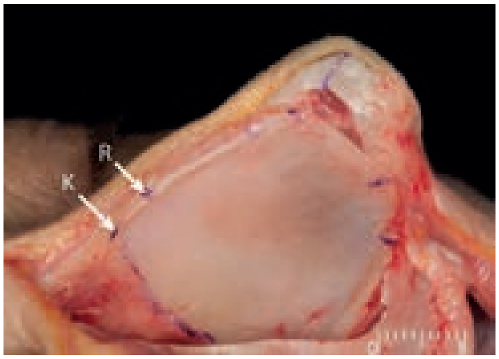


The nasal bones serve as a “bony cap” whose position is largely determined by growth of the cartilaginous septum. The nasal bones vary in size and dimension but form a thin “bony cap” contour overlaying the cartilaginous structures. Thus, the nasal hump is a reflection of the underlying cartilaginous vault with a thin bony cap overlay, rather than a large osseocartilaginous structure comprised of 50% cartilage and 50% bone.

Step #4 – Anatomy of Septal Cartilage/PPE Junction and Relationship to N and R

One of the most important anatomical findings is the variation between the location of the keystone point (R) and the dorsal junction between the cartilaginous septum and the perpendicular plate of ethmoid (E point). In most cases, the dorsal cartilaginous septum will extend 8-10 mm beneath the nasal bones.

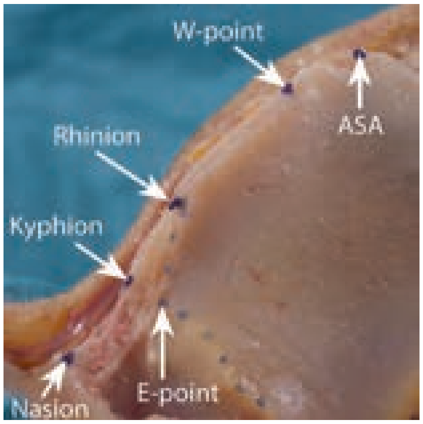


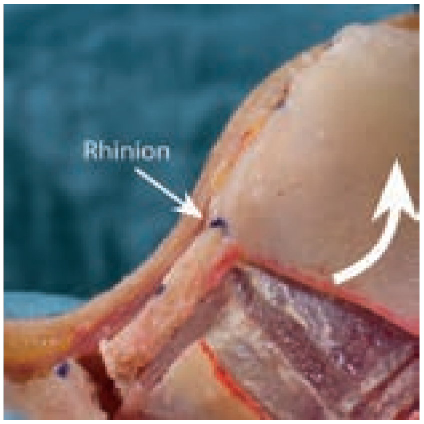


However, one must be aware that significant anatomical variations exist as to the location of the junction point. The ability to know the junction point between the subdorsal cartilaginous septum and the perpendicular plate of ethmoid prior to surgery is yet another indication to do a cone-beam CT-scans prior to rhinoplasty surgery.

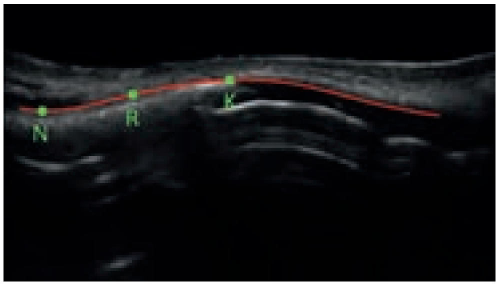
Step #5 – Concept of the "Chondro-Osseous" Joint

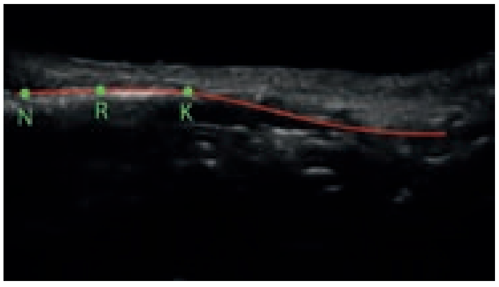
The periosteum on the deep surface of the bony cap fuses with the perichondrium on the superficial aspect of the cartilaginous vault (below on the left). The result is a flexible dorsum which allows the convexity of the dorsum to be eliminated by reducing the underlying cartilaginous septal support. Thus, the vault can be modified from convex to concave without losing its continuity by either a high strip or Cottle septal resection. The two photos below on the right are sequential photos, demonstrating the flattening that appears at the Rhinion during Cottle-type resection. The skull is kept in a fixed position.





As shown in the sonograms below, provided by Dr. Kosins, a very distinct flattening of the osseocartilaginous junction is observed between pre-op (left) and one-week post-op (right) following a Dorsal Preservation procedure.



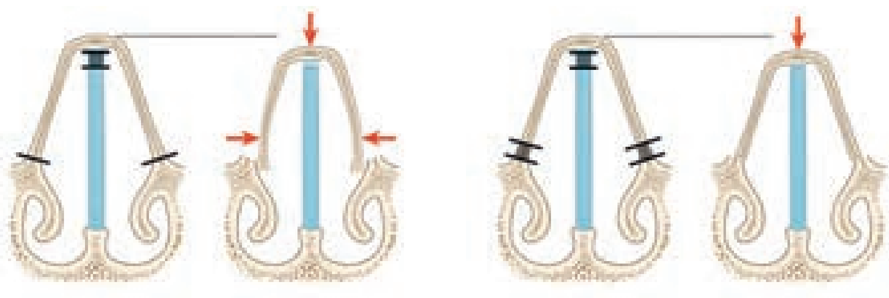


OPERATIVE STEPS OF DORSAL PRESERVATION

Dorsal Preservation (DP) is done using the following three steps: (1) excision of a septal strip, (2) total mobilization of the bony vault with osteotomies, and (3) downward impaction of the osseocartilaginous vault. It is important to realize that the sequence of these steps vary based on the surgeon's preference. Additionally, surgical preference extends to the method of mobilization (push-down vs let-down), which in turn determines the types of lateral osteotomies.

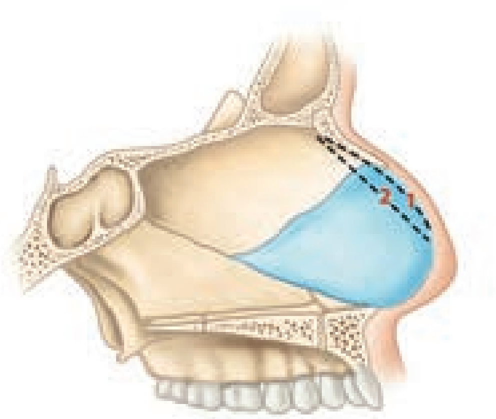
Step #1 – Push-Down vs Let-Down: Concepts

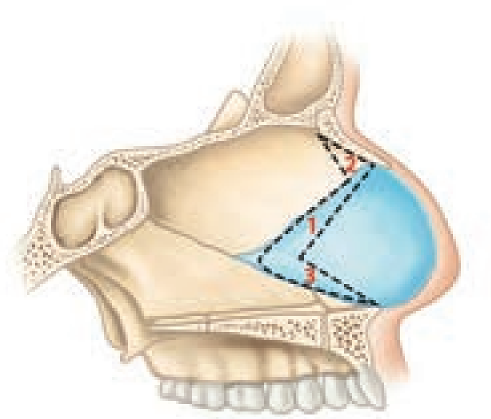
The classic DP techniques require a Push Down or Let Down bony lateral wall lowering. Push Down includes low-to-low osteotomies followed by pinching of the completely mobilized osseocartilaginous vault and impacting it downward into the nasal cavity. In contrast, the Let Down involves excision of a tapered triangle of the frontal process of the maxilla, which provides space for the mobilized vault to be lowered into. Most experienced surgeons develop a distinct preference for one technique or the other, while others have specific indications for each.



Step #2 – Anatomy of the Septal Strip Excision

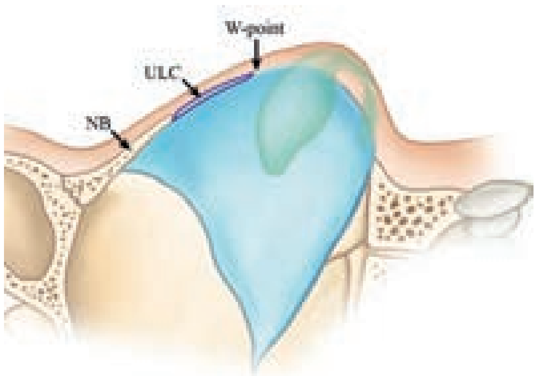
Historically, the septal strip excision has varied extensively as to amount, shape and location. There are 2 basic type of septal excisions: high septal strip – subdorsal (below left) and the Cottle-type septal excisions (below right). Currently, the majority of surgeons prefer the following: high septal strip – immediately subdorsal and tapered in shape.



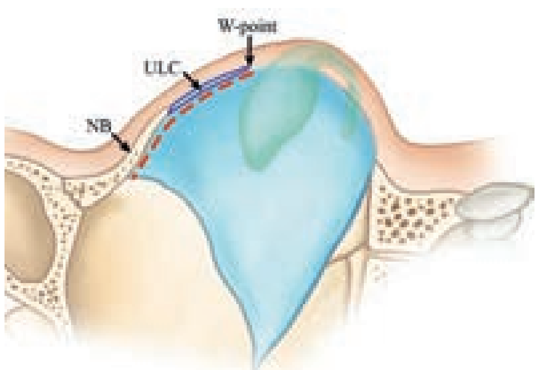


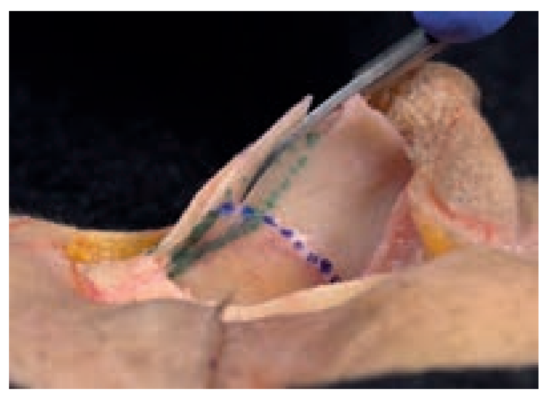
Step #3 – Septal Strip Excision: Cartilaginous Component

The cartilaginous strip excision consists of an incisional curved subdorsal cut first and then a straight excisional cut through the septum for removal of the intervening cartilaginous strip. It is important that the cartilaginous cut NOT start at the ASA point, but rather at the W-point. The W-point represents the point of separation of the ULCs from the septum. From the surgeon's viewpoint looking from caudal to cephalic, it resembles the letter W. Anatomically, the W-point will be 4.4 mm (range: 1-8 mm) (Palhazi et al. 2015) from the ASA. However, we recommend clinically to place the incision at the actual W-point, which should be at least 6-8 mm cephalic to the ASA.

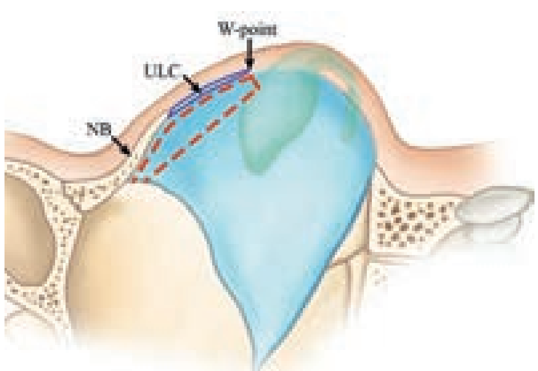


The *incisional cut* then continues subdorsal, keeping intimate contact between the scissor tips and the undersurface of the dorsum. The incision passes cephalically until bone is encountered at the junction of cartilaginous septum and the perpendicular plate of ethmoid (PPE).



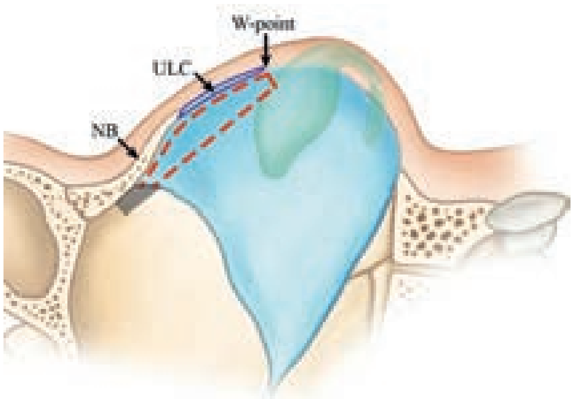


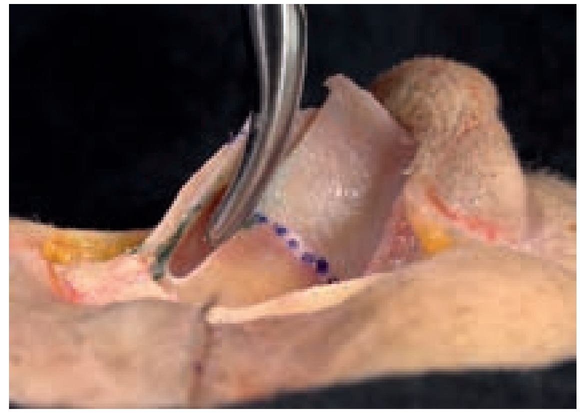
The *excisional cut* is a straight cut using straight scissors, and it begins 2-4 mm below the W-point. It then continues until the bony septum is encountered. One should conceive of this as an incremental strip excision and not a definitive setting of the profile line. Remove half of what you think you need initially, then add incremental excisions.



Step #4 – Septal Strip Excision: Bone (PPE) Component

Once the initial cartilage strip has been excised, one must obtain mobility at the bony PPE component of the septum and provide space for the dorsum to descend. As previously stated, pre-operative cone-beam CT scans are extremely helpful in estimating the extent of bone removal that will be required, as well as the method.

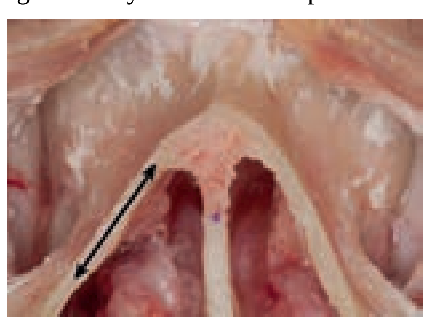




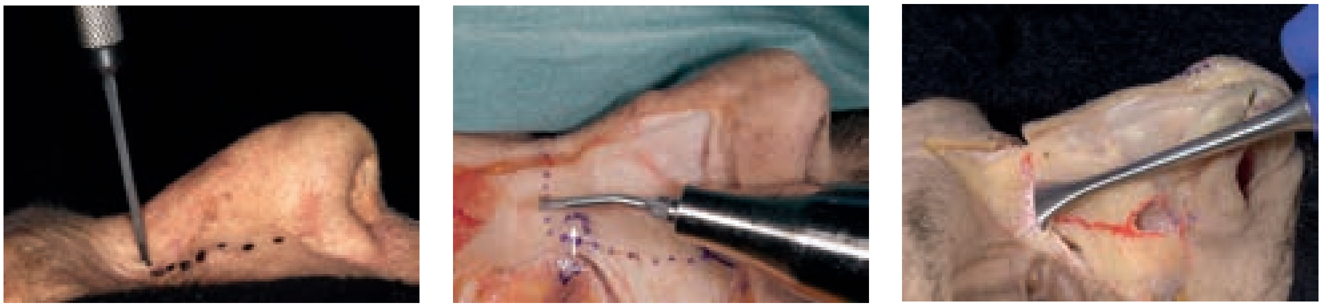
Saban takes a progressive approach to mobilizing the bony septum, depending on the amount to be excised: no excision, simple fracture, triangular excision, or quadrangular excision. Çakir prefers to use a micro-tip Rongeur (Medicon Instruments). It is important to remove the bony PPE with multiple small cuts and to avoid any twisting motion. At this point, one can begin the osteotomies to mobilize the entire osseocartilaginous vault. Please note that the above seen cadaver case is only for demonstration purposes. Also, the Rongeur is usually smaller.

Step #5 – Anatomy of the Transverse Osteotomy

By definition, a transverse osteotomy extends from the level of the lateral osteotomy across the frontal process of the maxilla and nasal bone into the radix area, terminating at the ipsilateral dorsal aesthetic line. It is usually a straight line. Its location may vary depending on the location of the new nasion (N), which in turn corresponds to the location of the radix osteotomy. The transverse and also the lateral osteotomy can affect the medial canthal ligament. This clinically does not cause tarsal instability, because it is only its anterior limb. The medial canthal ligament (MCL) has three limbs. The superior and posterior ones are responsible for stabilization of the tarsus. The anterior limb mainly originates from the orbicularis oculi muscle. When one performs a total subperiosteal elevation, then the anterior MCL can be elevated, and it will reattach. Also, bleeding is minimized because the angular artery and vein are superficial to the MCL, as seen below.

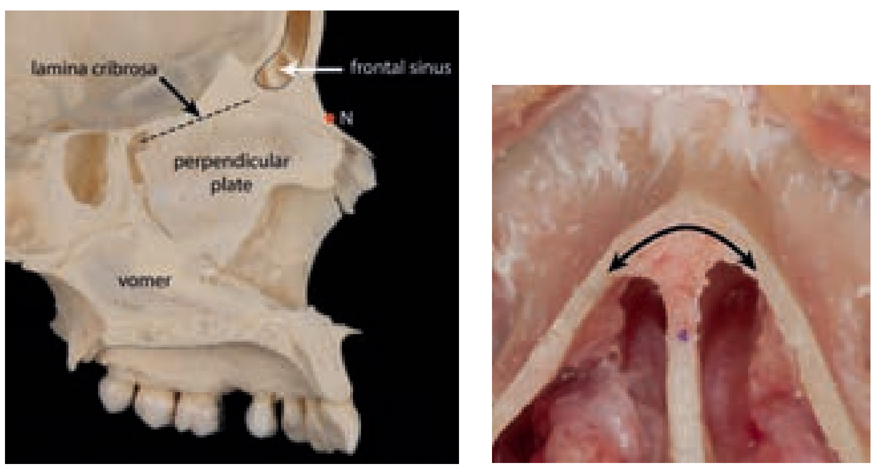


The transverse cut is made first, as the bones are stable; a clean cut can be made, either with a hand saw or a piezo blade. Alternatively, a percutaneous osteotomy can be done with a 2-3 mm osteotome.

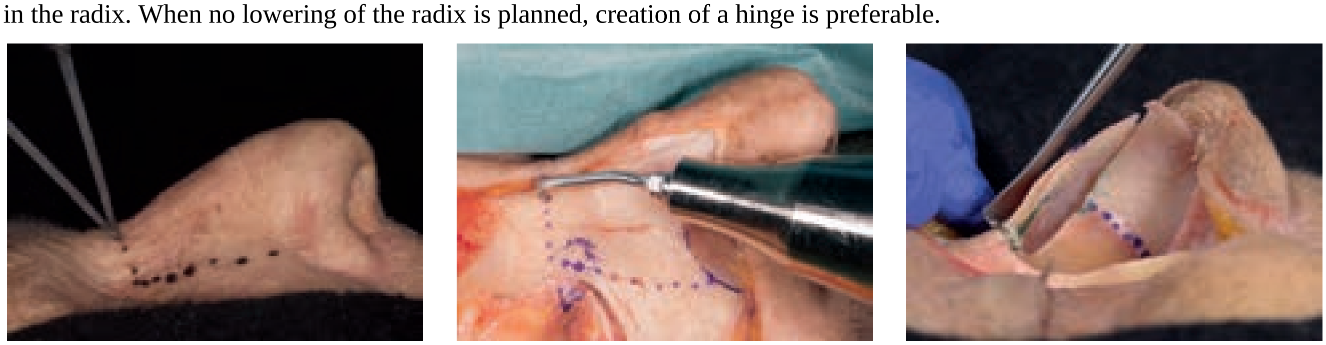


Step #6 – Anatomy of the Radix Osteotomy

The radix osteotomy may be called the nasion, or even the nasofrontal osteotomy. Its purpose is simple: (1) to unite the two transverse osteotomies, and (2) to fracture downward through the fused nasal bones and then the nasal spine of the frontal bone in order to enter the previously resected area of the bony septum. This osteotomy must be approached carefully yet firmly to cut through the fused syndesmosis of the nasal bones. When using percutaneous osteotomes, it is important to stand at the head of the table and angle the osteotome at a 45-degree angle downward away from the cribriform plate.

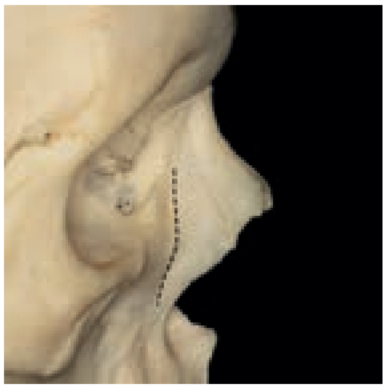
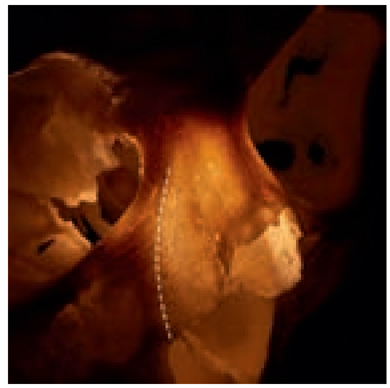


The location of the radix osteotomy is critical: at the desired nasion point (N) within the radix area. In the majority of patients, there will be no desire to change N, and this site will be selected. It should be noted that the nasion or soft tissue sellion is often 4-5 mm above the medial canthal ligament. As one moves the site of the radix osteotomy caudally, one tends to create a deepening of the radix and caudal displacement of N, leading to an infantilization of the nose (Kosins). The orientation of the percutaneous osteotome is also highly important in producing a step (perpendicular) or a hinge (oblique) in the radix. When no lowering of the radix is planned, creation of a hinge is preferable.



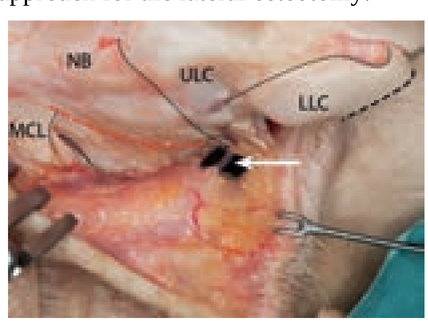
Step #7 – Lateral Osteotomy and Webster's Triangle

A traditional low-to-low osteotomy is performed beginning at the caudal border of the pyriform aperture, then straight across the ascending process of the maxilla, before terminating at the level of the transverse osteotomy. Once completed bilaterally, the entire osseocartilaginous vault should be mobile. This traditional lateral osteotomy is done a couple of millimeters higher than our preferred low-to-low osteotomy during DP, especially if it is done by Piezoelectric saw. It has to be done along the *Nasofacial Groove* (see below) which is where the frontal process of maxilla shapes and creates the bony nasal pyramid. During Piezoelectric rhinoplasty one has no other landmarks but this.

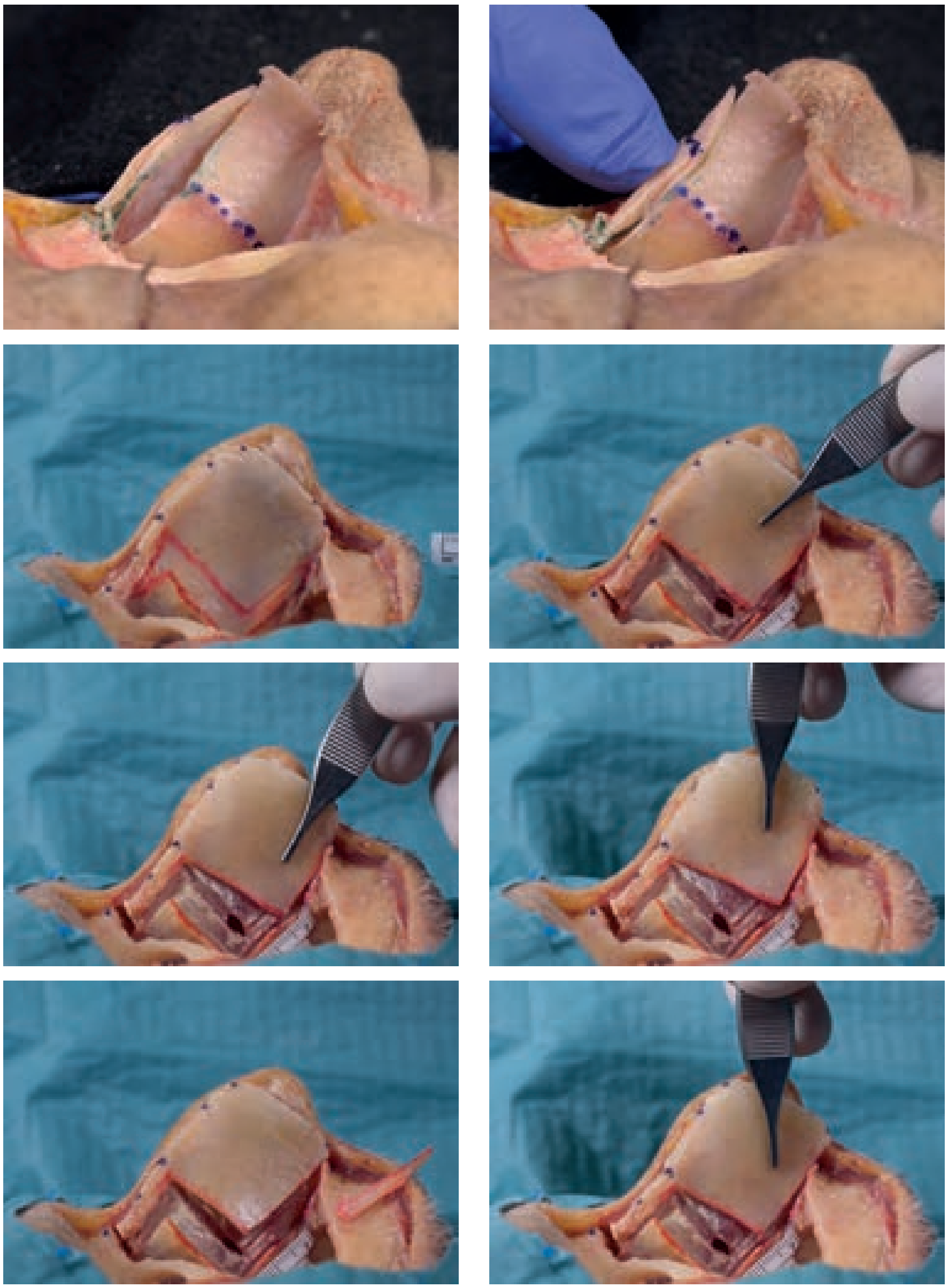
Many surgeons excise the Webster's triangle area using a small tip Rongeur. This is done prior to the lateral osteotomy. In many ways, this is simply resecting the same area as one would in a let-down procedure. Also, it prevents any potential medial bony displacement toward the head of the inferior turbinate. Conceptually, this approach can be considered a type of hybrid Let Down / Push Down lateral bony wall lowering.


There are veins just on the top of the periosteum; these can bleed during lateral osteotomy if one is not subperiosteal. These veins also connect to the internal nasal vessels through the Mucosal Space. This anastomosis usually bleeds when one does the mucosal cut along the pyriform aperture to create the approach for the lateral osteotomy.

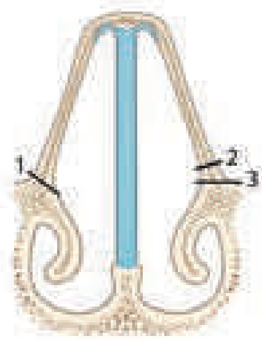



Step #8 – Mobility

Once the bony osteotomies are completed, it is important to check that the bony cuts are all connected to each other and deep enough through the bone to allow complete mobilization. The bony vault can be grasped between thumb and index finger, and then totally moved from one side to the other. Alternatively, a 90-degree chisel can be placed in the cuts to ensure their adequacy. Most often, there will need to be additional mobility achieved at the radix cut (often just minor mobility, or fracturing with the 90-degree chisel) and along the lateral osteotomy line. The latter problem has been minimized by resection in the Webster triangle area, but this excision may need to be extended cephalically.

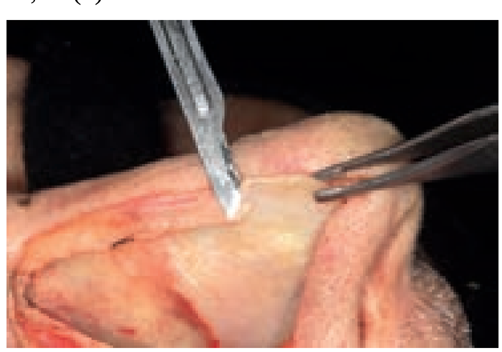


As seen in the drawings below, the lateral bony wall is thick along the Nasofacial Groove. It is extremely important to understand the differences between the traditional osteotomy cuts, piezoelectric cuts, and the osteotomies for Push Down or Let Down. During classical osteotomies with conventional instruments, the osteotome will automatically follow the line of least resistance, which results in higher osteotomy lines (#2). When performing classical bony wall medialization for example during a cartilage only DP, sinking of the lateral wall into the nasal cavity is not desired, so the orientation of the cut is more horizontal (#3). In contrast, during Push Down mobilization, to enhance the impaction, it is advisable to cut more sagittally (#1), which is easily achievable using Piezo saws. During a pure Let Down lateral bony wall lowering, these considerations have no significance, since a bony strip is always removed.



Step #9 – Adjustments Including the W-ASA Segment

Once the osseocartilaginous pyramid has been lowered to the desired position, then the profile line should be evaluated, both for height and alignment. The W-ASA Segment (the area between the W and ASA points) must be checked, as it was deliberately kept high initially to avoid any potential saddling. Frequently, a straight-line cut from ASA to W is sufficient. Additional adjustments may include the following: (1) minor septal strips excised, (2) the undersurface of the dorsum released with partial vertical cuts, or (3) the dorsum shifted to one side or the other.



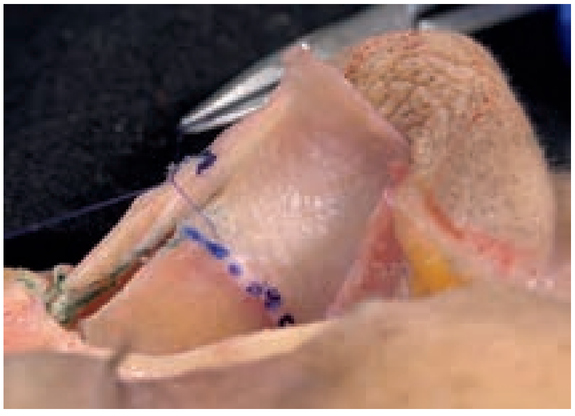
Step #10 – Three-Point Suture Fixation/Stabilization

Once the surgeon is satisfied with the dorsal profile, then the dorsum is fixed to the underlying structures. Kosins has developed a three-point suture fixation technique which allows for minor adjustments, rigid stabilization, and reduction of post-operative problems.

Suture #1 is placed at the original K-point of the hump. Small drill holes are made through the bone on either side (most often these holes are placed at the start of the case). A 4-0 PDS suture is passed through one hole, then across the dorsal septum, out the opposite bone hole and then tied in a cerclage fashion. The goal is to keep the dorsum flat and resting against the septum, thereby minimizing the chance of a recurrent hump.

Suture #2 is placed at the W-point with 5-0 PDS. Since the distal cartilage vault is still mobile, certain adjustments can be made. The steps are as follows: (1) the vault is moved from side to side until the best location is found, (2) the vault is then fixed to the underlying septum with a #25 needle, and (3) the suture is then inserted to stabilize the structures in the correct position.

Suture #3 is inserted midway between the other two sutures using a 4-0 PDS suture passed in a cerclage fashion. Essentially, one has locked down the dorsum in the desired position and fixed it at three points.



CONCLUSIONS

Anatomy is at the critical center of the rhinoplasty triad of aesthetics-anatomy-surgical techniques. Anatomy determines the surface aesthetics and is the structure upon which we operate. Yet, for surgeons wanting to master Preservation Rhinoplasty (PR), there are the problems of having to learn new techniques based on a new anatomy and also the limited visibility that occurs in most clinical cases. Thus, the surgeon must understand the anatomy and surgical techniques which have been illustrated in this chapter in detail. Elevation of the soft tissue envelope in a complete subperichondrial-subperiosteal plane will minimize post-operative morbidity and the need for revision surgery. Understanding the anatomy of the keystone area enables dorsal reduction with retention of the natural dorsum, without the need for intraoperative mid-vault reconstruction or secondary rib graft procedures. Thus, a new era in Rhinoplasty Surgery is evolving, based on an appreciation of recent advances in our anatomical knowledge.

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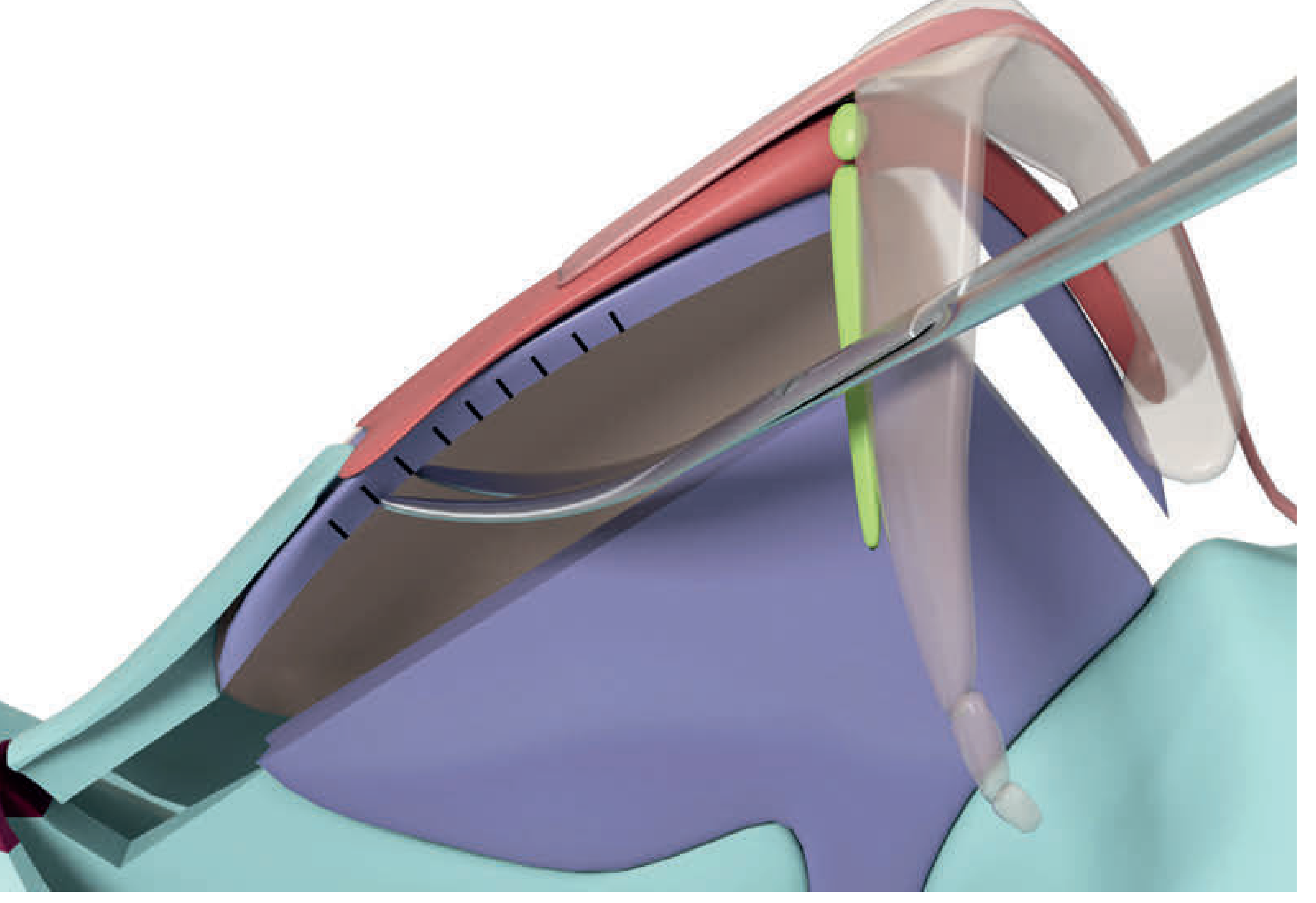
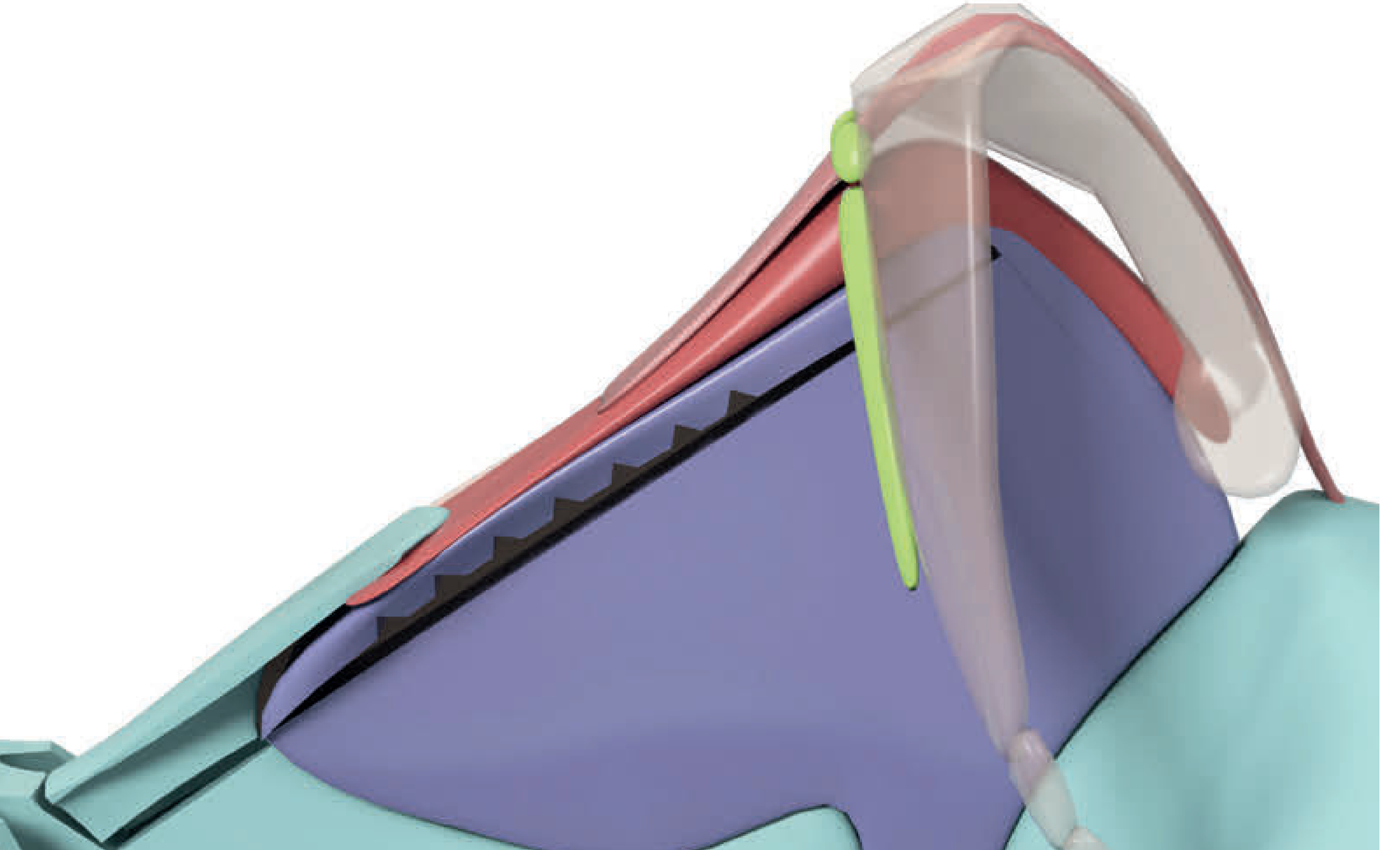




My First 500 Dorsal Preservations

Barış Çakır, Hüseyin Güner, Eren Taştan

I began my rhinoplasty journey in 2004. I had an idea about dorsal preservation techniques from the literature, but I was only taught the classical dorsal resection techniques. In 2016, Yves Saban explained the dorsal preservation technique to me on fresh cadavers in Budapest (see above). Instead of resection and reconstruction, he preserved the dorsum with septal strip excision and osteotomies. The dorsal surgery took only 3-4 minutes. I was stunned at its simplicity and started performing the technique the following week in Istanbul. I continue to learn and explore the applications of dorsal preservation techniques. In this chapter, I will share with you my dorsal preservation experience over the past 4 years. The surgeons from whom I gained my knowledge through personal contact or talks in meetings are: Yves Saban (High Septal Strip DP), Valerio Finocchi (Low Septal Strip DP), Luiz Carlos Ishida (Cartilage Only DP), Hüseyin Güner and Miguel Ferreira (High Septal Strip Cartilage DP).

DORSAL PRESERVATION & CLASSICAL DORSAL RESECTION

The dorsal resection technique eliminates the dorsal hump and lowers the profile but requires midvault reconstruction. In addition, when the roof is opened, it is necessary to adjust the heights of each of the two upper lateral cartilages, the septum, and the two bony sidewalls. It is not easy to accomplish this in a closed rhinoplasty. Dorsal resection usually needs dorsal reconstruction and dorsal camouflage. A C type crookedness may appear if a classic resection is applied in a patient with a beautiful dorsum and high septal deviation. It is not easy to re-establish dorsal aesthetic lines over a deviated septum. Dorsal Preservation (hereinafter DP) maintains the dorsal roof without requiring reconstruction. The closed cartilage roof in particular provides a major advantage. The nasal bones remain stable when the roof is not opened, as the two sidewalls remain attached to each other. Postoperatively, two of the risks of DP surgery is the occurrence of a residual hump and loss of height in the radix area.

In summary, DP achieves an ideal natural dorsum in appropriately selected cases. It is not wise to apply DP nor resection technique in every single case. I do think that most surgeons performing rhinoplasty should add DP techniques to their armamentarium. If the patient already has an attractive nasal dorsal cartilage, I believe that it is better to preserve it. If the nasal dorsum is excessively convex, only the cartilage can be preserved, and the bony hump can be managed with modified resection.

WHICH TECHNIQUE TO DO FIRST?

You can start by performing cartilage only DP with a high septal strip in a patient with a minimal hump and no septal deviation. It will also be wise to first perform DP techniques with an open approach. In this way, you can see better how the dorsum moves. You should do this in your first 5-10 cases. Your second technique should be a low septal strip cartilage only dorsal preservation in patients with high septal deviation. The low septal strip resembles very much the swinging door septoplasty technique. ENT surgeons may find this technique easier. After 20-30 patients, you may start preserving the bone together with the cartilage which also requires complete mobilization to permit impaction techniques. At this point, one may want to start applying DP techniques in a closed approach.

TYPES OF DORSAL PRESERVATION

According to preserved structures:

1) Osseocartilaginous *Impaction DP*,
2) *Cartilage Vault DP*: (with or without bony cap).

According to septal resection:

1) Low septal strip,
2) High septal strip,
3) Middle septal strip.

WHEN TO USE IMPACTION DP AND WHEN CARTILAGE VAULT DP?

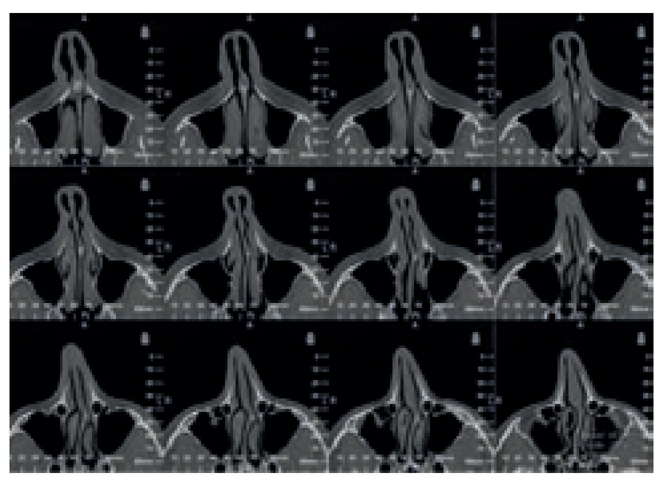
For a while, I tried to perform dorsal preservation in every patient. I was obtaining very good results, but I was having a difficult time during the surgery in certain cases. Some of my patients ended up with a bony hump recurrence. I have been evaluating all the different DP techniques and their indications for the past 2 years. I can say that my dorsal surgery at the moment consists of 80% DP of which 40% are dorsal impaction and the other 40% is cartilage vault dorsal preservation. The percentages will of course change as my experience evolves.

CONE BEAM CT

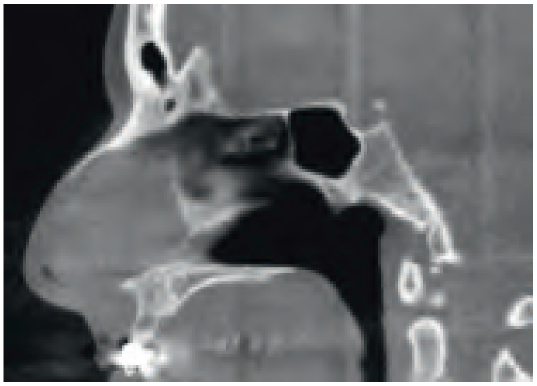
ENT surgeons have a more comprehensive knowledge of the intranasal anatomy. They are more involved in endoscopic examination and evaluation with computerized tomography (CT) compared to Plastic Surgeons. I have started ordering cone beam tomography (CBCT) in every patient at Yves Saban's suggestion. Cone beam tomography is a device used frequently by dentists. It gives off less radiation and it is less expensive than conventional CT. Although it might not be as sharp, CBCT provides enough information about the anatomy. I can decide more accurately which technique to use with cone beam tomography. I pay more attention to high septal deviations.

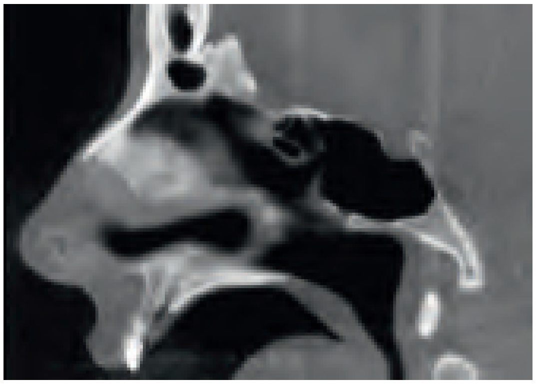
OSSEOCARTILAGINOUS IMPACTION DP VS. CARTILAGE VAULT DP

- *Wide bony dorsum:* If the bony dorsum is very wide, there is no reason to preserve it. In contrast, if the cartilaginous roof is wide, it can be shaped and preserved.
- *Deformed cartilaginous dorsum:* If the cartilaginous roof is very thin and deformed, you don't want to preserve it.
- *Convex hump:* It is not easy to correct the bone in patients with excessively convex humps. A straight dorsum can be achieved by preserving only the cartilage vault.
- *Narrow nasal base:* The nasal bony base is already at a proper width in 10-20% of the cases. Osteotomies may not be necessary in these cases. Lateral osteotomies, which are a must in the impaction DP technique, will narrow the nasal base more than necessary. Therefore, I prefer Cartilage Vault DP in these cases. There are cases where I finish the surgery rasping the convex bones without osteotomies after lowering the cartilage. The surgery becomes very fast and easy. It is necessary to determine the width of the nasal aperture using direct examination with a speculum, endoscopy or computerized tomography.

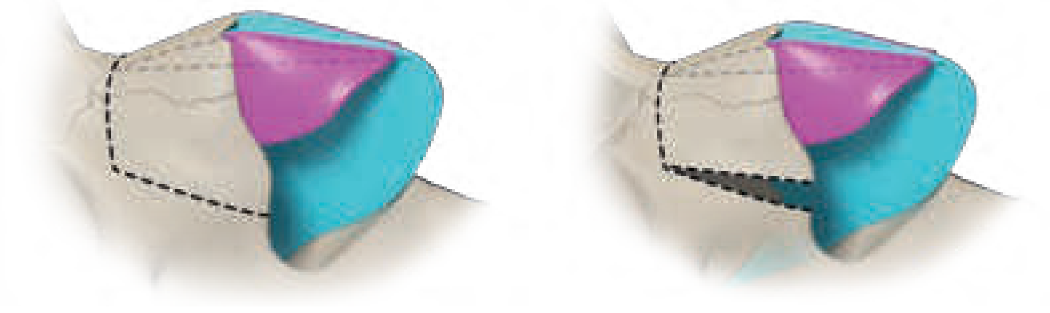


- *Long Perpendicular Plate of Ethmoid bone (PPE):* It is necessary to create a space under the bony hump to lower it. A bony resection deep under the bony hump is needed in patients with a long PPE. A precise bony resection in such a deep location can be both difficult and risk mobilizing the PPE from the frontal bone. The most agonizing maneuvre for me was shortening the PPE under the dorsal bony hump. Therefore, I prefer to perform cartilage vault DP in patients with long PPEs. I carry out impaction DP in patients who have cartilage right under the radix osteotomy site. Below you can see examples of short and long PPEs.





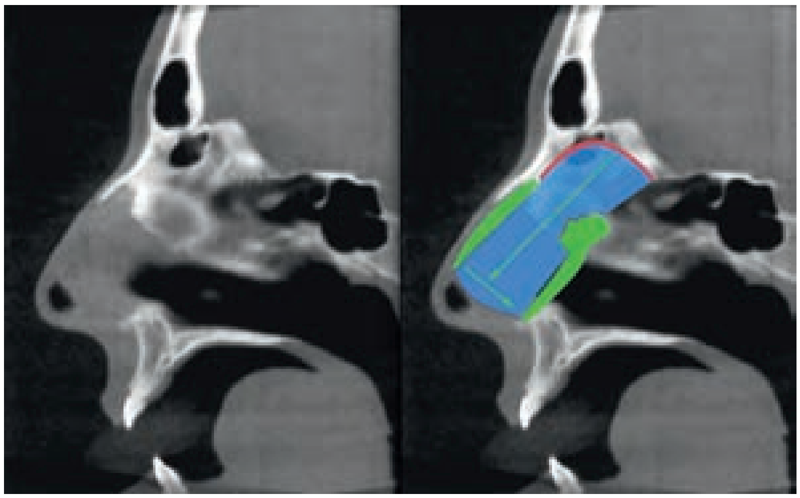
- *Age:* It may be difficult to straighten the dorsum in older patients. The PPE may easily fracture as the bones are fragile. I prefer cartilage vault DP in these patients. Based on the personal experiences of Dr Sercan Gön and Dr Günter Hafız, the common characteristics of patients with spontaneous cerebrospinal fistulae are middle aged, overweight and osteoporotic individuals. It seems to be advisable to make minimum contact with the PPE in these middle aged overweight patients.
- *Thick and long nasal bones:* It is difficult to straighten the dorsum in patients with a short cartilaginous dorsum and long nasal bones. When doing a revision surgery on a patient where I had my biggest hump recurrence, I realized that the the nasal bones were very long. Thus, I made caudal resection of the nasal bones. I managed to correct the recurrent hump by excising bone and cartilage from the K point. The width of lateral bony wall at the nasal base in some patients may be as thick as 4-5 mm and this is not a rare finding especially in certain ethnic groups. It is not easy to slide these thick bones into the pyriform aperture. The nasal base can be narrowed in the open roof technique. .However, if a dorsal preservation is performed, then a triangular piece of bone is resected from the base of the lateral nasal wall (a Let Down Operation).



- *Concha Bullosa:* It will be difficult to slide the bones inward if patients have large turbinates. A Cartilage Vault DP might be preferred. An Impaction DP may still be performed if the concha bullosa is treated.

LOW SEPTAL STRIP VS. HIGH SEPTAL STRIP

I choose to perform high septal strip in patients with a straight septum and low septal strip in patients with significant septal deviation. I started my DP journey with high septal strip and did it in every patient. I realized that in those cases where I resected the deviated vomer, the PPE was slightly mobilised which concerned me. If the high septal strip technique is used after correcting the deviations in the septal base and vomer, then the septum is only attached to the PPE. As the PPE is not supported by the vomer anymore, the PPE is attached to the frontal bone and skull base. Thus, pressure on the dorsum puts stress on the PPE. This anatomical observation must be the reason why the PPE became mobile.



Therefore, I prefer the low septal strip in patients with high septal deviation or in patients where I need to detach the septal base from the vomer. When the dorsal cartilage is wide, the cartilage can be shaped by making resections from the upper lateral cartilage (ULC) – septum junction. Such resections decrease the stability of the K point. It is better not to do the high septal strip in these patients as one may encounter rotations in the dorsal cartilage. On the other hand, the high septal strip causes a widening in the dorsal cartilage when the reduction in the dorsum exceeds 4 mm. This alteration becomes advantageous in patients with a pre-existing narrow dorsum.

SEPTORHINOPLASTY & THE SKULL BASE

One can get close to the skull base during a septoplasty. The deviations in the vomer – PPE junction is often 1.5-3 cm distance to the skull base. When resecting the part of the PPE under the radix, the cribriform plate may be less than 2.5-3 cm away. The points to consider during surgery in the vicinity can be summarized as follows:

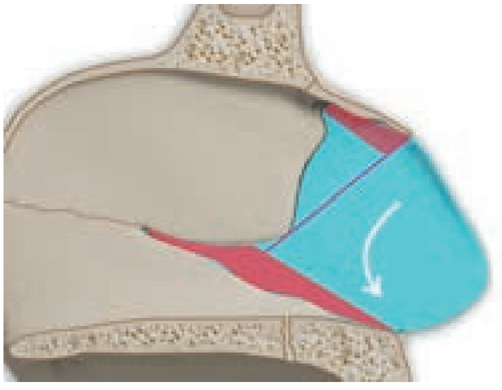
- The mucosa dissection under the radix should be kept to a minimum. The site where the first olfactory nerve emerges should be avoided.
- Extensive mucosal dissection to excise high septal deviation should be avoided. The surgical instruments placed in this area should not be large to avoid widening of the mucosal pocket. A true-cut forceps of 2-3 mm size may be the safest instrument. The pushing of instruments at the attachment sites of the middle turbinate by forcing the mucosa is hazardous because cerebrospinal fluid (CSF) leakages occur from the lateral sides of the middle cranial fossa, not from the midline. It is important to work under guidance of CT in patients with high septal deviation. We need to know the distance between the skull base and deviation. We need to be cautious in patients with a deep skull base. It is strongly recommended to avoid making an intervention in high septal deviation without having an imaging study with cone beam tomography (See East Chapter).

SEPTAL STRIP REMOVAL: *Low Septal Strip*

The septum is approached through a high unilateral trans setal incision. A cartilage strip of half a mm width at the caudal septum may be left attached to the Pitanguy ligament. The septum is bilaterally dissected.

Do not completely dissect the mucosa at the junction site of the septum with the ULC. In this way, detachment of the ULCs and the possibility of right or left torsion of the dorsal cartilage are avoided. A 2 mm strip is excised from the septal base. Minimal resection is done near the maxillary spine as the greater the cartilage excision the greater the loss of height in the supratip region. The first 3-4 mm of the cartilage incision is made with a scalpel. The rest of the incision is made with a lateral osteotome. This method ensures a safe excision of a cartilage strip. At first, I prefer to take a strip big enough for a strut graft. Note: I take all possible risks into consideration. When I ask for an osteotome during the surgery, some nurses grab the hammer. You may need to warn the nurse beforehand. A low septal strip can be obtained after detaching the septum from the base. Scissors are used for this. But it may be difficult to take out a properly shaped piece of cartilage.

The cartilaginous and bony septum are separated. To straighten the dorsum start cutting the septum from where the dorsum is the most convex. From here cut towards the posterior tail of the septum to spare the maximum amount of cartilage.

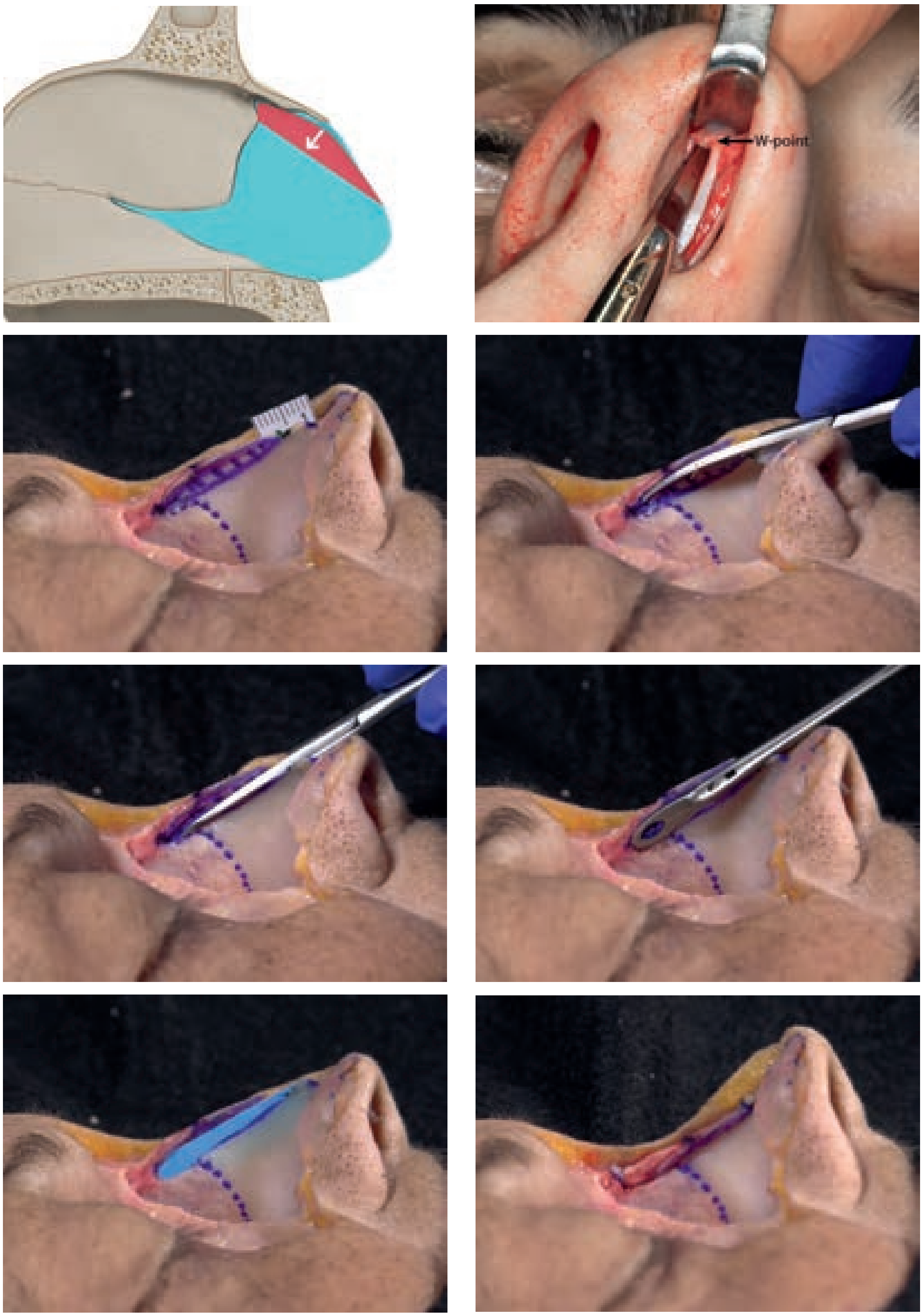


The gap that arises after the rotation of the septal flap decreases the stability of the septum. The bigger the septal cartilage, the more stable the dorsal fixation. Pushing the septum right or left with the speculum will reveal the high septal deviation. The deviations are meticulously fixed. Rotational forces with forceps should *not* be applied to the PPE. Bone scissors, rongeur or powerful thru-cut forceps can be used.

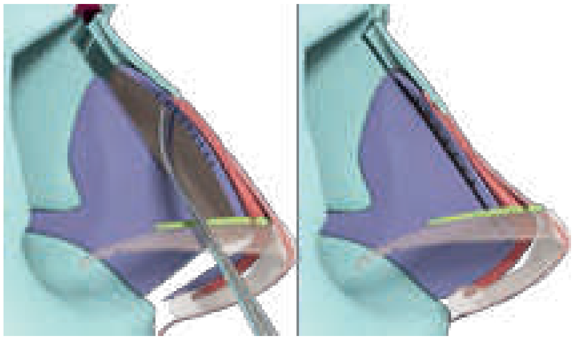
A triangular cartilage of 2-3 mm width under the radix is excised with a 2 mm thru-cut punch. The amount of the cartilage excised will determine the height of the upper part of the K point. Over resection will lead to excessive lowering of the radix. On the other hand, insufficient excision will cause hump recurrence. The septum is grabbed with Adson-Brown forceps. The dorsal height and position of the K point are arranged. Extra cartilage can be excised from the septal base if necessary. The septal base is fixed to the periosteum of the maxillary spine with 5/0 PDS. I prefer to make such extra excisions and the septal positioning *after the tip surgery*. I place at least three 5/0 PDS sutures between the periosteum of the maxillary spine and septum. At this stage, it is necessary to check if the septal tail and the PPE overlap. Excise the overlapping parts with a thru-cut forceps. In the low septal strip DP, the fixation of the septum to the maxillary spine will determine the position of the K point. If there is any tension, the resistance points should be checked. As noted by Finocchi (SPQR Chapt), failure to maintain the position of the caudal septum leading to backward rotation of the septum is the primary cause of revision surgery after low septal strip procedures.

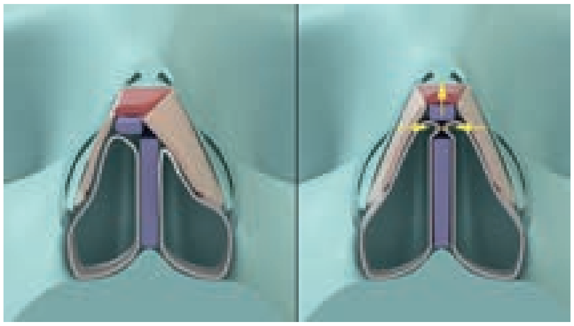
SEPTAL STRIP REMOVAL: *High Septal Strip*

The septum is bilaterally dissected close to the dorsum. Starting from the W-point, the septum is detached right under the dorsum with sharp tipped scissors. A second cut is made with septal scissors so that a 2-3 mm strip is excised. The shape of the PPE resection under the dorsum may range from straight line fracture to triangular to rectangular.



The excised cartilage can be used as a strut graft. Emptying the area under the K point is important for straightening the dorsum. Scoring under the K point with sharp tipped scissors will decrease the resistance of the dorsum to flatten (see figure below on the left). The septum is comprised of cartilage up to just below the radix, especially in young patients. A 2 mm thru-cut rongeur can be used to remove the septum under the radix. The area below the radix osteotomy should be removed for at least 1 mm. For this purpose, 1-3 mm of bone is often excised from the PPE. Septal excisions are continued until the desired dorsal height is achieved. There is a possibility of supratip depression with this technique. Therefore, a higher W-ASA segment should be planned. Otherwise, this depression can be prevented by suturing the perichondrium of the W-ASA segment. This manoeuvre prevents supratip collapse as well (see figure below on the right).



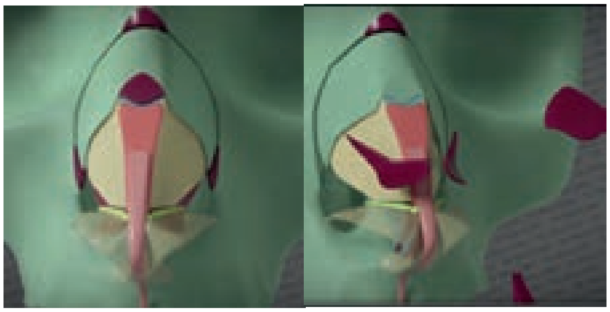


After the dorsum is lowered to the desired level, it is beneficial to suture the perichondrium on both sides of the septum to each other with 5/0 PDS at the level of the K point. Even though the K point seems to be straight during surgery, it may move anteriorly with mucosal oedema. Always check the radix osteotomy. Even if there is only a 1 mm step, use bone dust or cartilage grafts for camouflage. The step may not be palpated because the soft tissue at the radix is abundant. Patients can feel the osteotomy line after the oedema resolves. The transverse osteotomy lines close to the radix will also benefit from grafting.

BLOCKING POINTS OF DORSAL PRESERVATION

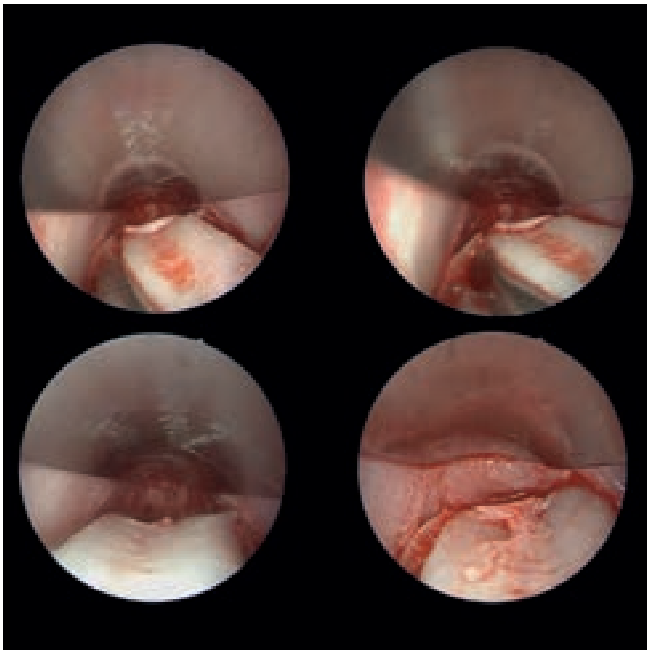
Do not push on the K point to straighten the dorsum. Don't forget that the force is directed onto the septum. The dorsum should settle to its proper position with the force of *gravity only*. If the dorsum is not correctly aligned, then the following blocking points should be checked:

- Septal resection may not be sufficient.
- Lateral keystone dissection may be inadequate.
- There may be bony excess at the nasal aperture. This excess may be removed with a rongeur.
- The antero-caudal corners of the nasal bones may prevent straightening. They can be resected with a rongeur.
- The dissection on the internal mucosal side of the lateral bony wall may be insufficient.
- The resistance may be due to the compaction of a wide ULC laterally and caudally. The lateral sides of the ULC may be dissected off the mucosa. Additionally, lateral resections can be made. If the K point is still high, the bone and cartilage at the K point may be shaved off. Sometimes the dorsal perichondrium may have been stripped off from the radix and rolls up at the K point. Either resect it or put it back in place.



DORSAL PRESERVATION WITH BONY HUMP RESECTION / CARTILAGE VAULT LOWERING

Step #1. Expose the dorsum subperichondrially and subperiosteally. Dorsal dissection will be easier before septal strip excision.



Step #2. Excise low or high septal strip. The indications have been discussed.

Step #3. Mobilize the dorsal cartilage from the most anterior part of the PPE by passing a Cottle elevator through the septum and dorsal dissection. Almost no PPE needs to be excised from under the radix in a cartilage vault only DP.

Step #4. Dissect the bone subperiosteally. My subperiosteal dissection extends 3 mm beyond the lateral osteotomy line as I do ostectomy. If lateral osteotomy is to be performed through a tunnel, the subperiosteal dissection can be carried out as long as a good re-drape of the dorsum can be achieved.

Step #5. Dissect the dorsal cartilage from the bone subperiosteally. The amount of dissection will correlate to the amount of hump resection.

Step #6. Resect the bony hump. You can use bone scissors, a chisel or rasp. I rough-hew the bony hump with bone scissors or chisel and then fix the bony edges with a rasp. A short nasal bone anatomy is mimicked in a way. In some of the patients, lateral rasping makes osteotomy redundant. Normal anatomy needs to be imitated. After the open roof, the anterocaudal corners of the bones are usually resected. The edges of the bones should be 1-3 mm below the dorsal cartilage so that they are not visible. When the desired bone height is reached, you need to thin the bones on an angle from the sides by rasping.

Step #7. Close the bony roof with standard osteotomies (lateral, transverse and/or medial oblique).

Step #8. Make bone dust or cartilage gel camouflage between the K point and radix. Make sure that no bone or cartilage particles enter the lateral keystone dissection zone.

Alternatively, you may preserve the bony cap together with the dorsal cartilage. In these cases, you would prefer a sub-SMAS dorsal dissection. A “V” shaped osteotomy is performed through the paramedian grooves with a lateral osteotome to preserve the bony cap. This technique does not require camouflage. However, the bony cap may break off when the dorsum is rasped. Nevertheless, the breaking off of the bony cap is not a big loss (See Ishida Chapter).

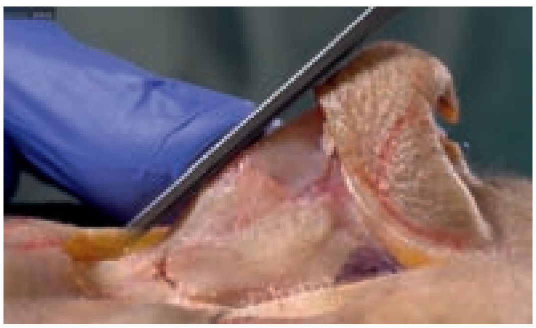
IMPACTION DORSAL PRESERVATION

Step #1 – Sub-SMAS dissection

The dorsum is dissected subperichondrially over the cartilage vault and subperiosteally over the bony dorsum. The perichondrium filling the Supraseptal Groove may fold over at the K point and lead to a perichondrial hump. The perichondrium at the K-point may be as thick as 2 mm. The dorsum needs to be dissected before the septal strip is removed.

Step #2 – Bony Cap rasping & Lateral Keystone Area disarticulation

Rasp and thin the *Bony Cap* and dissect the *Lateral Keystone Area* to straighten the dorsum. The amount of rasping and dissection changes depending on the case and the amount of deprojecting.



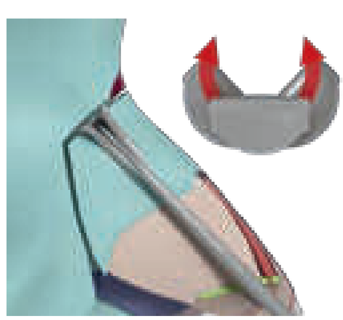
Step #3 – Septal strip excision

Excise the low or high septal strip. Plan the radix osteotomy. I prefer to make the radix osteotomy where the hump starts on the bone. The more cephalic the radix osteotomy, the thicker the bone that you need to cut and the larger the PPE you need to excise.

Step #4/1 – Transverse osteotomy

The sequence of osteotomies: if a saw will be used for transverse osteotomy, make it first. The handsaw works best when the bones are stable. If an external osteotomy is planned, leave it to the end.

I usually prefer the Taştan-Çakır handsaw. This saw can make a cut as sharp as a piezo. The transverse osteotomy works like a screwdriver. The neck of the handsaw is controlled with the thumb of the non-dominant hand and the dominant hand makes a rotational movement at the wrist. The transverse osteotomy can be completed in 30-60 seconds. You may find it difficult in the first 5-10 patients. Experimenting with the handsaw on a piece of wood will be beneficial. A handsaw will be sharp enough in the first 100 cases. The bone dust between the teeth of the handsaw needs to be cleaned before using it on the contralateral side. When the transverse osteotomy is performed one should leave a 1-3 mm wide bridge of intact bone at the radix, then a greenstick radix fracture can be done.

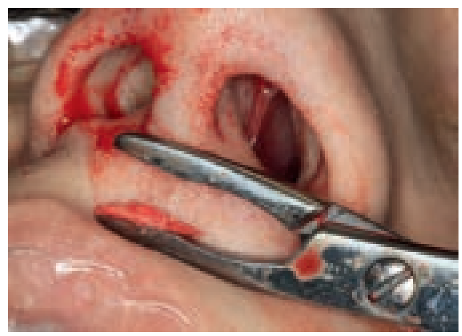


Step #4/2 – Lateral *Osteotomy (Push Down)*

If a push down procedure is planned, then a high-low high lateral osteotomy is made with a curved lateral osteotome. In this way, Webster's triangle is preserved, and the transverse osteotomy line is entered without moving on to the medial canthal area. As the width of the aperture is narrower at the level of the medial canthal tendon, the lateral and transverse osteotomies should unite in such a way that a corner does not form at the junction. Keeping the osteotome angulated obliquely, facing medially, will make it easier to slide the bone into the nasal cavity. This method is preferred if the bony base is wide.

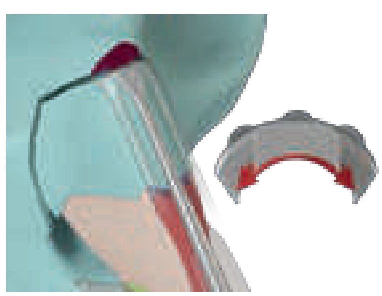
Step #4/3 – Lateral *Ostectomy (Let Down)*

This method of excising a triangular segment of bone is used in let-down procedures. Two lateral osteotomies are mad (a high to low and a low to low) followed by resection of the intervening bone. A subperiosteal dissection needs to be done internally and externally before the osteotomies A baby rongeur may also be used for the ostectomy. Following the osteotomies, the bone slides in minimally with the Let Down procedure. This technique may be preferred if the bony base is not to be narrowed. If the bony base is already narrow, it would be wiser to perform a Push Down.

Step #4/4 – Radix osteotomy

The transverse osteotomies on both sides may be united with a concave handsaw. The radix handsaw cuts the bone with a C type of movement. If a reduction in the radix is not wanted, the transverse osteotomies on both sides can be approximated as close as 2 mm and a green stick fracture can be obtained with digital pressure to the right and left.



Step #5 – Mobilization of the nasal dorsum

Try to mobilize the dorsum with a sideways gentle pressure. If the dorsum cannot be mobilized with gentle pressure, the nasal bones may need to be separated from the maxillary bone. Check the osteotomies until mobilization is achieved with gentle pressure. The radix osteotomy may be done with a 2 mm chisel *from inside to outside*. It may even be safer that the first bony cut is outwards away from the face. However, you need to be sure about the direction of the chisel. While holding the chisel with one hand, feel the tip of the chisel at the radix with the index finger of the other hand.

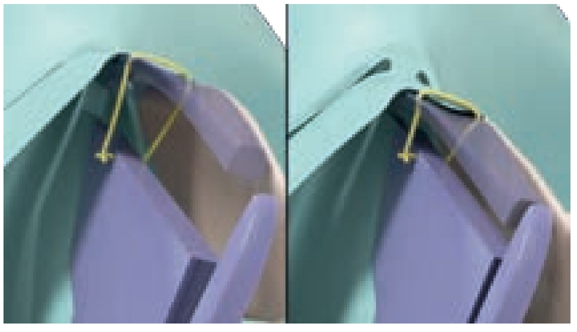
Important note: Do not make the first mobilization movement straight downward towards the nasal cavity. An abrupt posterior mobilization may put excessive pressure on the PPE.

Important note: When performing a disarticulation impaction maneuver, you have to know for certain that the radix osteotomy is totally separated from the PPE before attempting mobilization. Otherwise, the dorsum will mobilize the PPE. I check the area under the radix osteotomy with a Crile retractor after the initial movement. I introduce the Cottle elevator inside the radix osteotomy and gently turn it. I make sure that the bony vault is totally separated from the PPE and it is not putting pressure on it.

Step #6 – Dorsal fixation

Low Septal Strip: The whole septum is attached to only the dorsal vault in this technique. As the posterior septal angle is pulled inferiorly, the K-point moves posteriorly and the supratip anteriorly. The caudal septum pushes the columella inferiorly. Additional resections are made from the septal base. The posterior septal angle is fixed to the maxillary spine with three to four 5/0 PDS sutures on a round needle. The necessary resections are made from the caudal septum and the tip is fixed to the septum.

High Septal Strip: The mobilized dorsum is fixed to the underlying septum with sutures. A round 5/0 PDS suture is passed through the septum right below the K point. A long and thin needle holder is suitable for its placement. Push the needle from below the K point anteriorly so that the needle comes out from the right or left paramedian groove. Then pass the needle from the other paramedian groove and pull the needle from the inside. If you do not wish to tie the knot in the empty space, you may pass the needle once again through the septum.



NO SKIN DISSECTION DORSAL PRESERVATION

My indication for doing a DP procedure with no skin dissection is very rare. It may be suitable in patients with a beautiful dorsum, but an axis deviation. I have performed 4 or 5 such cases. I feel that the dorsal skin should be elevated in order that it redrapes better and the exposure makes the lateral keystone area dissection easier. If there is no skin dissection, then the radix and transverse osteotomies are made percutaneously and the periosteum is not dissected. The lateral osteotomy can be performed internally or externally. I prefer to make the osteotomy from the inside with a Gubisch lateral osteotome because an incision is already made to dissect the lateral osteotomy line.

CASE #1

Low septal strip dorsal preservation. No dorsal skin dissection. Postop 1 year. Correction of the dorsal axis deviation fixed the tip deviation because the scroll ligaments were preserved. Dorsal preservation is a really powerful technique in this kind of problem. Axis deviations with no hump are really dificult cases for dorsal resection techniques and often require camouflaging the dorsum.

CASE #2

Case-study of a patient ideal for let-down procedure, ten months postop.

CASE #3

Case-study of a patient after dorsal preservation procedure, one-year postop. You may end up with a convex dorsum with dorsal preservation techniques. While there are some patients who particularly like such results, there are others who dislike it. You should be aware that you will sometimes maintain s slight convex dorsum if you use a DP technique for most noses. I share this fact with my patients during consultation. Most of my patients tell me that they find it more natural to have the suggestion of a hump, which this patient did appreciate.

CASE #4

Case-study of a patient after dorsal preservation procedure and tip surgery, one and a half year postop. Severe right axis deviation treated by asymmetric let-down technique.

CASE #5

Case study of high septal strip dorsal preservation. Postop 15 months.

CASE #6

Case study of a true Cartilage Vault Dorsal Preservation with high septal strip. Dorsal aesthetic lines are attractive preoperatively and most of the dorsum is comprised of cartilage. The nasal bones are short and broad. Cartilage Vault DP and closed tip surgery were performed. One and a half years postop.

CASE # 7 – COMPLICATIONS

Dorsal preservation technique has a risk of residual hump. Straightening the dorsum is not easy at the beginning of the learning curve, and therefore the complication rate may be higher than desired. Although patients generally find a minimal dorsal hump naturel, this patient did not. However, fixing this problem is easy. The photographs below show the patient at fourteen months postop with a slight bump on profile which she finds objecatable.

CASE # 8 – COMPLICATIONS

I utilized preservation rhinoplasty techniques in this patient. The nasal dorsum was in the midline. An axis deviation to the right appeared after the surgery, and a hump appeared on lateral view. Furthermore, the patient asked for a more upturned nose. This was my third revision patient on whom I used the let-down technique. In the first two I rasped the recurrent hump. In this patient, I re-mobilized the dorsum and brought it to the midline. I had not taken the cartilage strip close to the dorsum. I did not dissect the septum extensively. I removed a 1 mm strip of cartilage from right below the dorsum with a limited dissection. I cut the Pitanguy ligament and obtained fullness in the supratip region. I dissected the upper lateral cartilages from the bone to increase straightening. I corrected the extremely convex cartilages and also dissected the lateral crura from the mucosa. I slightly increased rotation.

CONCLUSIONS

Dorsal preservation ensures a natural dorsum without the need for grafts to reconstruct the midvault. Ultimately, the result is a naturally attractive nose with retention of the normal anatomy which creates a better aesthetic result and minimizes the complexity of any possible revision. Currently, I am using DP techniques in 80% of my cases with 40% classic impaction DP techniques (Push Down, Let Down) and 40% Cartilage Vault DP techniques with resection or preservation of the bony cap. The Learning Curve has been surprisingly smooth from a technical viewpoint but requiring experience for patient selection. Hopefully, this text will provide the essential information to shorten the reader's learning curve.

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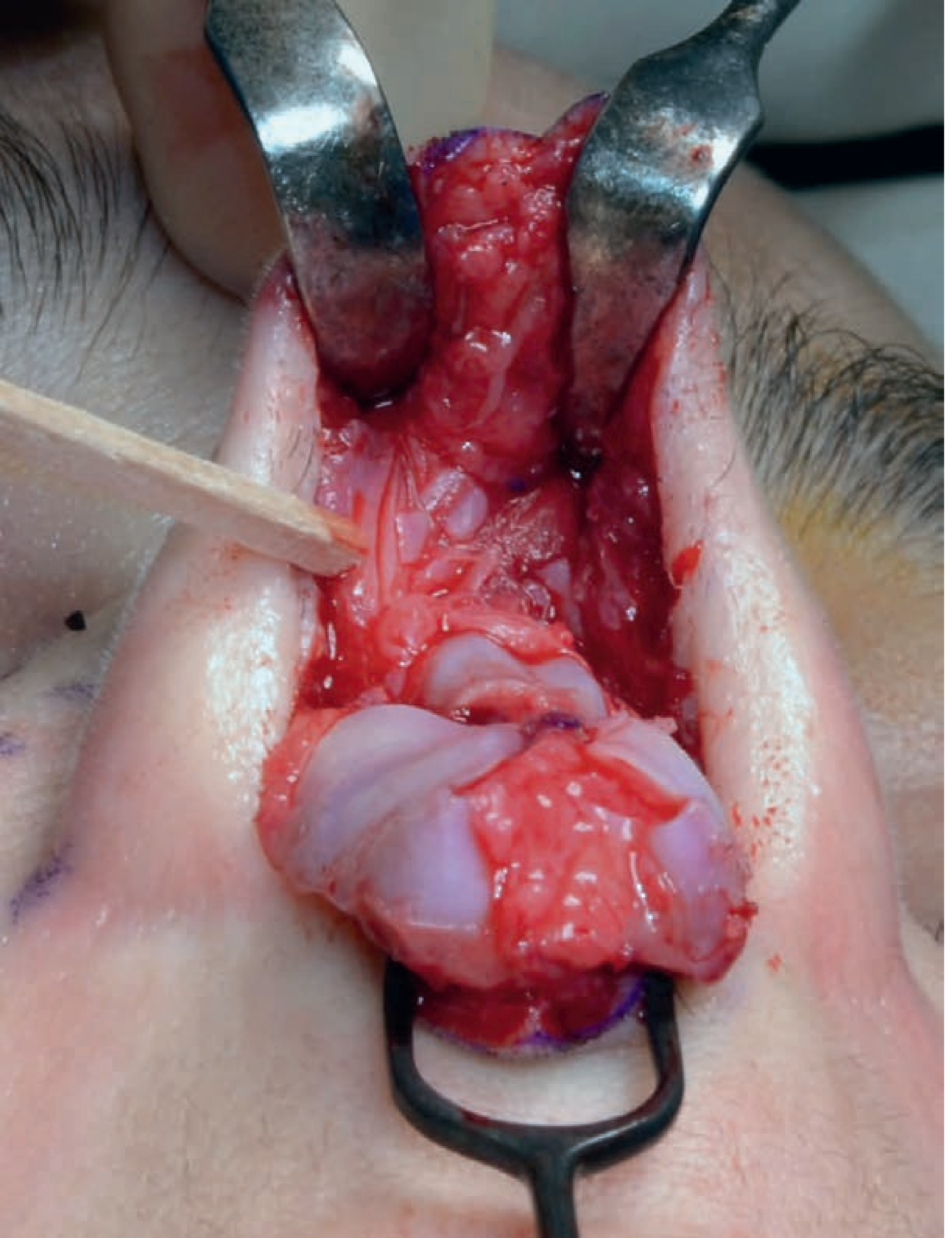
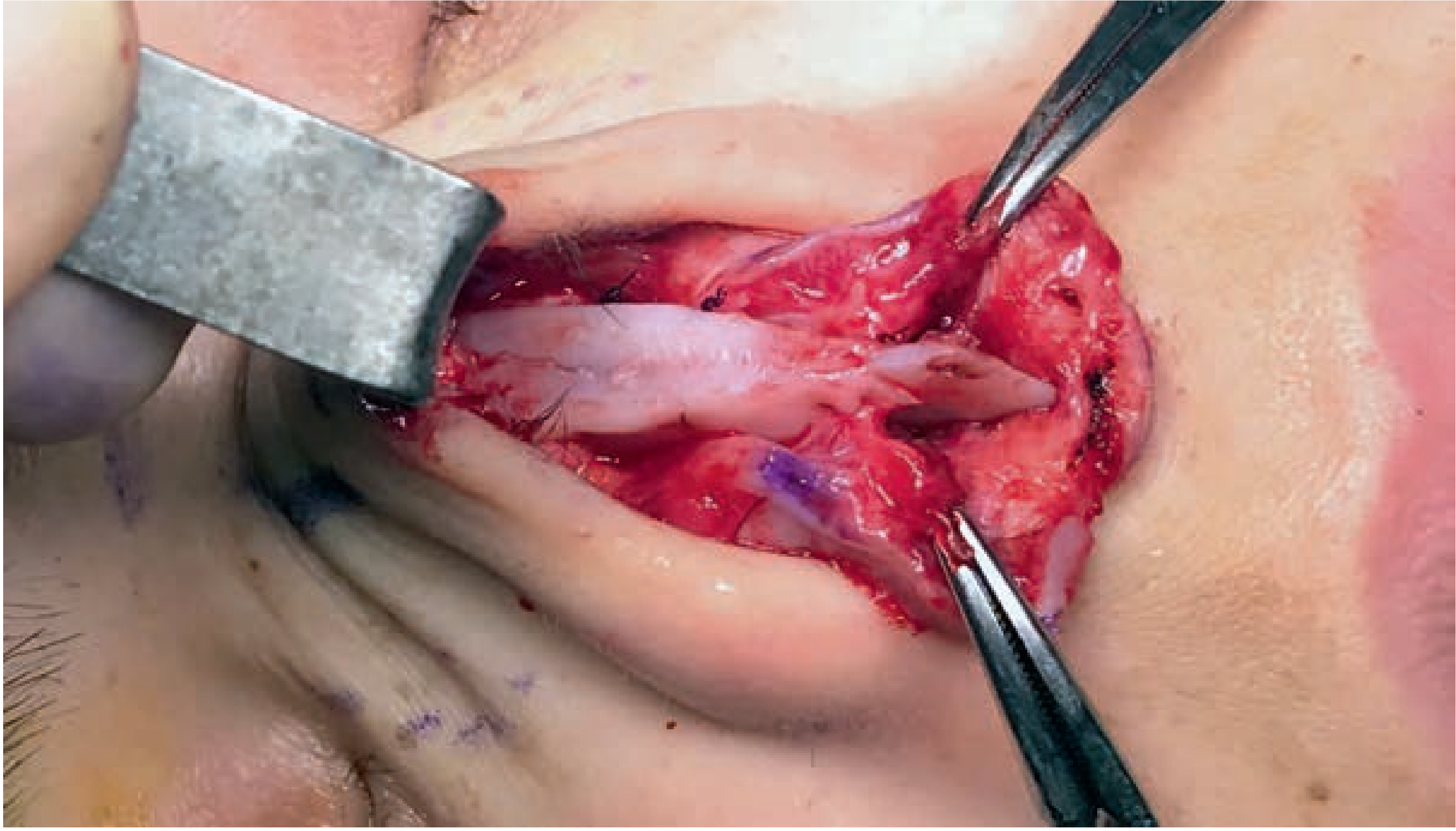




The Learning Curve of Preservation Rhinoplasty

Aaron M. Kosins

Surgery of the dorsum has never been so dynamic nor as easily learned as at the present time. Reproducible preservation techniques offer incredible results that can be difficult to achieve using component reduction in certain patients. Once a surgeon understands the philosophy of dorsal preservation (DP), one will look for opportunities to preserve the dorsum. An expanding repertoire of techniques is evolving as the most creative and innovative rhinoplasty surgeons push the limits of the philosophy. For the beginner, easier techniques should be chosen initially for patients with the best indications. Once one becomes comfortable, it makes sense to progress to the next phase and learn the more complicated operations. Each DP operation builds on the others. Over time, I am convinced that these philosophies will make you not only a better surgeon of the nasal dorsum, but also a better surgeon of the septum and the nose in general. To understand DP, you will need to gain a new appreciation of the cartilaginous septum, the perpendicular plate of ethmoid, nasal osteotomies, and anatomy of the nose where you do not operate with traditional component reduction. Through this journey, I have evolved immensely and now I understand rhinoplasty surgery in greater depth than I did before. The end result is that I can achieve a more beautiful nose where the normal anatomy has been preserved.

SOFT TISSUE ENVELOPE PRESERVATION

The ultimate goal of a rhinoplasty technique is an attractive, predictable, long-term result with a low incidence of revision surgery. For this reason, Preservation Rhinoplasty (PR) has become an important part of my rhinoplasty practice. During my initial consultation with every primary rhinoplasty patient, I ask myself "What can I preserve?" Early experience with ultrasonography of the nasal soft tissue envelope (STE) convinced me that 1/3 of patients have a STE *preoperatively* that negatively affects the final rhinoplasty result (Kosins, 2018). After reviewing the ultrasounds of the STE of hundreds of patients, it became apparent that certain skin sleeves underwent a longer healing process with more edema and less predictable soft tissue contraction. Conversion to a subperichondrial-subperiosteal dissection of the dorsum and tip in the majority of patients resulted in less bruising and edema during surgery and early in the postoperative period as well. Excellent shape and contour was apparent at 2-3 months post-operatively instead of 1-2 years. This dissection plane is utilized in almost all patients on the dorsum for the last 6 years, and approximately 1/3 of patients on the tip. Likewise, gradual adoption of the closed approach and maintenance (as opposed to cutting and reattaching) of Pitanguy's ligament increased the speed of healing as evidenced by ultrasonography and a soft/pliable STE within 3 months.

ALAR CARTILAGE PRESERVATION

Preservation of the lateral crura and nasal ligaments (Pitanguy's and scroll) with closure of dead space has resulted in less loss of projection, alar retraction, nostril asymmetries, and need for alar contour grafts. Tip definition is seen when the alar cartilages are forced against the STE to create defined surface polygons. A strong and straight lateral crura, with a caudally everted edge, is the new goal, as opposed to a 6 mm lateral crura strip with domal convexity next to lateral crural concavity. While the Cranial Tip Suture (Kovacevic) and Cephalic Dome Sutures (Cakir) have given an overall better shape to the tip cartilages, minimal resection of the lateral crus and maintenance of Pitanguy's and scroll ligaments has resulted in more definition and increased stability forcing the alar cartilages against the STE. (See Kosins Tip Surgery Chapter)

DORSAL PRESERVATION

Bony pyramid control, particularly at the keystone area, was greatly enhanced with utilization of the full open approach and piezoelectric surgery (Gerbault, 2016). However, dorsal deformities occurred years later including keystone irregularities, bony irregularities, callous formation, asymmetry of the middle vault, and long-term contraction. To avoid bony splay and middle vault contraction, bone suturing became necessary after piezoelectric osteotomies as well as major restructuring of the middle vault with combinations of spreader grafts and flaps. Unfortunately, irregularities of the aesthetic dorsal lines, especially in the middle vault, continued to be an issue for rhinoplasty surgeons over the long-term. Thus, the ascendency of DP which dramatically reduces these complications.

PERSONAL EXPERIENCE WITH DORSAL PRESERVATION

My introduction to DP came in 2016. The concept at the time seemed simple: preserve the dorsum by lowering the osseocartilaginous vault into the nasal cavity. Since the keystone area would be kept intact and the middle vault would not be opened, irregularities/asymmetries/contraction could potentially be avoided. In addition, I was very excited at the prospect of a narrow, yet stable middle vault. Up to this point, I felt the only way to maintain stability was restructuring and this often widened the middle vault. After dozens of hours of discussion with Drs. Saban and Daniel, I did my first dorsal preservation in March, 2017. Over the next year, other surgeons including Drs. Cakir, Kovacevic, Gerbault, East, Palhazi, and Göksel also began in parallel performing DP. Through literally hundreds of hours of casual conversations, emails, roundtable discussions, presentations, and meetings, I learned the essential technical details of DP. I was able to understand how to perform the high septal strip push/let down technique and achieve stable and predictable results. After 2 years of experience with the high septal strip DP operation, I found that approximately 1/3 of my primary rhinoplasty patients were good candidates (Kosins, 2020). What became more exciting over time, was the resurgence, development and modification of techniques that *expanded my indications* for DP (Kosins, 2020). Throughout 2018-2019, several techniques came to the forefront of rhinoplasty surgery including Finocchi's modification of the Cottle technique as well as the cartilage pushdown techniques championed by Ferreira (Ferreira, 2019) and Ishida (Ishida, 2020). Now in 2020, *over 50%* of my patients can successfully undergo DP with excellent results utilizing a variety of techniques, each with its own preferred indications.

Progression of Preservation Rhinoplasty Procedures:

	2017	2019
Subperichondrial Tip	36%	24%
Subperichondrial Dorsum	90%	>99%
Alar Preservation	70%	92%
Dorsal Preservation	31%	50%
No Dorsal Skin Dissection	0%	15%
Closed Approach	1%	8%

THE SPECTRUM OF DORSAL PRESERVATION

PR is not just DP, nor is DP just a push down or letdown *impaction* procedure. DP has become a spectrum of techniques whereby the surgeon preserves all or part of the osseocartilaginous dorsum. Put simply, DP can be divided into both impaction as well as dorsal modification techniques. Impaction techniques lower the entire osseocartilaginous vault by first separating the nose from the septum followed by separating the nose from the face. Dorsal modification techniques lower only the central cartilaginous vault (with or without the bony cap), while the bones are treated separately as in component reduction. Technically, dorsal modification techniques are easier to learn and to execute for the surgeon beginning DP. In addition, the dorsal modification techniques widen the application of the preservation philosophy.

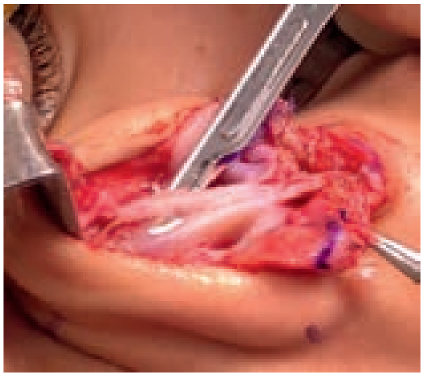
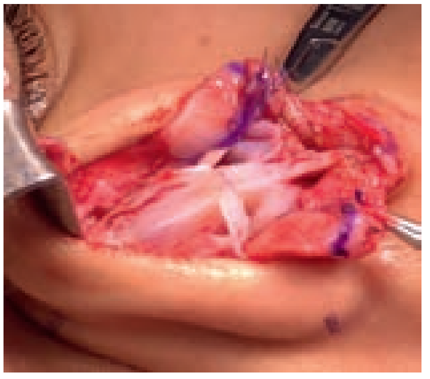
As the surgeon becomes more experienced with DP, one will want to preserve the dorsum and to avoid midvault reconstruction. While it is theoretically possible to use one technique for all patients, it is much better to apply the optimal technique for each patient. Below I will summarize *my indications* for each DP procedure in order of increasing complexity. I would like to emphasize that I have not invented any of these techniques. However, I have used all of them in hundreds of cases over a 3-year period and have become very aware of each technique's inherent advantages and disadvantages. The reader should realize that the proponents of certain procedures will apply their technique to a wider range of cases with excellent results. On the other hand, I prefer to switch between techniques depending on the case.

Each surgeon will select the technique to use based on their own experience and patient population. The step-by-step technical details of these procedures are summarized in other chapters in this book. 4 forms of Dorsal Preservation are seen below. The progression represents the degree of difficulty.

1) Bony cap removed; dorsum shaved without opening the middle vault mucosa (CVM)
2) Bony cap removed, cartilage vault only push down (CVP)
3) Subdorsal septal strip (Saban)
4) Low septal strip (SPQR – Finocchi)

DORSAL MODIFICATION / CARTILAGE VAULT MODIFICATION

Cartilage Vault Modification (CVM) is the simplest technique for dorsal preservation. CVM modification is a hybrid DP technique that consists of 4 steps :1) incremental modification and ostectomy of the bony cap including the lateral keystone area to convert the bony dorsum to cartilage, 2) shaving the upper lateral cartilage shoulders and dorsal septum WITHOUT opening the mucosa. 3) piezoelectric rhinosculpture and osteotomies to narrow and sculpt the bony pyramid, and 4) closing any cartilage defect over the underlying mucosa and shaping the upper lateral cartilages. Thus, CVM is a surface technique whereby only the bony cap is removed and the cartilaginous vault is modified/lowered. The bones are dealt with separately (as in a component reduction) and no impaction of the osseocartilaginous vault into the pyriform aperture is performed. No septal surgery is required to achieve the dorsal reshaping / lowering.

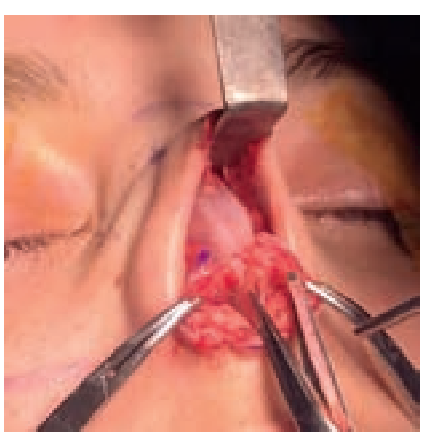
My indications are as follows:

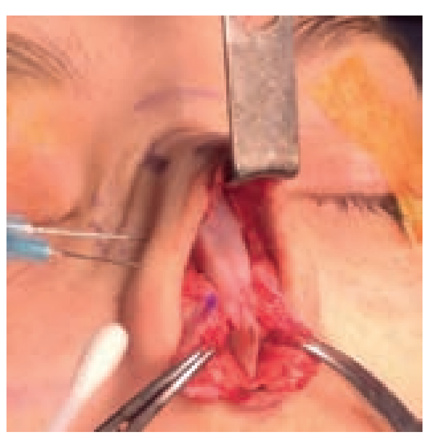
- small hump/convexity < 2mm
- small hump with need for tip projection
- small hump with wide bones and/or need for osteotomies.

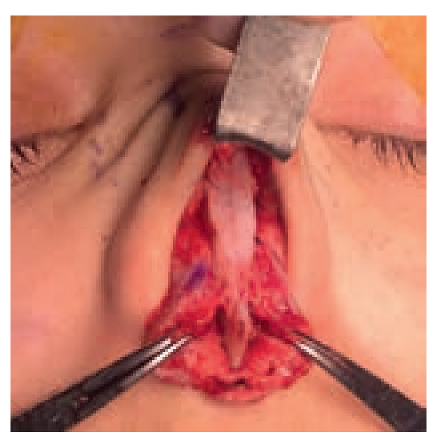

The main advantage of the CVM technique is its simplicity, especially in an open approach. If a patient has a small osseocartilaginous hump, the osseous part is removed up to the desired profile line, and any excess cartilage is shaved. The cartilaginous vault is almost completely maintained as is the internal valve mucosa. As there is no open roof, there is no need for midvault reconstruction. However, endonasal spreader grafts can be easily placed in submucosal pockets to help with asymmetries and deviations. The bones can be modified as needed including standard osteotomies for narrowing dorsal or base bony width. The entire septum remains available for septoplasty and graft material. This technique has been particularly useful in the Hispanic nose where a small pseudo hump and lack of tip projection is a frequent deformity. The main disadvantage of this CVM procedure is that the surgeon may remove too much cartilage and open the middle vault. If this occurs, conversion to a standard component reduction is simple.

DORSAL MODIFICATION / (CARTILAGE VAULT PRESERVATION

Cartilage vault preservation (hereinafter CVP) has been a very important category of techniques in my rhinoplasty practice. It is widely applicable, easy to perform, fast, and has a very low complication rate. CVP can be done using a high or low septal strip, which is described in more detail elsewhere (see Cartilage Conversion chapter). CVP is a hybrid technique that consists of 4 steps – 1) preservation or ostectomy of the bony cap (including the lateral keystone area) to convert the dorsum thereby permitting a cartilage-only pushdown, 2) septal strip resection under the dorsum by removing a high or low septal strip, 3) precise downward fixation of the cartilaginous vault, and 4) piezoelectric rhinosculpture and osteotomies to sculpt and narrow the bony pyramid.







Thus, it can be conceptualized as a surface technique whereby only the cartilaginous vault is lowered with or without the bony cap. The bones are dealt with separately (as in a component reduction) and no impaction of the osseocartilaginous vault into the pyriform aperture is performed. If the bony cap is *flat*, it can be preserved and lowered with the cartilage vault. If the bony cap is *curved (convex)*, it is better to remove the bony cap or modify it for lowering along with the cartilage vault. My indications are as follows:

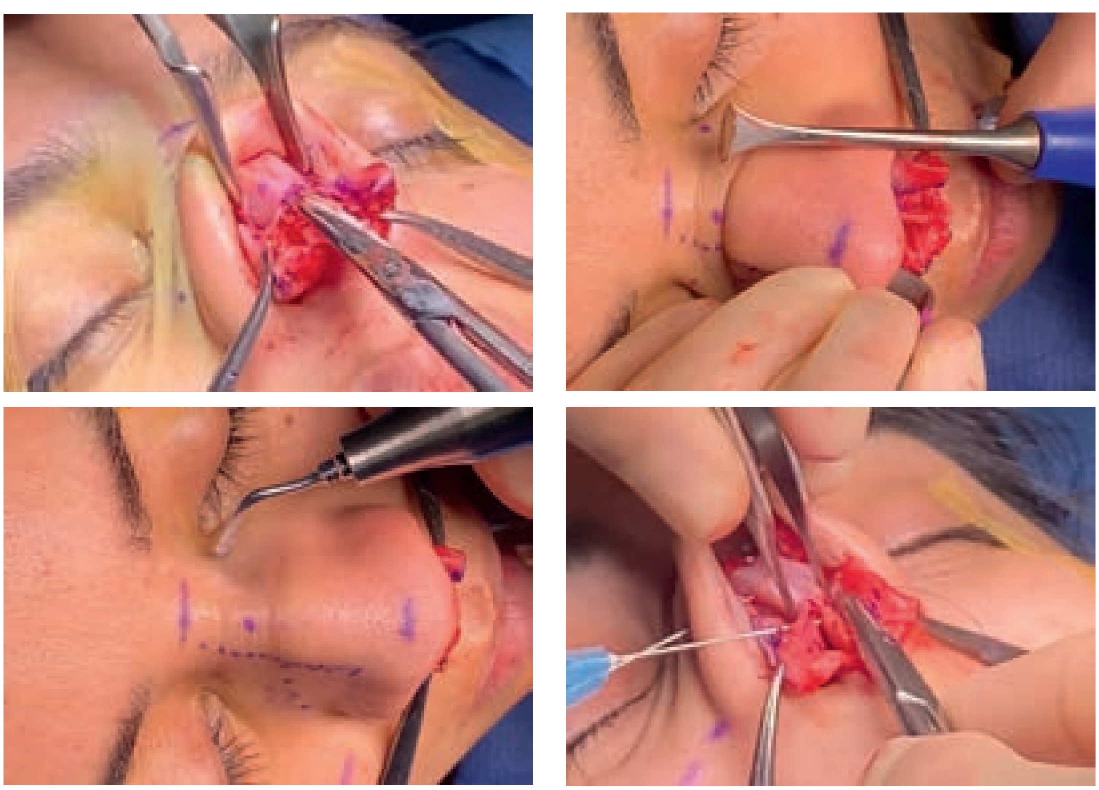
- small hump/convexity 2-3.5 mm
- small hump with S-shape nasal bones where bony cap and high septal strip removal "break" the dorsal convexity
- small hump with under projected tip and/or low radix
- small hump with need for osteotomies

If the hump is bigger than 2mm, it is better to lower the whole cartilage vault than to modify it by shaving the ULCs. Too much shaving will eventually open the middle vault. If the hump is bigger than 2mm and the nasal bones have an S-shape, it is better to remove the bony cap AND lower the whole cartilage vault. Like cartilage modification (CVM), the main advantage of this technique is its simplicity. The bony cap can either be released from the nasal bones with osteotomies or removed, and the cartilage vault is lowered independent of the nasal bones by removing a septal strip. My preference is to perform CVP by removing a high septal strip for 4 reasons: 1) removing 2-3mm of subdorsal cartilage allows for incremental and easy lowering of the cartilaginous vault, 2) minimal release is needed at the lateral keystone area to allow lowering of the cartilage, 3) the cartilage vault can be precisely sewn down to the underlying septum and sutures used to modify width and asymmetries, and 4) the technique can be easily converted to component reduction if necessary. Step 3 is the reason that makes this technique so powerful - the dorsum is preserved in continuity, but sutures can be used to modify the post-operative width, symmetry and shape.

When a low septal strip is used in a CVP procedure, the cartilage vault must be completely released from the bone (LKA dissection) to allow lowering, and this maneuver can be quite destabilizing. Also, any low strip procedure *cannot* be converted to component reduction. Nevertheless, some patients present with a small hump and axis deviation of the cartilaginous dorsum only, as seen below. These patients are optimal candidates for a low septal strip cartilage preservation.


DORSAL PRESERVATION: HIGH SEPTAL STRIP

High septal strip dorsal preservation (DP/HS) consists of 3 steps – 1) septal strip resection (high underneath the dorsum) to flatten the dorsal hump and to separate the dorsum from the septum, 2) osteotomies to mobilize the bony pyramid, and to separate the dorsum from the face which causes the dorsal profile to lower via impaction into the pyriform aperture, and 3) fixation of the osseocartilaginous vault to the underlying septum. Thus, this is an *impaction technique* whereby the entire osseocartilaginous vault is lowered.

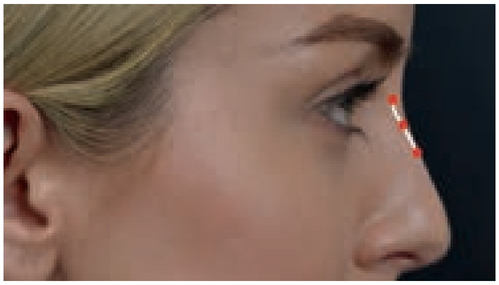


My indications are as follow:

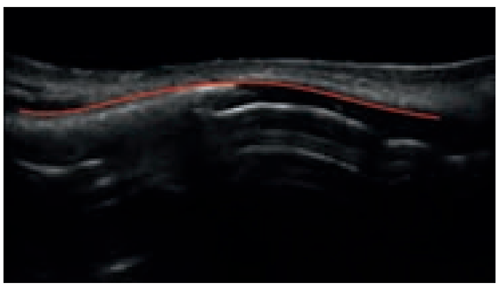
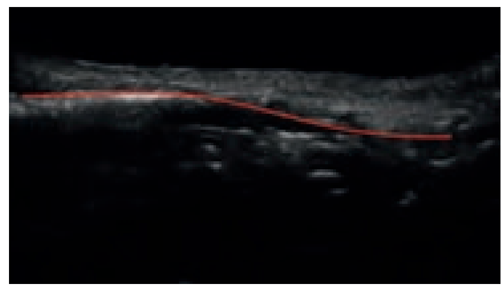
- over projected or slightly convex dorsum
- cephalic hump
- V-shape nasal bones
- normal or high radix
- cartilaginous nose (tension nose)
- large amount of septal cartilage needed for grafting (Hispanic noses)

Of all the available techniques, the high septal strip DP can be applied to the greatest percentage of rhinoplasty patients. The technique can be used in any size hump plus it is easy to learn and to understand. There is, only one degree of movement (down), and the procedure can be converted to a component reduction if trouble arises. In addition, large amounts of septum can be harvested (very important in the under projected tip), mid-vault width can be tailored with sutures, and dorsal hump flattening is achievable if patients are chosen properly.

Two factors must be carefully understood for selecting patients for a high septal strip DP procedure– 1) the types of osseocartilaginous humps and 2) what happens to the hump. Based on our previous work (Lazovic, 2015), we demonstrated that there exist 2 types of bony humps- either a V or S-shape. Three points are marked on the dorsum – Nasion (N) marking the deepest depression of the nasal bones, Kyphion (K) marking the most prominent point of the nasal bones, and Rhinion (R) marking the caudal extent of the nasal bones. V-shape nasal bones have a straight line configuration from nasion to kyphion to rhinion with 1 locus of angulation (below, left). S-shape nasal bones have a sharp takeoff of the hump from the Nasion (N) resulting in a high Kyphion (K) point and a second locus of angulation (below, right).




When doing a high septal dorsal preservation procedure, 2 concurrent factors allow for "flattening" of the hump. During the letdown or pushdown procedure, the hump lowers and can disappear just based on the fact that the soft tissue envelope is thinnest at the Rhinion and thicker at the supratip and radix. The second factor is the "coat hanger effect" as described by Saban, where release of tension on the keystone area allows the osseocartilaginous joint to flex (Saban, 2018).

As shown in the preop and postop DP sonograms above, disappearance of the hump is a result of lowering the dorsum as a whole as well as a flexion of the Keystone Area joint. Assuming all blocking points are released, flexion of the KA joint is easier when more cartilage is present than bone. Bone can never be flattened, so *convex bone* must be modified or removed. Cartilage flexion becomes easier with 3 steps: 1) by removing bone, 2) by doing a limited lateral keystone release, and 3) by sewing the cartilage vault down to the underlying septum. In fact, with good 3-point fixation, none of my patients have needed revision surgery for a recurrent dorsal hump in 3 years of high septal strip DP.

With DP/HS and flattening of the KA joint, flaring of the middle vault and widening of the internal valve occurs. In addition, widening of the dorsal aesthetic lines becomes evident. In fact, the larger the strip of septum removed and/or the more kyphotic the hump, the further narrowing of the bony vault and widening of the middle vault occurs. These changes in the dorsal aesthetic lines must be kept in mind when doing a DP procedure. In an open approach, the dorsum is fixed to the underlying septum with 2 #25-gauge needles and width can be adjusted with sutures just as in the high septal strip cartilage-only DP. This key advantage allows the surgeon to tailor dorsal width and modify any asymmetries.

Finally, controlling the radix is critical in any impaction technique. With the radix osteotomy, the nose is released from the face. If there is a gap below the osteotomy site, then the radix will drop. If the radix is high preoperatively, this descent can be an advantage. However, controlling movement of the radix and specifically the nasion (N point) is paramount to DP. Two points are important to consider. First, in the majority of cases only cartilage needs to be removed under the dorsum. Ethmoid bone (PPE) is only removed if it impedes the impaction of the dorsum. Second, accurate osteotomies can be done with piezosurgery or osteotomes to achieve an incomplete (greenstick fracture) at the radix. In an open approach, the transverse ostectomies are brought anteriorly with a piezoelectric saw up to the radix on both sides. The radix bone is left intact for approximately 2-3 mm and then a partial cut is made. Gentle pressure is applied to the dorsum, which "clicks down" as the greenstick fracture occurs resulting in a *hinge* movement. I have found this method to be the best way to control radix movement in an open approach. In a closed approach, it is best to leave the periosteum attached to the bone at the radix and to do the osteotomy in an oblique fashion with the osteotome pointing towards the chin (as opposed to a perpendicular cut).

DORSAL PRESERVATION: LOW SEPTAL STRIP

Low septal strip dorsal preservation (DP/LS) consists of 4 steps – 1) a vertical cut in the quadrangular cartilage at the highest point of the nasal hump, 2) septal strip resection (along the maxilla and vomer) to lower/flatten the dorsal hump and to separate the dorsum from the septum, 3) osteotomies to mobilize the bony pyramid, to separate the dorsum from the face, and to lower the dorsal profile via impaction into the pyriform aperture, and 4) precise fixation of the quadrangular cartilage flap to the ANS. Thus, this is an impaction technique whereby the entire osseocartilaginous vault is lowered.

My indications are as follows:

- asymmetric developmental deviation of the nose (axis deviation)
- high septal deviations
- small amount of cartilage needed from the septum for structural tip grafting

Of all the DP techniques, the low septal strip is the most powerful. However, it is also the most difficult to learn and to understand. The technique can be used in any size hump, but unlike the high strip dorsal preservation, there are 3 degrees of movement - posterior, lateral, and rotation/advancement. This movement allows for the correction of very complex deformities. *However, it cannot be converted to component reduction.* In addition, smaller amounts of septum are available to harvest, and midvault width cannot be tailored with sutures as compared to the high strip.

When doing a low septal DP procedure, two concurrent factors allow for the “flattening” of the hump. First, the entire osseocartilaginous hump lowers during a letdown or push down procedure. The second factor is rotation and advancement of the quadrangular cartilage flap (QCF) that allows the osseocartilaginous joint to flex. As the bone moves down, the septal flap swings caudally and anteriorly. Therefore, disappearance of the hump is a result of lowering the dorsum as a whole as well as advancement of the septal flap along the vomer and premaxilla. Assuming all blocking points are released, flattening of the KA joint becomes easier when more cartilage is present than bone along the dorsum. Bone can never be flattened, thus convex bone must be modified or removed. In addition, the highest point of the hump must have the cartilage exposed in order that it can flex. Cartilage flexion becomes easier by removing dorsal bone and by doing a limited LKA release. Using this technique, it is paramount that all tension is taken off the KA joint and that the caudal septum is securely fixed to the ANS. Unlike the high strip dorsal preservation, there is only 1 point of fixation.

With low septal strip DP and flattening of the osseocartilaginous joint, flaring of the middle vault occurs and widening of the internal valve, but less than with the high strip. These changes in the dorsal aesthetic lines must be kept in mind when doing a DP procedure. In addition to controlling the radix, it is also very important to control the amount of resection at the caudal septum. Over-reduction can lead to loss of supratip height – the most common problem when learning the low strip technique.

Perhaps the best indication for this technique is true axis deviation of the nose – a straight nose that is deviated off the midline axis in both its bony and cartilage components, as seen above. A low strip technique combined with an asymmetric letdown procedure will allow lowering of the bony component and impaction into the midline. The cartilage flap will follow because the vertical cut releases the dorsum from the deviated perpendicular plate of ethmoid (PPE). In traditional component reduction rhinoplasty with L-strut, the PPE translates tension onto the cartilaginous portion of the septum. With a low strip DP, total mobility is achieved allowing the bone and cartilage to swing into the midline without tension. For me personally, these have been the most exciting DP cases - very difficult, asymmetric noses that can be corrected without the necessity of a total or subtotal septoplasty while preserving a natural dorsum without recourse to mid-vault reconstruction.

DECISION MAKING

It is my opinion that no one operation is useful in 100% of patients. When I see or read about a new technique, my primary goal is to understand which of my patients would benefit and how. I began DP with the high strip Saban technique and expanded my skill set from there. Since I practice in Southern California, my practice is an "ethnic rhinoplasty" practice with a large percentage of Middle Eastern, Hispanic, and Asian patients. Initially, DP appeared to be a good option in approximately 15-20% of primary rhinoplasty patients. However, with better understanding of DP/HS, I was able to apply the technique to 33% of my patients. Now, with the addition of cartilage conversion techniques and low septal strip dorsal preservation, I can preserve the dorsum in over 50% of patients. Thus, my rule is "if I can, I preserve".

The initial decision is made based on the *anterior view* of the patient. During physical exam, the surgeon must determine whether or not the natural dorsum is ideal in terms of width and shape of the *cartilaginous* dorsal aesthetic lines. In selected cases, cartilage modification or cartilaginous preservation can be done while treating the bones separately. Bones can be sculpted, narrowed, or removed, but the cartilaginous vault must be retained intact thereby separating the underlying mucosa from the skin envelope and avoiding an open roof syndrome. The determination of which patients can undergo DP will be different for every surgeon based on experience as well as their tolerance for asymmetries, deviation and width. DP is very attractive once a surgeon learns the technique because it is much simpler than dorsal reduction as it avoids medial osteotomies and middle vault reconstruction. I now believe that most astute surgeons will find that only 40-60% of patients truly have a dorsum that will benefit from DP. However, surgeons will always push the limits by doing asymmetric preservation procedures by adding grafts, rhinosculpting bones, etc. With this approach, probably 70-80% of patients become candidates.

Once a surgeon has decided that they would like to preserve the dorsum based on the anterior view, the next step is to examine the profile. Based on my ultrasound studies and hundreds of postoperative results with each technique, the following key points must be assessed.

Position of Radix

As described above, the radix lengthens in the longitudinal plane with DP techniques and the starting point of the nose (Nasion, N) moves caudally as the radix drops. Ideal patients for impaction techniques have a normally positioned radix or slightly high radix in relation to the glabella and cornea. In these cases, a movement in radix position will not be detrimental to the final result. On the other hand, patients with a low radix, radix hypoplasia, a strong glabella, and/or a prominent premaxilla must be approached much more carefully, and a radix graft must be considered. Because the radix does not drop with surface techniques, radix issues can be dealt with separately and do not influence decision-making. Performing a DP in the wrong patient or unintentionally dropping the radix can result in "infantilization" of the nose.

Type of Hump

The easiest patients for DP have a straight dorsum that is too high or over projected. In these cases, one can lower the whole dorsum or only the cartilaginous dorsum as there is no true hump.

However, most patients have a hump. Understanding the difference between a V and S shape hump is critical to choosing initial patients for dorsal preservation. It is much easier to “flatten” the osseocartilaginous vault in patients with a V shape hump as they have only 1 locus of angulation. S shape humps are much more difficult. These noses tend to have a sharp takeoff of the hump from the Nasion (N) resulting in a high Kyphion (K) point and a second locus of angulation. It has been my experience that these noses are more difficult to flatten and any convexity in the bone must be removed. In my early experience, I resected larger amounts of septum and PPE to treat S shape nasal bones. This resection allowed the dorsum to push down further cephalically and essentially the thick radix soft tissue envelope camouflaged the hump. However, patients would tell me that their nose looked straight, but they could still “feel” the hump. Their observation is true because the hump has not been flattened. Rather; the surgeon has taken advantage of the fact that the radix soft tissue envelope is often four times thicker than the keystone soft tissue envelope. However, with more experience it became apparent that removing bone at the keystone junction (moving the junction cephalically) allows for easier straightening of any nose regardless of the technique. The surgeon should begin with easier humps to flatten regardless of the technique.

Length of Bony Vault

The length of the bony vault is a critical determinant of how easy it will be to flatten a hump. Longer nasal bones are harder to flatten because cartilage is easier to flex than bone. Initial dorsal preservation patients should be chosen who have primarily cartilaginous noses.

Position of Anterior Septal Angle

The position of the anterior septal angle (ASA) must be inspected carefully preoperatively. Early on, a surgeon will take out a strip of septum only to find that they have caused what appears to be a dorsal saddle. Again, looking at a picture of a straight nose via sonogram demonstrates that the keystone area projects much more than the sellion / soft tissue nasion (N) or ASA. It is the soft tissue envelope thickness that makes the nose look straight. With any DP technique, it is important to modify the caudal septum as the last step. Using the high septal strip techniques, the W-ASA segment should be modified last. Using the low septal strip techniques, the posterior portion of the caudal septum should be modified last.

Position of Radix (N) relative to Premaxilla

The position of the radix relative to the premaxilla occurs ideally in the same vertical facial plane. Patients with a prominent maxilla and/or premaxilla often complain of tip over projection. However, it is the prominent premaxilla that creates the visual appearance of over projection because the nose is sitting on a platform that is over projected. Dorsal reduction in these patients can make patients appear to have an over-projected nose that sticks out like Pinnochio. The appearance occurs because the radix lengthens and moves caudally giving an even bigger discrepancy between the radix and tip-defining points. These patients often do better with radix grafting and/or reducing the dorsum more caudally than cephalically. Radix grafting creates an acute nasofrontal angle that is aesthetically more pleasing.

TECHNICAL DETAILS & LESSONS LEARNED

Patient selection is the number one determinant of success with any rhinoplasty technique including DP. As discussed, surgeons should begin with patients who have ideal dorsal aesthetic lines with minimal deviation, asymmetries, and width discrepancies. It is also wise to keep in mind that the bony dorsal aesthetic lines may narrow slightly cephalically, and they may widen slightly caudally following a DP procedure. Also, one effect of surgery may be that the nasal base bony width will narrow, and the bones will verticalize. These changes give the nose a stylized look, which most patients and surgeons like.

Looking at the profile, *ideal patients* will have a well-positioned or high radix, a V-shaped dorsal hump or no hump (only over projection), and shorter nasal bones. The septum should be without major deviations. Overall, avoid patients with a prominent glabella or premaxilla as well as radix hypoplasia. Keeping these things in mind, patients will typically look great immediately after surgery. It is also important to note that since the middle vault is not opened, the patients have minimal bleeding under the skin and photograph well even at 10 days post-operatively.

How to Learn Dorsal Preservation Surgery. If I were to start my journey all over again, I would take a slightly different route to minimize my own stress. The best technique to start with is the Dorsal Modification / Cartilage Vault Modification (DM/CVM). Surgeons can become adept at removing the bony cap and preserving the underlying cartilaginous vault. This procedure is done in patients with small humps, and the surgeon can easily convert to component reduction if they become uncomfortable. Next, the surgeon progresses to High Septal Strip, Cartilage-only Dorsal Preservation (DM/CVP). Now that the surgeon has become familiar with bony cap removal, one can remove a subdorsal strip of cartilage only. This is the scariest part of learning the operation for those of us taught the standard L-strut philosophy. This operation is done in patients with small humps and the surgeon can convert to component reduction while doing traditional osteotomies. Once the surgeon is comfortable removing a subdorsal strip, it is time to progress to traditional DP procedures with lowering / impaction of thee osseocartilaginous vault. The surgeon *must* have proper instrumentation – a small rongeur to remove PPE incrementally as well as precise osteotomes. The first few High Septal Strip Dorsal Preservation (DP/HS) cases are very stressful. However, over time, you will begin to feel comfortable. Even with this technique, it is easy to transition to component reduction at any point if things are not going smoothly. Lastly, the Low Septal Strip procedure (DP/LS) can be learned. This technique has the steepest learning curve by far and is the hardest to control. With the DP/LS techniques you *cannot* convert to a component reduction. To learn these procedures, it is desirable that you visit a surgeon who performs DP/LS in order to see it being done and have the opportunity to ask questions.

CASE # 1 – Dorsal Modification / Cartilage Vault Modification (DM/CVM)

A 22 year old female of Hispanic descent presented with a 2mm dorsal hump, a bulbous tip and a plunging tip on smiling. The tip is also under projected. The patient had a DM/CVM procedure with removal of the bony cap using piezoelectric surgery and modification of the cartilaginous vault. The ULCs and a small amount of the dorsum were shaved with a #15 blade without opening the middle vault mucosa. Medial oblique, low-to-low and transverse osteotomies were performed with piezoelectric instruments. A septal extension graft was used to support the nasal tip. Her tip was dissected sub-SMAS and her dorsum in a subperichondrial plane. Her ligaments were preserved and no cartilage was removed from her alars (only tip suturing). Therefore, she underwent a complete PR (PR-C). Postoperatively, she demonstrates improved dorsal aesthetic lines, elimination of the dorsal hump, and excellent tip contour.

CASE # 2 – Dorsal Modification / Cartilage Vault Preservation (DM/CVP)

A 22 year old female of Middle Eastern descent presents with a 3.5 mm dorsal hump, a wide bony vault and a plunging tip. The patient had a cartilage push down procedure after bony cap modification (DM/CVP using a subperichondrial dissection). The bony cap was removed with PEI plus a 3 mm strip of subdorsal septum. The cartilage vault was conservatively disarticulated from the nasal bones at the LKA. 5-0 PDS sutures were used at multiple points to sew the cartilaginous vault down to the underlying septum. Piezoelectric medial oblique, transverse and low-to-low osteotomies were done to narrow the bony dorsum and bone base. The tip was supported with a columellar strut and all ligaments were preserved. No cartilage was removed from her alars (only tip suturing).

CASE # 3 – Dorsal Preservation / High Septal Strip (DP/HS)

A 24 year old male of Caucasian descent presented with a 5 mm dorsal hump, and an ideal osseocartilaginous vault. His profile demonstrates an over projected dorsum with a minimal hump. The patient is shown preoperatively and postoperatively after he underwent a high septal strip push down with no dorsal undermining of the skin sleeve and subperichondrial dissection of the nasal tip. A 6 mm strip of subdorsal septum was removed and external osteotomies performed. The tip was supported with a septal extension graft to stabilize the nasal base and no cartilage was removed from his alars (only suturing). Therefore, he underwent a complete PR without dorsal undermining. Postoperatively the profile line is improved without opening the middle vault.

CASE # 4 – Dorsal Preservation / Low Septal Strip (DP/LS)

A 23 year old female of Persian descent presented with asymmetric, developmental deviation of the nose. She has an ideal osseocartilaginous vault with a small hump and straight-line deviation to the right. She also has a bulbous tip. A low septal strip and asymmetric let down were done. The quadrangular cartilage was disarticulated from the ANS, vomer and perpendicular plate creating a “swinging door. A “push over” of the osseocartilaginous vault was performed and profile line lowered by removing a 4 mm low septal strip and performing low-to-low and transverse osteotomies bilaterally as well as a radix osteotomy. On the long (left) side, a 3 mm strip of lateral nasal wall was removed at the face of the maxilla. On the short side, osteotomy was performed without bone removal. The caudal septum was reattached to the ANS via a drill hole. The tip was supported with a columellar strut and only tip suturing was performed (no cartilage was removed from the alars). Total subperichondrial dissection was with preservation of ligaments. Thus, it was complete preservation rhinoplasty.

CONCLUSIONS

All new surgical techniques come with a learning curve. As I am a younger surgeon in this group of authors, I have built my rhinoplasty practice on the shoulders of giants and have had hundreds of opportunities to discuss and to develop these techniques with them. We worked hard and thought a great deal about these techniques to make them safe and predictable. For the surgeon beginning their journey with PR, there is an obligation to learn the new nasal anatomy and to master the intricacies of the techniques detailed in this book. The reader should make every effort to visit surgeons who do DP regularly. For me personally, these techniques are applied to different subsets of patients in my practice and have given excellent results with enhanced predictability. No dorsum looks as good as a natural dorsum, and long-term issues with the middle vault and keystone area are avoided. Preserving the alar cartilages whenever possible and utilizing a subperiosteal-subperichondrial dissection plane whenever indicated will lead to fewer problems long term. If you begin conservatively and pick your first patients carefully, you will be successful.

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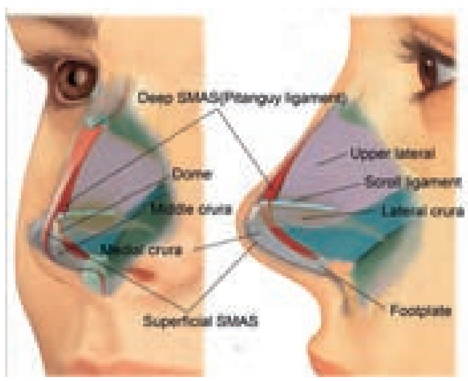
Subperichondrial - Subperiosteal Rhinoplasty

Barış Çakır, Ali Murat Akkuş

The subperichondrial dissection plane in rhinoplasty is a relatively atraumatic, avascular plane that minimizes soft tissue injury and results in decreased intraoperative edema and a more predictable postoperative result. The use of a subperichondrial plane in rhinoplasty is in many ways similar to the approach used for septoplasty which minimizes soft tissue trauma and scar formation. The muscles, fat, ligaments, nerves and blood vessels are located above the perichondrium and within or superficial to the superficial musculo-aponeurotic system (SMAS). During elevation of the soft tissue envelope in a sub-SMAS dissection plane, one routinely sees muscle fragments on the alar cartilage, transection of neurovascular structures, and destruction of multiple nasal ligaments. In contrast, elevation in a subperichondrial plane is bloodless, clean, and preserves the anatomical integrity of the entire soft tissue envelope. The benefits are visible immediately intraoperatively with less edema and ecchymosis as well as postoperatively with less swelling, numbness and thinning of the overlying skin. Preservation of the nasal ligaments results in more stability of the nasal valves and maintenance of tip support.

PRINCIPLES

Awareness of the nasal ligaments became wide-spread with Dr. Ivo Pitanguy's publications. The nasal SMAS becomes thicker in the supratip and tip area where it divides into a superficial and deep component (Saban et al. 2008). The superficial SMAS passes over the domes, continues between the medial crura, and joins the superficial orbicularis oris muscle. This superficial SMAS is considered the Superficial Pitanguy midline ligament. The deep SMAS further separates into three sections – a central and two lateral components. The central section is designated as the Deep Pitanguy midline ligament and passes beneath the interdomal ligament and the anterior septal angle. It continues within the membranous septum and joins the medial crura and the paired depressor septi nasalis muscles (Daniel et al. 2013). The Deep Pitanguy midline ligament creates an elastic cushion just beneath the domes and provides significant tip projection. Thus, cutting of the ligament leads to a loss of tip projection. The lateral components of the deep SMAS inserts into the scroll area as the left and right Vertical Scroll Ligaments (VSL) bilaterally. The VSL connects the transversalis muscle to the scroll region / internal valve. The ULC and lateral crura are connected by the Longitudinal Scroll Ligament (LSL). During cadaver dissections and surgery, these two scroll ligaments can be differentiated, but histologically a significant difference is not obvious. Therefore, the VSL and LSL can be called Scroll Ligament Complex (SLC). A standard sub-SMAS dissection in the scroll region damages the muscle insertion leading to fullness at the supratip as well as collapse of the internal valve.



IMPORTANT POINTS REGARDING THE SURGICAL TECHNIQUE

- The technique is easier to perform with the Daniel-Çakır Elevator, developed specifically for this type of dissection.
- Limited dissection is performed in the Pitanguy's ligament when opening a window between the superficial and deep SMAS in patients with thick skin.
- Defatting is not removing fat, but removing muscle, which may lead to valve problems. I do not perform defatting, but instead focus on "redrape control."
- In patients with a short lobule, the Pitanguy's ligament dissection can be increased by 2-3 mm, in order to ensure sufficient space for the lobule.
- In thin skin patients, the dissection should be increased so as to avoid an acute supratip break point.
- In thin skin patients with over-projection, it is necessary to cut the Pitanguy's ligament (10-20%). Cutting the Pitanguy ligament results in an obvious deprojection and supra-tip fullness.

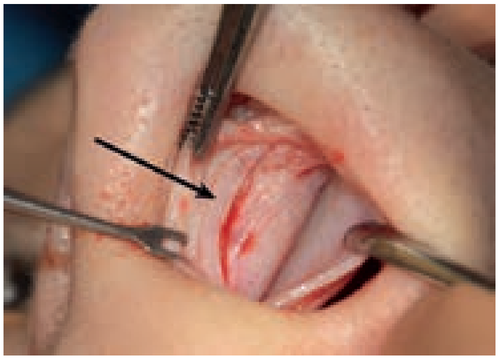
SURGICAL TECHNIQUE

Subperichondrial dissection can be achieved in either the open or endonasal approaches for rhinoplasty. In the open approach, the Pitanguy ligament can be protected; however, in order to protect the structures passing through the membranous septum, a unilateral trans-septal incision is utilized.

Step #1 – Low Septal Incision

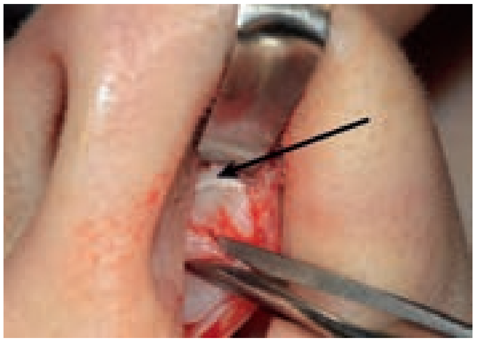
A unilateral low septal incision is performed 3-4 mm cephalic to the caudal edge of the nasal septum through the mucosa and mucoperichondrium (see figure below on the left). A back-cut of 3-4 mm towards the internal valve can increase exposure. Additional caudal dissection allows for exposure of the caudal septum.

A trans-septal cut is made 1-2mm back from the caudal edge leaving a 1-2mm posterior strut (see on the right). Dissection continues on the contralateral septum in a submucoperichondrial plane. This approach protects the structures and ligamentous attachments of the membranous septum and also serves as guide when suturing the caudal septum at the end of the operation.

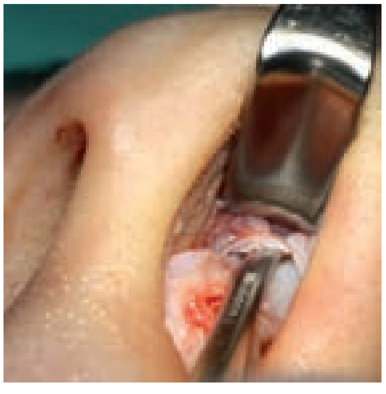
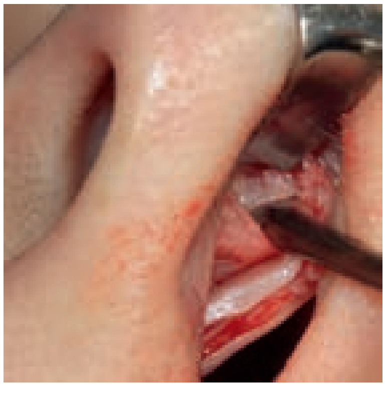



Step #2 – Subperichondrial Dissection of the Dorsal Septum

Above the anterior septal angle, the surgeon uses pointed scissors to advance the dissection. Upon reaching the upper lateral cartilage, the dorsal perichondrium becomes visible.

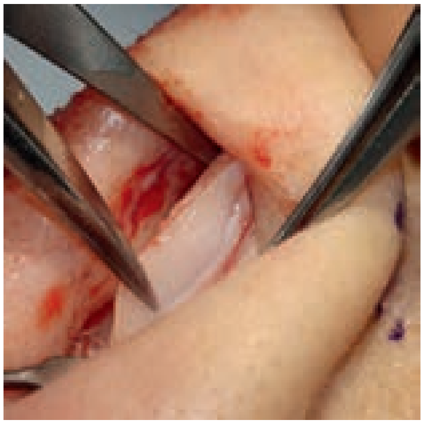


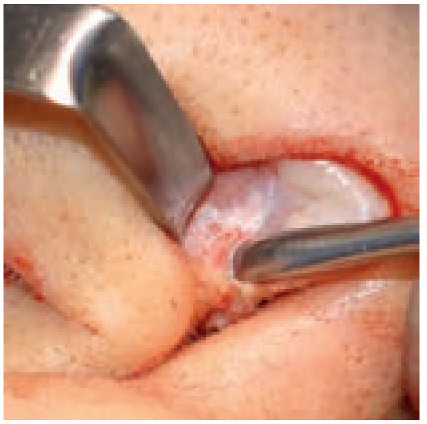
The surgeon inserts the pointed scissors beneath the dorsal perichondrium to start the dissection followed by a thin, pointed, tiny blunt elevator. At this point, the dorsum can be quickly dissected within 5-6 seconds, much like the septum. Once the dissection has been performed up to the keystone area, the surgeon continues to dissect left and right towards the upper lateral cartilages, until the scroll region, and stops there.

Step #3 – Subperichondrial Dissection of the Lower Lateral Cartilage (LLC)

After the infracartilaginous incision, a hook is placed underneath the lateral curvature of the lateral crus mucosa, and the assistant retracts it downwards. A #15 blade scalpel in the reverse direction is inserted underneath the perichondrium to achieve entry into the subperichondrial plane. The surgeon advances a further 2-3 mm with pointed scissors (see figure below on the left). The Crile retractor is inserted under the perichondrium, and the dissection is continued with the help of a Daniel-Çakır elevator. Squeezing the perichondrium between the skin and the retractor and applying countertraction facilitates an easier dissection (see figure below in the middle). Now the perichondrium can be dissected in full view. Upon reaching the dome, the surgeon places a hook, and the assistant pulls laterally. The subperichondrial dissection is continued above the dome and then down onto the medial crus (see figure on the right).

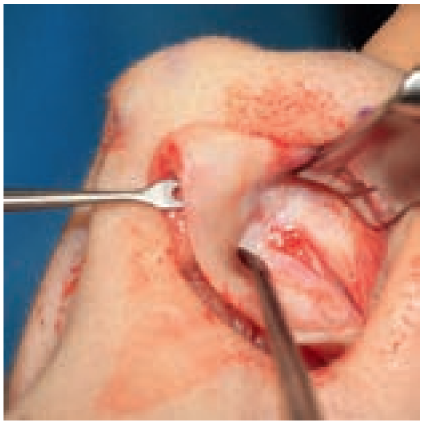




Step #4 – Protecting the Scroll Ligament

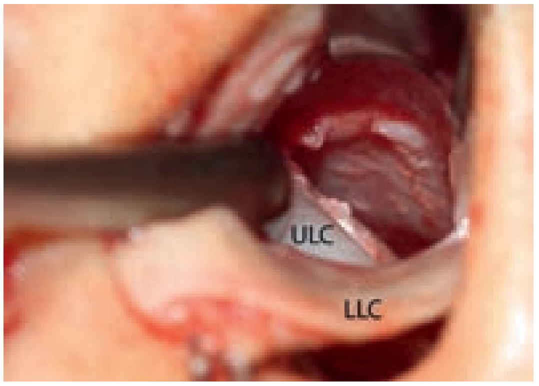
The hook holding the dome is retracted inferiorly. The retractor is inserted under the skin of the ala, providing counter-traction. The surgeon uses the elevator to complete the dissection of the lateral crus until the scroll region is encountered (see figure below on the left).

After reaching the scroll region, advancing the elevator becomes more difficult due to the ligamentous attachments. At this point, the surgeon should depress the lateral crus which, due to the counter-traction, keeps the scroll cartilages up since they are attached to the SMAS, thus exposing the upper lateral subperichondrial plane (see figure below on the right). The surgeon continues the dissection until reaching the bone.



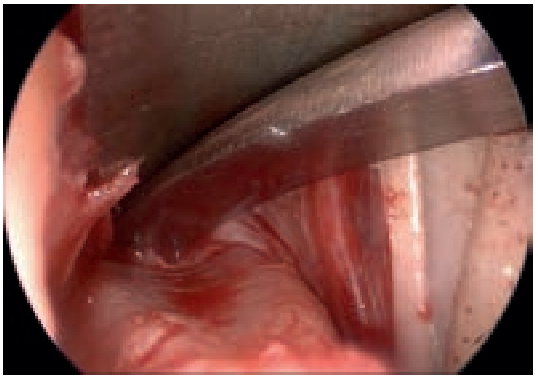
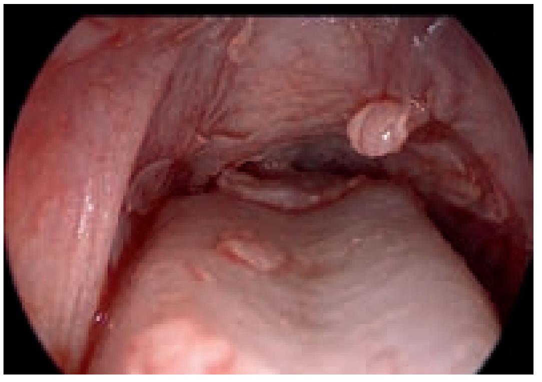

Step #5 – Subperiosteal Dissection of the Lateral Nasal Bone

With the tip of the Daniel-Çakır periosteal elevator, the surgeon scrapes along the caudal edge of the nasal bone. The dissection is performed between the periosteum and the sharp caudal edge of the bone with the elevator, which allows for dissection of the lateral bone in full view. The periosteum is cut between the elevator and sharp bone border. The lateral bony wall periosteum is dissected under direct vision. The radix is dissected while using an Aufricht retractor.



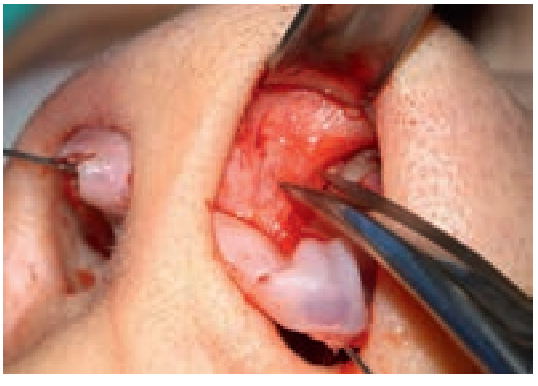
Step #6 – Joining the Dissection Plane

The caudal edge of the dorsal periosteum is cut by scraping with the elevator. The right and left dissection planes can be joined by dissecting the midline periosteum of the dorsum.

Step #7 – Opening a Window between the Superficial SMAS & the Pitanguy Ligament

Hooks are attached to both domes, so that they can be pulled apart laterally. After a Crile retractor has been inserted, a window is opened in the plane between the superficial and deep SMAS. Thus, the Pitanguy ligament is protected. The dissection is continued to wherever the supratip break point is desired. The other end of the dissection is performed all the way to the medial crura.

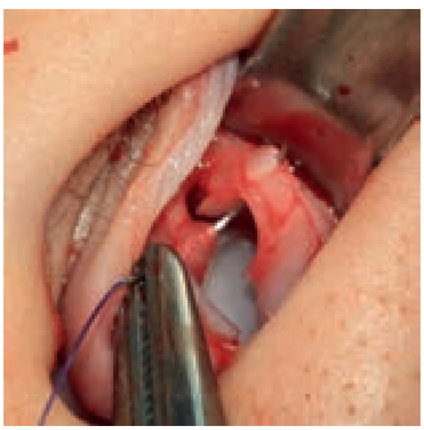
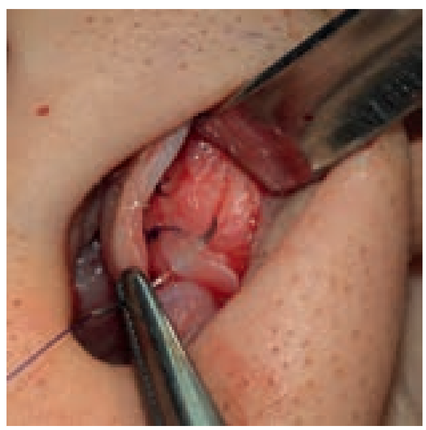
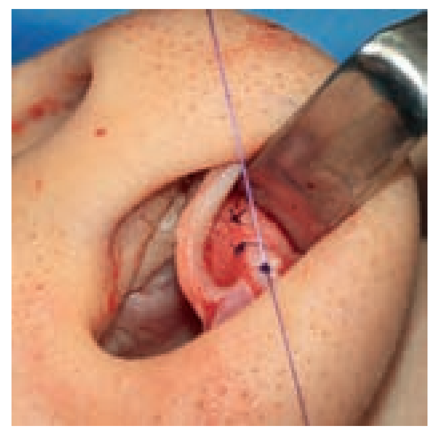



Step #8 – Reconstruction of the Low Septal Incision

Following completion of the tip work and management of the dorsum, the posterior strut is sutured to the caudal septum at the desired tip projection, and the mucosa is closed with 6/0 Monocryl sutures.

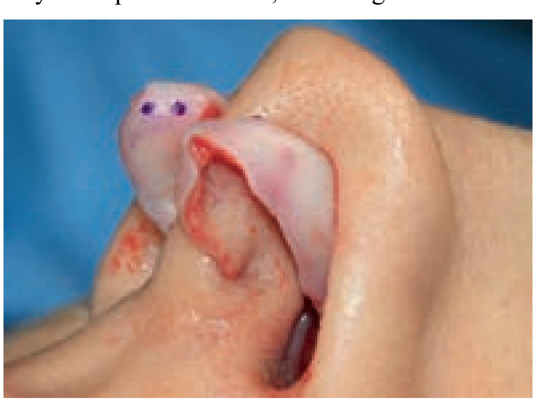
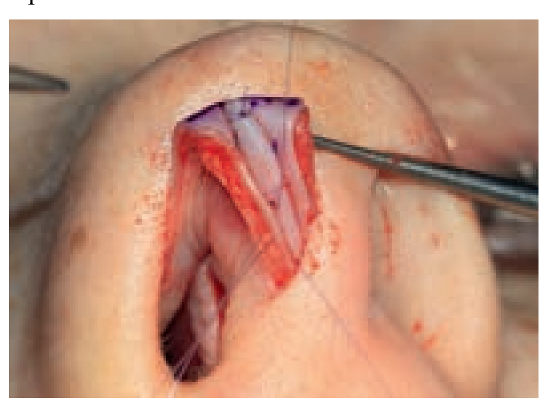

Step #9 – Scroll Ligament Repair

The scroll ligaments are repaired with 2-3 sutures with 5-0 PDS, fixing them to the caudal edge of the ULCs. In this way, the transversalis muscle will be reinserted. The infracartilaginous incision is closed with 6-0 Monocryl.

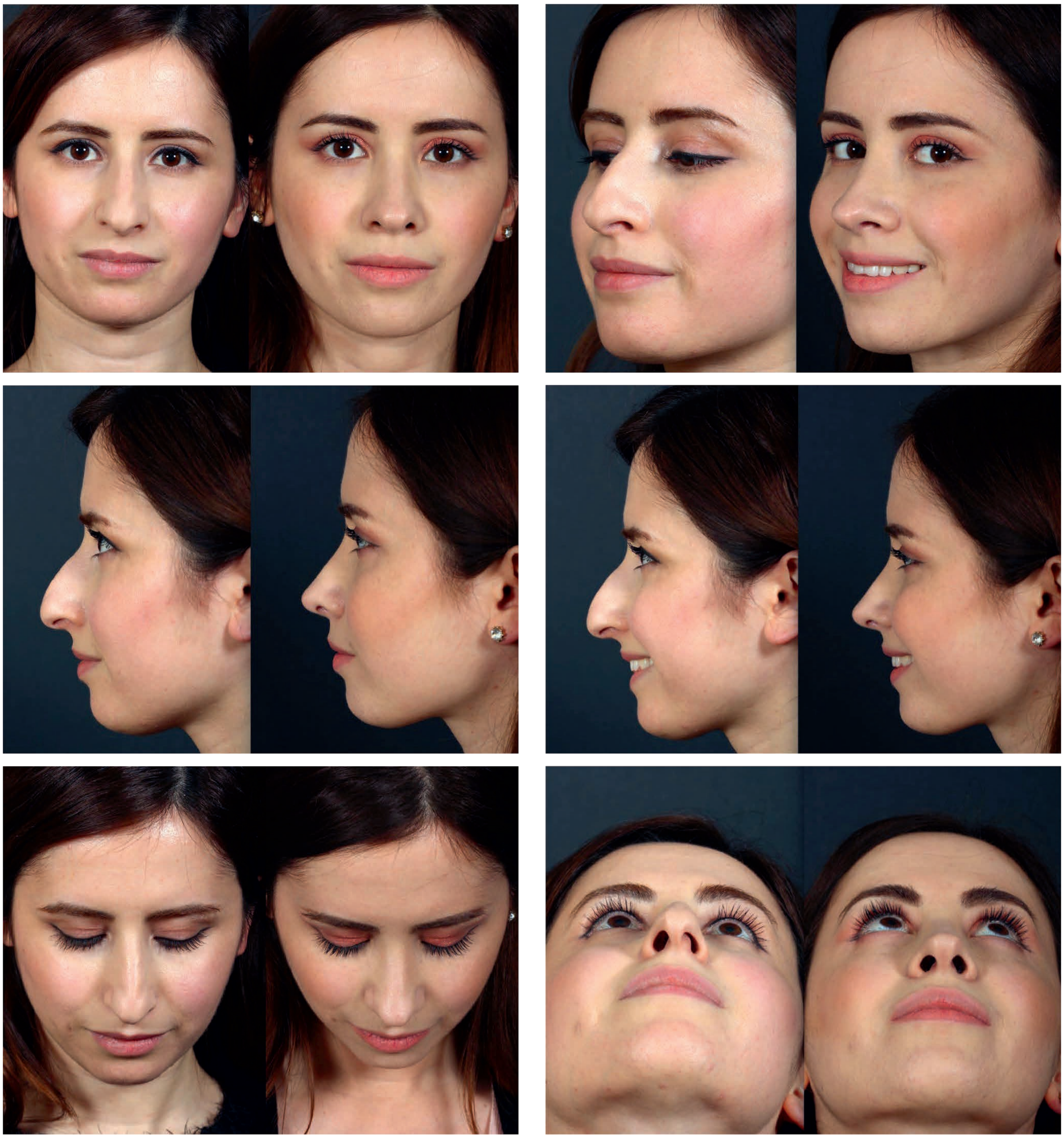
Step #10 – Modification of the Cartilaginous Framework

Combination of intercartilaginous and marginal incisions allows for tip delivery. Only marginal incision also allows for tip delivery and tip modification, including dome sutures and placement of the columellar strut.

CASE #1

Preoperative and one-year postoperative photograph can be seen. The patient has thin skin which is the most general indication for subperichondrial rhinoplasty.



CASE #2

Preoperative and one-year postoperative photograph can be seen. The patient has heavy skin. Skin redrape control.

CASE #3

Preoperative and 7-years postoperative photograph can be seen.

CASE #4

Preoperative and 5-years postoperative photograph can be seen.

CASE #5

Preoperative and 5-years postoperative photograph can be seen.

CASE # 6 & 7 – Complications

Protecting the Pitanguy ligament and suturing the scroll ligament can result in an exaggerated tip definition in patients with thin skin and over-projection of the tip as well as in patients with an already defined supratip break point. In seven of my patients, I performed revision rhinoplasty because of over-projection and depression at the supratip (see Case below). I cut the Pitanguy ligament and decreased projection. While placing the tip cartilage, one has to ensure that the perichondrium on the domes rests exactly on the cartilage and that the superficial SMAS is inserted between the cartilages. If the superficial SMAS is placed exactly into the interdomal space, a proper relationship between the cartilage and skin is guaranteed; if not, tip asymmetries may occur. Making 2-3 mm cuts to the perichondrium at the tip decreases the likelihood of such a complication. It is difficult to cut the Pitanguy ligament and suture it in a symmetric fashion; therefore, it is better to leave it intact. Previously, I would perform a plication in order to increase projection, but this often resulted in asymmetries. Therefore, protecting the Pitanguy ligament and avoiding a plication is a more logical decision.

CONCLUSIONS

The tissue damage resulting from dissection in rhinoplasty may lead to atrophy of the subcutaneous tissues and less predictable post-operative outcomes. With subperichondrial dissection, the vascularity of the perichondrium remains intact, which decreases intra-operative and post-operative edema. This reduction in edema speeds up the recovery process and maintains the ligamentous attachments of the cartilaginous framework. Subperichondrial dissection allows a uniform, well vascularized skin and soft tissue envelope to cover the altered structural framework. On the other hand, sub-SMAS dissection leaves the perichondrium over the cartilage, and this perichondrium is lost with cartilage resection.

Patients often complain about excessive shine on the dorsal skin following rhinoplasty. This shiny appearance of the skin may result from extended inflammation and changes in innervation. This occurrence has become much less frequent with subperichondrial dissection.

As the Pitanguy ligament is protected and the scroll region repaired in the subperichondrial dissection, post-operative development of soft-tissue pollybeak and loss of tip projection has decreased significantly. Usage of onlay tip grafts during primary rhinoplasty is limited to less than 1% of rhinoplasties performed in the subperichondrial plane. Particularly in patients on which reduction rhinoplasty is performed, the scroll ligaments can be easily repaired by pulling the excess skin laterally towards the sides.

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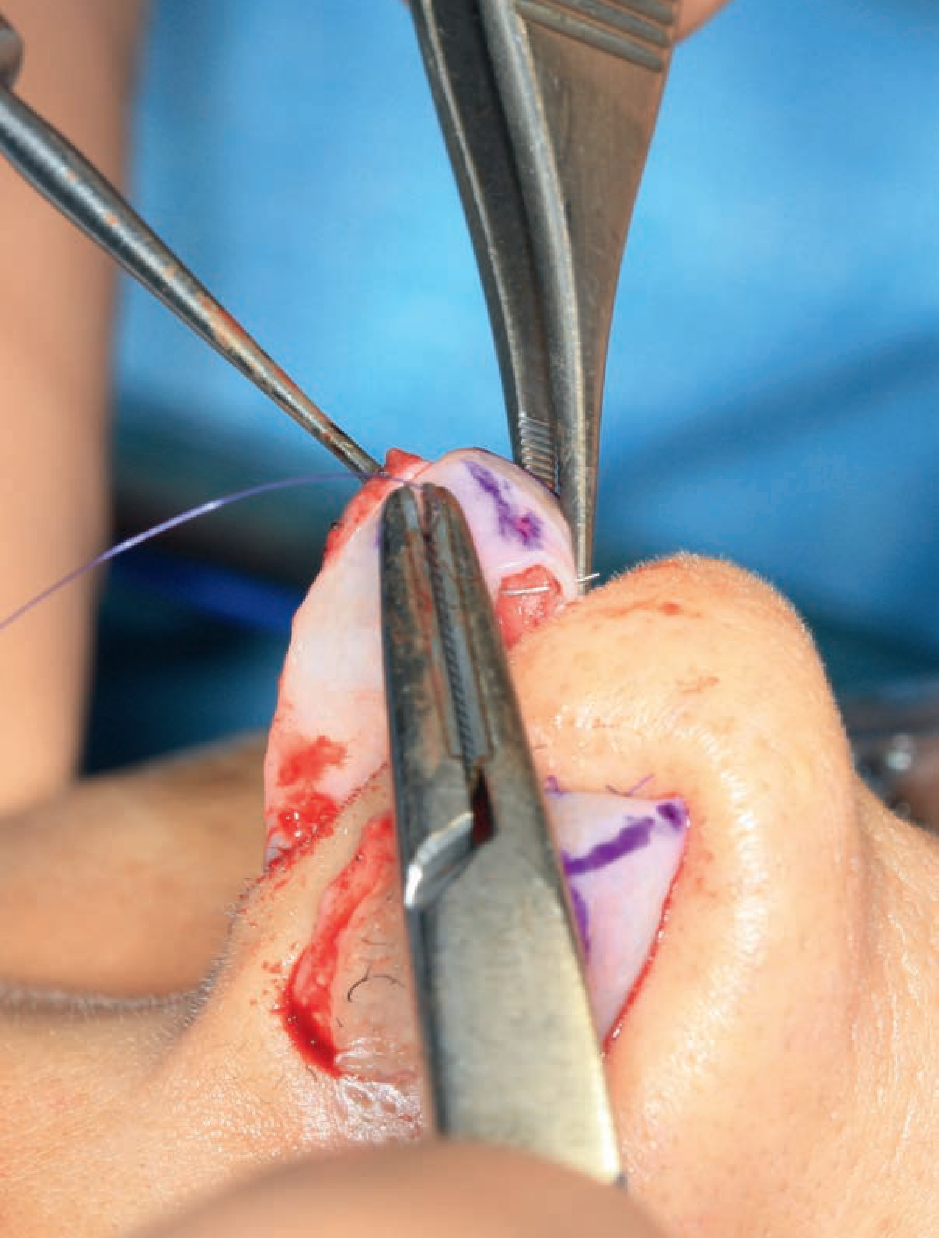
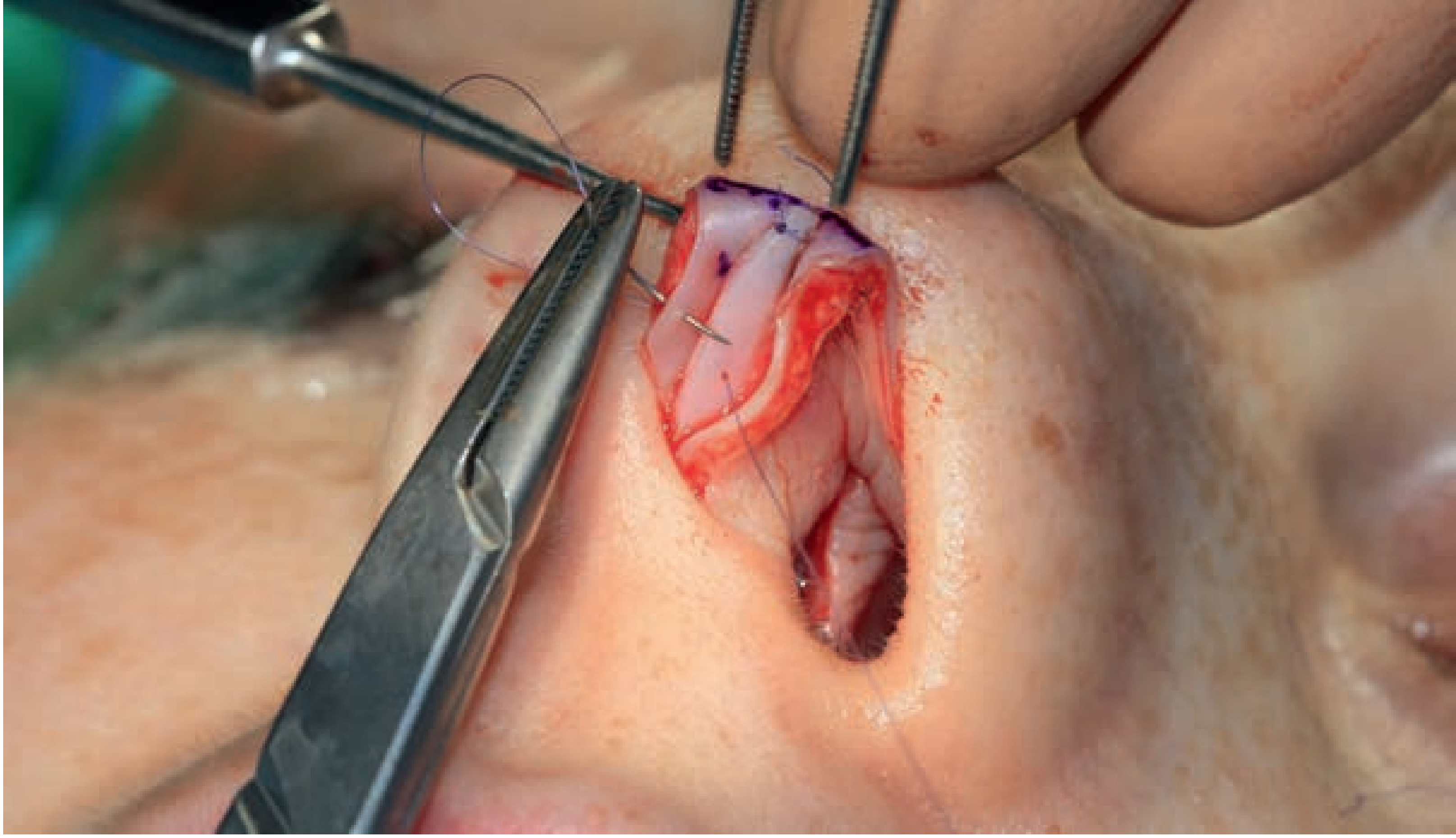




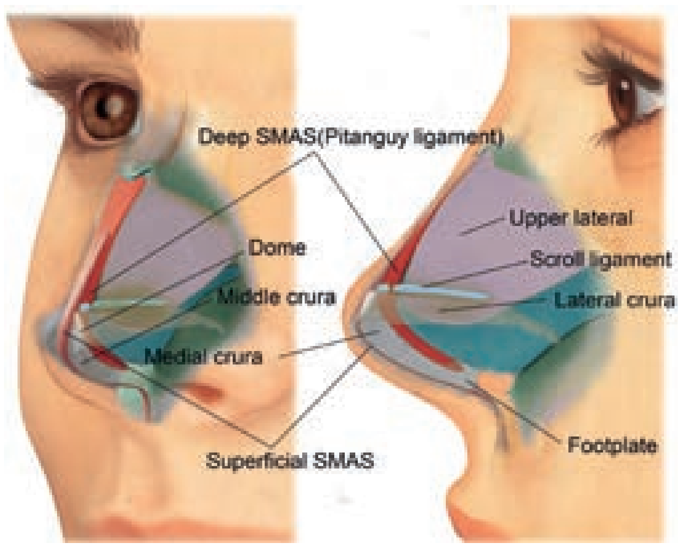
Aesthetic Tip Surgery with Ligament Preservation

Barış Çakır, Bülent Genç

Rhinoplasty surgery began with reduction surgery using a closed Approach. With the advent of the open approach, controlled resection and reconstruction became more popular. Concurrently, endonasal surgery using an intracartilaginous approach without visualizing the tip cartilages lost its popularity, as young surgeons found it too difficult. In contrast, open rhinoplasty became very popular, as it is easy to learn and perform. Stiffness and numbness are generally ignored. With experience, the author has developed an endonasal tip operation which achieves the desired aesthetic polygons while preserving the nasal tip ligaments. Preservation of these ligaments enhances the outcome of the tip surgery and is crucial for projection, mobility and definition.

PRINCIPLES

The nose consists of mobile and immobile parts. The mobile tip is formed by the lower lateral cartilages (LLCs). The immobile part is formed by the septum, upper lateral cartilages (ULCs), maxilla and nasal bones. The mobile nasal tip is connected to the septum and ULCs by the midline Pitanguy and scroll ligaments. The nasal tip is stabilized by these ligaments while allowing its upward and downward movement. The Pitanguy and scroll ligaments are formed by thickening of the superficial musculoaponeurotic system (SMAS) in the supratip region and they are functionally important as they are part of the SMAS (Daniel, Palhazi 2018). The reason behind a wide nasal tip is the wider width of the dome and lateral crus. The area between the nostrils and the lateral crus, e.g. the facet polygon, is usually narrow. Overgrowth of the nasal septum and nasal bones can lead to an aesthetically unappealing nose with a dorsal hump.



NASAL DEFORMATION

There is a distinct relationship between the tip cartilages (intrinsic factors) and their abutting fixed structures (extrinsic factors). In many adolescents, overgrowth of the septum pushes the ULCs anteriorly and the medial crura caudally. Concomitantly, the ULCs pull the cephalic edge of the lateral crus anteriorly and distort the *resting angle* (the angle between the ULC and lateral crus of the LLC). An antero-caudal septal cartilage bends the middle crura and leads to more caudally situated domes. The over growing septum can also increases tip projection as well. As the lateral crura become dominant in the tip region, the tip widens. The convex lateral crura and abnormal lateral crural resting angle give rise to a wide and round tip. Thus, there is a close relationship between the surface aesthetics of the nose and the underlying anatomy.

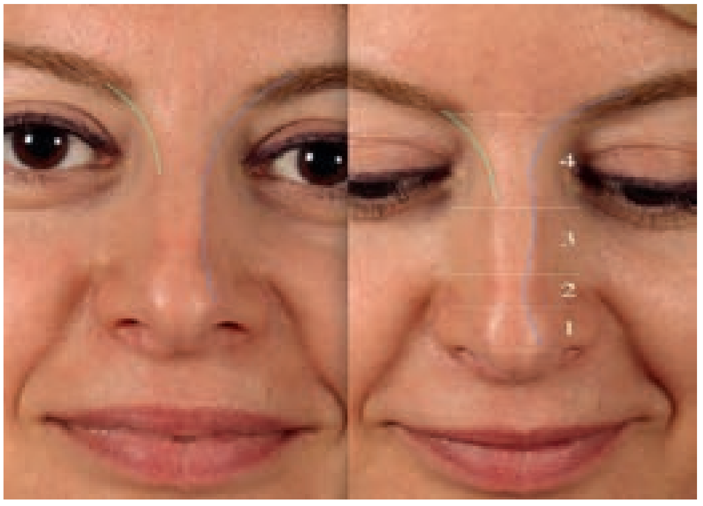
PHYSICAL EXAMINATION

Visual inspection is an important part of the examination and the problems identified can be verified on photographs. The nasal tip is often wide. The lobule is usually short. The lateral crus of the LLC is often convex, long and wide. The cephalic edge of the lateral crus is anterior to the caudal edge. Dorsal septum and nasal bones are hypertrophic. The nasal tip tends to become droopy during smiling, as the nasal septum pushes the nasal tip anteriorly (tension nose). Strong cartilages and a thin skin respond better to rhinoplasty surgery. Information can be obtained about the Soft Tissue Envelope (STE) and cartilages by palpation of the nasal skin and examination of the internal mucosa using a light source. Frontal, basilar, helicopter, profile (lateral) and oblique view photographs are essential. Frontal and lateral photographs during smiling give information about the dynamics of the nasal tip.

PLANNING

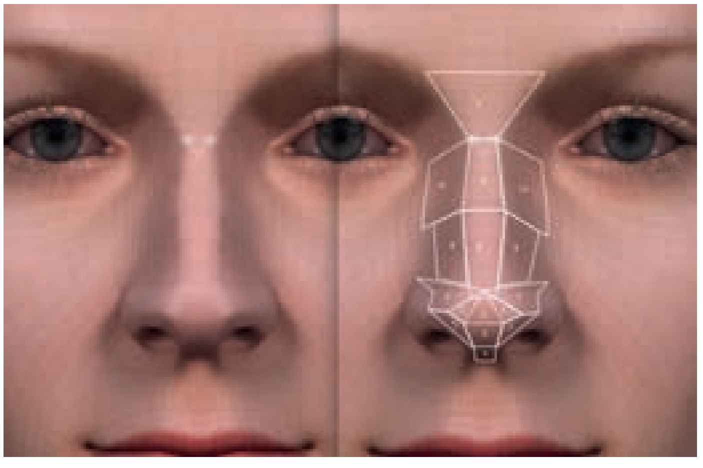
It is crucial to do pre-operative computer planning on lateral view photographs. The patient's expectations can be understood when computer planning is done together with the patient. In addition, planning of the projection and rotation can be accomplished. As I have become a specialist in plastic surgery, my biggest question was about the anatomy of a functional and attractive nose, the widths and lengths of the cartilages, and their relationships. That is why I took drawing lessons intermittently for six years, working with artists and sculptors. I analyzed attractive noses with this information and tried to combine the aesthetic surface analysis with the underlying anatomy of the cartilage and bones. I believe that one needs to have a mentor in rhinoplasty surgery.

Dorsal aesthetic lines are defined as two light lines formed by the nasal dorsum. Until recently, these lines have been drawn as a simple arch (hourglass) as seen on the left picture. However, if one goes into details, it becomes obvious that the dorsal aesthetic lines are in reality *parabolas*. As a matter of fact, the light density is low in areas #4 and #2, and sharper lights form in areas #1 and #3.



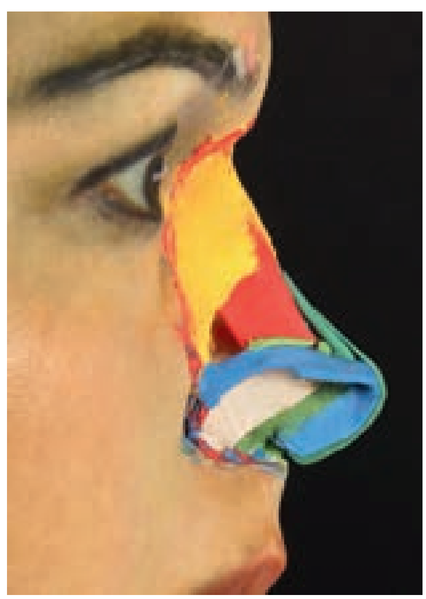
SURFACE POLYGONS

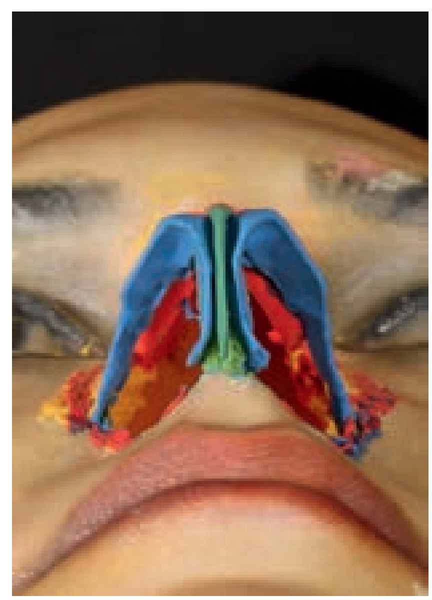
During drawing lessons, what I enjoyed most was to observe organic models with the help of cubic forms. One is examining the shapes of sections formed by shadows and light reflected from the nasal surface. The following surface polygons can be identified: 1) dome triangle, 2) interdomal polygon, 3) infralobular polygon, 4) columellar polygon, 5) facet polygon, 6) lateral crural polygon, 7) dorsal cartilage polygon, 8) upper lateral cartilage polygon, 9) dorsal bone polygon, 10) lateral bone polygon, 11) glabellar polygon.



Tip definition points: Tip infra (Ti), Tip supra (Ts), Rim medial (Rm), Rim lateral (Rl), Columella break point (C)

A model of ideal nasal anatomy is seen below that we constructed. Pay attention to the nasal tip cartilages and the spaces in-between them.

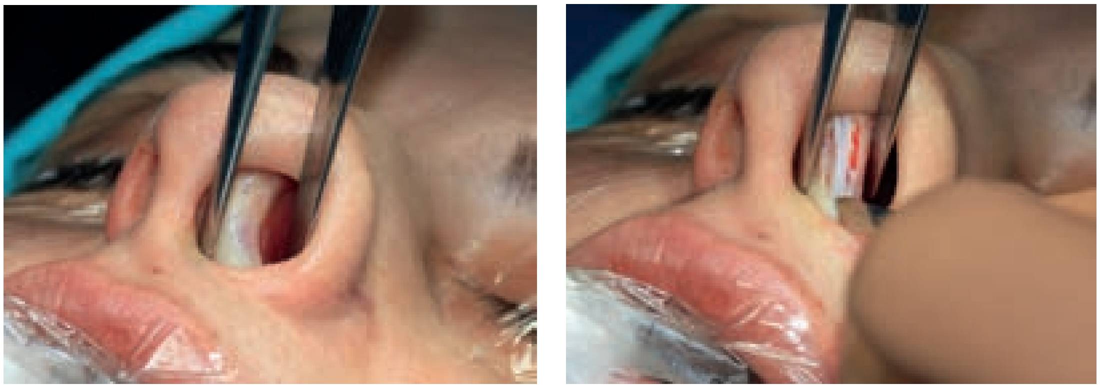




SEQUENCE OF TIP SURGERY

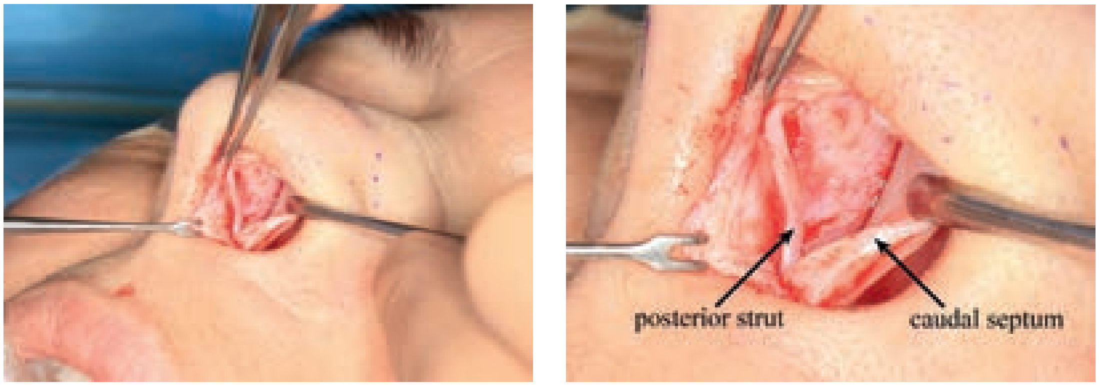
Step #1 – Hemi-transfixion Incision

The septum and the dorsum are reached through a hemi-transfixion incision. The subperichondrial dissection insures preservation of both the Pitanguy and the scroll ligaments. Arranging the correct lateral and medial crural lengths is important. In this chapter, we examine cartilage resections, flaps and tip sutures. The sequence of exposure is discussed in-depth in the Subperichondrial-Subperiosteal Rhinoplasty Chapter.



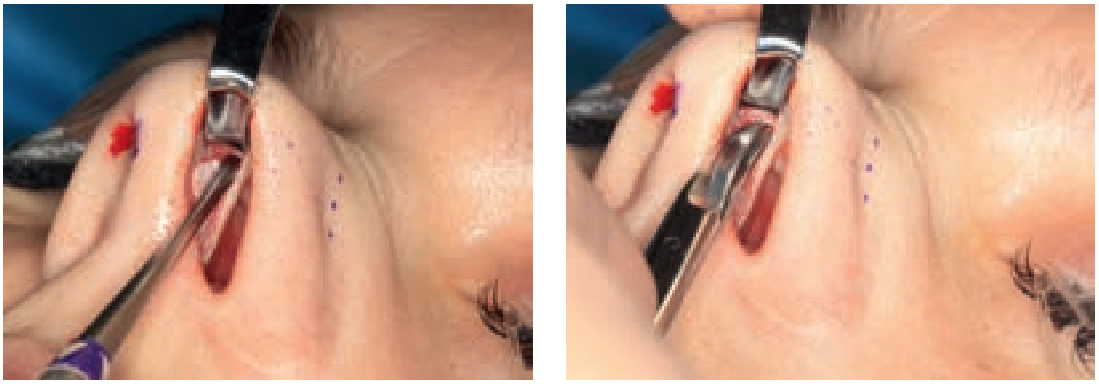
Step #2 – Posterior Strut

The most caudal one mm of the septum is left attached to the deep Pitanguy ligament, which is also preserves the membranous septum. The integrity of the Pitanguy ligament coursing through the membranous septum is kept intact as is the elasticity of the nasal mucosa. The caudal septum is exposed, and the other side of the septum is dissected. The septum is exposed only to the extent that caudal septal resection can be carried out. However, if the patient needs septoplasty, it can be performed at this stage.



Step #3 – Subperichondrial-Subperiosteal Plane Dissection of the Dorsum

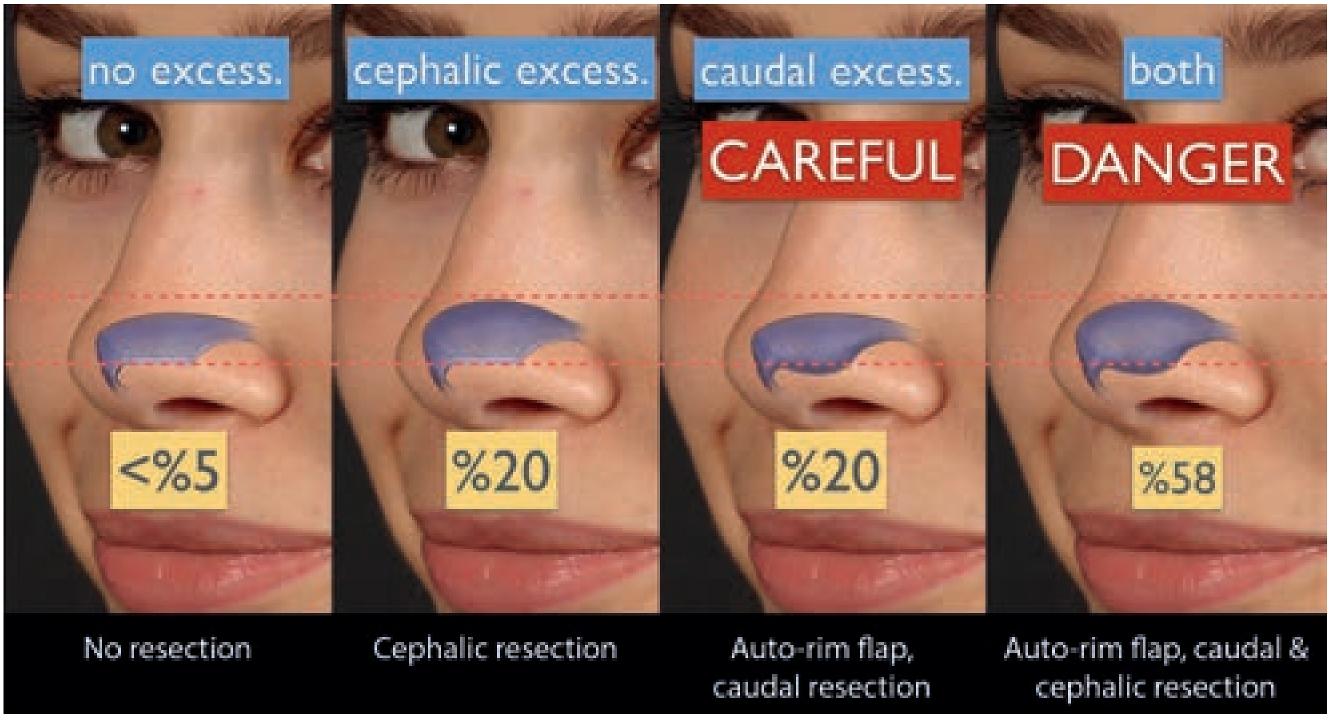
Dorsal septum and ULCs are dissected subperichondrially, while the bony pyramid is dissected subperiosteally.



Step #4 – Auto-Rim Flap (Transcartilaginous Marginal Incision)

The auto-rim flap is an inseparable part of my tip operation. When treating lateral crural width with only cephalic resection, a 7 - 8 mm cartilage resections may be necessary. But with the auto- rim flap technique, wide lateral crura are treated caudally as well. In this way, cephalic over-resections and its related complications can be avoided.

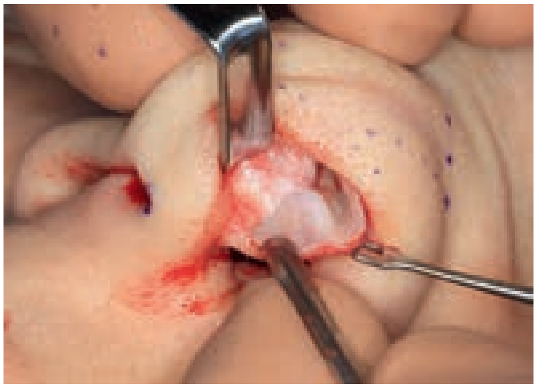
Auto-rim flaps are performed if the lateral crural polygon overlaps the facet polygon and narrows the facet. Approximately 80% of my patients have an indication for auto-rim flaps. We have made a classification according to Dr. Ali Murat Akkuş's suggestion. There is no cephalic or caudal excess in the first picture on the left side below. There is cephalic excess in the second picture, whereas there is caudal excess in the third picture, and both cephalic and caudal excesses in the fourth. picture. Care needs to be taken in patients with caudal excess. We analyzed 50 of our patients according to this classification. The first group is less than 5%. The second and third groups are in the vicinity of 20%. The fourth group amounts to around 60%. There is an indication for rim flap in the third and fourth groups, as there is caudal excess. In my opinion, patients with both cephalic and caudal excess are the most precarious. If this group of patients are treated with cephalic resection only, the risk of pinch nose, alar retraction or disfigurement in the nostril shape is very high.



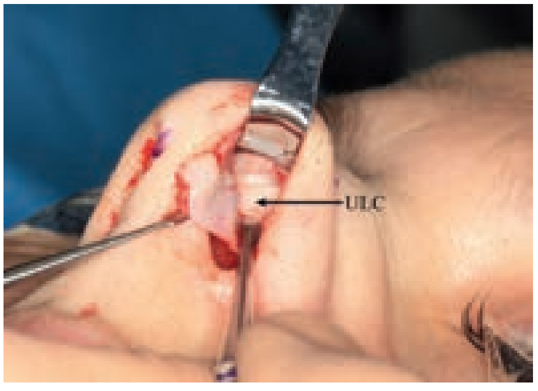
A straight incision is made so as to leave the caudal excess of the lateral crus on the nostril rim side. The incision needs to be straight and symmetric. An auto-rim flap of 2 mm width is usually sufficient.

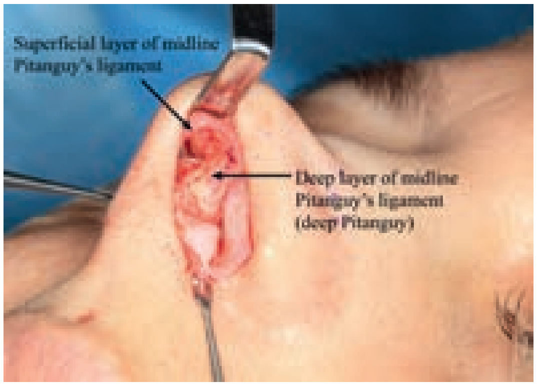
Step #5 – Dissection of Tip Cartilages

The lateral crus, middle crus with its dome and medial crus are dissected subperichondrially.

The tip and dorsal compartments are combined, leaving the scroll ligament in the SMAS on the undersurface of the elevated skin envelope (see figure below left). The LLCs can be brought together by opening a window between the superficial and deep layer of the SMAS (see figure below right). There is no need for an intercartilaginous incision to deliver the cartilages. Pay attention to the continuity of Pitanguy ligament between the medial crus and supratip SMAS. I initially performed open rhinoplasty surgery for three years. I use to encounter supratip deformity very often. In the following eight years, I performed closed surgery with preservation of Pitanguy's ligament and have greater supratip control.

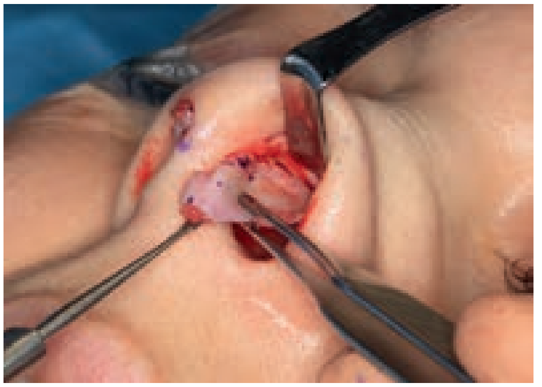




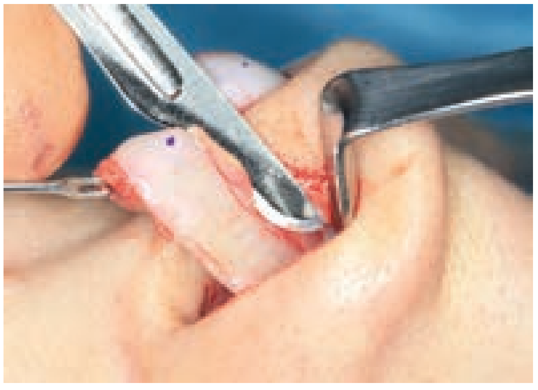
Step #6 – Markings & Resections

The existing domes are marked by stretching the cartilages in the midline with forceps (see figure below left). A marking is made at the new dome, mimicking a lateral steal with forceps (see figure below right).


A Cephalic Dome Suture will be used to make the new dome. The Resting Angle of the lateral crus is corrected. The part preventing rotation is marked and excised.



There is no need for excessive cephalic resection by virtue of the auto-rim flap. Cephalic resection of more than 2 to 3 mm is rarely necessary in this technique (see figure below left). Sometimes it is essential to make a caudal resection from the dome (see figure below right). Please be careful as more than a 1 to 2 mm resection can be hazardous.

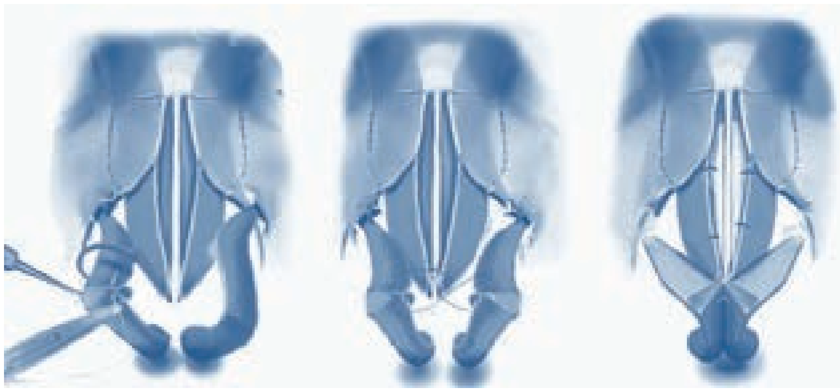


The marking of the contralateral dome is made by using the symmetry test.

Step #7 – Cephalic Dome Suture & Lateral Crural Steal

In my initial suture experience, I would often place a transdomal suture in a lateral steal location and assess its effectiveness. After repeated attempts, the domes would become friable. Then, I started putting a test suture between the cephalic edges of the medial and lateral crura. After a while, I realized that this test suture was shaping the domes better than the transdomal suture. Thus, was born the cephalic dome suture in 2008 and published in 2016. In 2010, Dr. Dosanjh and Dr. Gruber published this suture first under the name “hemitransdomal suture”.

The suture is passed 3 mm away from the point of the new dome, biting 2 mm from the cephalic edge of the medial and lateral crura and the knot is tied primarily. In this way, a domal triangle is obtained. This suture may lead to the formation of a dog ear at the Ti point and can also elevate it. On occasion, I make a dog ear excision. A dog ear does not form when the cephalic resection is made so as to leave a lateral crural width of 5 mm at the area where the dome will be created.



Step #8 – Interdomal Suture

Both domes are delivered through the nostril on the same side as the operating surgeon. The surgical nurse holds the farther dome in the midline with a hook. At this point I ask the nurse to sit down. The nurse sits still resting their hand on the patient's forehead. The domes are united by suturing the soft tissues between the domes together. This suture helps to equalize the domes. This can be considered a repair of the interdomal ligament, which is anatomically located some millimeters anterior to this point between the middle crura.

Step #9 – Domal Equalization Suture

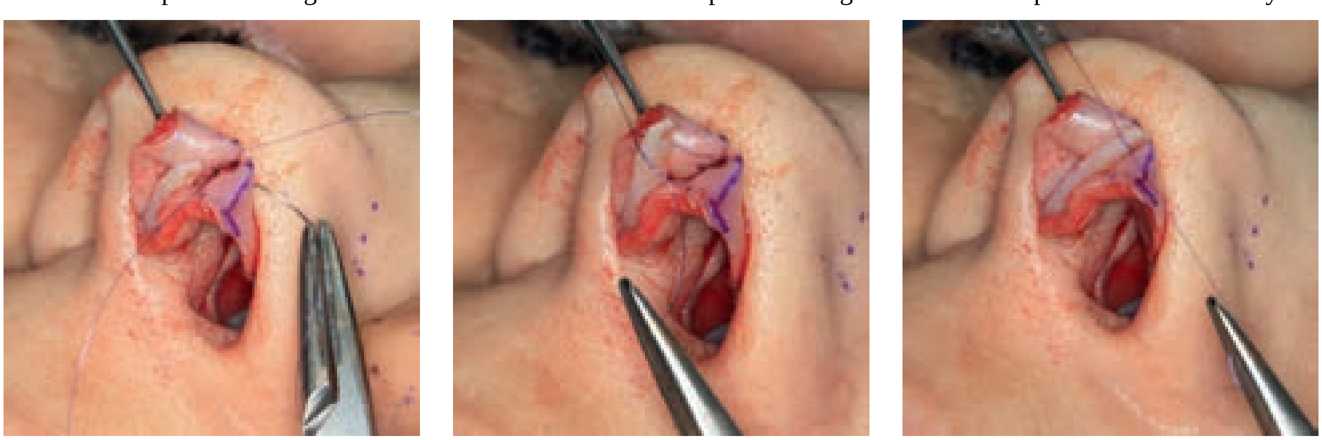
It may be appropriate to equalize the cartilages after repairing the interdomal soft tissues. The domes are equalized with a figure of 8 suture. It prevents the overlapping of the cartilages. Besides, it acts as a second cephalic dome suture.

Step #10 – Placement of the Strut Graft

The strut graft is placed in the middle of the columellar. There is no need to use an excessively strong strut graft. Where deprojection needs to be done, a thin and short strut grafts is placed in a more extended fashion. A tunnel is created with sharp scissors, avoiding the columellar nerves and vessels. The strut graft is placed in between the blades of the scissors (see figures below). Then, the medial and middle crura are fixed to it with sutures.

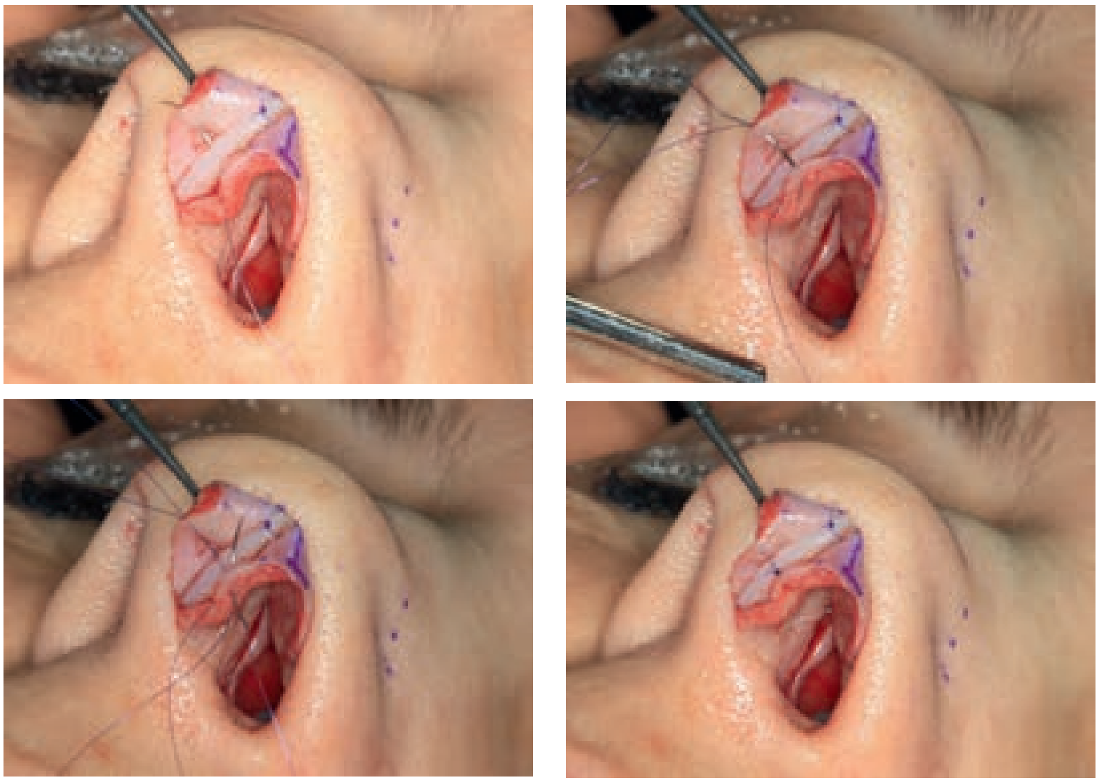
Step #11 – Tie Suture

The tip of the strut graft is encircled with a U-suture that passes through the domes and pulls the strut cranially.



Step #12 – C’ Suture

This suture is 6 to 7 mm posterior to the domes, starts deep and ends superficially. At the deep pass of the suture, it goes through the strut. The superficial part of the suture travels above it. A columellar breakpoint (c’) is created with this suture.

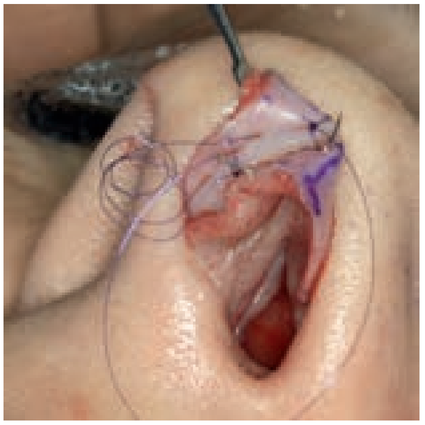
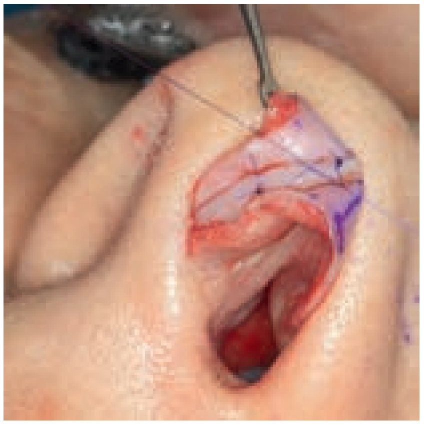


Step #13 – Fixation of the Columellar Polygon

Unlike the c’ suture, this suture passes through the strut cartilage in both directions, always underneath the mucosa.

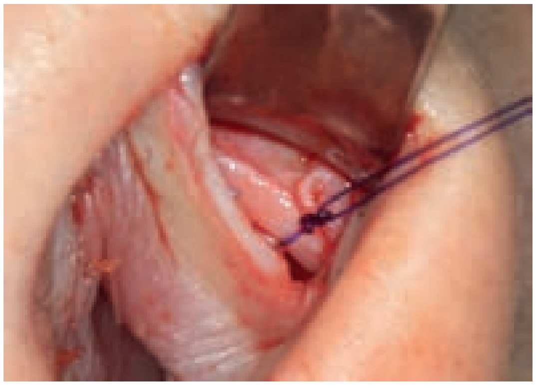
Step #14 – Fixation of the Infralobular Polygon

This suture is a good choice both to stabilize the lobule and to keep the strut cartilage in a deep location. It is important that there should be a space between the cartilages to form the interdomal and infralobular polygons where facets are formed when the skin lies over these spaces. Unnatural results occur when these spaces are obliterated. This suture can be described as a figure of 8 horizontal mattress suture. It also looks like a bow-tie.

Step #15 - Repair of the Scroll Ligament

Place the LLC in such a way that the superficial SMAS fills the space between the medial and middle crura. The scroll ligaments are repaired. The resting angle of the lateral crura is secured by stabilizing the cephalic edge of the lateral crura. In addition, the transversalis muscle is fixed to the internal valve. I believe this is very important *functionally*.

STEP #16 - Closure of the Mucosa

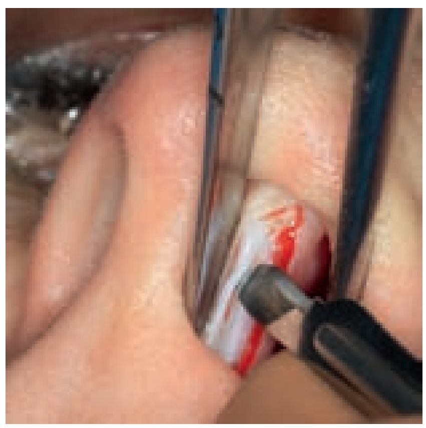
The mucosa is closed with 6/0 Monocryl, starting laterally with 4 to 5 sutures.


CASE #1

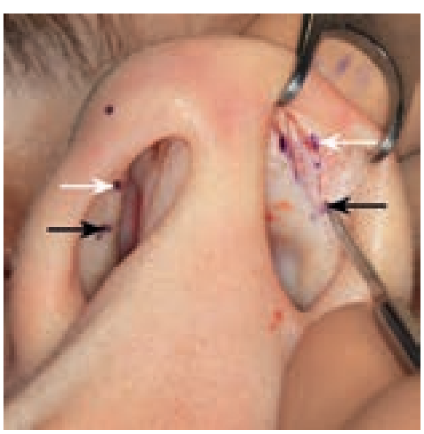
The patient presented for rhinoplasty with a droopy tip. There is minimal caudal and cephalic excess in the lateral crura. A 2-3 mm cephalic resection is planned. The infratip lobule seems to be short. The projection of the tip is normal, nostril apex projection is 2-3 mm high, and lobule projection is 2-3 mm low. As seen in the middle row, minimal nostril apex deprojection and increasing the lobule projection with lateral crural steal is planned.

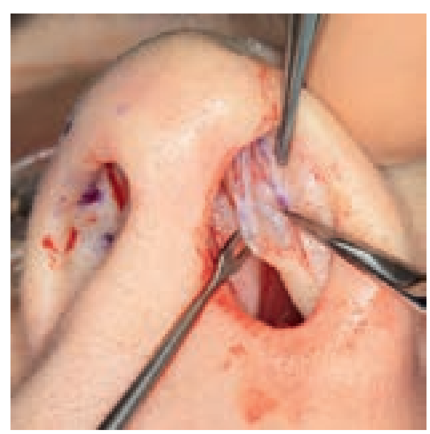
Adrenaline solution is injected into the nose. A line showing the new tip location is drawn on the cheek.


The caudal septum is reached through a unilateral low septal incision and a caudal septal strip of 0.5 mm width is left attached to the Pitanguy's ligament. The septum is dissected bilaterally in a subperichondrial plane. The dorsal perichondrium is reached at the W point and the ULC are dissected subperichondrially.

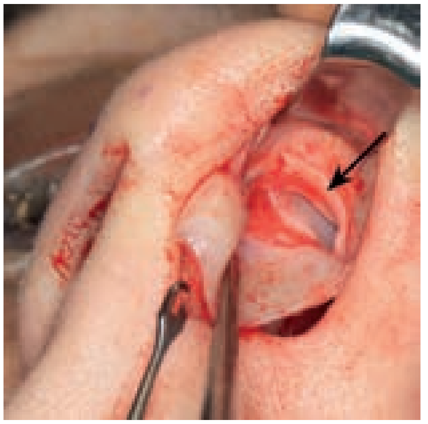

Auto-rim flaps, 2 mm wide and 6 mm long are marked. Please note that the rim flaps begin at least 4 mm caudal to the dome. The incision starts from the caudal edge of the domes. The subperichondrial plane is reached with the aid of the reverse side of the scalpel and Çerkeş scissors.





The perichondrium covering the domes is dissected with scissors and thereafter the medial crura are dissected. A window is opened in the vertical scroll ligament by pushing on the lateral crus. Please pay attention that the sesamoid cartilages in the scroll region are left attached to the SMAS and elevated with the skin envelope (arrow, below).





The contralateral side is also dissected. A wide dissection up to the radix and downward to the lateral osteotomy lines is done in this patient. After the dissection, the pocket is flushed with adrenaline containing isotonic solution. Please note that the meticulous dissection despite being wide, has not created any visible changes on the skin.



The domes are delivered with hooks and a dissection towards the midline is performed starting from where the perichondrium ends medially at the dome.

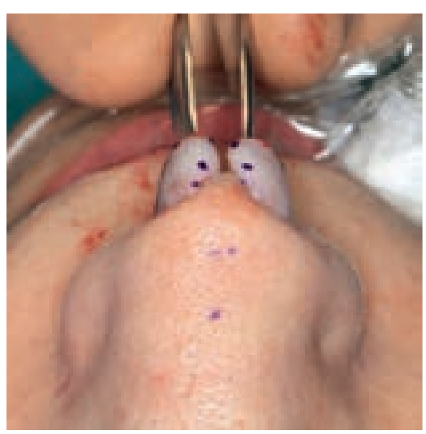


A window is opened between the superficial and deep Pitanguy ligament. Dissection is continued until one reaches the location of the desired supratip break point.

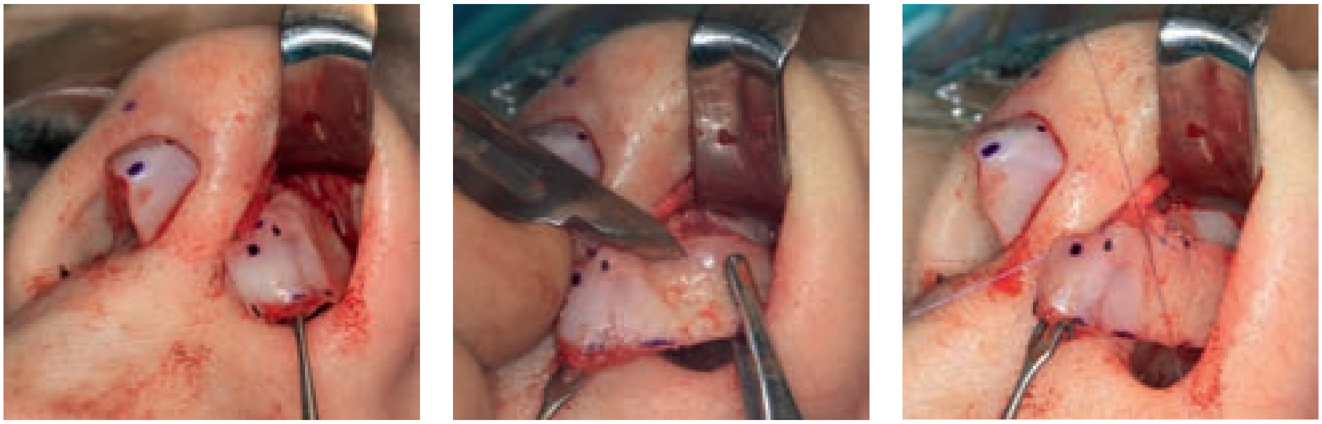


The dorsum is lowered using a low septal strip cartilage excision. The first step in an eventual DP procedures.

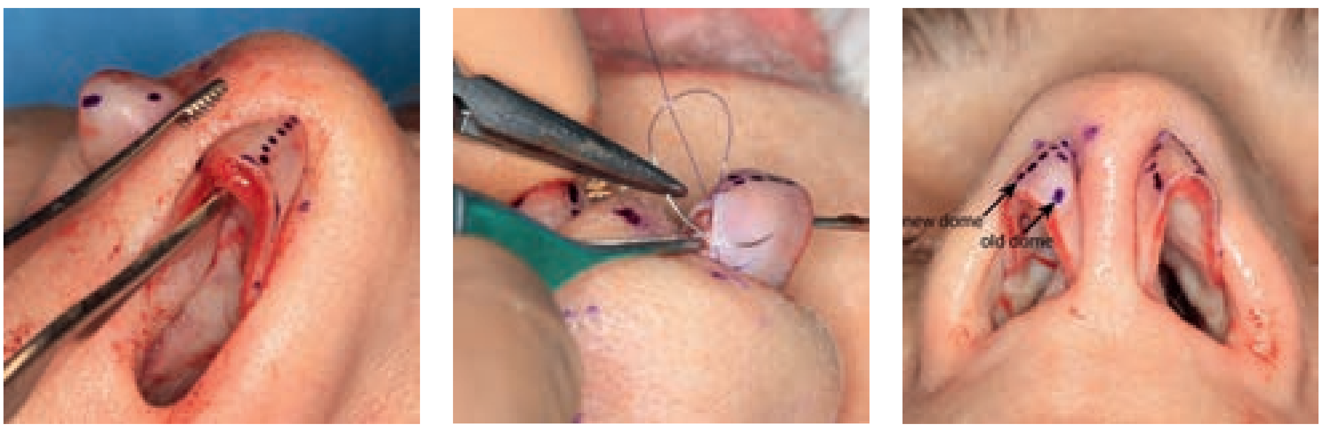

A subperichondrial dissection is carried out, leaving a 2 mm auto-rim flap on the skin. The domes are delivered. The skin is actually pushed upward. The existing domes are marked, pulling them to the midline. A minimal caudal resection is made.

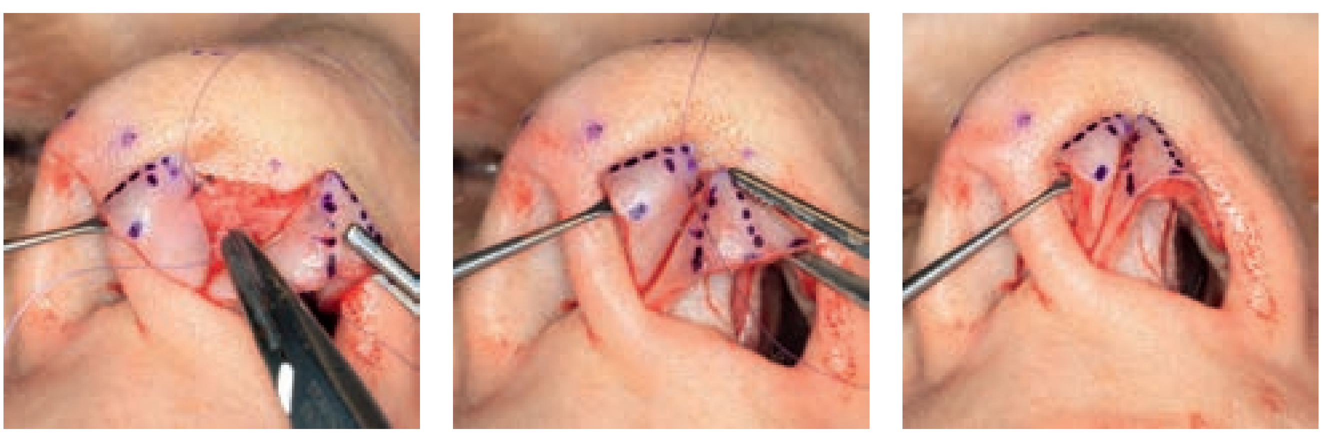

The cephalic excess of the lateral crus is cut and slid under the lateral crus, and then fixed (Özmen).



A lateral crural steal is planned and the new domes are marked. On the left, the correct resting angle can be simulated. The new domes are established with cephalic dome sutures. The new domes is seen on the right.

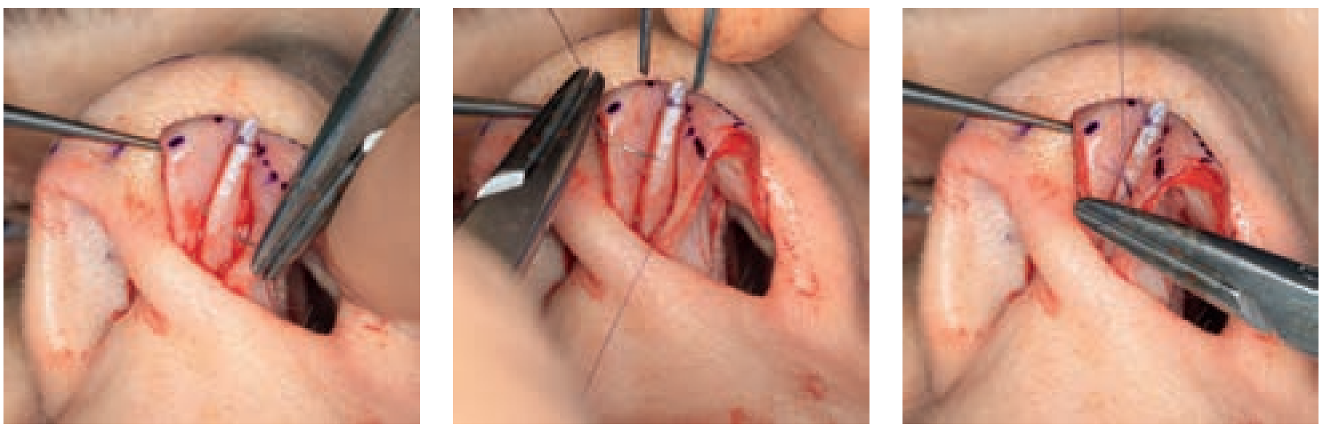


The domes and soft tissues are equalized with a figure-of-eight suture.



A strut graft is placed and fixed with a tie suture.

The columella break point is created with a c’ suture.



Checking the tip aesthetics.

Transdomal sutures are placed to increase definition. A minimal caudal resection is done in the dome to slightly decrease tip width.

Tip surgery is almost finished. The bony vault is closed with lateral and transverse osteotomies. The caudal part of the ULCs is trimmed because it is preventing rotation.

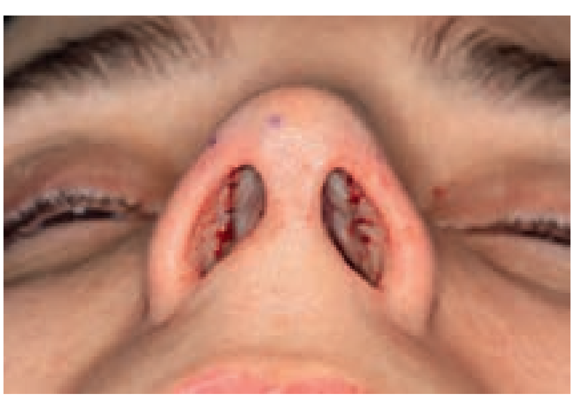
Caudal resection of the septum is performed. The septal perichondrium is sutured back to the septum. Please pay attention that the perichondrium, especially on the right is in continuity with the Pitanguy's ligament. Therefore, these sutures control tip projection and rotation.

The scroll ligament is repaired both medially and laterally. The mucosa is closed with 6/0 round monocryl.


On table final result.








CASE #2

Tip surgery was carried out with closed approach and dorsal reduction with let-down technique. Preoperative and one-year postoperative below.

CASE #3

Patient with moderate skin thickness. Tip surgery with closed approach, classic dorsal resection reduction, and midvault reconstruction with libra graft technique. Pre-op and two-and-a-half-year post-op below.

CASE # 4

Patient with thick skin and a big nose. Tip surgery with closed approach and dorsal reduction with let-down technique. Pre-op and two-year post-op below.

CASE #5

Thin and sebaceous skin, bulbous tip, over-projection. Tip surgery with closed approach, classic dorsal resection reduction and reconstruction with libra graft technique. Pre-op and four-year post-op below.

CONCLUSIONS

For the past decade, I have continued to refine my tip surgery. It represents the integration of aesthetic planning using the polygon concept, a subperichondrial dissection through an endonasal approach which allows me to preserve the tip ligaments, and a progressive sequenced tip suture technique which achieves the desired aesthetic changes. Rather than merely planning the tip changes in general terms and performing a standard operation repeatedly, each tip operation is planned in very specific detail and executed with meticulous attention to detail cognizant of the final surface aesthetic polygons. For those seeking greater detail they will find it in the Second Edition of Aesthetic Septorhinoplasty (2020).

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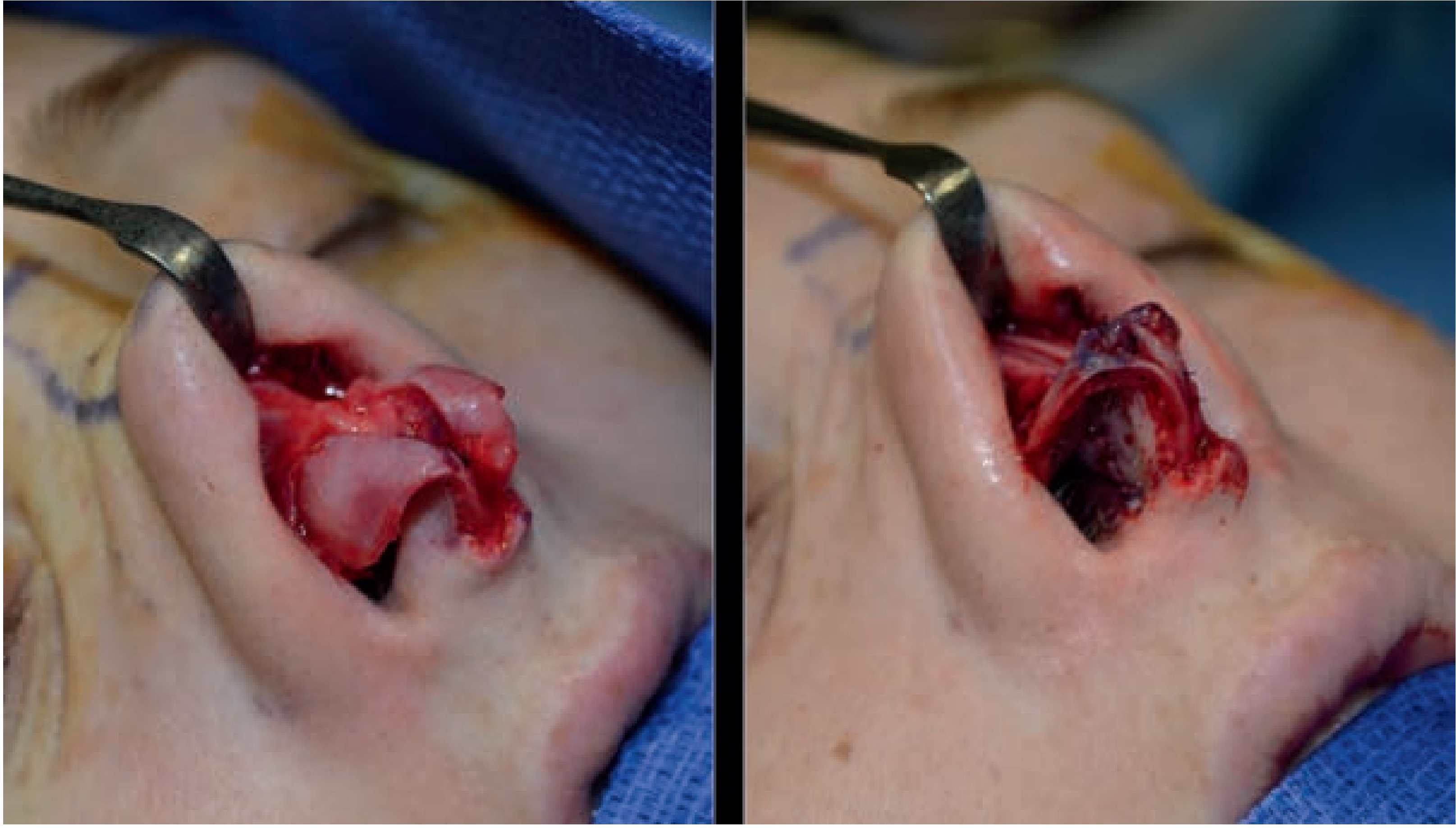


Nasal Tip Surgery with Maximal Alar Preservation

Aaron M Kosins

Preservation Rhinoplasty (PR) is composed of the following 3 parts: 1) elevating the soft tissue envelope (STE) in a subperichondrial-subperiosteal plane, 2) preserving the dorsum, and 3) maintaining the alar cartilages with minimal excision while achieving the desired shape using sutures and tensioning. Note: PR refers to these 3 components, one of which is dorsal preservation (DP). The two terms should not be used interchangeably. This chapter will focus on maximal alar and ligament preservation when performing nasal tip surgery.

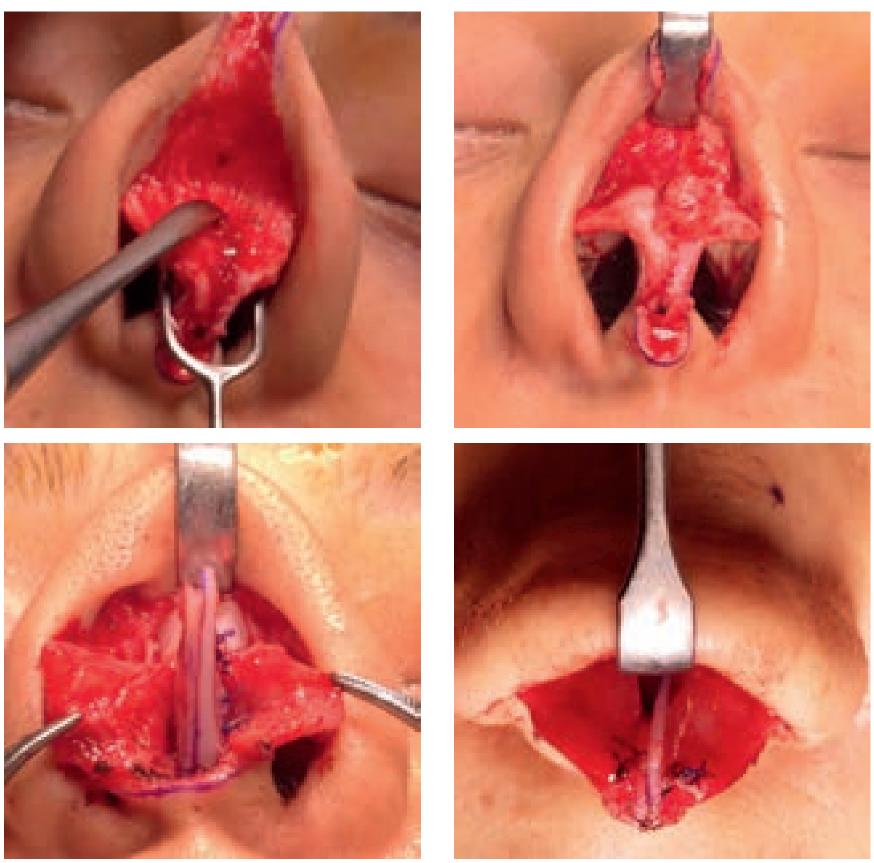
The principles of Preservation Rhinoplasty have had a profound effect on how we currently approach tip surgery. The era of reflex excisions, transections, and numerous grafts in tip surgery has now passed. Similar to DP, I now ask myself the following question at each consultation – “Can I shape the alar cartilages with sutures and preserve them?” The 3 critical steps in my approach to tip surgery are the following: 1) achieving ideal domal shape, 2) remodeling the lateral crus, and 3) achieving tip support utilizing tensioning techniques.

ALAR CARTILAGES

Traditionally, surgeons achieved the desired tip shape using a combination of excision, incision, sutures, and grafts. Although results were usually good initially, a significant percentage of these cases degraded over time. Improved long term tip projection and shape was achieved following adoption of tip suturing and structural support employing various columellar struts, septal extension grafts, and tongue-in-groove procedures. The concept of *preservation techniques* advances tip surgery even further by preserving virtually the entire alar cartilage, which enhances function and reduces potential problems. In addition, revisions become much simpler. The combination of a subperichondrial exposure, maintenance of a completely intact alar cartilage, and restoration of the intact scroll ligament complex represents a dramatic new advance in tip surgery.

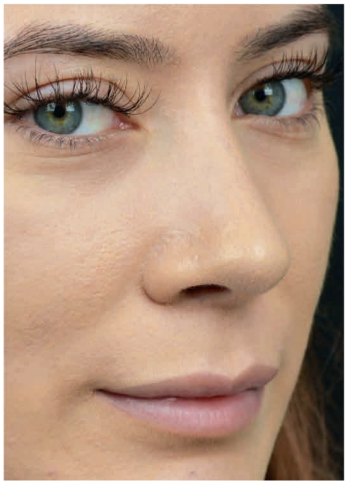
CLASSIFICATION

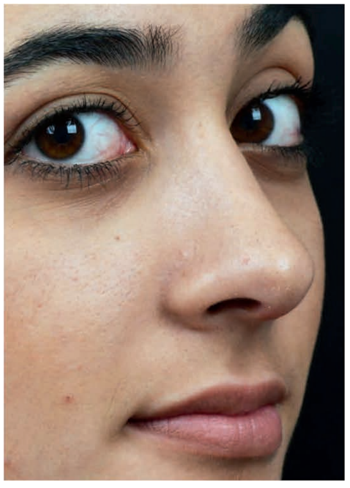
Due to the wide variety of anatomy and aesthetic goals, surgeons will employ a large number of preservation surgical techniques. Ideally, a complete Preservation Rhinoplasty (PR-C) would be done consisting of elevating the STE as a single subperichondrial-subperiosteal sheet, preserving the dorsum (DP), and retaining all of the alar cartilages and ligaments (Kosins, 2020). However, surgical reality reveals that certain patients should not undergo all 3 preservation modalities but rather have a *partial* Preservation Rhinoplasty (PR-P) (see the Overview chapter). For example, many Latin patients have thick skin and an under projected tip. For these patients, an en-bloc SMAS excision is done after dissecting the tip in a subdermal plane (see below). On the other hand, the cartilaginous dorsum is preserved and lowered while the alar cartilages are preserved and supported on a septal extension graft. Thus, this patient is classified as a partial Preservation Rhinoplasty procedure - PR-P(DA). This indicates that the dorsum and alar cartilages were preserved whereas the STE was not. Similar modifications will lead to different combinations of preservation. Ultimately PR is both a rhinoplasty philosophy as well as a set of specific surgical techniques.

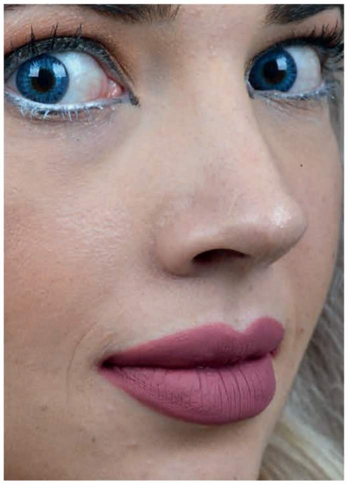


PRINCIPLES

The importance of preserving nasal ligaments as well as the alar cartilages (in particular the lateral crus) is a relatively recent occurrence. *The 3 critical steps are the following: 1) to shape the domal cartilage with sutures, 2) to control the lateral crus with tensioning techniques, and 3) to achieve tip support.* The goal of this chapter is to demonstrate simple, predictable and effective techniques and philosophies that create a beautiful nasal tip while minimizing deformities and long-term deterioration. As with all rhinoplasty surgery consultations, I evaluate the soft tissue envelope, nasal tip and dorsum to decide what can be preserved. I start with the question "Can I make a beautiful nose without removing anything?" I then work my way through the aesthetic and functional evaluation. It is very important for the surgeon to have an idea of what the final tip shape should be. Without this shape in mind, it is very difficult to plan a surgical sequence. Regardless of ethnicity, skin thickness or tip deformity, I am very aware of the final tip shape I desire. As a surgeon I then need to decide what is the simplest way to change the preoperative nasal tip deformity into a beautiful post-operative appearance as seen below in 3 postoperative patients.







A few very important principles need to be stressed: 1) the more you take apart, the more you must reconstruct – don't disrupt more than you have to; 2) the more you remove, the more scar contracture – use non-excisional techniques if possible; 3) instability leads to warping – tensioning is better than floating; 4) unlike most of Plastic Surgery, less is not more – doing less will often lead to a worse result; 5) learn a predictable set of techniques that work for you and then expand; and 6) keep meticulous records so you can evaluate your own results- there will be surprises.

BACKGROUND

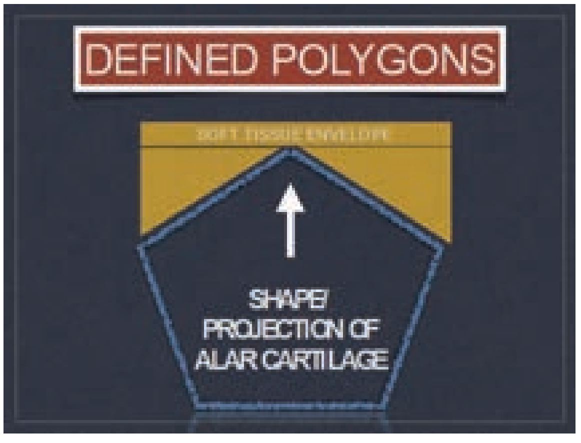
To understand why alar cartilage and ligament preservation is so important, we need to evaluate the thought processes of our innovative predecessors. The aesthetics of the nasal tip and tip surgery came to the forefront with Sheen, where grafts were inserted in a closed approach to create a nice tip contour (Sheen, 1988). With the open approach came a better understanding of nasal anatomy. Open tip suture techniques were widely popularized, and in a 25-year review, Daniel described the aesthetics of nasal tip surgery to be domal convexity next to a straight lateral crura with the goals of achieving definition and symmetry (Daniel, 2011). Daniel's tip suturing sequence became a gold standard as it is reliable and works well in the great majority of patients. Like all surgical techniques, tip suturing also had its disadvantages. The first significant issue is that tip suturing was typically performed at the patient's native dome. Unfortunately, the diagnosis of most nasal tip deformities includes suboptimal domal position (the dome is in the wrong place) and suboptimal crural length (medial, middle, and/or lateral crura).

The combination of an open approach, division of nasal ligaments, and suturing at existing domes can create lobular issues, asymmetries and loss of projection. In addition, improper suturing can create pinched tips, closing of soft triangles, and alar rim weakness/asymmetries. Because of these problems, several grafting solutions became necessary:

- Closing of facet polygon → subdomal grafts, facet grafts, alar contour grafts
- Convexity of lateral crura remains → lateral crural strut grafts, lateral crural transection
- Long lateral crura → Lateral crural transection/transposition
- Ongoing asymmetries → Tip refinement grafts, alar contour grafts
- Loss of projection → Strut graft, extension grafts, integrated tip grafts

Although the open approach and tip suture techniques improved results, the combination of improper suturing technique and loss of support created a domino effect necessitating grafts, with each graft having its own set of disadvantages and complications. Over time, the new goals of tip surgery now include tensioning of the lateral crura (Davis, 2015), eversion of the caudal border of the lateral crura (Toriumi, 2009), and long-term control of projection and rotation.

Once a surgeon becomes aware of the beautiful tip shape they are trying to create, they must understand structurally what is creating the shape. A beautiful tip shape is seen when a specific *shape* of alar cartilage *projects* with enough force against the *soft tissue envelope* to create *defined polygons*.



SURGICAL SEQUENCE OF TIP SURGERY

Step #1 – Exposure: Plane of Dissection

Choosing the plane of dissection is the first step in approaching the nasal tip. The preferred dissection plane is *sub*-perichondrial for the following reasons: 1) bloodless; 2) maintains nerves/vessels/lymphatics; 3) maintains an anatomic nose; 4) faster healing; 5) easier revisions because the sub-SMAS plane can be utilized in revision surgery; and 6) decreases dead space for more predictable healing. However, this plane of dissection makes the cartilage significantly more malleable. Therefore, I use this plane of dissection when the cartilage is medium to firm, when the tip has good projection, and when ligaments and a strut will give me good tip definition. On the other hand, if the cartilage is weak or flimsy, or if the tip projection/support is weak, I use the *supra*-perichondrial plane (sub-SMAS). This plane maintains the strength of the cartilage. In some patients, the *subdermal portion* of the soft tissue envelope is very thick. In these patients a *subdermal* plane of dissection is used and an en-bloc SMASectomy is performed. This is common in Asian, Indian, African, and some Latin patients. Note: A 6-0 PDS suture on a round needle is used on the more malleable alars following a sub-perichondrial dissection; a 5-0 PDS suture on a tapered needle following a supra-perichondrial dissection.

Step #2 – Ligaments

In 99% of cases, the ligaments are preserved when opening the nose. If a closed surgery is performed, Pitanguy's ligament is always preserved. If an open surgery is performed, Pitanguy's ligament as well as the scroll ligaments are marked and divided as the nose is opened. At the end of the surgery, all ligaments are repaired. In some cases (particularly if a septal extension graft is used), Pitanguy's ligament must be excised at the end of surgery because reconstruction causes a supratip deformity. Ligament reconstruction maintains an anatomic nose, closes dead space, and supports the internal framework.

Step #3 – Tip Time-Out

When performing rhinoplasty with a preservation philosophy, it is important to do a tip time-out for evaluating the shape of the cartilages once they are visualized. Three questions need to be answered: 1) Do I need to change the tip shape, 2) Do I need to decrease the tip volume, and 3) Can I change the tip shape AND decrease the volume AND increase the force of the alar cartilages pushing against the soft tissue envelope without excisional procedures? The following is an algorithm for controlling tip shape with tensioning:

1. Put in dome sutures +/- lateral crural steal

   ⇩ Alar preservation?

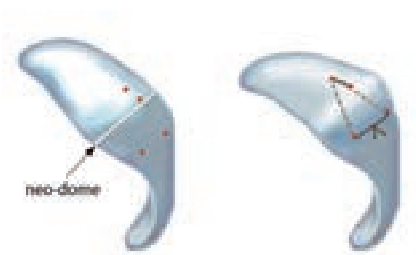
2. If necessary, cephalic trim leaving 7-8mm and slide under maintaining longitudinal scroll ligament

   ⇩ Ligament preservation

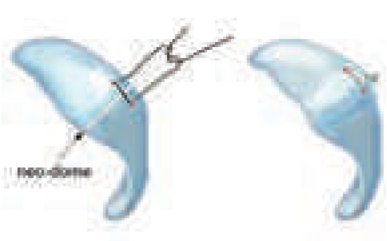
3. Reattach scroll ligament complex

Step #4 – Dome Shape

The first surgical step is to adjust domal shape by utilizing domal creation sutures with or without a lateral crural steal. Accentuation of domal definition is achieved with sutures. It is important to understand that with subperichondrial dissection the alar cartilages are significantly more malleable and easier to shape with sutures. If the cartilage is weak or thin, a sub-SMAS dissection can be used. One of 2 sutures is used for domal creation with lateral placement (depending on the amount of the lateral crural steal). A cranial tip suture, as described by Kovacevic, is a triangular stitch across the neo-dome. This stitch gives definition to the dome, straightens and strengthens the lateral crus, and everts the caudal border. Below you can see the effect of a cranial tip suture and lateral steal on the right dome only.



A cephalic dome suture, as described by Cakir, is a more aggressive suture. It is used as a simple suture tied on the cranial edge of the neo-dome. Intrinsically, the cephalic dome suture does the same thing as a cranial tip suture; however, it gives a sharper dome, more concavity to the lateral crus, and major eversion of the caudal border of the lateral crus. This suture is used in patients with thick skin, strong cartilage, and/or patients who request maximum tip definition. More than 1 suture can be used on each dome and/or both sutures can be used depending on the shape of the cartilage.



Using these sutures in combination with lateral placement (lateral crural steal) is what gives tension to the lateral tip complex. When necessary, a *lateral crural steal* is planned to create a new optimal dome point, to optimize projection/rotation, and to stiffen and straighten the lateral crura while everting the caudal border. This procedure is extremely valuable in wide tips with minimal definition and under-projection as it provides projection, rotation, and lengthening of the infratip lobule (intrinsic tip). In addition, a lateral crural steal helps to *tension* the lateral crura and the tip complex giving it strength and rigidity.

The surgical sequence begins by marking the neo-dome bilaterally and checking to make sure that the new lateral crural lengths from neo-dome to the lateral crural turning point are equal. After domal creation, the domes are again checked to make sure that the *dome to turning point distances* are equal on the right and left side with equal tensioning. A domal equalization suture as described by Daniel is placed to create tip symmetry (Daniel, 1999). After suturing, the cephalic edges of the neo-domes should gently touch creating the nasal tip polygons. Intradomal sutures and sutures to close the infralobular polygon have been almost entirely abandoned. Transections of lateral crura are never done unless a lateral crural strut graft is to be placed, which is very rare for primary rhinoplasty in my practice.

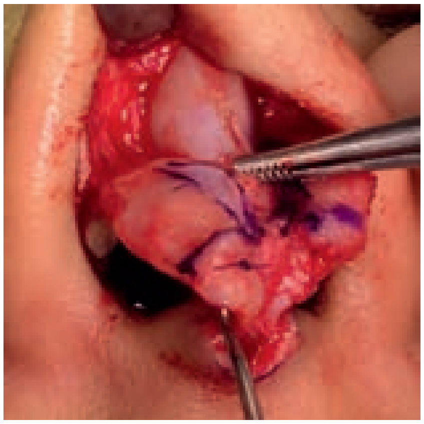
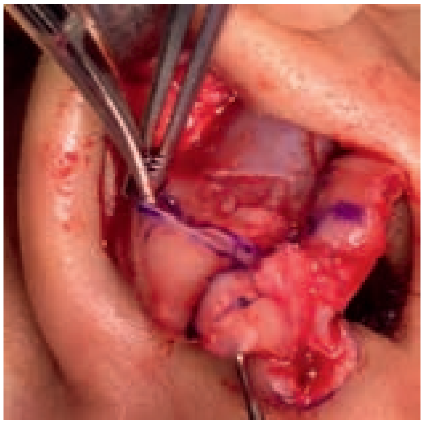
In step #4 we begin the first portion of tensioning with domal creation sutures and the lateral steal. Once the domes have been placed in the right position and the lateral crus tensioned *intrinsically*, the lateral crural volume can be dealt with.

Step #5 – Lateral Crus

Once domal shape has been adjusted with domal sutures and the lateral crura appropriately tensioned with lateral crural steal, the surgeon must decide if *lateral crural volume* must be adjusted. Every attempt is made to preserve the maximal amount of alar cartilage. Alar preservation is important because transection and excision (cephalic trim) weaken alar shape and projection.

Complete alar preservation is the goal! Many surgeons reflexively trim the lateral crus. However careful evaluation of long-term results helped me to understand that this does not create a more beautiful tip shape in the majority of patients. This is especially true if the patient has an under projected tip. It is much better to tension and project the existing cartilage against the soft tissue envelope than to excise lateral crus and expect the skin to accommodate to the smaller tip complex.

If lateral crural volume must be adjusted, the surgeon can choose a technique that decreases volume while also strengthening the lateral crus. In 2009, Ozmen et al (Ozmen, 2009) described a technique of incising the cephalic lateral crus longitudinally and then sliding the intact cephalic portion of the lateral crus underneath the remaining strip.

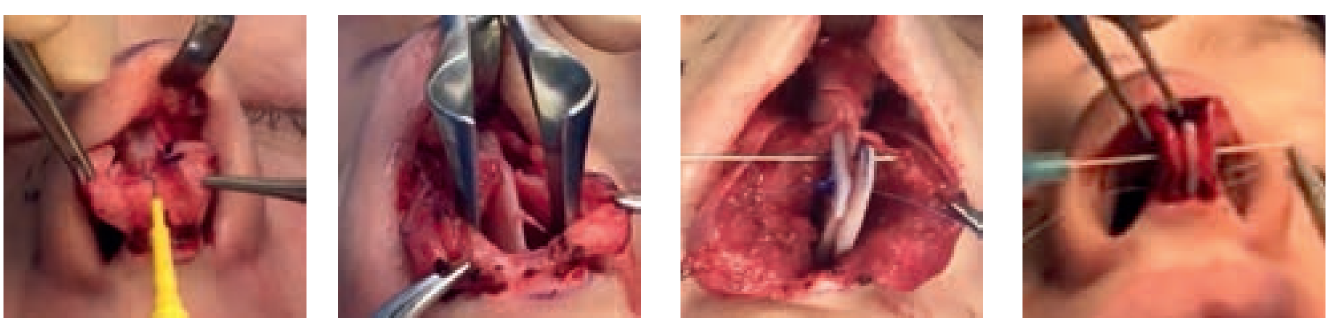




As shown above, this technique decreases the volume of the lateral crus and is valuable for 3 reasons: 1) the remaining caudal cartilage (7-8mm rim strip) is strengthened because the lateral crus becomes laminated posteriorly, 2) the longitudinal scroll ligament remains intact, and 3) the vertical scroll ligament can be reattached before closure. Unlike excision/transection techniques of the lateral crus, the “cephalic slide under” increases alar strength and support by maintaining the lateral crus and scroll ligament complex. As stated above, the goal is to flatten, shape and force the alar cartilage against the soft tissue envelope. If excisions/transection need to be made on the lower lateral cartilages because of excessive length, this is best done at the junction of medial-middle crura because this area is easily supported with grafts.

Step # 6 – Tip Support

Once domal shape and lateral crural shape/support have been established, the last step is to provide central support to the tip complex. In all cases, either a septal extension graft or columellar strut is used. Preoperative imaging and simulation of the postoperative result guides the decision, as well as the ethnic population of the surgeon's practice. A *septal extension graft (SEG)* is used for the following clinical cases: 1) an under projected tip (common in my practice), 2) a normally projected tip encased in a thick soft tissue envelope, 3) a normally projected tip, but the patient requests maximum tip definition, and 4) a tip with major crural asymmetry. If a septal extension graft is chosen, preservation of ligaments is crucial to close dead space in the supratip and scroll regions and to control the soft tissue envelope. *The ligaments DO NOT provide central tip support or projection.* In this case, the SEG serves as the central pillar and the domes are tensioned onto the graft. Therefore, 3 forms of tensioning are occurring – 1) from the domal sutures, 2) from the lateral crural steal, and 3) from attaching the domes to the SEG.

The septum is exposed through a tip splitting incision as the soft tissue is divided from the domes down to the footplate segment of the medial crura. This soft tissue is not repaired as support will come from the septal extension graft itself. When using a septal extension graft, it is critical to make certain that the graft is in the midline. Although an end-to-end method is preferred, the overlapping method with a contralateral laminating graft to brace the graft is most common. Care is also taken to make certain that the posterior portion of the graft does not "bulge" into the nasal airway nor cause footplate distortion. Once the tip is finished, the nasal ligaments are reattached to close the dead space and support the internal valve.



A *columellar strut* is preferred in the following cases: 1) normal projection, 2) over projection, and 3) the desire for an elastic, mobile tip (the patient rejects the notion of a stiffer tip post-operatively). *If a columellar strut is chosen, preservation of ligaments is crucial to maintain tip support.* In cases when a columellar strut is used, the septum is exposed through a right, unilateral transfixion incision while maintaining a posterior strut as described by Cakir. This incision is actually a trans-septal incision as it leaves 1-2mm of caudal septum attached to the membranous septum. By using this approach, Pitanguy's ligament remains intact and the "posterior strut" can be used to control tip projection and supratip.

If Pitanguy's ligament is excised or transected, 2 undesirable events occur in the majority of cases over time: 1) loss of tip support and 2) rounding of the infratip lobule. After the dorsal work has been completed, the nasal ligaments (Pitanguy's and bilateral scroll ligaments) are reattached and tip suturing is performed. The columellar strut is then inserted and attached to the tip complex in a floating fashion. The strut does not increase projection. It only helps to maintain tip support. Finally, the posterior strut is reattached to the caudal septum. The sutured Pitanguy's ligament provides additional tip support and compresses the infralobule.

MORBIDITY / COMPLICATIONS / REVISIONS

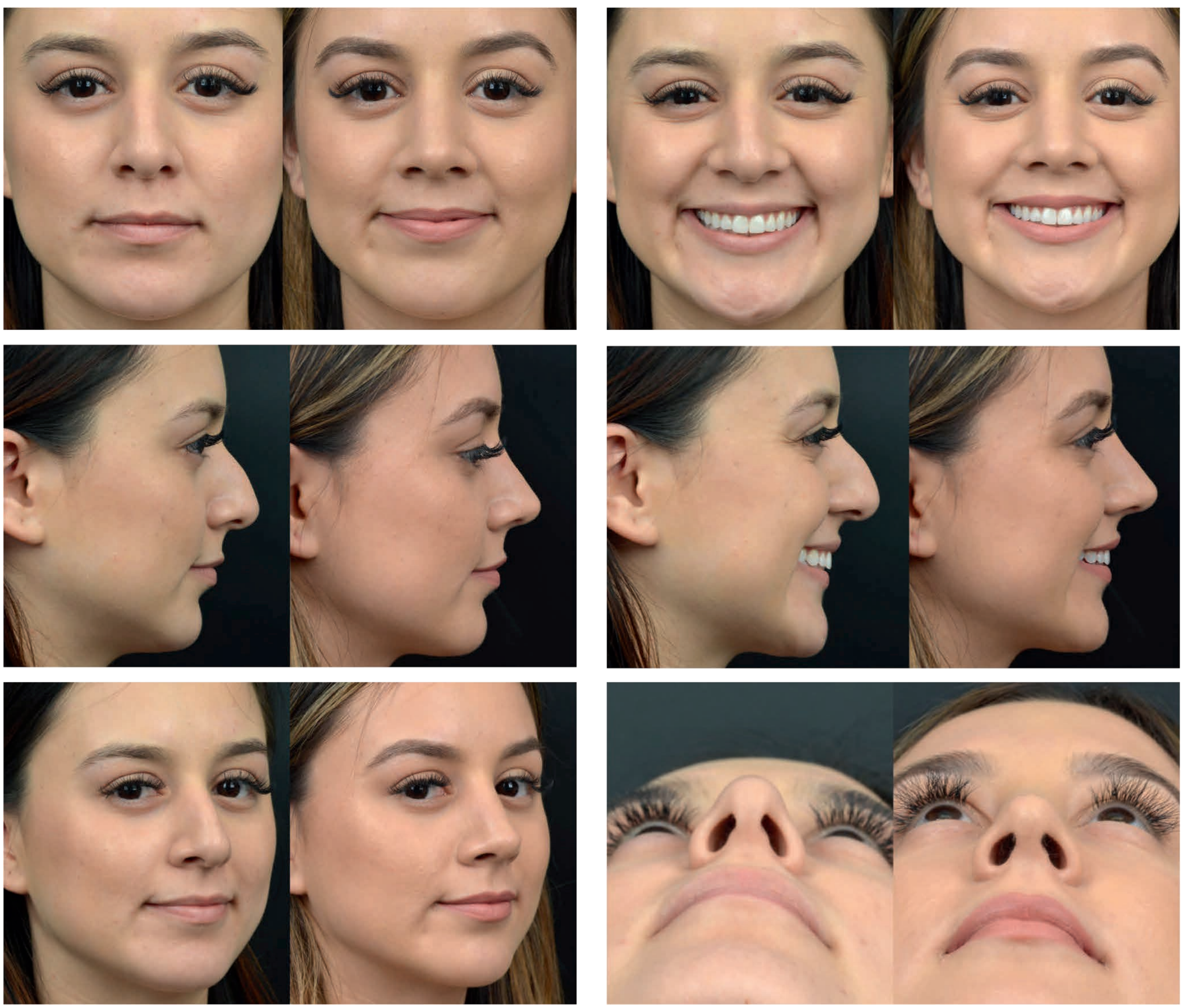
I began my career using columellar struts in all patients, which was fantastic for maintaining tip support and shape. However, in patients with poor projection, weak cartilage, and/or thick skin, loss of definition was a real problem. Since I have an "ethnic" rhinoplasty practice where only 1/3 of patients are Caucasian, the SEG improved my results dramatically. The SEG graft gives excellent support and is a fantastic way of increasing projection in seleced patients. Placement of the SEG graft has a very difficult learning curve and has caused the greatest amount of angst for me as a surgeon. Side-to-side grafts along the caudal septum are easy to perform but can cause all types of asymmetries of the nasal base, nostrils and tip. If strong cartilage is not used, the graft itself can bend. If the domes are tensioned unequally, the tip will displace. If the caudal end of the graft is not in the midline or thicker on one side, columellar asymmetries can occur. I no longer place grafts on one side of the septum if at all possible. Instead, *laminating* 2 pieces of cartilage around the caudal septum works much better. End-to-end graft placement is best, but it necessitates a large amount of cartilage as they need to be held anteriorly with extended spreader grafts and posteriorly with bracing grafts.

Once through the learning curve, true complications with a SEG are rare and they are easy to revise. Small base asymmetries are solved by shaving the graft itself. Deviations are fixed by re-tensioning the cartilages. If need be, the graft can easily be converted to a columellar strut. Complications of columellar struts are also very rare, and usually are because of a loss of tip support. This often results in sub-optimal tip definition. Adding a small cap graft would be an easy solution, but real central tip support (with an SEG) is the best solution. Particularly in secondary rhinoplasty, many tip problems are solved with rigid central support.

CASE # 1 – Total Tip Preservation

A 23 year old female of Hispanic descent presented with a 5mm dorsal hump, a bulbous tip and plunging tip on smiling. She has an under projected nasal tip. The patient is shown pre-operatively and post-operatively after a complete preservation rhinoplasty.

A subperichondrial-subperiosteal dissection was performed of the STE with preservation of Pitanguy and scroll ligaments. No alar cartilage was removed and a high septal strip pushdown was performed. Because the patient had very weak cartilage, a septal extension graft was used to project the lower lateral cartilages against the soft tissue envelope to gain projection and definition. Cranial tip sutures were used with a 2.5 mm lateral steal. The combination of tip sutures, a lateral steal procedure, and septal extension graft effectively tensioned the tip. Tip definition with adequate projection and rotation was gained without removal or transection of alar cartilage. All ligaments were preserved. In effect, nothing was removed from the alars nor from the osseocartilaginous vault.



CASE # 2 – Total Tip Preservation

A 22 year old female of European descent presented with a 4mm dorsal hump, a wide bony vault, a bulbous tip, and plunging tip on smiling. She has an over projected nasal tip. The patient is show pre-operatively and post-operatively after rhinoplasty.

A subperichondrial-subperiosteal dissection was performed of the STE with preservation of Pitanguy and scroll ligaments. Piezoelectric osteotomies were performed in a medial oblique, transverse and low-to-low fashion while spreader flaps were used to reconstruct the middle vault. Because the patient had a tension nose and an over-projected tip, a deprojection-reprojection technique was used to deproject the nose while rotating the nasal tip. The nasal tip was deprojected onto the caudal septum in a tongue-in-groove fashion by setting back the footplates. Cranial tip sutures were used with a 4mm lateral steal. Tip definition with adequate projection and rotation was gained without removal or transection of alar cartilage. All ligaments were preserved to close the dead space in the supratip region.

CASE # 3 – Cephalic Slide Under

A 57 year old female of European descent presents with a 4.5 mm dorsal hump, a bulbous tip, a wide dorsum, and plunging tip on smiling. She has an over projected nasal tip. The patient is show pre-operatively and post-operatively after rhinoplasty.

A subperichondrial-subperiosteal dissection was performed of the STE with preservation of Pitanguy and scroll ligaments. No alar cartilage was removed and a component reduction was performed on the dorsum. Piezoelectric osteotomies were performed in a medial oblique, transverse and low-to-low fashion while spreader flaps were used bilaterally as well as a right spreader graft to reconstruct the middle vault. Aa deprojection-reprojection technique was used to deproject the nose while rotating the nasal tip plus a 6mm caudal septal resection and dissection of the anterior nasal spine. A columellar strut was used to support the tip complex. Cephalic dome sutures were used with a 5 mm lateral steal and a 3 mm medial crural overlap. A cephalic slide under was performed to decrease the volume of the tip cartilages as well as alar rim flaps and a 1.5mm caudal resection. All ligaments were preserved to support the nasal tip.

CONCLUSIONS

Ultimately, tensioning of the alar cartilages against the soft tissue envelope occurs due to 3 factors. First, the domal creation sutures enhance domal shape and create tension by forming a straight and strong lateral crus with the caudal border higher than the cephalic border. Second, lateral crural steal creates tension by shortening and straightening the lateral crus. Third, attachment of the crura to a strut, especially a septal extension graft, tensions the tip medially. The combination of these 3 steps as well as ligament reconstruction creates a strong tip complex tensioned at all 3 legs of the tripod combined with internal ligament support. Using the techniques described above, 90% of primary rhinoplasty patients do not need any excision from the lateral crura. These techniques are reliable, easy to perform and avoid the necessity of multiple tip grafts.

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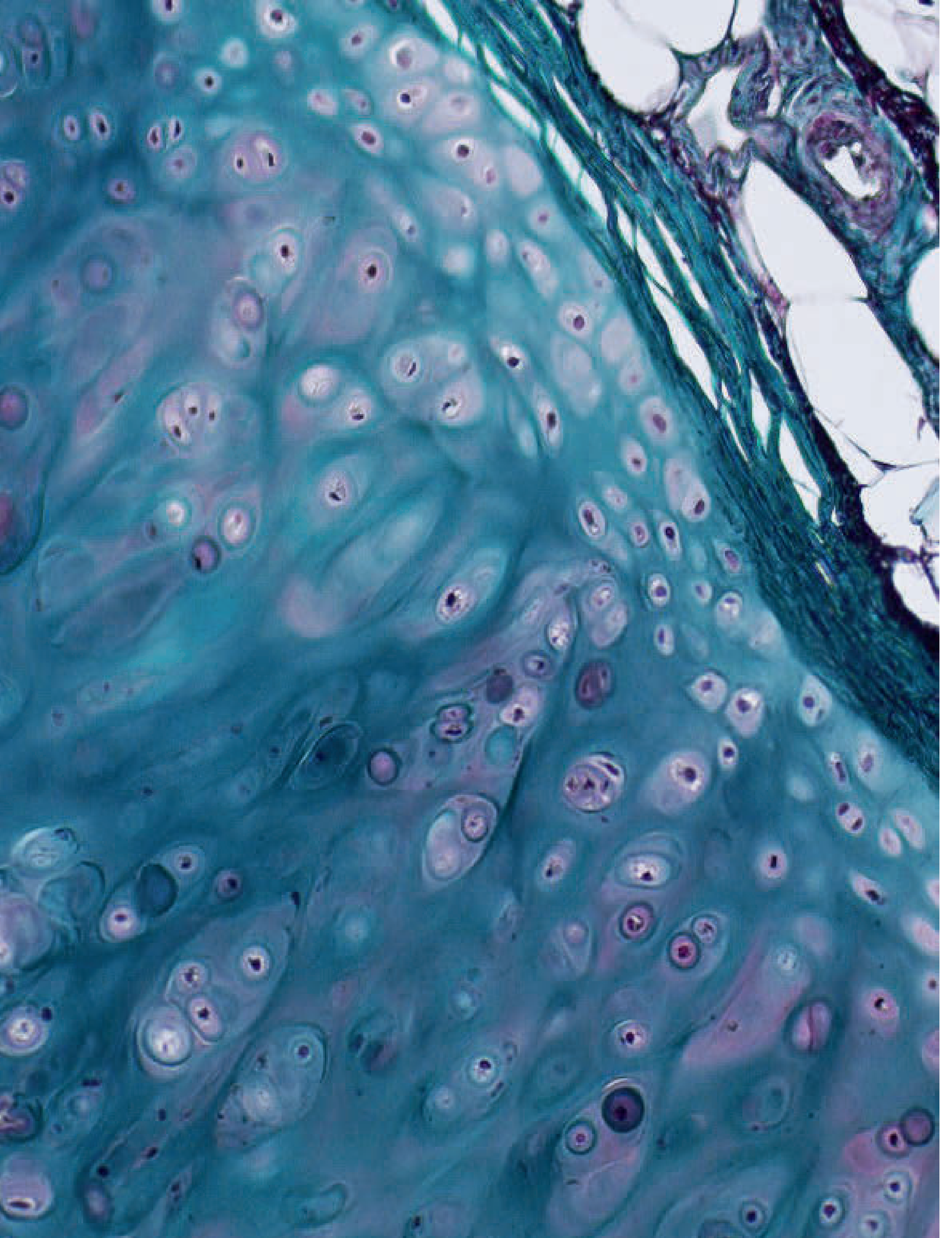
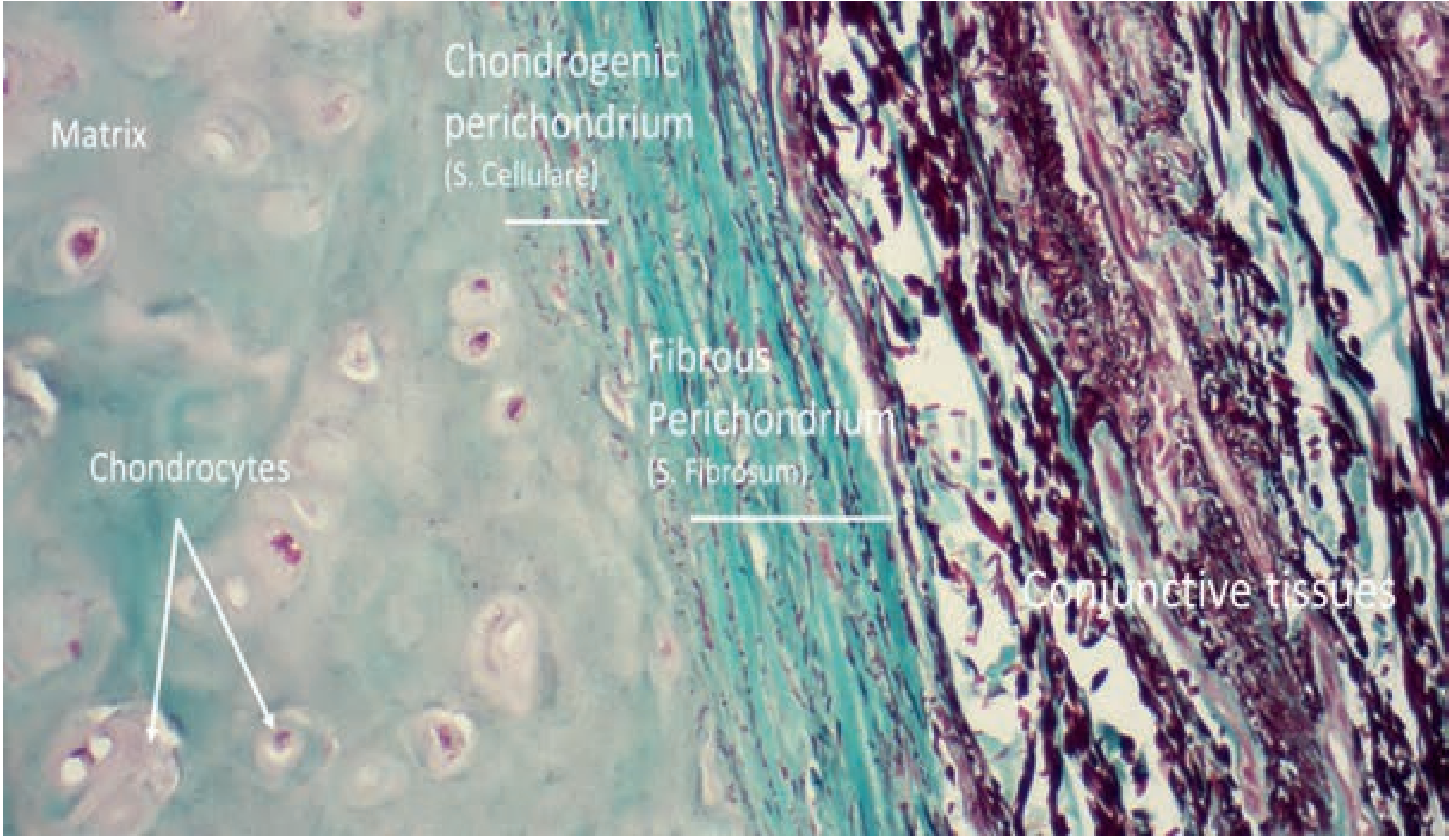




Practical Histological Anatomy for Preservation Rhinoplasty

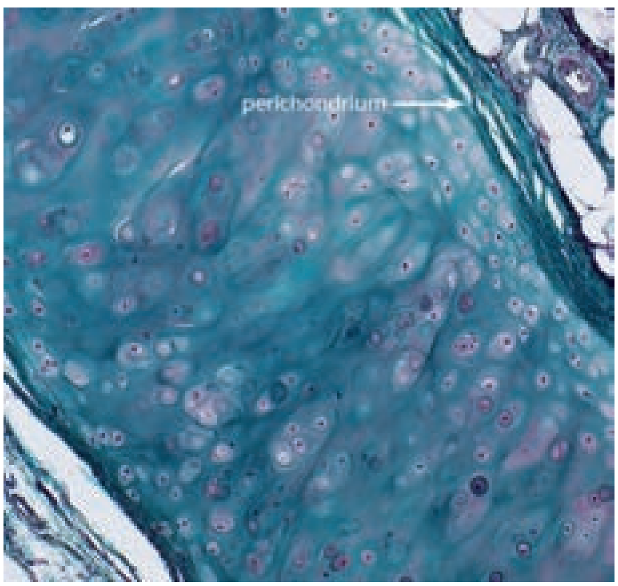
Vincent Patron

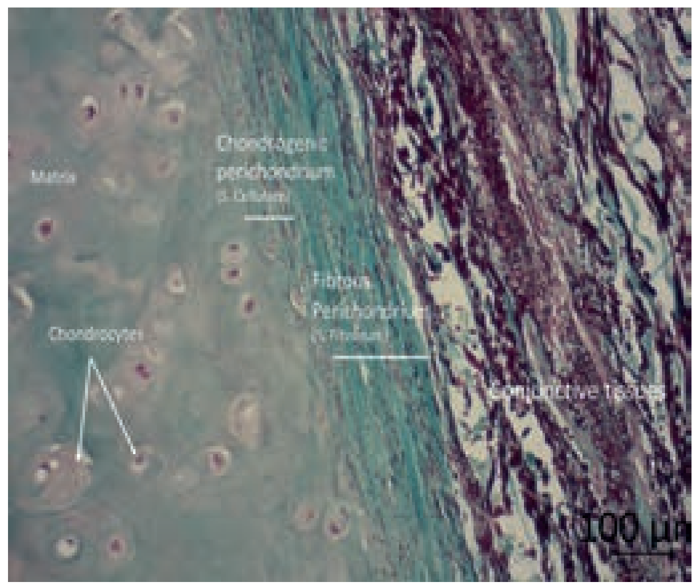
The aim of Preservation Rhinoplasty (PR) is to maximize preservation of the soft tissues, cartilages, and bone in the nasal pyramid. Knowledge of anatomy is thus of paramount importance. Although nasal surgical anatomy has been detailed in-depth, the anatomy of the soft tissues, especially the perichondrium and periosteum, remains poorly described (Daniel and Pálházi 2018; Saban et al. 2008). The aim of this chapter it to provide an in-depth discussion of the histological anatomy of the nasal soft tissue envelope. Hopefully, this information will increase the surgeon's knowledge, providing one with a better understanding of the current and correct sequences for soft tissue dissection.

THE CARTILAGE

Nasal cartilages are made of hyalin cartilage, which is similar to costal and tracheal cartilage. Histological section of an alar cartilage with Masson trichrome staining is seen below on the left. Note the orientation of the chondrocytes – those close to the surface are parallel to the surface, while those in the center are more perpendicular. Hyalin cartilage is different from articular cartilage which has no perichondrium. Nasal cartilage is made of extracellular matrix and the chondrocytes that produce it. The matrix is mainly composed of collagen II, IX and XI, which provide stiffness. The cartilage has no innervation and no vascularization in itself, which means that pain and bleeding during surgery are not caused by the cartilage, but rather by dissection of the surrounding tissues.

The structure of the perichondrium is very important for us. It is connective tissue, mainly composed of collagen I. It is innervated and vascularized, and it is responsible for nourishing and healing of the cartilage. It is of paramount importance when performing a subperichondrial dissection. It is composed of two layers: an outer one and an inner one. The layers of the perichondrium are seen below on the right in a histological section of an alar cartilage with Masson trichrome staining and orceine that marks the elastin fibers (purple).

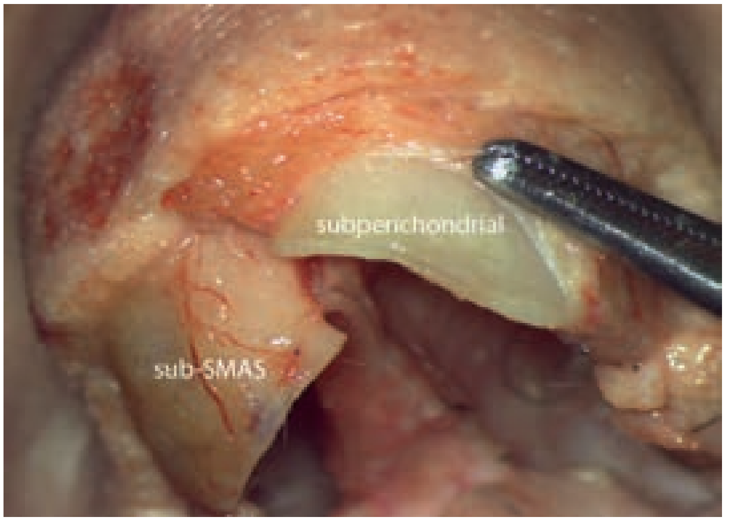




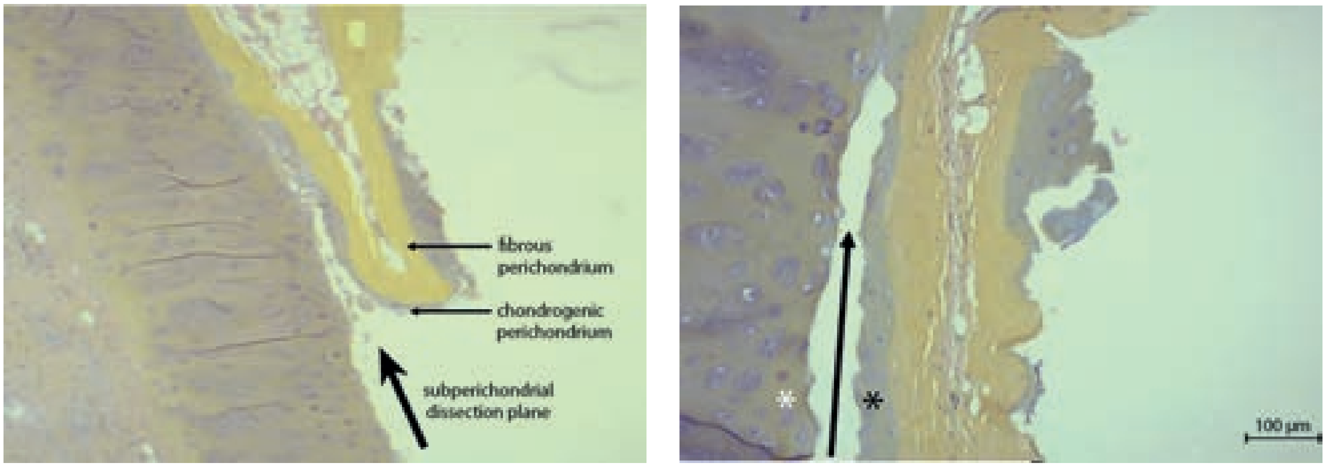
The outer layer is called the *stratum fibrosum*. It is a fibrous, vascularized and innervated connective tissue layer that nourishes the inner layer, called the *stratum cellulare*. This latter layer is of utmost importance, as it is a chondrogenic layer, composed of chondroblasts, and is responsible for cartilage growth. Certain authors describe a third, intermediate layer composed only of connective tissues (Bairati, Comazzi, and Gioria 1996).

THE REAL SUBPERICHONDRIAL PLANE

According to the concept of PR, dissection is performed in the subperichondrial-subperiosteal plane (SSP). The following figure shows an anatomical dissection of Lower Lateral Cartilage (LLC). Note the feeding vessels above the cartilage following the sub-SMAS dissection. The whitish flap corresponds to the perichondrial flap between the forceps.



As previously stated, the figure above shows a dissection in the subperichondrial plane, while the figures below are its magnification under microscopic examination (histological section with HES staining). One can see that the subperichondrial dissection is made right under the perichondrium, as well as that the chondrogenic and the fibrous perichondrium are elevated in a single flap. The large arrow shows the dissection plane. The difference in size of the chondrocytes/chondroblasts between the cartilage (white star) and the chondrogenic perichondrium (black star) can be seen clearly (the cartilage and chondrogenic perichondrium is *shaded* in *purple*, and the fibrous perichondrium in *yellow* for better understanding. This dissection separates the chondrogenic perichondrium from the underlying cartilage, which explains the need to scratch the cartilage firmly to find the correct plane. The presence of the chondrogenic perichondrium at the inner part of the flap also probably explains the whitish and bloodless aspect of the flap once elevated during surgery. Sharp instruments are thus absolutely mandatory for entering this plane.



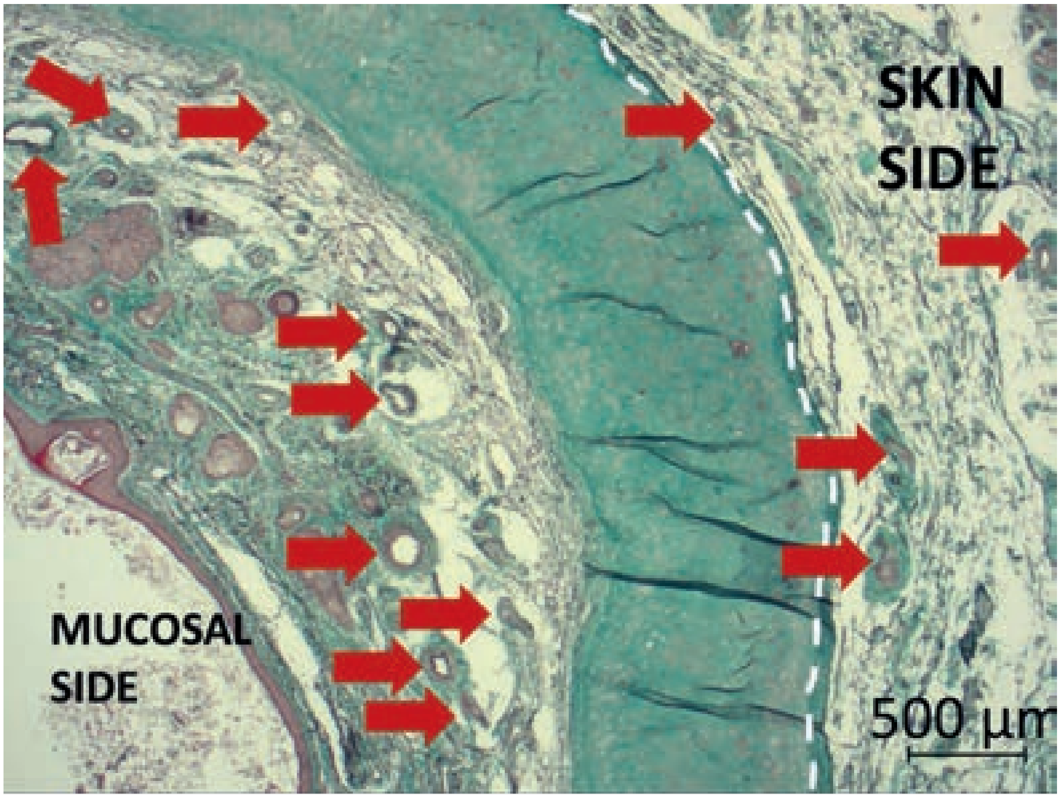
RISKS OF SUBPERICHONDRIAL DISSECTION

Subperichondrial dissection raises many questions: does it generate fibrosis? Does it devascularize the cartilage?

Fibrosis is the consequence of activating fibroblasts secondary to trauma. Fibroblasts are present in the connective tissues: skin, subcutaneous tissue, SMAS or the fibrous perichondrium.

They are absent from the inner perichondrium and the cartilage, where the only cells are chondroblasts and chondrocytes respectively. Theoretically, a true subperichondrial dissection results in activation of chondroblasts, not fibroblasts. This is confirmed by fundamental studies that show that only trauma of the inner perichondrium can generate cartilage formation (Duynstee et al. 2002) and that subperichondrial dissection with conservation of cartilage results in an increase in cartilage and perichondrium thickness (Ozdemir et al. 2018). However, this is only in *in vivo* animal models.

With regard to cartilage vascularization, as mentioned previously, cartilage is not a vascularized tissue. Vascularization comes from the fibrous perichondrium and the surrounding tissues, and allows the cartilage to be supplied by diffusion of nutriments, metabolites and oxygen from the vessels to the chondrocytes (Macé, Bertrand 2008). Figure below (histological section of LLC with Masson trichrome staining) shows the vascularization above and underneath the cartilage and highlights the absence of vascular trauma during the subperichondrial dissection (white dotted line). Veins and arteries are present above and underneath the cartilage (red arrows).

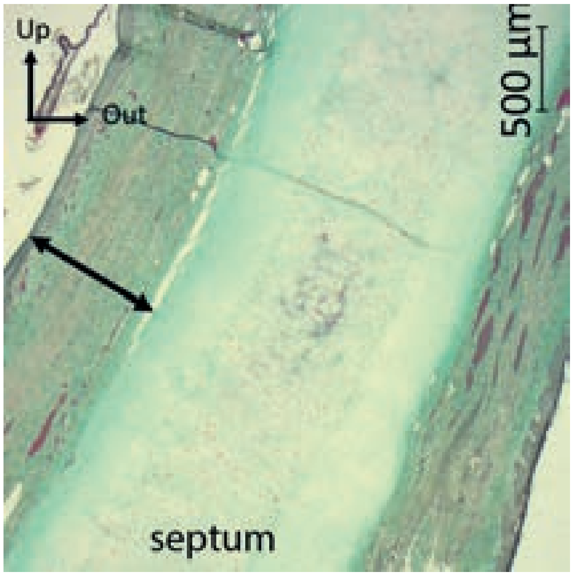


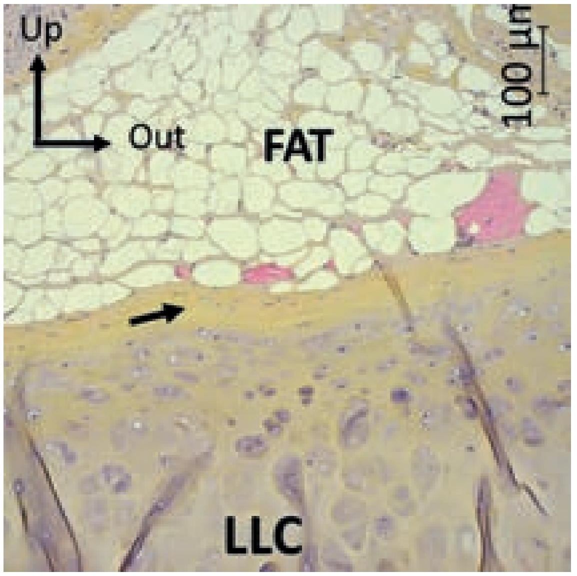
To our knowledge, the consequences on human cartilage regeneration of a subperichondrial elevation have not been studied, but it has been shown in an animal model that complete regeneration of cartilage can be achieved if only a single perichondrial side is present (Mo et al. 2014). This should be kept in the surgeon's mind when performing aggressive dissection on both sides of a cartilage: cartilage regeneration is a matter for the perichondrium, not vascularization. Preservation of the perichondrium should thus always be obtained by means of careful subperichondrial dissection.

SEPTAL VS. LLC & ULC SUBPERICHONDRIAL DISSECTION

Septal subperichondrial dissection is the classical plane for surgery. Why is it more difficult to be in the subperichondrial plane over the LLC and the ULC than in the septum? There are 3 main reasons for this difficulty:

1) The septal perichondrium is thicker. The thickness of the septal perichondrium is 150 to 200 µm whereas the LLC and ULC perichondria are only 50 µm thick, and thus less resistant (Bleys et al. 2007).
2) Septal soft tissues are dense while the tissues around the LLC and ULC are loose. Periseptal tissues are mainly composed of connective tissues and glands, whereas the soft tissues around the LLC and ULC are mainly composed of fat and loose connective tissues (see figures below).
3) Septal cartilage is stiff, whereas the LLC and ULC are not. The primary task of septal cartilage is to provide stiffness. The only task of the LLC and ULC is to open the internal and external valve. They are thinner and more flexible.



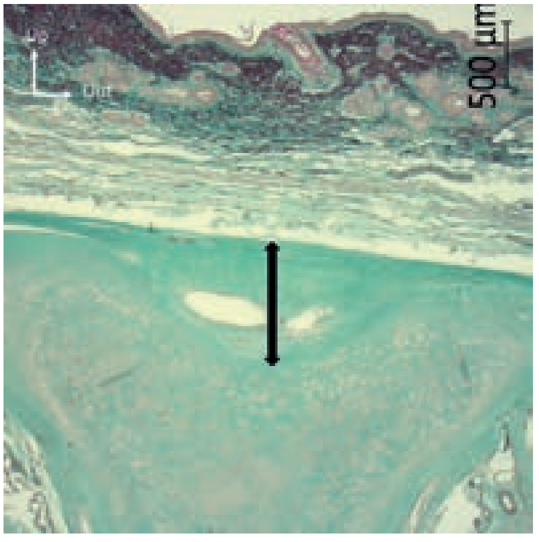


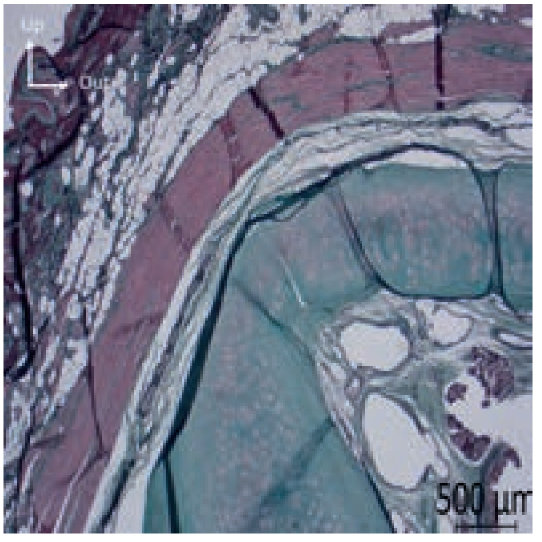
Then, when we need to scratch the cartilage to find the subperichondrial plane, it is easier on the septal cartilage because it is more resistant and less mobile than the LLC and ULC. When searching for the subperichondrial plane on the LLC or ULC, try to stretch it and make counter pressure so that it is easier to scratch. One can understand this concept by looking at the painting "The Floor Scrapers" by Gustave Caillebotte (Musée d'Orsay, Paris, Public domain): it is easier to scrape something hard and resistant than something weak and mobile.

SUBPERICHONDRIAL PLANE OF THE DORSUM VS. CAUDAL PART OF THE ULC?

Similar to dissecting over the alar cartilages, it is a matter of perichondrial thickness, cartilage stiffness and mobility. On the dorsum, the septal perichondrium can be very thick, up to 1000 µm as shown in figure below on the left which is a histological section of the septal Y with Masson trichrome staining. The double-headed arrow shows the 1000 µm thickness of the perichondrium. In addition, the septal Y is resistant, and easy to scratch.

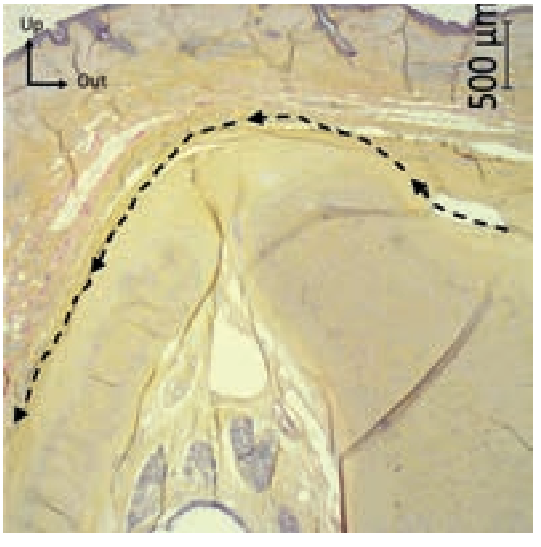
One particularity of the dorsum is the presence of the transverse muscle just above the perichondrium. It can be very thick and resistant as well, when under tension. As shown in the figure below right, histological section of the septal dorsum with Masson trichrome with orceine staining reveals a large, transverse muscle.





The perichondrium of the ULC is thin, and the ULC is a weak, mobile cartilage. It is therefore difficult to scratch the ULC especially the caudal part which is very mobile.

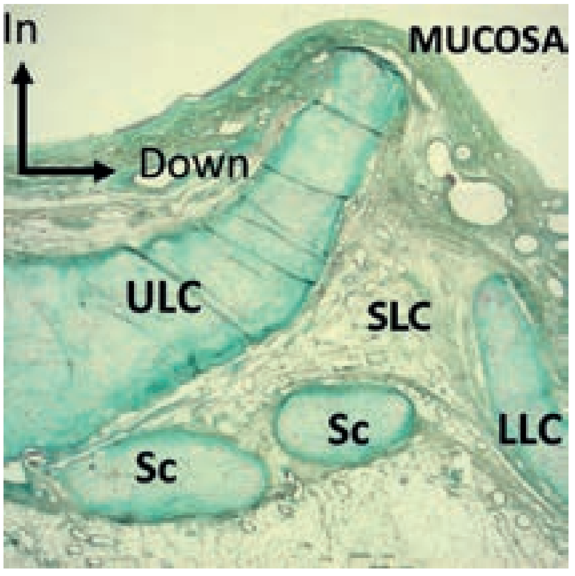
This is why, in order to dissect the ULC in the subperichondrial plane, it is easier to begin from the midline on the septum, then to go laterally to dissect the ULC perichondrium, rather than trying to find the plane from the caudal part of the ULC. Figure below shows a histological section of the septum and ULC with HES staining. The dotted line shows the dissection path starting from the midline and proceeding laterally.



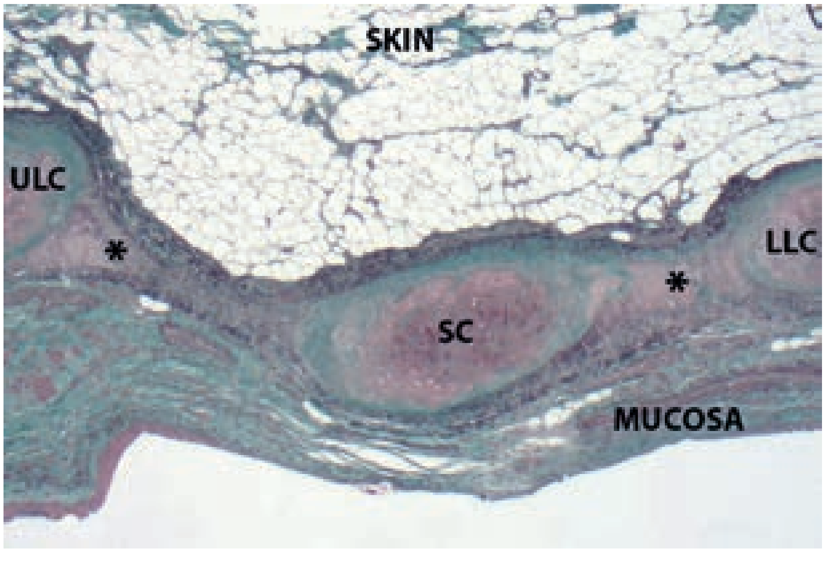
PERICHONDRIUM CONTINUITY FROM CRANIAL TO CAUDAL

When performing a subperichondrial dissection from the caudal part of the LLC to the nasal bones, two areas are difficult to dissect: the *Scroll area* and the *Keystone-junction* (ULC/bone). In both those transition areas, it is difficult to follow the subperichondrial plane. According to some authors, the periosteal and perichondrial envelope is continuous, especially in the keystone-junction area. Popko et al. describe the blending of the periosteal and perichondrial fibers, referring to it as the periosteal/perichondrial covering (Popko et al 2018).

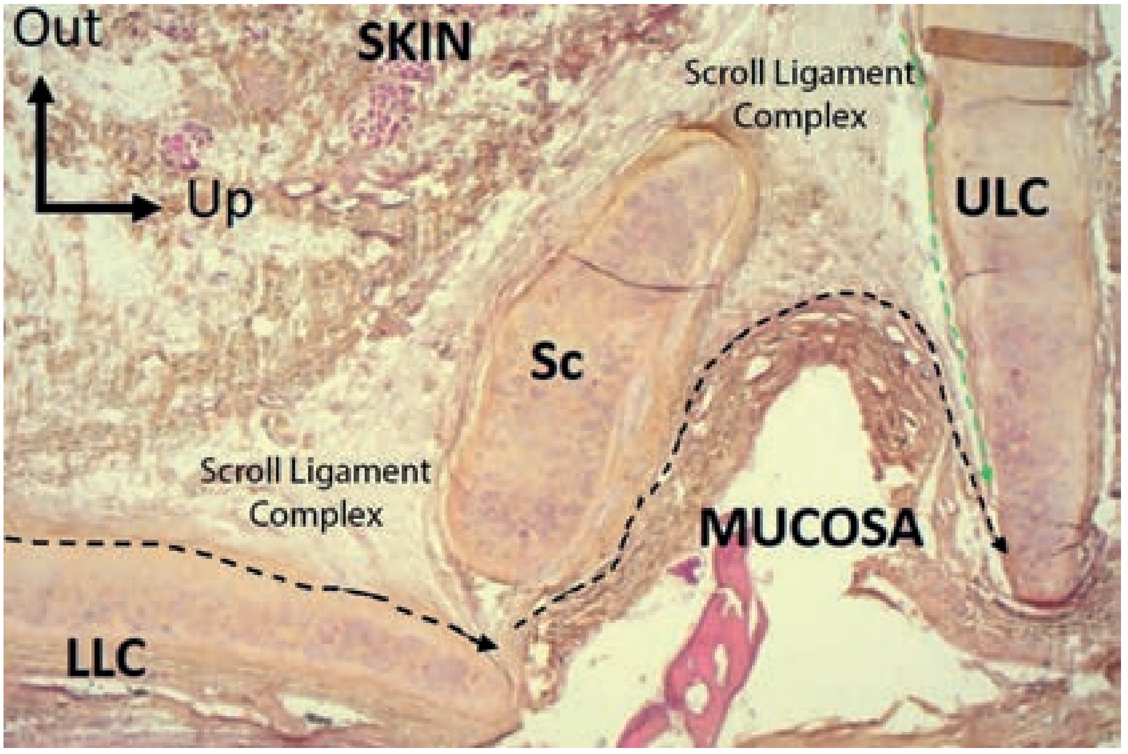
When examining the scroll area specifically, it appears that the scroll area is composed of dense, connective tissue rather than a continuous 2-layered perichondrium. This connective tissue correspond to the so-called *Scroll Ligament Complex (SLC)=Vertical & Longitudinal Scroll Ligament* (Daniel and Pálházi 2018). The ULC, LLC and each scroll sesamoid exhibit their own perichondrium.



In some cases, the distinction is more difficult, as in figure below. This is a histological section of the scroll area with Masson trichrome staining and orceine. The asterisks in the scroll area indicate dense collagenous bundles and continuity of the perichondrium into the scroll area. It was also described by Karapinar et al. (Karapinar et al. 2013).



Regardless of the anatomical variations in the scroll area, a dissection should preserve its integrity. To achieve this goal, when one reaches the cranial part of the LLC in a subperichondrial manner, the dissection should continue beneath the Scroll Ligament Complex just above the vestibular mucosa, then reach the caudal part of the ULC. Opening the perichondrium here is difficult. At this level, the dissection should join the subperichondrial dissection performed from the midline to the caudal part of the ULC. In the figure below, one can see a histological section of a scroll area with HES staining. The black dotted lines indicate the dissection planes from below. The green dotted line indicates the subperichondrial dissection plane from above.



CONCLUSIONS

Subperichondrial dissection is a genuinely subperichondrial dissection under the inner chondrogenic layer of the perichondrium. If the perichondrium is respected during dissection, it does not generate fibrosis nor devascularization, but instead activates the chondrogenic activity of chondroblasts, resulting in cartilage production. It is therefore of paramount importance to take care of the perichondrium when you dissect.

More practically, what histology teaches us is that to correctly enter the subperichondrial plane, properly performing the scratching maneuver requires 1) sharp instruments, 2) maintaining the cartilages stretched during the scratching maneuver and 3) performing appropriate counter pressure if possible.

Starting the dissection at the point where the cartilage is its stiffest and least mobile, and where the overlying tissues are the densest, can make the maneuver easier.

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Dorsal Preservation by Subdorsal Septal Strip Resection

Yves Saban

Dorsal hump reduction can be achieved in primary rhinoplasty by lowering the dorsum without any resection of the outer bony cartilaginous skeleton. Reducing the rate of revision rhinoplasties or making these revisions easier on untouched bony cartilaginous framework is one of the main advantages to keep a nice and natural pre-existing dorsum intact. Moreover, nasal valve functions are improved, as demonstrated by the opening of the internal nasal valve angle and space of the septum-ULCs junction during this procedure. Deviated noses may be straightened by an asymmetric lowering procedure, that is, a "push over" operation. This result can be achieved by resecting a pre-operatively determined strip of sub-dorsal septum just under the dorsum. A free space is thus created where the dorsum will be able to drop in. The dorsal shape and height will be determined by the intact septum left in place (the median pillar structure), while the K-area will work as a semi-mobile joint, allowing flattening or even curving of the bony cartilaginous dorsum. Total separation of the nose from the face and the skull is performed by complete osteotomies, which allows for full mobilization of the bony cartilaginous pyramid and controlled dorsal height reduction. This chapter will cover the nasal hump reduction with dorsal preservation by sub-dorsal septal strip resection and push / let down procedures.

HISTORY OF DORSAL PRESERVATION WITH SEPTAL STRIP RESECTION

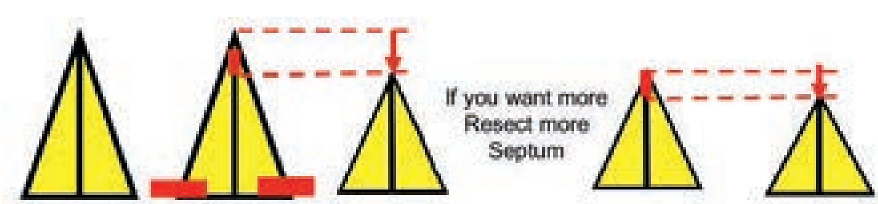
Dorsal preservation in primary rhinoplasty following high septal strip resection was initially described by Lothrop1 who published one case of reduction rhinoplasty. In 1989, in France, Gola2 followed this principle. In 2002 Saban published the nasal morpho dynamic related to the different K-area preservation techniques and showed anatomic mechanisms and surgical results. In 2006, he published his experience in dorsal preservation3 and popularized in France the preservation of the dorsum.4 Next, he introduced a modification of the technique5 moving the starting point of the strip resection just caudal to the septum/ULCs junction called “W-point”, thus leaving intact the septal support to the cartilaginous supratip and lower middle third. The resection should follow the deep aspect of the cartilaginous and bony dorsum till the radix. The pitfalls and postoperative deformities related to classic dorsal resections explains why there has been a renewed interest in dorsal preservation.

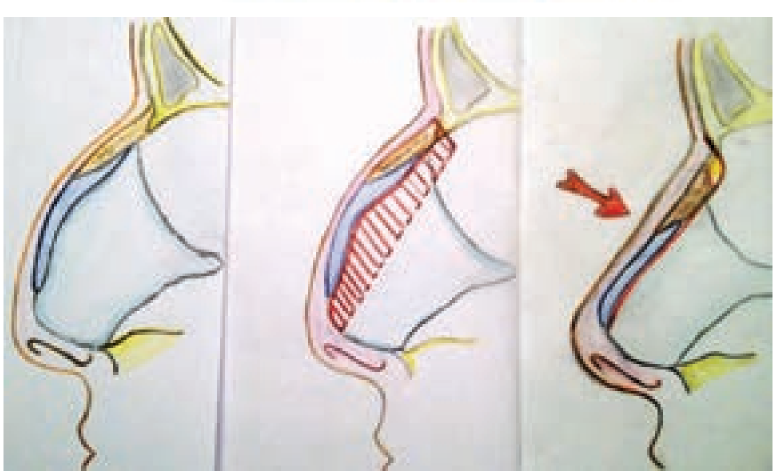
Recent developments of dorsum preservation and let-down procedure using piezo-instruments through open approach have been described by Göksel and Saban: Powered Piezo Open Preservation Rhinoplasty – “POP-Rhinoplasty” and presented in rhinoplasty meetings in the last 2 years16 (see Göksel chapter). It allows a better control of the osteotomy lines and mostly offers the possibility of nasal bony cartilaginous pyramid fixation to the stable septum through a crisscross suture using a powered drill as described by Haack and Gubisch.

CONCEPT (pls redo this text below…)

To preserve the vaults, the K-area, the soft tissue envelope. To lower the dorsum through high septum resection. To transform from 3D K-area (i.e. dorsum) to a 2D semi-mobile joint, that can flatten or curve. To secure: the nasal septum is the central pillar. To stabilize: bones and periosteum laterally, fixation by suturing to the septum.

Septum is the central pillar. Septum height gives the dorsal height. Incrementally by sub-dorsal septal strip resection.



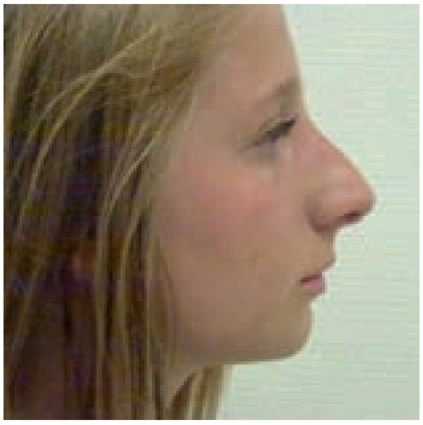
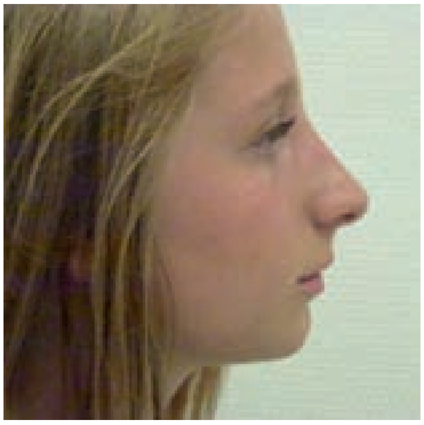
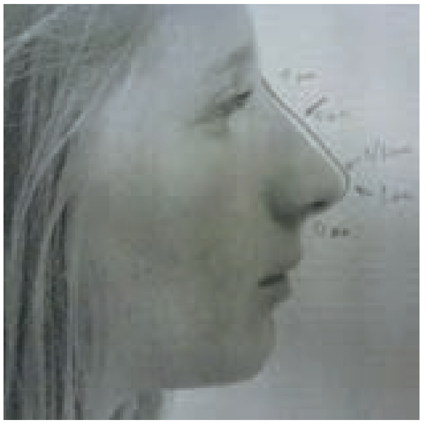


PATIENT INFORMATION

The major advantage is, in the post-operative period, an absolutely natural shape of the bony-cartilaginous pyramid which may be flattened or even curve during the surgery. In case of revision, the surgeon will face a “normal” anatomy nose allowing for performing any classic rhinoplasty procedure, or even another preservation technique. Nevertheless, pre-operatively it is important to inform the patient that the shape of their nose can present some distortions due to a lack of fixation of the lateral walls. Rarely, partial recurrence of the hump may happen. This should be discussed with the patient as well.

The patient is informed about the usual options of surgical techniques. To explain the principles of the surgery, comparison with the Eiffel’s Tower lowering is used: a smaller tower can be achieved via a tip resection, leading to the necessity of reconstructing the top, or via base resections leading directly to a smaller tower. The patient is then given more information in reference to their specific case.

On profile views, multiple computer simulations (generally 3-4 simulations are required) reflecting different options of dorsum lowering, nasofrontal angle reduction, tip rotation, and alar base resection are generated together with the patient. Next, measurements are performed on final printed documents to plan the surgery according to patient wishes and surgical possibilities.

Photographic examples of correlation between the simulation and post-operative results are shown to the patient. Most patients also ask to see other patient’s photos with pre/post-operative results. All of this information is written down in the patient’s chart.

SURGICAL TECHNIQUE

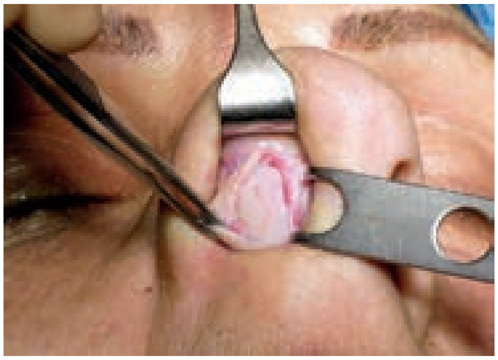
The dorsal height/shape/volume will be addressed, following the same principles as those one uses for tip surgery. The main steps follow an established sequence of ten steps: (1) approach and soft tissues undermining; (2) septal work; (3) complete bony osteotomies or ostectomies; (4) nasal pyramid mobilization; (5) adaptation of nasal profile by septal strip incremental resections: evaluation of the new dorsal line; control of a possible rocker effect that blocks the dorsum lowering or, by contrast, of a spring effect that pushes up to hump recurrence; then, new bony cartilaginous pyramid mobilization until the desired result is achieved; (6) stabilization (control of the lowering stability, sutures); (7) adaptation of the ULCs' caudal edge; (8) tip surgery; (9) final checking; and (10) ancillary procedures: chin augmentation, alar base reduction; and sutures and dressing.

Step #1 – Approach to the dorsum: infra- & retroligamentous approach

Reduction rhinoplasty and dorsal preservation require exposure of the caudal and dorsal septum, except sometimes in straight noses where dorsal undermining can be avoided. This is typically executed via an endonasal inter-septum-columella approach, as performed in routine septoplasty.

Septal Incision. Scalpel incision through mucosa and perichondrium follows the septum caudal border till the anterior septal angle. There is no intercartilaginous incision.

Septal Subperichondrial Dissection. With sharp instruments, the septal cartilage caudal border is followed on both sides upward until the anterior septal angle.



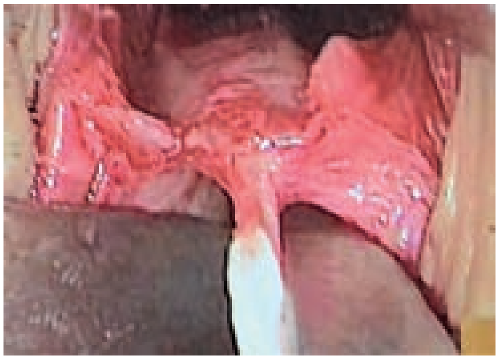
Superficial Nasal Dorsal Soft Tissue Undermining. Using sharp fine scissors, it is generally done sub-SMAS, thus freeing the septal/ULCs junction: W-point. Revealing the W-point which corresponds to the divergence point where the caudal medial ULCs borders (scrolls) are leaving their septal attachments is an important step. Care must be taken not to detach these attachments, nor to destroy the junction between ULCs and septum.

Then, when required, proceed cephalically, using a Daniel-Çakır or Joseph elevator, undermining as well subperiosteally or sub-SMAS the bony dorsum.

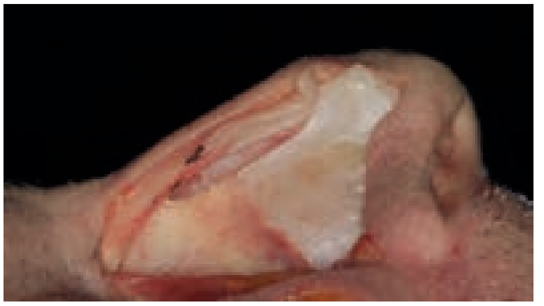
Deep High Septum Subperichondrial and Subperiosteal Undermining. Using the same elevators, septal bilateral subperichondrial superior tunnels are performed until the rough bony contact of the perpendicular plate of the ethmoid is encountered and then continued up to the radix area. This maneuver (extramucosal Robin's technique, 1973) gives protection to the high mucoperichondrium and helps in freeing the dorsal framework. Bilateral tunnel undermining should be about 1 cm in height in order to allow the instruments' passage and bony cartilaginous strip resection. It is good practice to check the depth of the instruments inserted toward the radix by comparing inside and outside landmarks.

Step #2 – Separation of the septum from the nasal pyramid

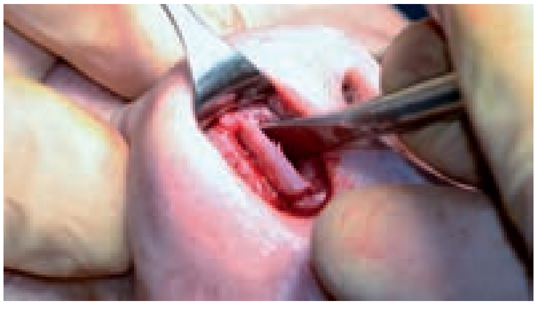
Cartilaginous Septal Resection. Resection of the septum is performed just below the dorsum, not to leave any remnant of upper cartilaginous septum under the K-area that could lead to a "coat-hanger effect." This section must be started at the W-point, where cartilaginous septum and ULCs diverge. This first section leaves the septum untouched caudal to this junction; this part of the septum, between the W-point and the anterior septal angle, is called the "free dorsal septum" or the W-ASA septum.



Bony Septal Division. The division of the cartilaginous septum under the dorsum will continue up to the ethmoid perpendicular plate bony contact. Then, the ethmoid perpendicular plate anterior bony angle will be resected using a 2 mm bone rongeur, incrementally up to the radix area. Always check the position of the instrument's tip when introduced toward the radix or the skull base, to avoid cribriform plate mobilization. Photos below show anatomical specimens.

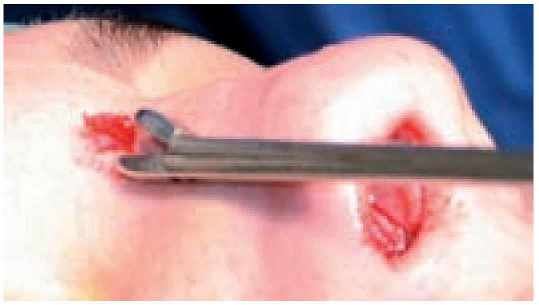
Complete Division – Checking. To check that the division has been completed, a Daniel-Çakır elevator is placed in the left superior septal tunnel under the K-area and moved horizontally following the dorsal vault until the contralateral right superior tunnel. This movement must be free of any blockage; otherwise, one should control the residual bridge and cut or remove it. After this step, there should be no more connection between the septum and the dorsum.

Step #3 – Septal strip resection

Cartilaginous Septal Strip Resection. From the W-point, using fine scissors, a second cartilaginous cut will be performed parallel to the first one. This first strip will usually be 3mm high, and the section will proceed from anterior to posterior, parallel to the dorsum. Arriving at the deep bony contact, this cartilaginous section will be blocked by the contact of the perpendicular plate. Then, the cartilaginous strip will be disarticulated from the bones simply by pressing with the tip of an elevator: the junction between the smooth cartilage and the rough bones can be easily felt with the tip of the periosteum elevator. Then the cartilaginous strip is easily pulled outside. This cartilaginous strip will be helpful later, as graft, if necessary, and preserved in saline.


Bony Septal Strip Resection. Section/resection of the superior anterior angle of the perpendicular plate of the ethmoid (called E-point, for ethmoid) will be done by using a fine and precise bone rongeur. This maneuver should be done precisely under the nasal bones, avoiding rotating the forceps and not pulling on the bone, to protect from any irradiated fracture to the skull base.



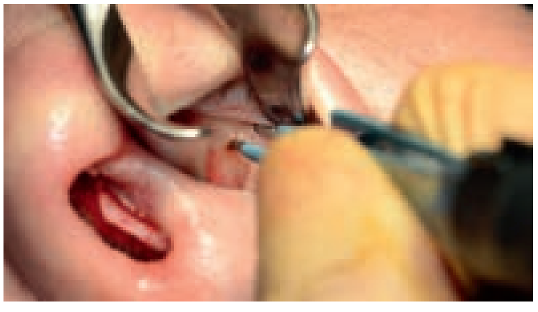
Step #4 – Complete mobilization of the nasal pyramid

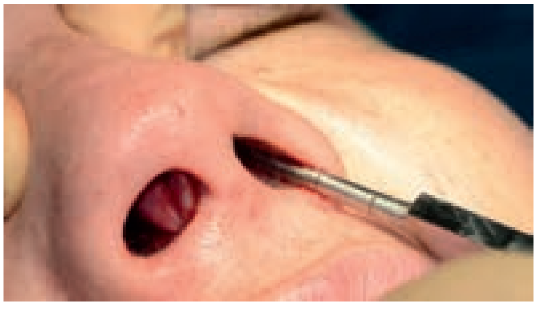
Separation of the osseocartilaginous vault from the facial skeleton. After this step, the bony nasal pyramid has been fully separated from the septum, and a free space has been created under the K-area and the vaults. In this anatomic dissection, a purple paper has been placed in the opposite superior tunnel.

The next step will be to separate the nasal bony pyramid from the facial and skull skeleton. To mobilize the bony-cartilaginous nasal pyramid, a section of the high septum and complete lateral, transverse and radix osteotomies will separate the nose from the face and skull. The osteotomy sequence is important: (1) lateral osteotomies, (2) transverse osteotomies, and (3) radix osteotomies.

Lateral Osteotomies. Our choice of technique depends on the height to be reduced. The osteotomies can be performed either *percutaneously* in small humps (<3 to 4 mm) without any endonasal approach, or *endonasally* after external periosteum undermining in case of bigger humps (>4 mm). For beginners, it may be easier to always proceed endonasally.

If the need of hump lowering is higher than 6-8 mm, an ostectomy is performed using a precise bone rongeur or piezo-electric instruments. This bony resection will be performed at Webster's triangle to avoid any narrowing of the pyriform aperture that could lead to postoperative breathing impairment. The first step is an endonasal incision performed in front of the inferior turbinate head using a monopolar cautery or Colorado tip to reduce the bleeding. The inner and outer periosteum must be elevated in the direction of the medial canthus.



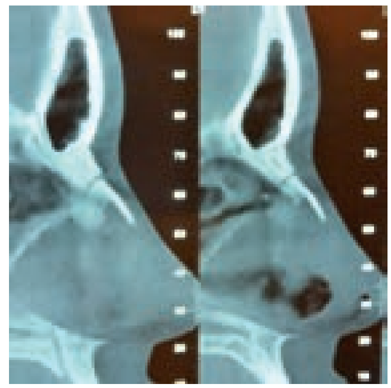


Care must be taken in the correct placement of these osteotomies, which must be done as low as possible in the nasofacial groove, following a low-to-low direction. Palpable, even sometimes visible, bony steps could happen if these osteotomies are located too high (too dorsal), leaving the frontal process of the maxilla partially in place. In this case, better to rasp or remove immediately these bony steps. In the open approach, piezo-electric instruments are helpful. In the closed approach, it is easier to proceed percutaneously with a 2 mm osteotome, to cut the whole step that can be felt by palpation, and to in-fracture this bony fragment, leaving it in place in the fracture line.

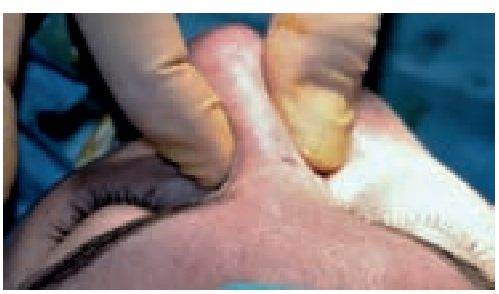
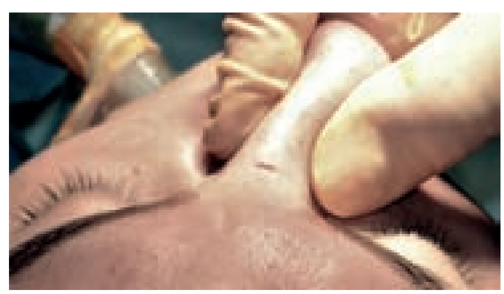
Percutaneous Transverse Osteotomies. Percutaneous osteotomies can cause bleeding. Therefore, previous local subcutaneous injection of lidocaine/adrenalin is done, as well as icing. Nevertheless, the incision is placed on the intercanthal line and the scar is never visible, if the incision is made with the tip of an 11 blade in a wrinkle. Sometimes the patient complains of a subcutaneous induration that will last a few weeks. A 2 mm sharp osteotome is used. For security reasons and in order for the surgeon to better feel the bone resistance on the osteotome tip, the assistant holds the patient's head firmly while the surgeon is performing the osteotomy. Other surgeons use dedicated micro-saws (Çakır, Taştan) introduced via endonasal approach or piezo-electric instruments (Göksel, Kovacevic, Gerbault) through an open approach.

Radix Osteotomies. The radix osteotomies allow complete separation of the nose from the face and the frontal bone—that is, the skull. Cooling and compression are helpful to reduce bleeding and swelling. The same 2 mm osteotome is oriented slightly in a cephalocaudal direction, and the osteotomy impact must be strong to cut through the frontal nasal bony overlap and the nasal spine of the frontal bone. In case of a high radix ("Greek nose"), a CT scan or cone beam must be performed pre-operatively to check for a possible frontal sinus presence in the radix area. After this step, the nose should have been completely separated from the septum, the face and the skull. It should be easily mobilized through the soft tissues.

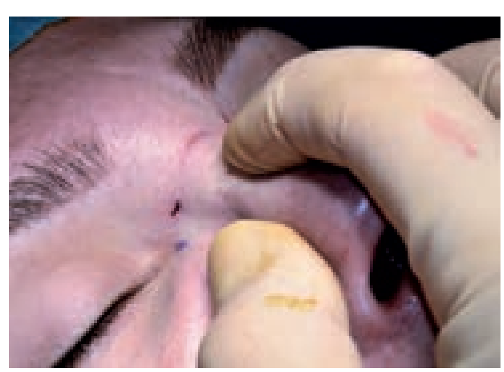


Nasal Pyramid Mobilization. One must notice that this handling maneuver produces a very special feeling for the beginners. The first step is the horizontal mobilization. The bony pyramid is handled by horizontal translation to the right and left sides, without any pinching of the bones nor pushing vertically. If mobilization is not completed, the surgeons will feel something like a bony bridge blocking this free lateralization. Then, it will be mandatory to redo the osteotomies until the complete freeing of the bony pyramid is achieved. Care must be taken not to force this mobilization, which could lead to undesirable fractures and make it impossible to correctly handle the nasal pyramid. If the osteotomies have been performed percutaneously, it may become useful to do them again through an endonasal approach.

Second step is the pinching and lowering. This maneuver of pinching and lowering is done using both hands; one is pinching, while the other is pushing downward carefully.

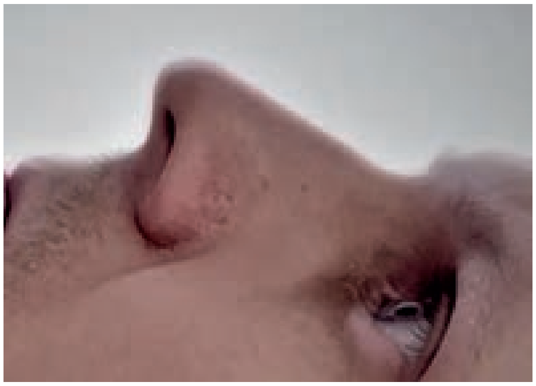



HEIGHT REDUCTION - ADDITIONAL INCREMENTAL SEPTAL STRIP RESECTIONS

To reduce the height of the dorsum, a strip of subdorsal septum must be removed, thus creating a free space below the dorsum, under the K-area, into which the dorsum will drop. This septal strip resection has been done previously, in step #3. Now the question is to align the current profile line according to the desired one, which may require further strip resection. The first step is to lower the dorsum; the next will be to curve the profile line.

Height Checking. An Aufricht elevator is inserted in the free space under the bony cartilaginous dorsum, to elevate the nasal pyramid already freed previously. This maneuver allows for resecting cartilaginous septal strips incrementally under direct vision, by using angulated scissors or dedicated instruments, and bone if required.

In high dorsum, this incremental strip reduction can lead to more than 1 cm height lowering. In the case below, 13mm of dorsum have been incrementally resected in four steps. Preop, intraop and 9-month postop result can be seen.

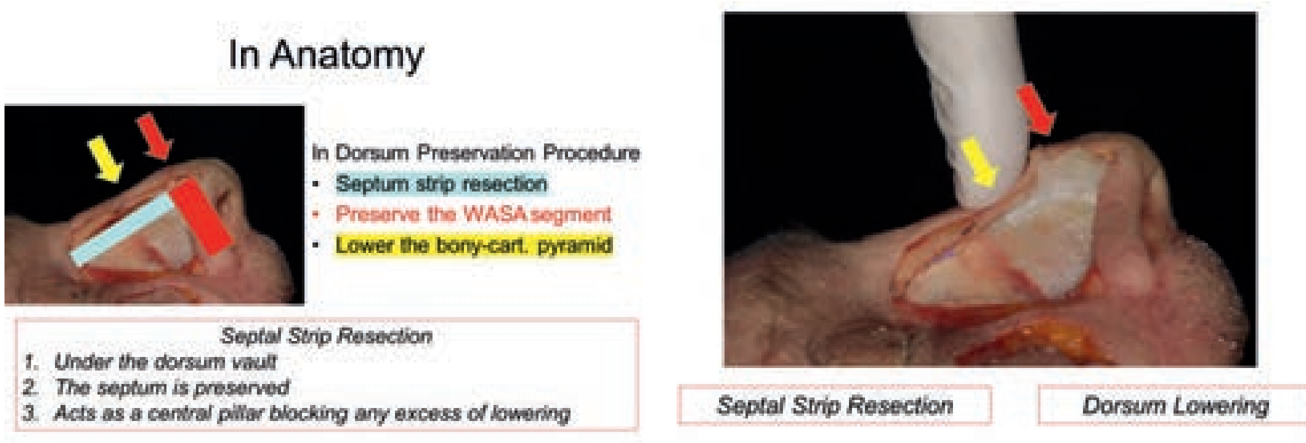


These cartilaginous strips, from 1 to 6mm height, will be conserved for later use, if required, in the following sequence: spreader grafts, columellar strut, alar rim grafts, and even chin augmentation. The maximum strip resection height in our experience is 18mm. Resection of the bony septum posteriorly is always performed using fine forceps or a bony rongeur, just below the bony dorsum until the level of the radix is reached. The resection does not extend above the radix. Comparison between the length of the instrument inserted endonasally and the distance to the radix is always checked, to avoid deep injuries to the perpendicular plate of the ethmoid (that is, however, 2cm away from this point). Also, this resection is mandatory so as to avoid mobilization (or even stripping) of the perpendicular plate of the ethmoid during the impaction of the bony dorsum. Then, the nasal pyramid is mobilized downward to check the result according to the preoperative planning.

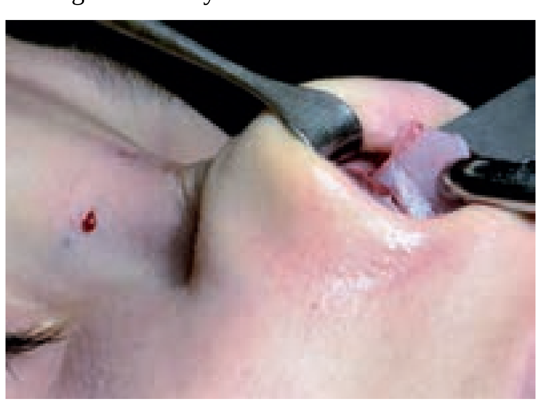
PROFILE AND DORSAL SHAPE REFINEMENTS

At this step, nasal pyramid is free from any facial or septal attachment. Dorsal lowering has been performed. Flattening or curving the dorsum is to be achieved. Using an Aufricht's elevator, the deep aspect of the bony-cartilaginous vaults will be inspected under direct vision, binocular loupes or video-endoscopic control, while lifting the vaults upward. Resection of all residual pieces of cartilage still attached below the vault allows the K-area bony cartilaginous junction to open like a joint. The cartilaginous dorsum rotates upwards while the bony hump is firmly applied on the deep and stable septum which was left untouched. Thus, the convexity of the hump should disappear.

The 3 main pitfalls: residual bony hump, bony hump recurrence ("spring effect") and/or middle third saddling.



To avoid any middle third saddling in the supratip area, reduction of the W-ASA segment of the septum is performed at the end of the whole procedure, according to necessity.

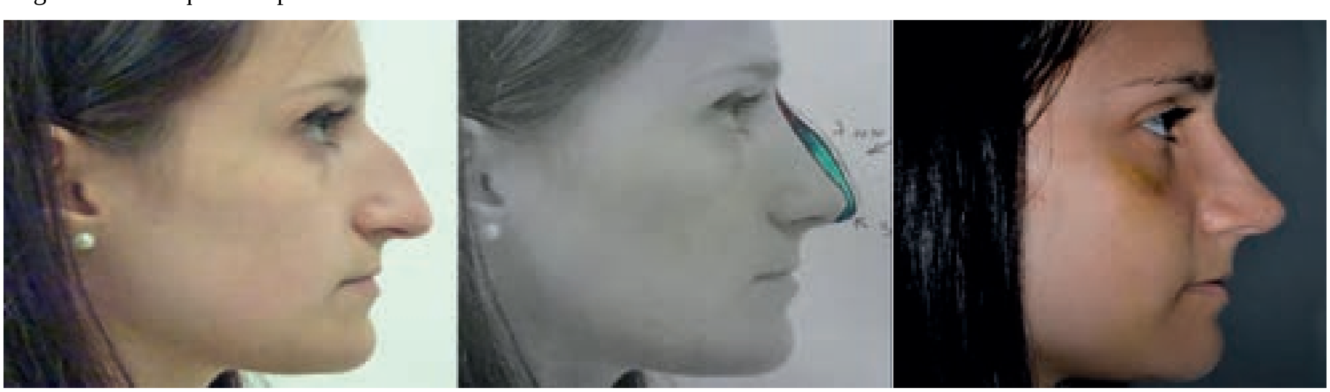


Generally, this free dorsal portion (W-ASA) of the septum should have been left untouched until the very end of the previous steps, as the strip removal should start at the W-point where the ULCs are attached to the septum. This free dorsal septum can work like an autoseptal extension graft, as it will merge from the anterior septum as a ship mast and can be used for further fixation in tip procedures, as shown in the intra-operative photos (see below).


It can also be resected. If any saddling appears, we insert an onlay graft or another camouflage procedure. This pitfall mainly happens to less experienced surgeons.

Profile alignment (same patient): W-ASA segment allows for tongue-in-groove technique.

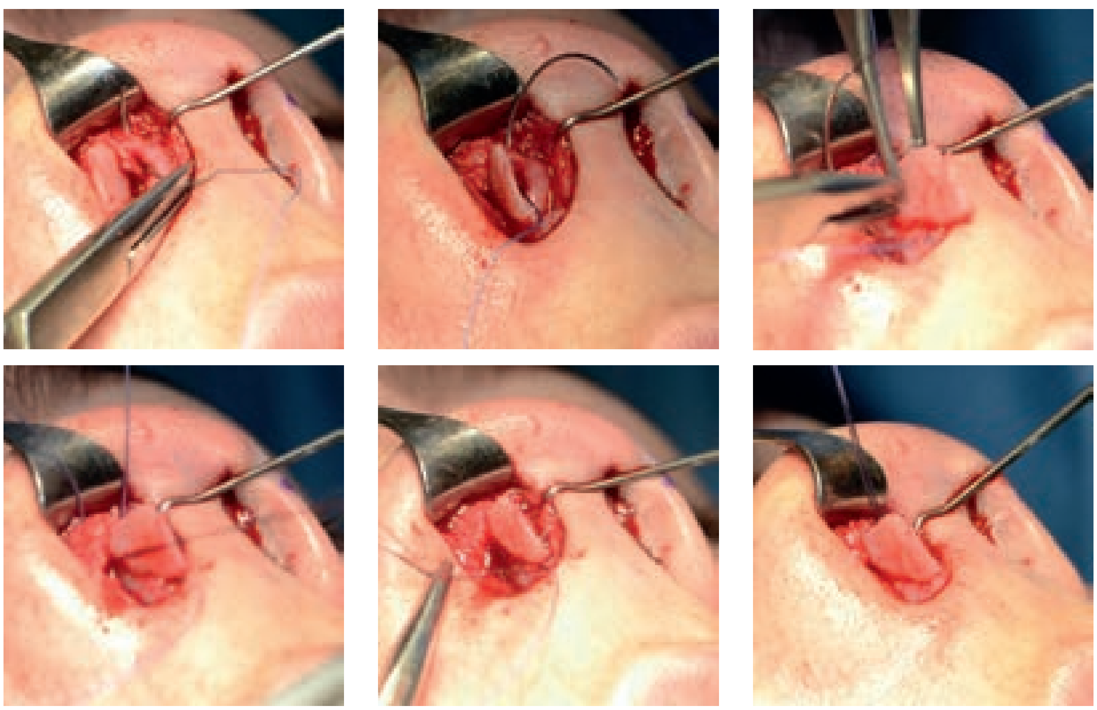

Preoperative planning and early postoperative result. Patient underwent PR and W-ASA preservation with tongue-in-groove technique for tip rotation and stabilization.



FIXATION OF THE NASAL PYRAMID

To avoid any lateralization, deviation or hump recurrence, fixating the dorsum to the stable septum is desirable. Then, if an endonasal approach has been performed, two cerclage-sutures are placed using a resorbable Vicryl 4/0 round needle: the first as high as possible, close to nasal bones, and the second at a lower level close to the caudal cartilaginous vault. These sutures are performed while the dorsum is firmly pushed downward to stay in close contact with the septum so as to avoid any dead space. Endonasally, the first passage of the suture is placed from underneath the caudal left ULC edge down to up, subcutaneously. Then follows the second passage through the right ULC caudal edge downward, and the needle is taken lateral to the septum. Next comes the third passage through the septum from right to left, and the knot is made in the left paraseptal undermining.

If an open approach has been performed, these sutures are easy to perform using a criss-cross transosseous fixation (Haack-Gubisch) and a drill powered-instrument. Final transfixing sutures are done to avoid any dead space in the internal nasal valve below the vault. No packing or splints are required, except in cases where an extended subperichondrial septal undermining has been done.



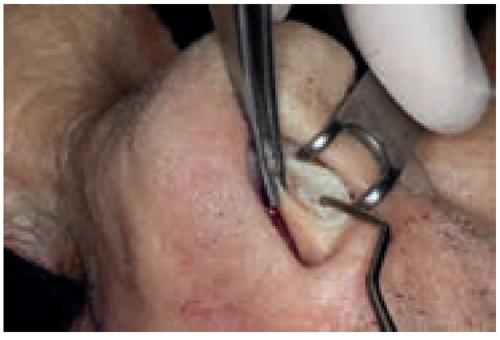
SUBDORSAL SEPTAL STRIP DORSAL PRESERVATION SEQUENCE DEMONSTRATED ANATOMICALLY

Step #1 – Separate the osseocartilaginous vault from the septum

Marking the septal caudal edge and plica nasi.


Endonasal incision: Septum and Columellar.

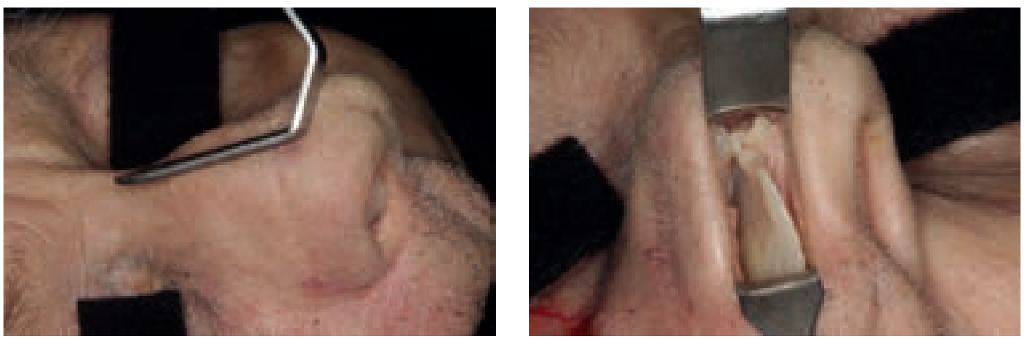

Subperichondrial plane dissection, identification of the Anterior Septal Angle (ASA) and Caudal Septum.



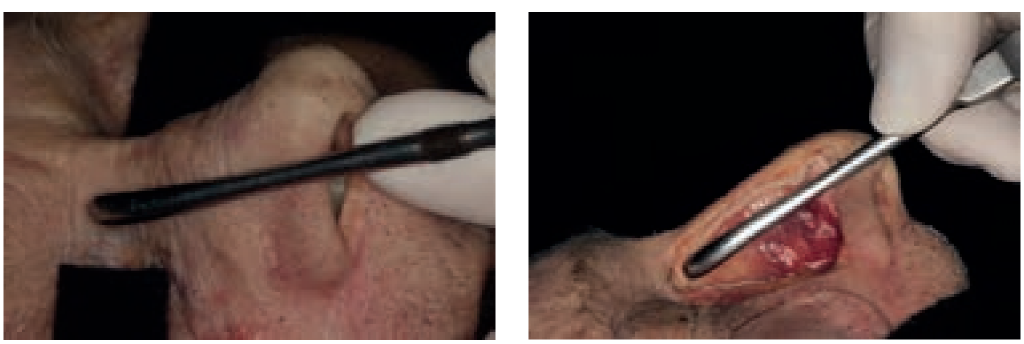

Sub-SMAS dissection above the ULCs (cartilaginous dorsum).


Subperiosteal dissection above the bony pyramid.

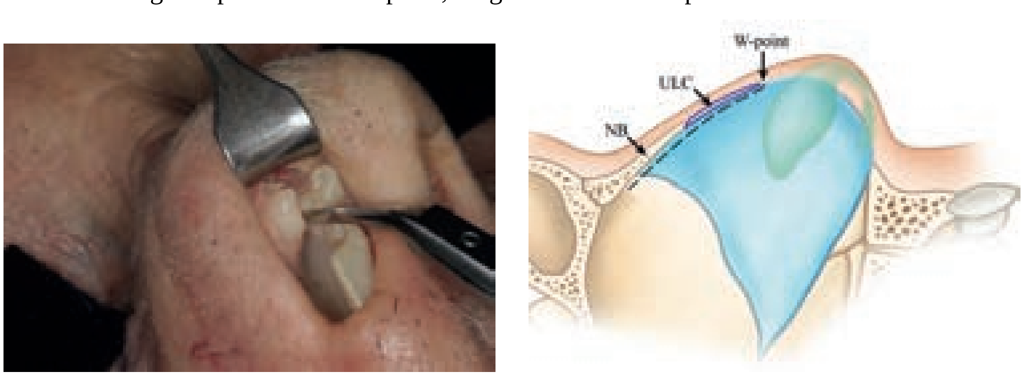
Identification of the W-point.



Bilateral superior subperichondrial tunnel on the septum.



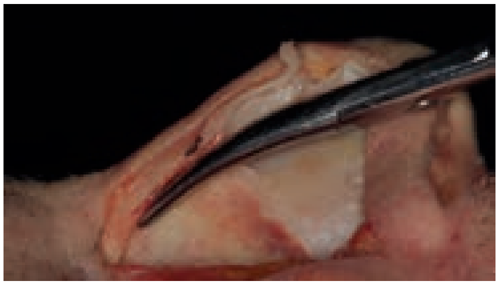
Septal subdorsal high strip first cut at W-point; longitudinal dorsal septum cross-section.

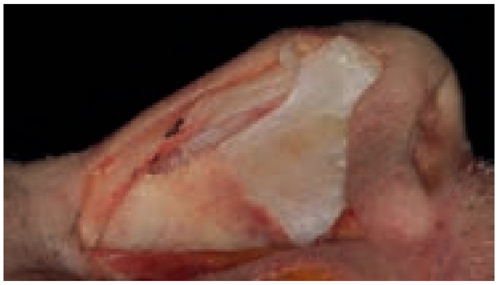


Check for complete division of the cartilaginous septum from the vault by passing an elevator from one side to the other under the vaults.

Second cut: cartilaginous subdorsal longitudinal septum at lower level, then disarticulation and resection.

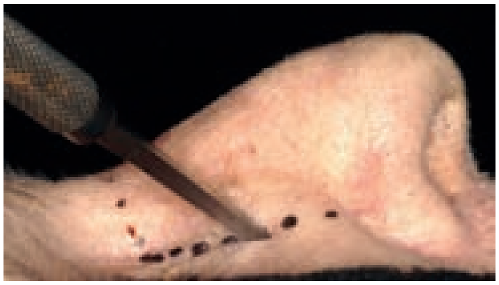
Ethmoid perpendicular plate anterior bony angle resection with precise Rongeur.

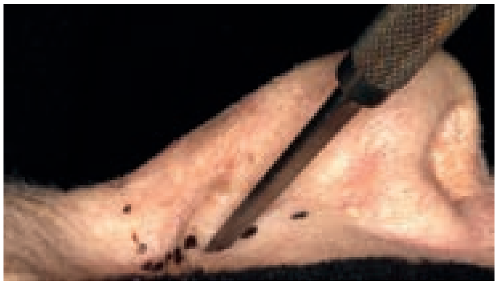




Step #2 – Separate the bony pyramid from the face - Lateral osteotomies in the nasofacial groove

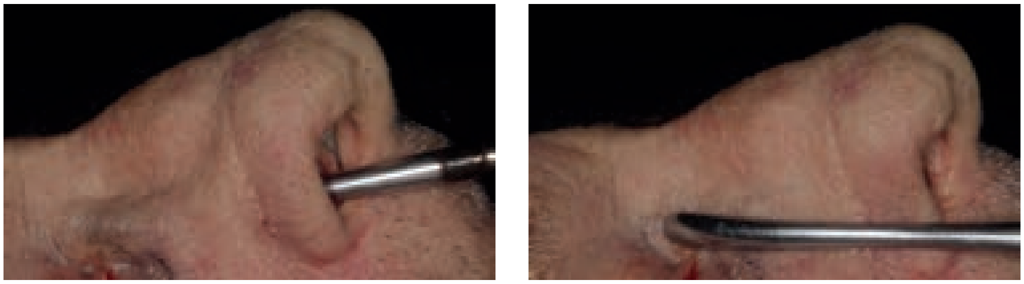
First option: percutaneous lateral osteotomy; entry point at mid-distance medial canthal ligament and pyriform aperture; repeat the local anesthesia at the osteotome entry point.



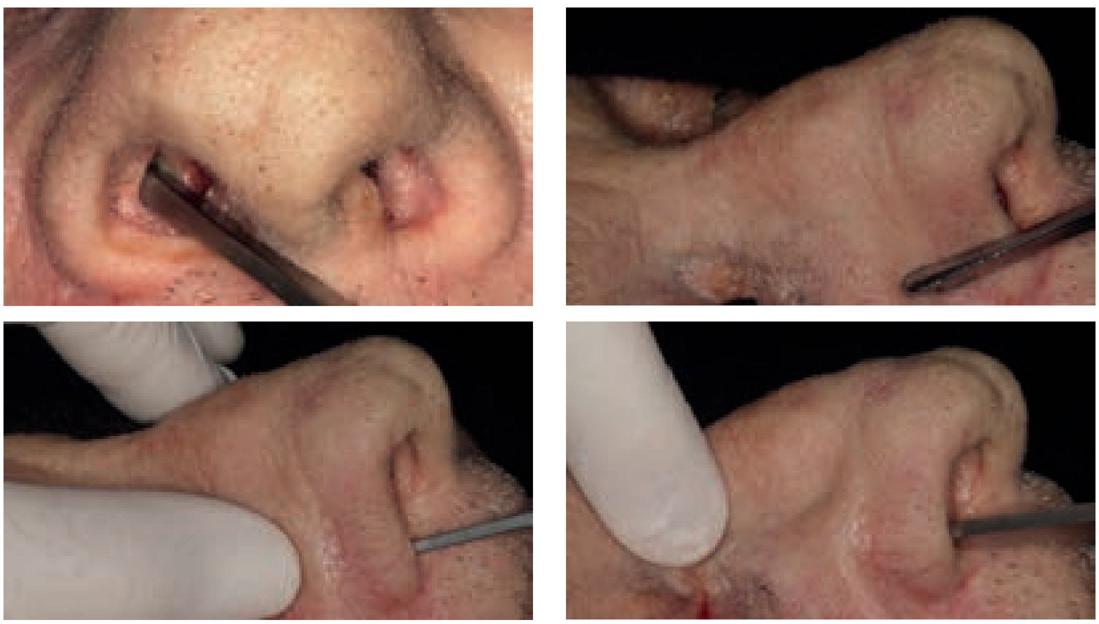


Second option: endonasal lateral osteotomy. Landmarks: Inferior Turbinate / Plica Nasi. Vestibular incision until bony contact.

Internal subperiosteal undermining and external subperiosteal undermining up to the medial canthus (medial canthal ligament can be elevated subperiosteally without any danger to eyelid stability).

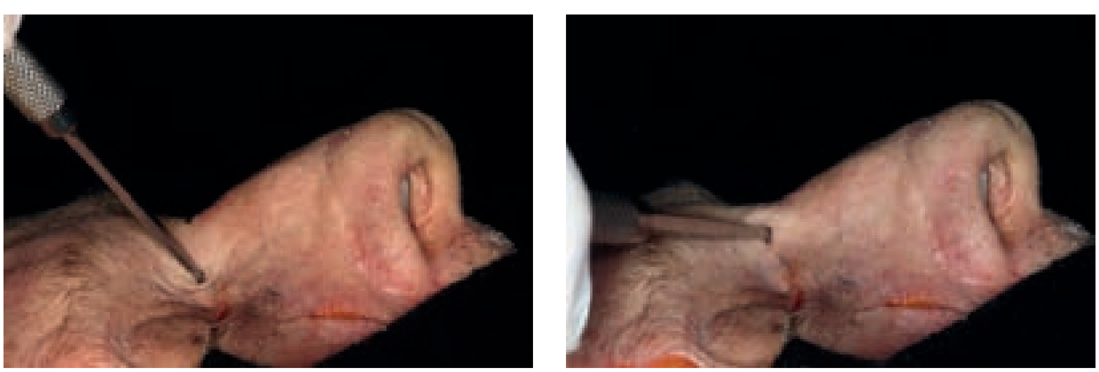


Lateral osteotomy/ostectomy in the nasofacial groove.

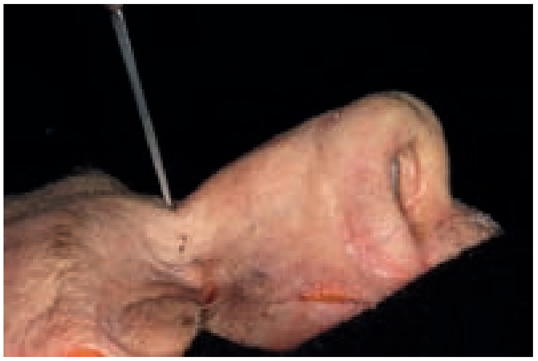


Step #3: Separation of the bony pyramid from the skull

Transverse osteotomy (internal or percutaneous)



Radix percutaneous osteotomy and the result of the lateral, transverse and radix osteotomies. Note: Even if the lateral osteotomy is placed in the nasofacial groove, the middle turbinates are not damaged.



Step #4 – Nasal mobilization in two steps

Complete transverse mobilization of the bony pyramid by manual movement from one side to the opposite side. For further mobilization of the bony pyramid, through the vestibular endonasal lateral approach, we use a periosteal elevator inserted in the lateral nasofacial osteotomy line.

Step #5 – Profile alignment

Lowering the dorsum. Nasal impaction: pinching with light pressure on the bony base with thumb and index finger.

Check dorsum profile height: additional septal strip resection if required. Check the dorsal profile line with a wet finger. From inside, elevate the nostril and check again the septum as regards height, length and shape. Notice how the ULC vault is joining the untouched stable septum; they must be in contact at the W-point.

Curving the dorsum: to curve the K-area, use the following sequence if required:

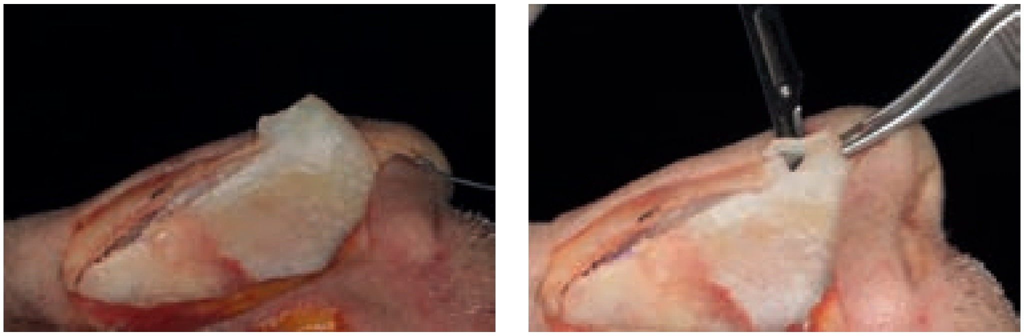
- Resection of the bony and cartilaginous septal remnants below the vaults. Check to see the ULC vault is semi-mobile.
- Undermine the mucoperiosteum widely under the vaults (Robin's extramucosal technique)
- Curve the dorsal septum below the central K-area junction using supplementary vertical cuts and check again the shape of the dorsum
- Divide the pyriform ligament along the lateral osseocartilaginous vault using a scalpel laterally at the bony contact and check the dorsal shape again
- Separate (undermine below the lateral bony cap) the lateral K-area, keeping the central K-area intact; check the mobility of the ULC vault: the dorsum should curve
- Stabilization: fixation of the K-area to the septum by two different transfixing sutures: crisscross on the bones and trans-cartilaginous "cerclage" suture

Step #6 – Volume & internal valve reshaping

Evaluation of the internal nasal valve opening: is there a middle third widening? If the supratip is too wide, perform a *W-plasty* by resecting a triangle from the caudal end of the ULC.

If the K-area is too wide, perform an intracartilaginous ULC sagittal section/resection (Kovacevic) and suture (open approach).

Supratip evaluation: free dorsal septum "W-ASA" and LLC supradomal area. "Free" dorsal supratip height adaptation (W-point to ASA point).



Trimming of cephalic lateral crura will be performed subsequently. Dorsum stabilization and sutures. Evaluation of nasal profile: columella excess? Tip rotation? Caudal septum adaptation and resection of any excess. Tongue-in-groove technique and sutures as necessary.

NASAL BIOMECHANICS FOLLOWING DORSAL PRESERVATION PROCEDURE

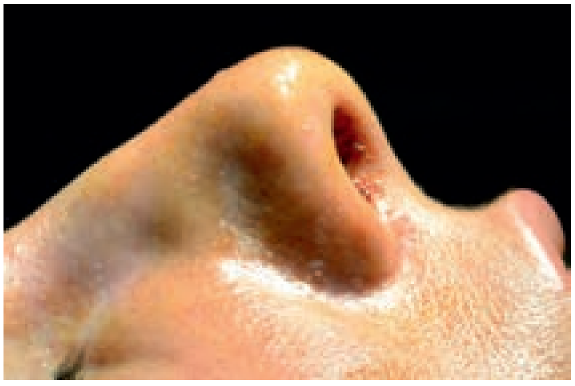
Nasal tip biomechanics

When an endonasal rhinoplasty has been performed, the nasal ligaments and the ULC/LLCs' junction will be intact, and tip deprojection and cephalic rotation occurs. At the same time, an opening of both the internal and external nasal valves should occur. If further tip rotation/projection is desired, endonasal tongue-in-groove technique using a 3/0 Vicryl-Rapid straight needle and/or caudal septal resection can be performed. The autoseptal extension is also an option, as this W-ASA portion of the septum can be used for tongue-in-groove technique or for giving tip support.

Endonasal tongue-in-groove procedure:

- *Exposure* is through the interseptum-columella incision, to evert the columella, one hook is placed on the medial crus foot, while the second one is placed at a higher level close to the infratip area. The assistant pulls these two hooks laterally, while the surgeon is pulling the skin.
- *Medial crura division* is done by using angulated Converse's scissors, divide in soft tissues in between the medial crura; sometimes these intermedial soft tissues correspond to a very strong deep Pitanguy's ligament that can be divided or resected. The tip of the scissors is opened and closed so that it becomes visible on the columella midline. Wide opening allows for creating a space into which the caudal septum will be introduced.
- *Introduce the caudal septum into the middle crus pocket*; check the correct aspect.
- *Transfixing sutures* are then done to fixate the tongue-in-groove in the correct location.

At the end of the tongue-in-groove procedure, the patient's columella and tip should be in the correct position.



A different case. A 23-year-old woman asked for a natural nose and hump reduction. Endonasal dorsum preservation, W-ASA preservation, tongue-in-groove, and a lateral crural steal were performed.

To keep or augment the tip projection, one should discuss a columellar strut following the "diamond tip shape" principles and/or a lateral crural steal. Further tip grafts could be discussed, using the septal strip harvested during the septal step to lower the dorsum.

ULCs biomechanics

Sometimes, a middle third paramedian bump or a middle third widening appears. This is generally related to an excess of residual caudal ULCs scrolls and/or to excess of ULC width. Resection of the scrolls can be done easily through the endonasal interseptum-columella approach without any need for intercartilaginous incisions. Partial division of the ULCs attachments to the septum followed by a V excision of the ULCs caudal edge immediately leads to a better appearance.

On the other hand, the ULCs' lateral attachments under the lateral K-area can act as 3-D blockers of the dorsum converting from convex to concave. Disarticulation of this lateral K-area is sometimes the solution for flattening the dorsum (Göksel, Saban).

Nostril biomechanics

Nostril flaring of the nostrils may also happen due to the vertical downward vector related to the dorsal lowering. This must be discussed with the patient before the surgery as it may require an alar base resection.

DRESSING

Intranasal sutures and dressing. Skin sutures are performed using a 6/0 Vicryl rapid. A transfixing master suture (Vicryl Rapid 4/0) is done just below the junction of ULCs/septum, called the nasal valve suture by Claus Walter. Other transfixing sutures are performed to avoid dead spaces on the septum. No packing or splinting is required. A small cotton wick dipped in Vaseline is left in the nostrils for a few hours.

External dressing is important to avoid any post-operative nasal bony pyramid displacement. An oily skin protection is placed under the adhesive paper on the dorsum and K-area, to allow for an easier cast removal without pulling on the nose. Then, a thermoplastic dressing (Aquaplast©) is placed on the nose with a forehead extension for one week.

Recommendations are given to the patient not to blow the nose, or to augment the blood pressure in the nose by inappropriate positions. Local ointments and cleaning are desirable. No antibiotics nor anti-inflammatory drugs are prescribed, but painkillers are given. Post-operative visits are scheduled, whenever possible, on the 3rd, 8th, 30th, 90th, 180th days and one-year mark, and a medical emergency cell phone is given to the patient.

During the post-operative period, massages are desirable, from the nasal tip to the brows; vertical pressure on the nasal dorsum, perpendicular to the face, can be suggested if any tendency of hump recurrence is feared. In some cases, a second dressing with adhesive paper can be useful.

CASE #1

This 25-year-old lady asked for nasal hump reduction and a very natural postoperative look. No special history of trauma nor nasal disease: no allergy, no sinusitis, no nasal breathing impairment. She showed a tension deviated nose. She underwent an endonasal dorsal preservation procedure: 1) endonasal unilateral inter-septum-columella approach; 2) a 2 mm subdorsal septal strip resection. Let-down procedure via lateral undermining of outer and inner periosteum and bony edge resection. Nasal tip cephalic rotation was achieved through caudal septum resection and septal skin resection according to the caudal septum reduction. Tip surgery with lateral crural steal and tongue-in-groove procedure. No alar base resection. No chin augmentation.

The duration time has been 1h 15min under general anesthesia (TIVA) with laryngeal mask. Locoregional and topical anesthesia have been done prior to hands cleaning, 10min before starting the surgery. She was hospitalized on the day of the surgery. No packing nor nasal splint were inserted. First postop visit on the 3rd day. Cast removal after 8 days. Postop follow-up at 1 month, 3 months, 6 months, 1 year.

CASE #2

A 28-year-old patient was presented for rhinoplasty with nasal obstruction related to septal deviation and asked for hump reduction. Facial asymmetry, wide bony vault, S-shape dorsum with deep radix. Dorsal hump reduction was performed after bony-cartilaginous vault disarticulation via unilateral endonasal inter-septum-columella approach and soft tissue undermining. Septoplasty was performed as the 1st step following a modified swinging-door procedure. The bony cap was resected, while the cartilaginous vault was kept intact and pushed down. Three osteotomies were done: lateral, transverse and medial oblique. No radix graft. Alar base reduction was performed, and the footplates were reduced.

TECHNICAL VARIATIONS IN DORSAL PRESERVATION TECHNIQUES

The basic DP procedure has been extensively presented. However, many technical variations are possible depending on patient's nasal morphology and expectations on the one hand and surgeon's personal skill on the other hand.

To flatten or to curve the dorsum, many sequential options can be suggested. The spirit of these modifications are the biomechanical possibilities to curve the bony cartilaginous junction:

- Resecting the coat-hanger underlying bony cartilaginous septum, through resection or vertical cuts. This weakening allows for transforming a 3D fixed structure into a 2D semi-mobile wing.
- Bony hump reduction by rasping the bony cap, that allows for reducing the bony overlap thickness and weakening the central K-area.
- Dividing the pyriform ligament that blocks the lateral wall expansion.
- Disarticulating the lateral K-area allows for opening the lateral wall junction and avoiding the spring effect leading to hump recurrence.

In very convex bony humps and deep radix, the bony shape might not be able to be preserved. The lowering of such a nasal bone convexity could lead to a smaller unpleasant residual hump that requires revision. This leads to the concept of nasal disarticulation emphasized by Ishida and Jankowski, even if the procedure differs. A dorsum resection is performed following Joseph's principles, while a cartilaginous vault preservation is done following Cottle's principles. This procedure is very helpful in selected cases, mainly those with high bony humps (called the S-shape bony dorsum) and can give excellent aesthetic and functional results.

CONCLUSIONS

Some technical points should be highlighted as related to new surgical anatomy and biomechanical concepts. The K-area consists of a composite fixed 3-D structure that can be transformed into a 2-D semi-mobile framework by freeing some of the anatomic blocking structures: sub-dorsal septum, bony cap, lateral K-area, pyriform ligament.

A new anatomy is merging describing high septal segment and landmarks. The W-point corresponds to the divergence between the ULCs attachments to the septum. A dorsal septum "W-ASA" segment is described between the W-point and the Anterior Septal Angle. In surgery, the first septum resection should start at this W-point and stay as high as possible under the vaults. Complete osteotomies are mandatory prior to any mobilization of the bony pyramid.

Dorsal preservation is an old philosophy newly re-assessed and popularized. The concept of lowering the dorsum through an endonasal limited approach offers many advantages for both patients and surgeons – a very natural results, normal aesthetic lines, and rapid healing. The principle of the sub-dorsal strip resection makes this procedure much easier than a deep septal surgery as performed in previous techniques. In deviated noses, an asymmetric push over to the long side, performed through an asymmetric undermining, gives amazing results after a very quick and safe procedure. In men looking for an improved male nose and no feminization, dorsal preservation is a very safe procedure.

This technique allows saving surgery time and is much less difficult to perform: mainly no difficult dorsal reconstruction and sometimes no tip surgery. Easy revisions if required (21 minutes mean range duration time), as the subperichondrial plane is done and the osteotomy lines are still mobile. The only required surgical procedure could be rasping a residual hump or lowering the dorsum by a new septum resection, or a supradomal camouflage graft. There is no need for reconstruction, grafts, ear or rib cartilage harvesting. All kind of surgical rhinoplasty procedures can be performed after a preservation procedure, even intra-operatively if any problem could occur ("sequential rhinoplasty").

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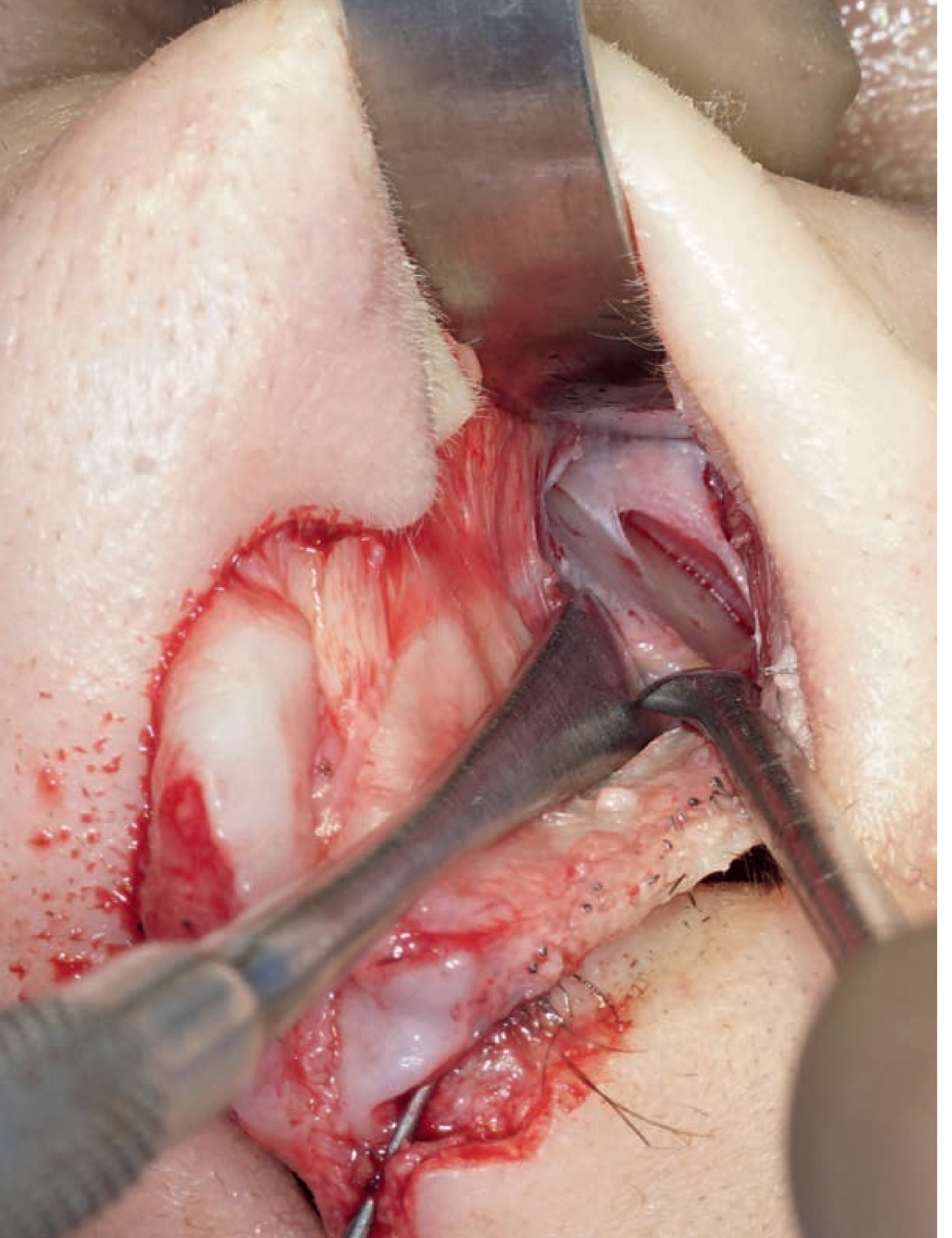


Piezo-Assisted Let Down Rhinoplasty

Abdülkadir Göksel

One of the most important and challenging parts of rhinoplasty surgery is achieving ideal aesthetic dorsal lines. Despite the fact that the most commonly used method to achieve dorsal lowering is by hump resection, there always exists a possibility of potential complications such as irregularities. Specifically, dorsal line lowering by means of ostectomy or rasping usually results in destruction of the keystone area, which necessitates reconstruction of the middle vault. Even the best possible reconstruction cannot bring back the natural anatomy. Considering all that, if there is a possibility of getting a satisfactory result (in terms of aesthetics and functionality) by preserving the natural anatomy, and if the patient's anatomy is suitable, two questions naturally arise: Why would we create a defect that we need to repair later on? Why not reshape the nose by preserving the natural dorsum? In contrast, preservation of the nasal dorsal anatomy does not disrupt the natural anatomy, and one can avoid many complications.

INTRODUCTION

Since the introduction of open structure rhinoplasty, many rhinoplasty surgeons have adopted this technique due to the ease of learning, anatomic evaluation, and multiple techniques. Specifically, the open approach provides better visualization and easier execution for tip, dorsal, and septal techniques. Moreover, new surgical methods and instruments have been introduced. Piezo-electric instruments (Gerbault O et al. 2016, 2018) can be used for shaping the bony dorsum, as well as for precise, delicate osteotomies. In this chapter, the reader will find details of a Preservation Rhinoplasty (PR) technique that enables the dorsum to be modified and preserved. It allows the surgeon to perform the Let-Down (LDO) and Push-Down (PDO) Operation techniques of Saban more easily and under more control (Saban et al, 2018). Our preferred technique for these operations is to utilize it with the assistance of the open approach and piezo-electric instruments (PEI). Throughout, I will emphasize the advantages, difficulties and the important technical points to be considered during the learning process. Note: PEI are used in all of the following cases, and I strongly recommend them for their precision.

Since the nasal ligaments are the main connection between the skin and the skeleton of the nose, by preserving them we reduce post-operative swelling and enable better, faster re-draping of the nasal skin envelope. It is possible to keep the ligaments intact in open preservation rhinoplasty and hence the operated nose can still retain its elasticity. This point is particularly relevant for the thick-skinned rhinoplasty patient, in whom it is often difficult to get contours, especially in the early post-operative period. In our experience, preservation of the ligamentous and skin attachments will help to create better contours in these patients.

PATIENT SELECTION

When deciding whether to preserve the nasal dorsum or not, it is essential to assess the patient's dorsum and its deformity. Also, the severity and composition of the dorsal convexity must be evaluated. Additional determining factors include the following: the surgeon's experience, the technique one is accustomed to, as well as the patient demands and expectations.

In our practice, we consider *contraindications* to be the following: 1) when total or partial nasal septal reconstruction is required, 2) secondary cases, 3) patients with prior open roof reduction rhinoplasty, and 4) patients whose angle between the nasal bone and the upper lateral cartilages is less than 150 degrees.

The best *indications* for the High Septal Strip (HSS) approach are the following: 1) dorsal hump ≤4mm, 2) hump is mostly cartilaginous, 3) high septal deviation, 4) over projected radix, 5) caudal septum is in the midline, 6) straight noses, 7) V shape nasal bones.

During the patient selection process, we divide the patients into three groups according to their soft tissue and dorsal deformity.

Group #1

These patients have good dorsal aesthetics, V shape nasal bones and only need reduction of the dorsal profile line. In this group, it is possible to do a preservation rhinoplasty via an open approach with no skin elevation on the dorsum and at the same time to preserve virtually all of the nasal ligaments. In the figure below, the red and orange areas are the dissected part. The green zone is intact, with no skin elevation. This limited dissection technique was described by Dr.Raymond Gola (Gola,1989). Dr. Hüseyin Güner and Dr.Teoman Doğan from Turkey developed a similar dissection witha closed approach.

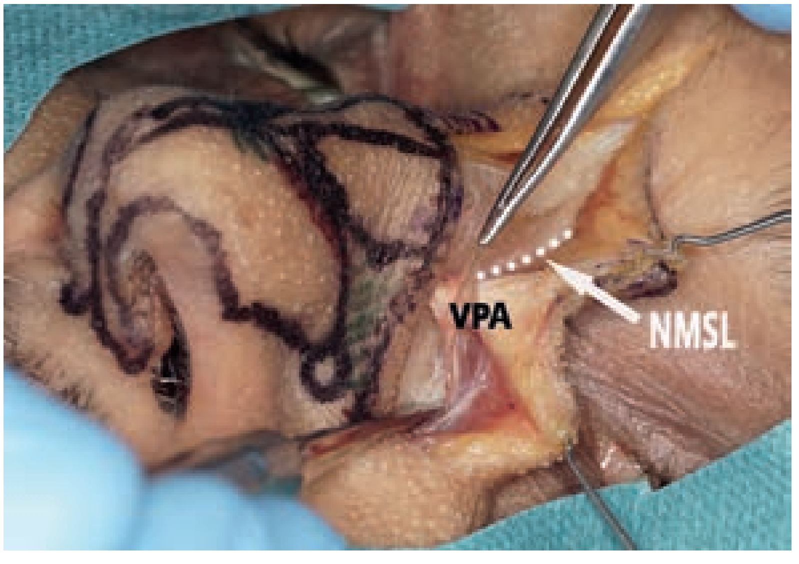
Group #2

These patients have good dorsal aesthetic lines; yet, they require modification due to the height of the bony hump. In this group, it is necessary to elevate the dorsal skin and partially dissect the ligaments. In the figure below, the red area demonstrates the dissected zone. We make a tunnel between the deep Pitanguy and Vertical Scroll Ligament (VSL) for approaching the dorsum. With this maneuver, we can refine the dorsal aesthetic lines while preserving ligaments. The green zone is not dissected, and the skin is not elevated.

Group #3

Despite irregularities and asymmetries on the nasal dorsum, it is still possible to preserve the dorsum. In this group the dorsum is reshaped and preserved through total dissection of the skin of the nasal dorsum. The Pitanguy ligament and Scroll ligament can be fixed at the end of the procedure. In this group, the dorsum is reshaped and preserved with dissection of the nasal dorsal skin, while preserving the deep Pitanguy and vertical scroll ligament. In the figure below, the red zone is the area of dissection. If there are significant deformities on the dorsum, we alter this approach to include total dissection and skin elevation without preserving the nasal ligaments.

We can preserve also Nasomaxillary Suture Line Ligament (NMSL), which is located along the suture line between the nasal bone and the frontal process of the maxilla in Group #1 and #2 cases. It is an important structure when it comes to osteotomies, notably because if this ligament can be kept intact during the piezo osteotomies, skin redraping and healing will be faster. Preservation of the Nasomaxillary Suture Line Ligament can be achieved by creating a tunnel posterior to this ligament for the low-to-low osteotomies. The dotted line shows this ligament (NMSL) along the suture line. VPA indicates the Vertical Pyriform Attachments (see Daniel & Palhazi, 2018).



SURGICAL TECHNIQUE

For the open approach, we prefer an inverted-V incision method for all patients. For the skin and SMAS dissection, it is crucial to define first the planned procedure on the nasal dorsum. We have three different soft tissue dissection plans. If we have no planned changes on the nasal dorsum, we continue with the ligament preservation method. If there is a need for rasping on the bony dorsum, we preserve ligaments, but dissect between the Pitanguy and vertical scroll ligaments to reach the dorsum. If there is a need for additional manipulations both on the bone and cartilage of the nasal dorsum, we elevate the dorsum supraperichondrially, by cutting through the deep Pitanguy ligament and preserving the vertical scroll ligament. During skin or SMAS dissection, if there is no need for rasping or camouflage, we create a subperiosteal tunnel for lateral and transverse osteotomies by approaching the pyriform aperture laterally from the vertical scroll ligament and the Pitanguy ligament without elevating the nasal skin. The lateral tunnel should be wide enough to enable utilization of PEI under direct visualization. For patients who need nasal dorsum reshaping, depending on the procedure required, we elevate the nasal skin supraperichondrially, by dissecting between the vertical scroll ligament and the Pitanguy ligaments. We dissect the bony dorsum in the subperiosteal plane for rasping of the bony cap. If there is a need for reshaping on both the bony and cartilaginous dorsum, we cut the Pitanguy ligament and the vertical scroll ligament. We dissect the skin in the supraperichondrial plane in the cartilaginous area and in the subperiosteal plane over the bony area. With a widened skin dissection, we conduct the procedure up to the radix area and pyriform aperture, including the superficial portion of the medial canthal ligament which enables use of PEI.

Dorsal Hump Modification

The main rhinoplasty indication in Caucasian patients, which constitutes the majority of our patients, is the nasal dorsal hump. The technique of rasping or resecting the nasal dorsum was developed by Joseph. Once the dorsum is reduced, the nasal dorsal lines of the keystone area must be restored and the open roof deformity closed. When the nasal bone and the upper lateral cartilage part are rasped, the natural anatomy is disrupted, and spreader grafts, flaps or camouflage grafts are needed to repair the defect, both aesthetically and functionally. The idea of correcting the dorsal hump by preserving the nasal dorsum is both aesthetically and functionally easier than reconstruction. DP reduces the operative time and the amount of graft material required. We have modifie Saban’s closed Push Down Operation for preserving the nasal dorsum (Saban et al. 2018). We perform it by using an open approach with the assistance of PEI.

Approaching the Septal Cartilage

In open preservation rhinoplasty, which we perform by preserving all the ligaments, we reach the septal cartilage by a hemitransfixion incision. If we are to cut the Pitanguy ligament and make a modification on the nasal dorsum, we reach the septum through the caudal area without additional incision. We approach the septal cartilage immediately under the dorsal hump by creating bilateral tunnels approximately 1 cm in width. We start the dissection from the caudal part of the septum subperichondrially. It is highly important to point out that the strip resection of septal cartilage should be started in the area just underneath the dorsal hump while by preserving the caudal part of septal cartilage. The resection continues up to the point where the upper lateral cartilages and the caudal septum meet. Septal cartilage resection in the amount of planned hump resection is carried out by a surgical blade or a pair of dissection scissors with an incision up to the meeting point of the bony and cartilaginous septum (E-point), visualizing the area with a nasal speculum. With a cut of the scissors just below the dorsal hump, we remove the strip of septal cartilage by separating it from the perpendicular plate. It is important to leave the smallest possible fragment of the septal cartilage under the dorsum.

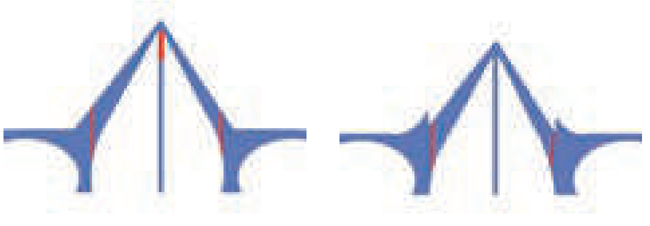
The perpendicular plate is excised with the long saw insert of the PEI (see figure below) or with a 2 mm Rongeur. Hence, we completely separate the frame of the nasal dorsum consisting of the nasal bones, ULCs and the nasal septum. Owing to this, the possibilities of unwanted fracture lines or CSF leaks after ostectomy and osteotomy are prevented, as we leave no connection between the rest of the ethmoid bone and the perpendicular plate while moving the dorsum.

Piezo Osteotomy/Ostectomy

PEI are useful for cutting through hard tissues such as bones. Thanks to the new generation of these devices, procedures such as reshaping, cutting through and rasping of bones can be carried out much faster and easier. Also, PEI do not damage soft tissues and membranes, nor cause bleeding during the bone shaping process. There are visibly less bruises on the skin in the postoperative period. Moreover, as this technique helps to avoid the unwanted fracture lines usually occurring with osteotomies carried out with osteotomes, it prevents typical complications during the reshaping of the bones. See Drs Gerbault and Zholtikov chapter on Ultrasonic Rhinosculpture.

Lateral osteotomies and ostectomies are performed for all our patients using PEI. In order not to create a visible or touchable step deformity in the lateral osteotomy area, we perform our osteotomies as close as possible to the maxillary bone, right above the Nasofacial Groove in a low-to-low approach. In transverse osteotomies, with patients from Group #1 and #2, we use the combination of Taştan-Çakır hand saws and a 2 mm external osteotome. With patients in Group #3, we carry out all the osteotomies including the transverse osteotomies with PEI.

As the lateral osteotomy is performed in the *sagittal plane*, it is possible to easily push in the nasal dorsum, in both osteotomies and ostectomies, and as the borders of the new bones are parallel to the sagittal plane, it enables the dorsum to move lower and prevents any residual hump or recurrence of the hump in the late postoperative period.



It is important to note that the resection on the bone does not determine the amount of nasal dorsum lowering. The main determinant of dorsal reduction is the amount of the septal strip removed from the dorsal septum. If there is a need for additional hump reduction, it is possible to remove more from the dorsal area of the septum. After ostectomy and osteotomy, one can reduce any resistance to dorsal lowering by elevating the periosteum of the inner surface of the maxillary bone beginning at the pyriform aperture and continuing cephalically.

The Webster triangle is another important anatomical landmark when we do low-to-low sagittal osteotomies. The head of the inferior turbinate's bony attachment is located immediately posterior to the Webster triangle. When the whole dorsum pushes down, the pyriform aperture of the maxilla can overlap with the inferior turbinate bony attachment exactly an the Webster triangle. This overlap has the potential to cause unwanted residual hump recurrence since the bony fragment of the inferior turbinate can block the intended downward movement of the lateral bony wall. Therefore, in order to prevent this undesirable consequence from occurring, we recommend that the Webster triangle be resected when using the preservation technique.

When using the piezo, this resection can be easily and accurately performed. Because of the bone overlap providing bony support, resection of the Webster triangle does not result in breathing problems from internal nasal valve lack of support and subsequent collapse in dorsal preservation techniques.

In both let-down and push-down cases, we conduct low-to-low lateral ostectomy on our patients. Scraper, straight, and angled piezo inserts are the easiest, fastest, and most precise instruments. In PDO patients, we conduct osteotomy by thinning the bone and leaving a thin bone layer intact. With LDO, I use the scraper for thinning and then excise a bone strip as narrow as needed. Later, by applying a transverse osteotomy from the radix, I merge the lateral osteotomy and ostectomy lines on both sides. The transverse osteotomy level is highly important for preventing potential step deformities and irregularities in the radix. If a transverse osteotomy is carried out from a level lower than the radix, from the end of the hump, the inferior radix part might cause a step deformity or a low projected radix. The best way to determine the transverse osteotomy level is to take the intercanthal area as a guide.

It is harder to reach the transverse osteotomy area and use PEI there when we preserve the ligaments and do not dissect the nasal dorsum. For that reason, in Group #1 cases we conduct the lateral osteotomies sagittally using PEI, but for transverse osteotomies we use Taştan-Çakır hand saws and a 2 mm osteotome. After conducting the transverse osteotomies on both sides, we complete it by doing the radix osteotomy externally. A 2 mm incision is made in in radix area using a #11 surgical blade. Once the osteotomies are completed, the whole dorsum becomes mobile.

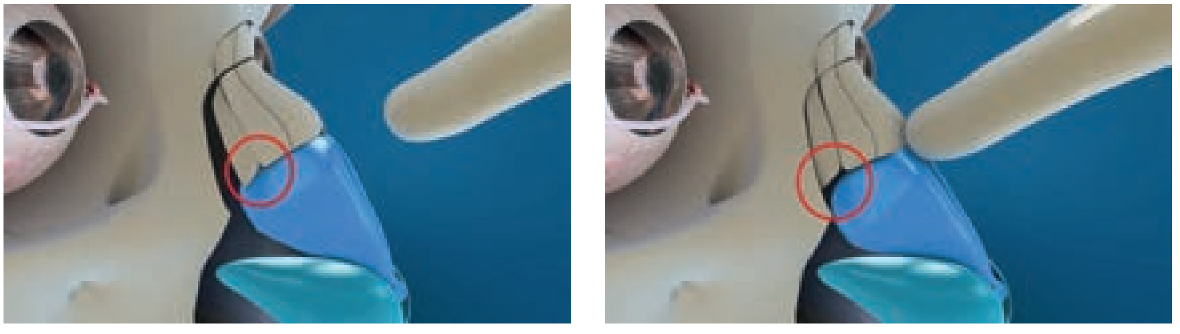
In cases of an over projected radix, there might be a step deformity after completing a transverse osteotomy and lowering the dorsum,. In these cases, we use a piezo scraper insert for equalizing the bone level. Also, for patients with an over-projected radix, it should be remembered that the sub-SMAS layer in that area might be thicker and that there is also the Procerus muscle. In these cases, if the bone is rasped to lower the radix, excising the Procerus muscle will help the skin to settle and allow us to create a more defined nasal start point.

How to control the new shape of the nasal dorsum?

Depending on the desired shape, the newly-formed nasal dorsum can be straight or concave. While it is impracticable to change the shape of the nasal dorsum with the technique developed by Cottle, with Saban's modified technique it became possible. First, it is vital to mobilize the osseocartilaginous connection between the ULC and the nasal bone. To change the shape of the Dorsal Keystone Area (DKA), the connection of the septal cartilage should be weakened. The residual septum underneath the dorsum can be mobilized by scoring.

Ballerina Maneuver (Lateral Keystone Release). If a more straight or concave look is desired on the nasal dorsum, the keystone area can be mobilized further by releasing the Pyriform Ligament (Daniel, Palhazi 2018). It is critically important to understand that the dorsal hump is not a two-dimensional structure. Apart from the release at the DKA we should also mobilize the Lateral Keystone Area (LKA) to change the shape of the nasal dorsal anatomy. Depending on the nasal dorsal shape and the height of the current nasal hump, it may be necessary to separate the ULCs from the nasal bone. To decide on the amount of dissection, the hump height and the desired shape is marked with blue, determining the end level of lateral dissection. In the figures below, one can see that the blue line marks the hump and at the same time determines the end of the lateral dissection. We are palpating and checking the new dorsal shape and its mobility. After drilling the nasal bone we apply a crisscross suture for fixing the newly positioned dorsum to the septum.

The figure below shows the lateral dissection area. With this dissection, we release the LKA for free separational movement during hump reduction. With these maneuvers, we prevent the complication of a residual hump.

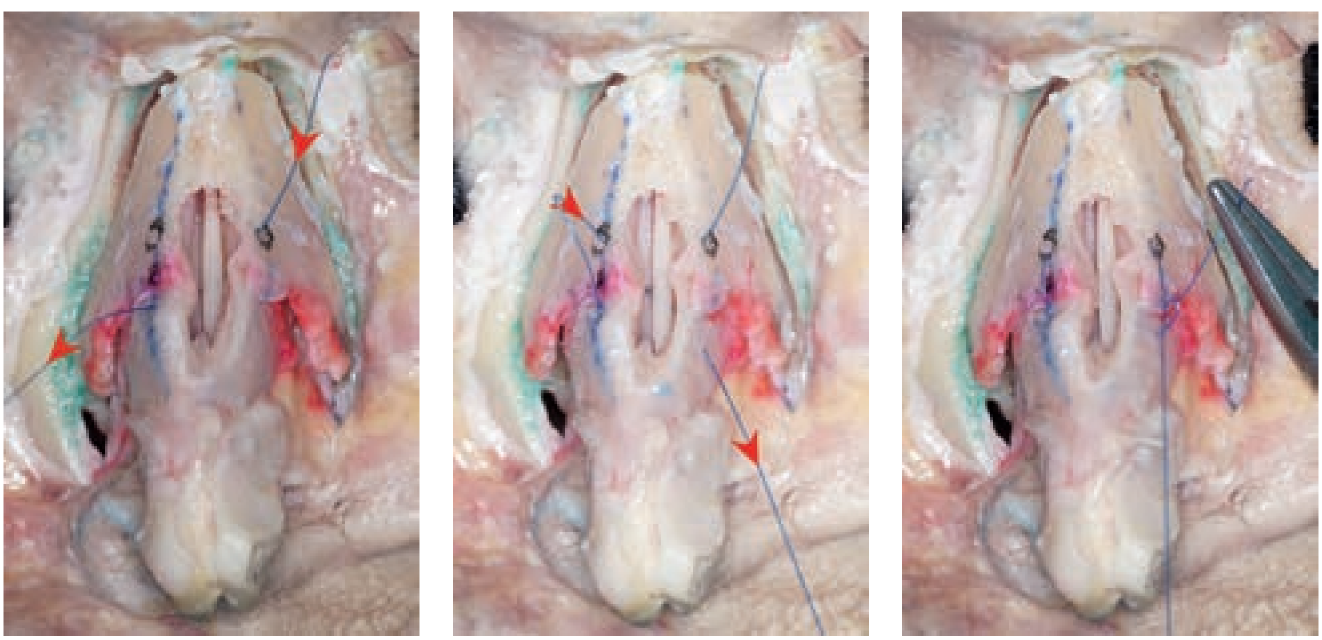


Also, rasping the nasal bone's dorsal area and weakening its connection with the ULC is another maneuver to help the nasal dorsum to achieve its new shape. If there is a desire to drop the nasal dorsum even further, there will be a need to remove an additional strip from the dorsal septum. The key determinant of the nasal dorsum is the septum. No matter how much bone is removed from the bony base, the amount of lowering the nasal dorsum depends on the amount of excision from the septum.

Fixing the New Nasal Dorsum

The nasal dorsum becomes fully mobile after all these above-mentioned maneuvers. Despite the fact that all the resistant areas are relieved with dissection, there is a need to fix the dorsum in its new positon with sutures. In some cases, the mobilized nasal dorsum might have to be fixed in the midline. Depending on the dissection type that is determined at the beginning of the operation, we fix the nasal dorsum with various methods. In Group #1 cases, the ligaments are preserved, and therefore we use a special suture method for fixation. First, we go through the ULC, moving from the inside of the nose and exiting the skin. Then, we enter again the same exit point used before, moving from the outside of the skin and crossing to the opposite lateral cartilage. Then we move out through the skin on the other side and finish the suture by passing through the same second exit point, going back to the nasal cavity. We use 5-0 PDS. After finishing the suture, the nasal dorsum is fixed to the septum.

With Group #2 and Group #3 dissection patients, a hole is made on the nasal bones using the piezo drill insert on both sides. Starting from one side and using 5-0 PDS, the suture passes through the dorsal area of the septal cartilage and the opposite side's ULC, respectively. Then, the suture passes through the nasal bone hole on the other side and reaches the starting point by going through the septal cartilage and the ULC on the starting side. When the sutures are completed, the nasal dorsum is fixed to the stable structure underneath, the septal cartilage. In the figure below, one can see that an open roof is created on a cadaver to show how the suture passes through the septum. At first, we pass through the bone and septum before exiting the opposite side's ULC. Then, performing the same procedure on the other side and after passing through the septum, we exit on the starting side on the ULC. When the stitch is completed, the nasal dorsum is stabilized to the septum. Note: The open roof is only for illustrative purposes; normally, the dorsum would be preserved.



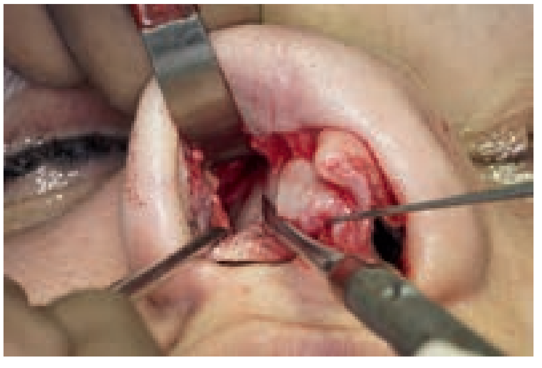
CASE #1 – Piezo-Assisted Let Down Rhinoplasty (Group #1)

Patient's pre- and postoperative photographs can be seen below, showing the sequence of piezo-assisted open preservation rhinoplasty. This patient is a good candidate to preserve all ligaments, skin and the dorsum. She has a bony and cartilaginous hump, straight dorsum, and a slight deviation on the caudal portion of the septum. The droopy tip can be solved by the lateral crural steal technique. We solved the problem of lateral crural convexity by using a lateral crural strut graft.

Following the injection of the lidocaine and adrenalin solution, we wait for the nose to completely blanch and the patient's blood pressure to stabilize. This process generally requires 15 minutes. We prefer an inverted-V shape columellar incision. When the incision is straight or does not have enough angles, it leads to excessive scarring. We dissect the columellar skin by cutting each corner with a sharp knife and then use sharp scissors for dissection. Bipolar cautery is used to prevent bleeding of the columellar artery. When the caudal edge of the lateral crus becomes visible, we are using the same sharp scissors for the rim incision and follow the cartilage to complete the rim incision.

The assistant helps me to proceed with my dissection in the supraperichondrial plane by pulling out the lateral crus with a small hook. We dissect the nasal bones subperiosteally, starting from the pyriform aperture in order to perform osteotomy easily with PEI. The probability of creating a perceivable step deformity when we do a let-down decreases if osteotomy is performed as close as possible to the nasofacial groove.

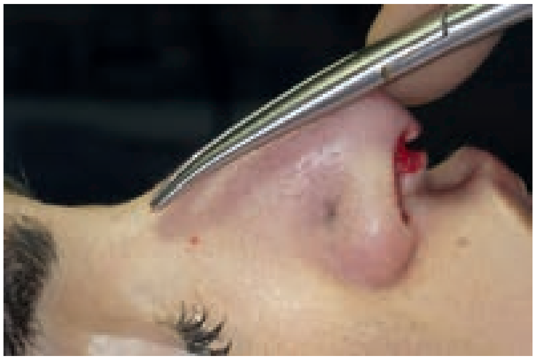
We dissect with a Freer elevator up to the medial canthal ligament, then make a turn to the midline and connect the two sides of the tunnel at the radix area. After performing the same dissection on the opposite side, I will be able to perform osteotomies sagittally with PEI.



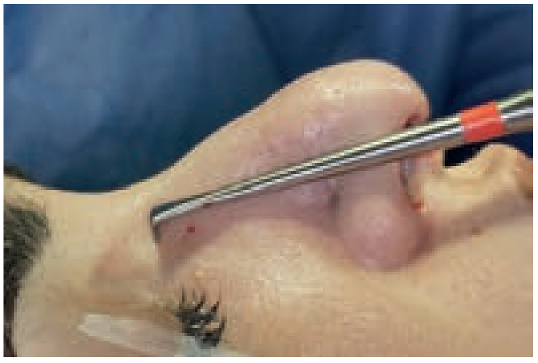
The septum is approached by a hemitransfixion incision. A dissection is made on both sides subperichondrially. On one side of the septum, the entire mucosa is undermined subperichondrially, while on the opposite side only a superior tunnel is made. This approach allows us to keep one side of the mucosa attached, which gives greater structural stability.

A cartilaginous septal strip is removed between the W-point (most caudal point of the ULC) and perpendicular plate to lower the dorsum. We do not excise the septum in between the W-point and the ASA at this stage.

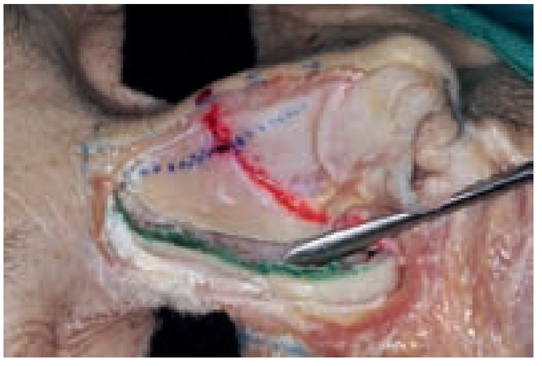
We release the connection between the nasal bones and the septum by cutting the bony structures under the nasal bones, using a 2 mm small rongeur. It is important to perform this maneuver before lateral and transverse osteotomies. If done after the osteotomies, then unwanted fractures of the perpendicular plate could occur. Lateral osteotomies are performed along the nasofacial groove with a straight piezo saw insert. A sagittal shape cut makes it easier to move the nasal bones downward. Thus, the thickness of the bone at its posterior border is not pushed into the nasal airways.



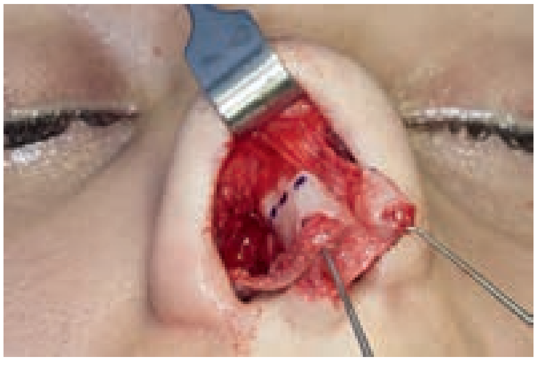
Transverse osteotomy begins at the lowest point of the radix (*sellion*). This level is almost always at the same level as the medial canthal ligament. It is important to precisely evaluate the osteotomy level in order to prevent any step deformity. We prefer to use the Taştan-Çakır hand saw, because often we are not able to use PEI safely in Group #1 patients. Radix osteotomy is the last step to make the entire dorsum mobile and to enable it to be pushed down. We prefer to use a 2mm sharp osteotome externally for the radix osteotomy. The direction of the osteotomy is another important point that depends on the wishes of the surgeon. If the goal is deprojection of the radix, then the osteotomy should be done in a direction perpendicular to the bone. However, if we wish to hinge the radix, then it is safer to do it in an oblique manner.




Elevation of the mucosa on the inner surface of the maxillary bone eases the shifting of the nasal bones inside the nasal cavity due to the lower soft tissue resistance.

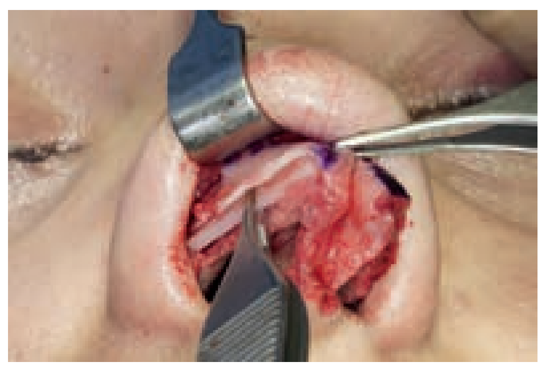



While pressing the bony pyramid downwards, it is important not to use excessive force with our fingers on the nasal sidewalls. If one squeezes with too much force, the bony pyramid may fracture and cause undesirable deformations. Afterwards, the border for the cephalic resection of the lateral crus is marked, and we make sure to leave the same amount of intact lateral crus on both sides. As visible in the below right figure, one can see that both the deep layer of the midline Pitanguy and the vertical scroll ligaments are intact.

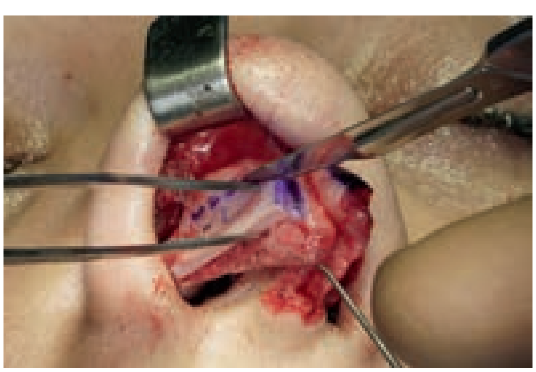



We usually use a lateral crural strut graft to flatten the lateral crus. Our other option is a turn-over flap, especially for patients with convex lateral crura and not enough graft material from the septum. After deciding on tip defining points, we prepare the grafts from cartilaginous material harvested from the cartilaginous septum. Afterwards the lateral crural strut grafts are prepared. It is important not to use grafts from the portion of the septal cartilage which is attached to the maxillary crest, because it can ossify and create some unwanted deformities.

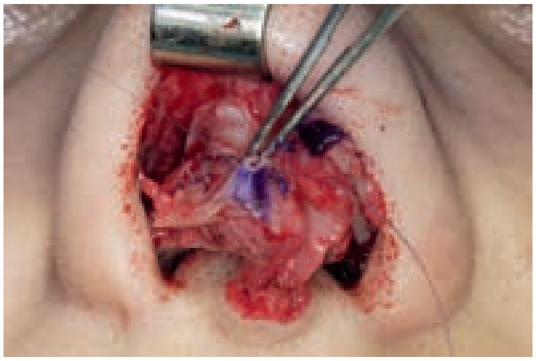

Vestibular skin is elevated with dissection scissors after hydro dissection. 6-0 PDS is used for fixing the graft, prepared from the thin and straight portion of the septal cartilage, into the prepared pocket.

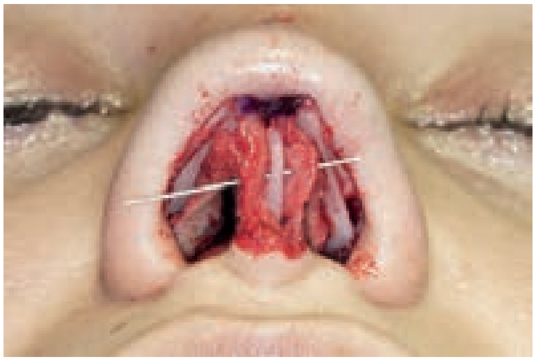



After graft placement, cephalic resection is performed along the marked lines on the lateral crura. Then, a Cranial Tip Suture is performed, as described by Kovacevic for the tip shaping. As it is different from the classical horizontal mattress suture, this technique helps not only to flatten the lateral crus, but also to evert the caudal edge of the lateral crus. Our choice is 5-0 PDS for this suture.

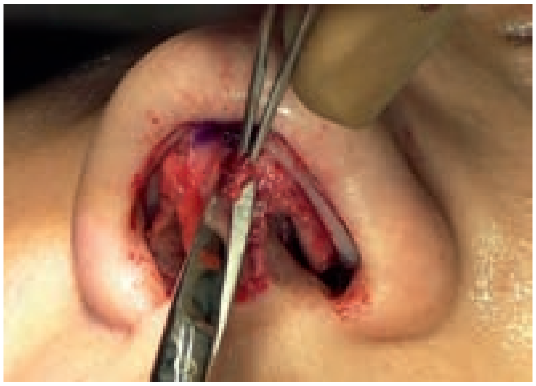



After removing any dog ear on the cephalic portion, one can add a hemidomal suture of 6-0 PDS to smooth the cephalic border. This stitch also works as a safety stitch. The next step is the columellar strut graft which helps to improve nasal tip support and stabilize the medial crura. The grafts should not be too wide and should be placed as posterior as possible between the medial crura.





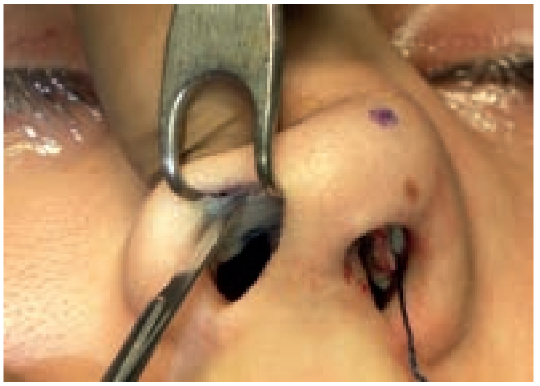
If it is necessary to adjust tip projection and columella- lobular angle, we use a medial crural set back maneuver by cutting the medial crura, overlapping them, and fixing them with 6-0 PDS. This maneuver helps to deproject the tip. Once completed, the columellar incision is closed with 6-0 PDS, by putting at least 5 knots at every corner. During the closure, the assistant is continuously washing the surface with saline solution. The marginal incision is closed with 6-0 rapid Vicryl.



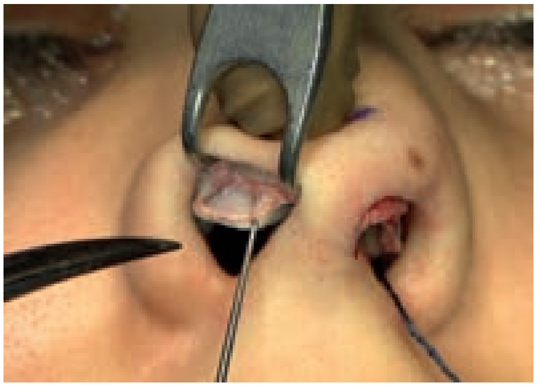
CASE #2 – Piezo-Assisted Let Down Rhinoplasty (Group #1)

This patient is an appropriate candidate for preservation rhinoplasty. She has a small dorsal hump in both the cartilaginous and bony dorsum, and an under projected tip. We can achieve a good result using an open approach and preserve all the ligaments. Additionally, tip sutures and if necessary, tip grafts can be applied for improvement of the tip.

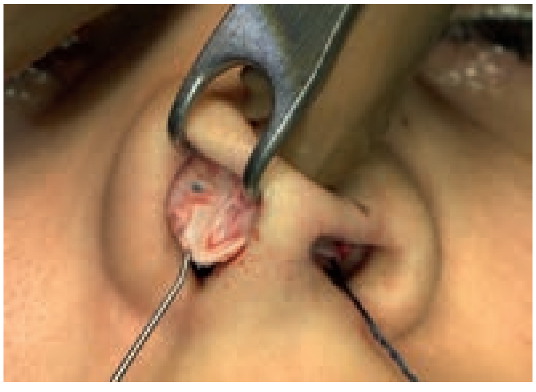
Thirty minutes before starting the surgery, we use oxymetazoline spray inside the nose to provide vasoconstriction. After administering the local injection, we wait until the patient's blood pressure is lower and the patient stabilized. During this period, we mark the nasal tip points that we want to create. Since we reshape the tip of the nose at the end of the surgery, we start the surgery with rim incisions.

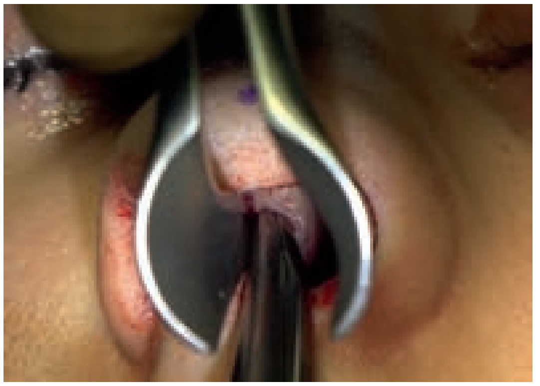
We continue this incision along the caudal sides of the medial crura in the columella. The alar cartilages are dissected in the supraperichondrial plane.

During dissection, the assistant helps me by stretching the vestibular skin with hooks, which makes the dissection process easier. As the pyriform aperture is reached, an adequate tunnel is opened for performing an osteotomy in a subperiosteal plane with PEI.

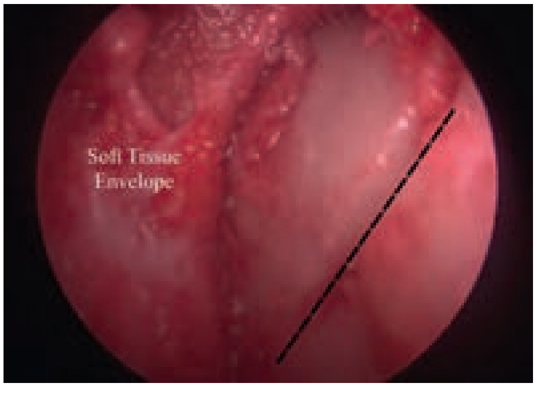


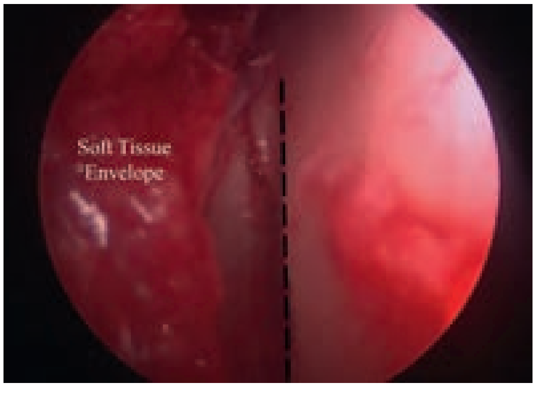

A hemitransfixion incision is done for approaching the septum via a subperichondrial dissection. A strip of cartilage from the dorsal portion of the septum is taken out, just immediately beneath the hump. In this way, the connection of the septum and dorsum is separated.



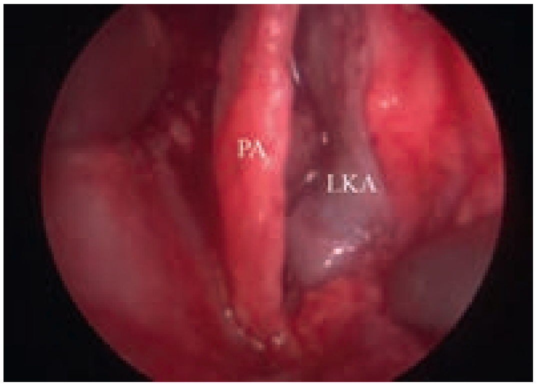
Osteotomy is performed at the level of the nasofacial groove using a piezo straight saw insert. The mucosa of the maxillary bone is elevated; thereby, the dorsum is let down to move freely, making a space for shifting.

For transverse osteotomies, the Taştan-Çakır saws are very practical. For connecting both sides of transverse osteotomies, an additional stab incision is performed, followed by a radix osteotomy using the 2 mm osteotome. The following figures show the endoscopic view of the transverse osteotomy line made with the Taştan-Çakır saw and the lateral osteotomy line made by PEI.

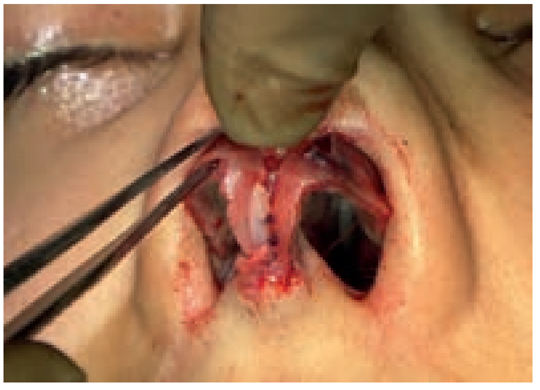




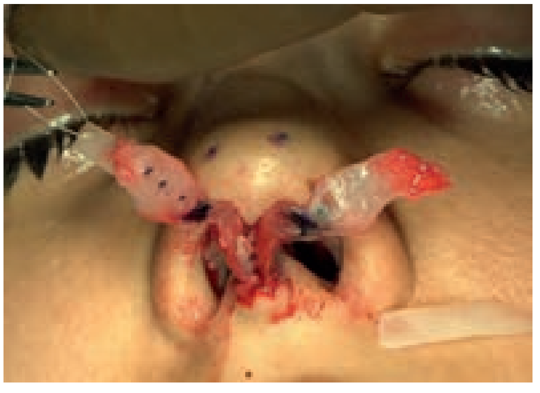
We perform a Lateral Keystone Area (LKA) dissection from the Pyriform Aperture (PA) for preventing the tissue resistance that may occur when the dorsal hump is pressed downward. When all those maneuvers are completed, the dorsum will be free to move, and with slight pressure, the dorsal hump can be pushed downwards and reshaped.



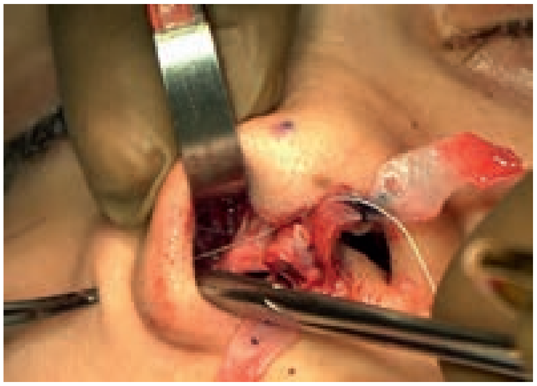
After completing all manipulations on the nasal dorsum, the Lower Lateral Cartilages (LLC) are dissected supraperichondrially through the columellar inverted-V incision. Using a columellar strut graft, we additionally support and equalize the height of both medial crura. We try to make this graft thin and to place it as posteriorly as possible.



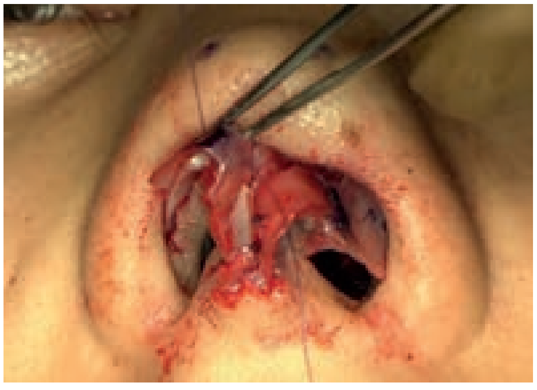
The lateral crus is dissected from the vestibular skin, followed by insertion of the lateral crural strut graft for crus flattening and shaping. Grafts are placed into pockets, which were created through the lateral crus and fixed with 5-0 Vicryl.



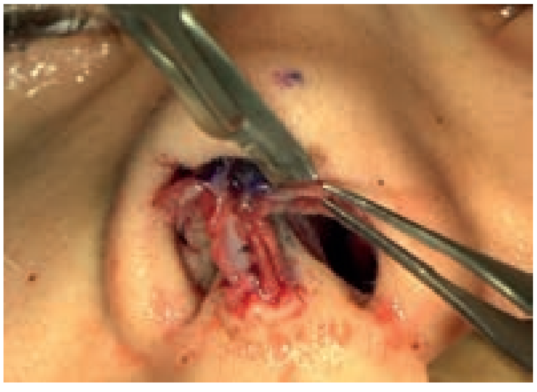
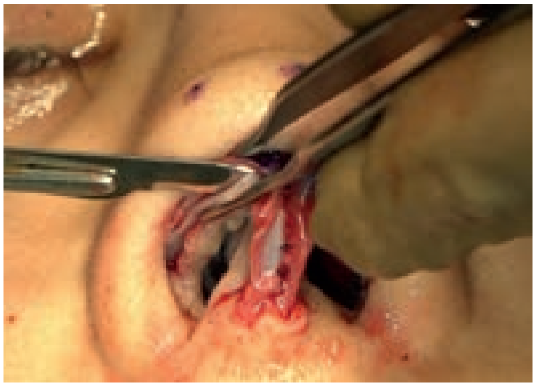
Both sides of the lateral crura are attached with the sutures passing through the skin. It helps to fix the positioning of the crura and to model the crural shapes more accurately.



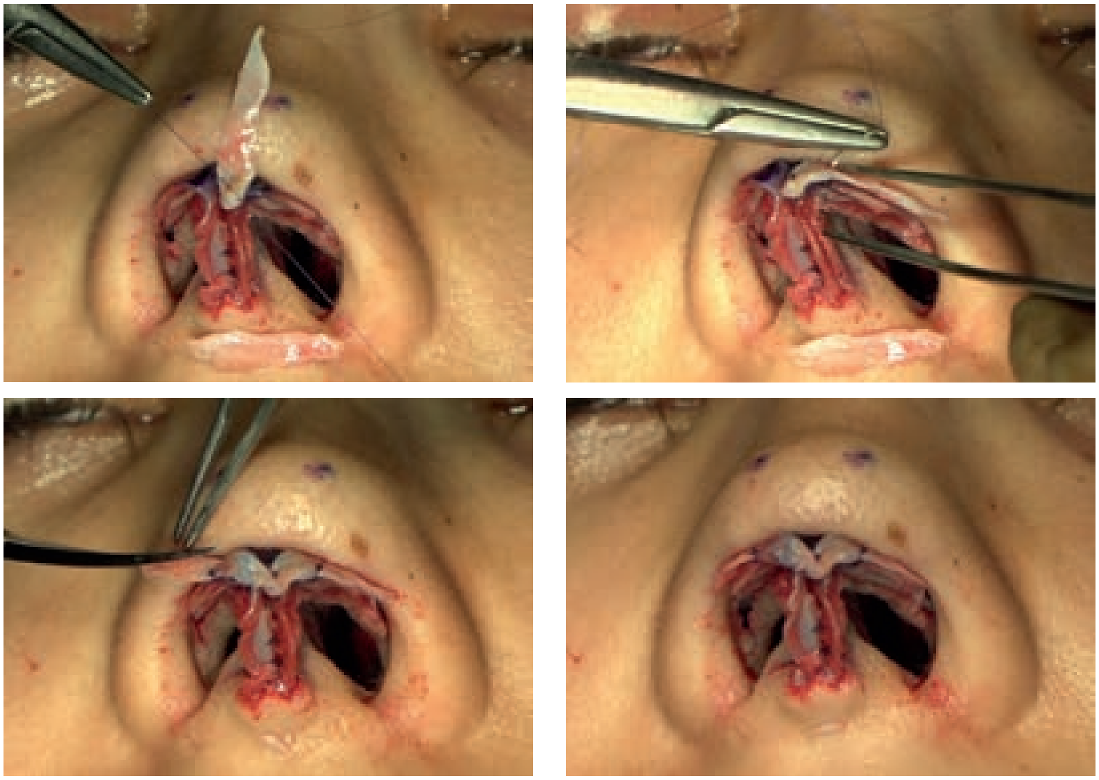

For nasal tip sutures, we prefer Cranial Tip Sutures (CTS). After taking out any dog ears, we often add a cephalic dome suture.




To achieve a softer light on the lateral crura's caudal margin, 1-2 mm cartilage is turned in by cutting with a 15 blade on both sides.

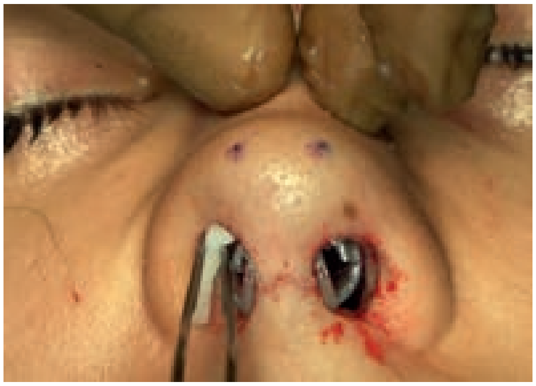



The resected portions of the lateral crura are reattached on both domes separately and thereby provide better and more natural light reflection on the nose tip, as well as higher tip projection.

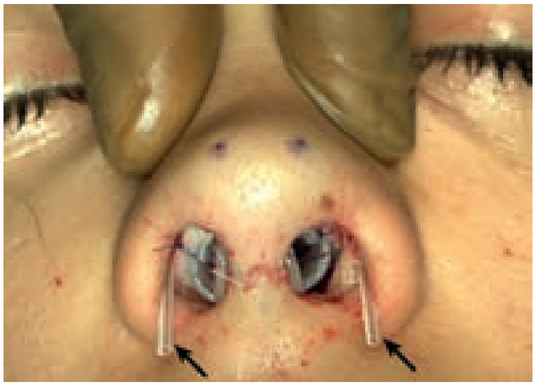


The columellar incision is closed with 6-0 PDS. The septal cartilage is covered with the airway silicon Doyle splints.

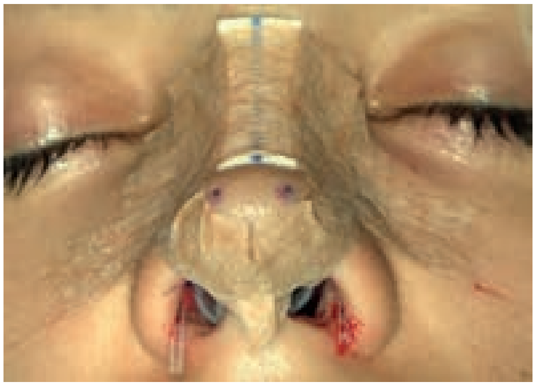
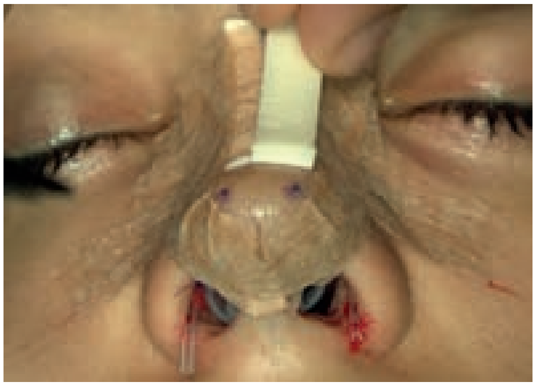
In cases where we completely separate the vestibular skin from the cartilage, we apply Merocel pieces to the silicon, placing them between the silicon and the vestibular skin to preclude a hematoma during the healing process.




For the dissection zone, which was created for the lateral osteotomies (entered subperiosteally), drains (prepared from venous catheters) are placed to stay there for one day. First, a thin layer of the cotton pad is placed to prevent any pulling on the skin during removal of the plaster.




Before the placement of the plaster, we add one layer of sponge to additionally stabilize the new shape by pressing on the nasal dorsum.

CASE #3 – Piezo-Assisted Let Down Rhinoplasty (Group #2)

Pre- and postoperative photographs of a Group #2 patient are shown below. I kept intact Pitanguy and the vertical scroll ligaments. I made a tunnel between them and reshaped the dorsum using a piezo rasp insert. Additionally, I did a limited undermining of the soft tissue envelope over the lateral sidewalls.

CASE #4 – Piezo-Assisted Let Down Rhinoplasty (Group #3)

Pre- and postoperative photographs of a Group #3 patient are displayed below. For reshaping the dorsum, I undermined the entire soft tissue envelope and did not preserve the ligaments. I used PEI to reshape the bony cap and added a diced cartilage camouflage graft for correcting the middle vault asymmetry.

CONCLUSIONS

As this chapter illustrates, it is quite feasible to do a "closed-open" approach, performing the dorsal preservation and osteotomies closed and then opening the tip to do advanced tip shaping procedures. The role of piezo-electric instruments has been illustrated using at least three different dissection methods with ligament preservation. Also, adapting the method of osteotomies (hand saws, osteotomes, piezo-electric instruments) to the patient's deformity is an important concept. Ultimately, the surgeon should incorporate preservation rhinoplasty into their own rhinoplasty technique and needs to realize that the operation is continuing to evolve.

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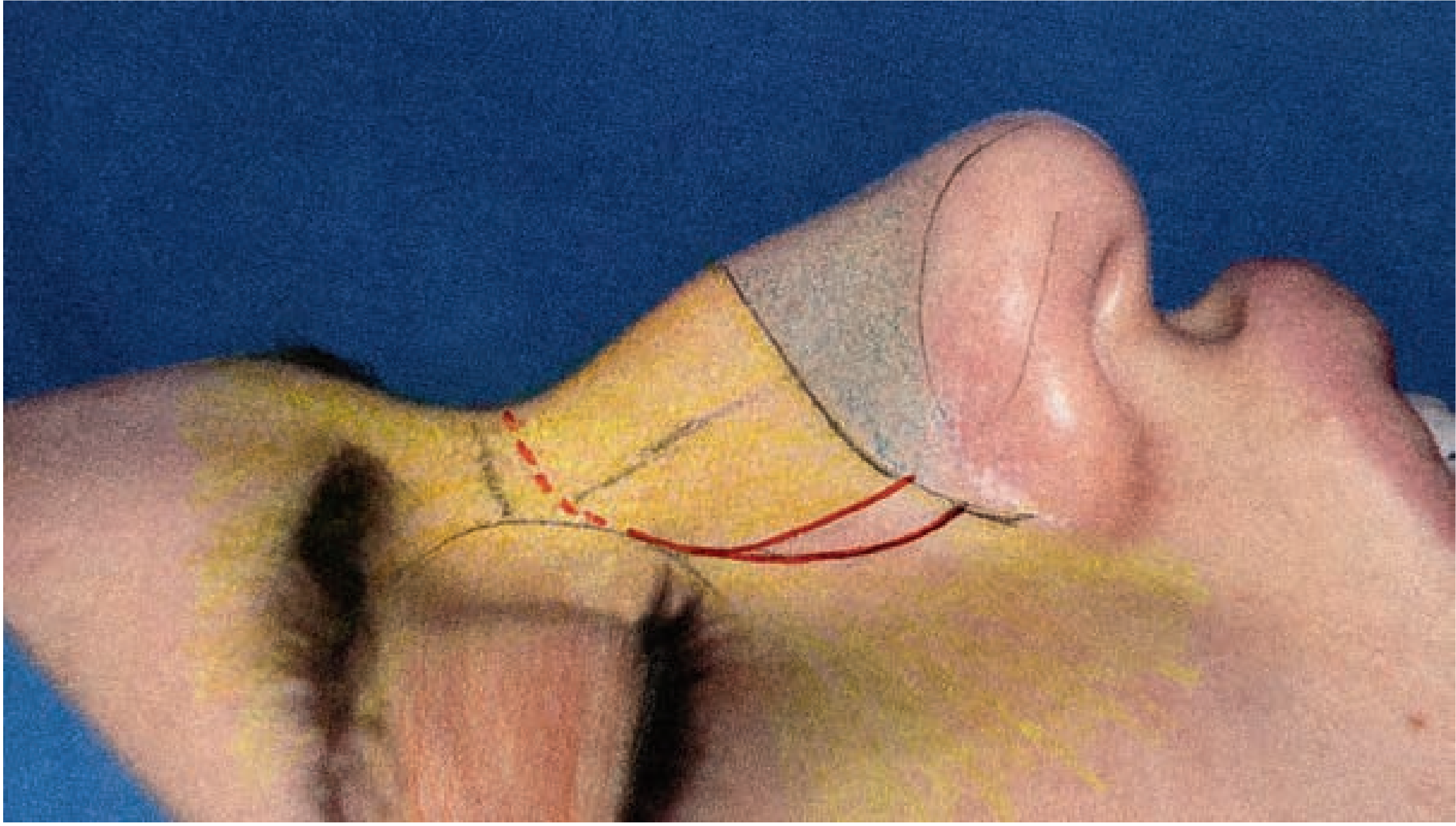


Let Down Rhinoplasty with Modified Cottle Technique

Fausto Lopez-Ulloa, Elizabeth Jasso-Ramirez

After several courses in the early 1970s with Dr. Maurice H. Cottle, Dr. Keneth Hinderer, and, Dr. Glen Drumheller, my father (Dr. Fausto López Infante) learned the push down technique. After his early education and subsequent faculty appointments in the United States, he returned to Mexico where he performed and taught the Let Down technique to many Mexican and Latin-American surgeons until 2010. The rhinoplasty he taught incorporated the endonasal approach and the Cottle's maxilla - premaxilla principle for septoplasty. He then modified the exposure for the nose with the Bilateral M-plasty endonasal approach. In the Mexican Rhinology School, we have continued to do this operation for the last 40 years. We have taught it to hundreds of residents and fellows who continue to perform the Structural Let Down Rhinoplasty Operation.

EVOLUTION

Dorsal Preservation rhinoplasty techniques have been published since the 1890s. In 1940, Maurel presented a technique where he resected a ventral septal strip based on the desired reduction in the profile and was therefore able to preserve the Keystone Area and dorsum. In 1954, Cottle described the push down technique. Its primary purpose was to leave the dorsum intact by pushing it down into the internal nose. This maneuver avoided nasal valve pathology and the open roof defect which resulted from the removal of the dorsal hump as previously described by Joseph.

Despite the advantages of dorsal preservation with the push down technique, the procedure had some technical limitations, including narrowing of the airway due to inward displacement of the osseous fragment which impacted against the inferior turbinate. This problem was especially true for humps larger than 5mm. For this reason, Huizing (Huizing, 1975) modified the push down technique by making double lateral osteotomies and removing a lateral wedge of bone. The evolution of the lateral wedge resection / let down technique is detailed by Pirsig and Konigs (Pirsig,1988).

The lateral wedge resection allowed the pyramid to descend freely. Therefore, this modification was called the Let Down Operation. One of the most important principles in it is to realize that the structures which form the keystone area are not rigidly fused. Thus, it can be considered an osseocartilaginous “joint”. Following the septal surgery and bony wedge resections, the restraining force on the nose can be overcome, resulting in a more flexible joint that allows it to flatten. The Let Down has numerous advantages including minimal trauma to the dorsum, structural preservation, and avoidance of valvular collapse. Thus, the common functional and aesthetic sequelae of the Joseph resection technique can be avoided.

The widespread adoption of the open approach with its superior visualization for teaching and surgical manipulation led to disuse of the endonasal approach and the Let Down technique. During endonasal surgery, the first assistant can see virtually nothing, and rhinoplasty was taught blindly. However, with the Bilateral M-plasty endonasal approach of Dr. Fausto Lopez Infante, the exposure was improved both for the surgeon and the student. Thus, the resident must stand behind the instructor's right shoulder to see the surgery, learn the procedure, and then be able to reproduce it. Yet, the open approach rose in popularity and many residents in other centers no longer learned the conventional closed approach and Let Down operation. Yet, the procedure continued to be done at certain clinical centers in Mexico, Brazil, Venezuela, Italy and France.

PATIENT ANALYSIS

Preoperatively, we should complete a very integrative evaluation of the nose realizing that the basis of success in rhinology is the diagnosis. We begin by inspection, evaluating the quality and texture of the soft tissue envelope and paying special attention to the nasal pyramid, both osseous and cartilaginous. We must, determine the following characteristics of the nasal pyramid: 1) is it centered on the median line, 2) is it high and tense, 3) is there any right or left deviation, and 4) is there any osseous or osseocartilaginous deformity (Palma et al., 2013). It is very important in preservation rhinoplasty to think that the septum and ULCs are a unique structure. Therefore, we must evaluate the relation of the ULCs to the Nasal Bones and the relationship with the LLCs to the septal cartilage, taking into consideration that the presence of pathology of the septal cartilage which can cause asymmetry and deviation of the cartilaginous pyramid and lobule. Once we have identified the pathology and arrived at an integrated diagnosis, we can design an operative plan to correct it. As part of a complete patient evaluation, it is necessary to take clinical photographs in a systematic order. We consider the frontal view and lateral view photographs as a basis for patient analysis. In all patients,, we request a nasal and paranasal sinuses CT scan in both the axial and coronal planes with 3D reconstruction.

OVERVIEW

To perform a safe and functional rhinoplasty, it is important to have complete access to the septum, dorsum and tip structures with the least possible trauma. The endonasal approach that we use for this preservation technique was designed by Fausto Lopez-Infante (Schulte et al., 1999). It combines several basic endonasal incisions (intercartilaginous, hemitransfixion) allowing access to the structures and full visualization of the nasal anatomy. The main characteristic of our "Let Down Rhinoplasty with Cottle modified technique" is that the pyramid and the septum are treated as a unit allowing the nose to be disassembled and then reassembled in the normal anatomical position.

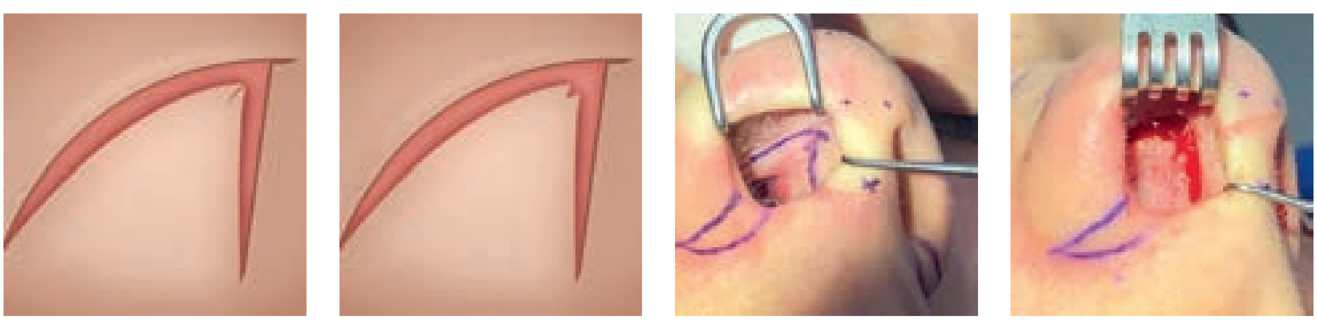
SURGICAL SEQUENCE

Step #1 – Infiltration

Infiltration of local anesthesia is done with lidocaine 2% and epinephrine (1:100,000) to block the external nasal, infraorbital, infratrochlear, supraorbital and nasopalatine nerves. In addition, local anesthesia is injected into the intercartilaginous incisional area, the membranous septum, and the vestibular cul de sac (space between ULC caudal and LLC cephalic border).

Step #2 – Access and Exposure

The integral approach for endonasal surgery is a combination of bilateral *intercartilaginous incisions* joined medially to the *hemitransfixion incision* and a subsequent "M-pasty" allowing visualization of the osseocartilaginous vault and exposing the caudal border of the nasal septum. This approach leaves the nasal tip complex free. The septum is easily addressed beginning with a complete maxillary-premaxillary approach as described by Cottle. It require subperichondrial dissection of the 4 tunnels for a complete exposure of the septum, including the anterior nasal spine (ANS) as well as the ventral septal border and its articulation with the perpendicular plate of the ethmoid (Cottle, 1958).



The left *intercartilaginous incision* is made first using a 4 prong retractor, followed by the left *hemitransfixion incision*. The intercartilaginous incision of the skin is performed in a lateral to medial direction beginning on the lateral border of the ULC. Upon reaching the cul de sac, the scalpel is inserted by applying pressure toward the nasal midline in order to reach the dorsal sub-SMAS plane and to avoid injuring the columella skin. The hemitransfixion incision is performed from below upward, joining both incisions in a T shape.

Without moving the 4 prong retractor, a single hook is positioned, pulling the mucosal flap under the caudal border of the right ULC followed by insertion of curved iris scissors into the subperichondrial plane. The cartilaginous dorsum is exposed from lateral to medial using blunt dissection by spreading the scissors at the intercartilaginous junction. Without removing the iris scissors, a medium Aufricht retractor is inserted and the dissection continues until the entire cartilaginous dorsum is visible. The caudal border and the scroll are identified as well as its relationship with the septal cartilage. The same dorsal exposure is repeated on the right side.

Returning to the right side, two 10 mm Joseph double hooks are placed on the anterior border of the hemitransfixion and another 7 mm double hook on the posterior border of the incision. Once tension is applied to the tissues, the caudal border of the septum is easily identified. Next, the perichondrial fibers that surround the septum are elevated. The septal cartilage is held with Adson-Brown forceps and the caudal border of the septum is scraped with a scalpel until the following are identified: right mucosa and perichondrium, septal cartilage, left mucosa and perichondrium. Next, a Goldman straight hook is placed perpendicular to the septal cartilage and the subperichondrial plane is entered 5 mm above the *posterior septal angle*. Then the straight hook is slid upward toward the *anterior septal angle* without difficulty, thus verifying the plane. Next, both hemitransfixion incisions are connected as a full transfixion incision thereby liberating the nasal tip complex.

With the help of the simple curved hook in the anterior border of the right hemitransfixion incision, the relation of the ULC with the quadrangular cartilage can be identified and the valve can be dissected. Using the Fomon scissors, the skin is released in the same subperichondrial and sub-SMAS plane. Then, the right anterior tunnel is widened. One continues toward the region of the cartilaginous junction of the ULC and the septum, thus releasing the returning of the ULC bilaterally - all from the right side.

Next, the Fomon scissors are introduced perpendicular to the septum, just at the apex of the juncture of the intercartilaginous and transfixion incisions. Thus, one has divided the 90º angle into two 45º corners and formed the M-shaped flap which will prevent retractile scarring which would occur with a round incision.

Step #3 – Septoplasty

Once the septal exposure is completed, a perpendicular incision is made through the septum at approximately 2.5 - 3 cm from the caudal edge of the septum with an angled Beaver blade or with an angled ophthalmological crescent blade. This cephalic placement of the incision will preserve a strong caudal portion of the septal L-strut and will provide requisite support and height following modification of the pyramid.

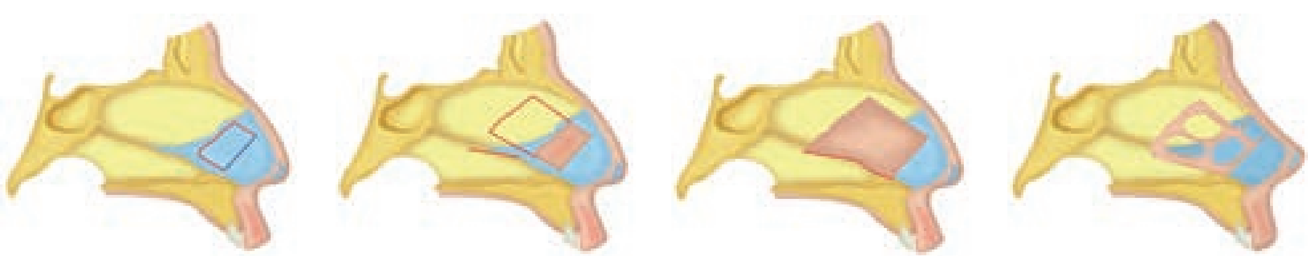
Next, we incise the remaining quadrangular cartilage using Ballenger knife while preserving a 1cm margin below the dorsal line. The, excised fragment of the cartilage will be kept for replacement or grafting as necessary.

Then with the Cottle angular scissor, we address the perpendicular plate of ethmoid (PPE) following the same line under the nasal dorsum. We also make an inferior cut with the scissor into the vomer. In this manner, we correct the septal pathology by excising bony and cartilaginous deviations. Portions of the excised septum will be straightened, reinserted, and fixed with transseptal sutures for stabilization.

At the last stage of the septoplasty the ventral border is released from the maxillary crest and moved laterally for descent of the pyramid. At this point, one evaluates the final length of the quadrangular cartilage.

This septoplasty is aggressive, but the supporting L-strut framework is strong as well as the dorsum. It is important to later replace the septal grafts to prevent sequelae (Barelli, 1975).

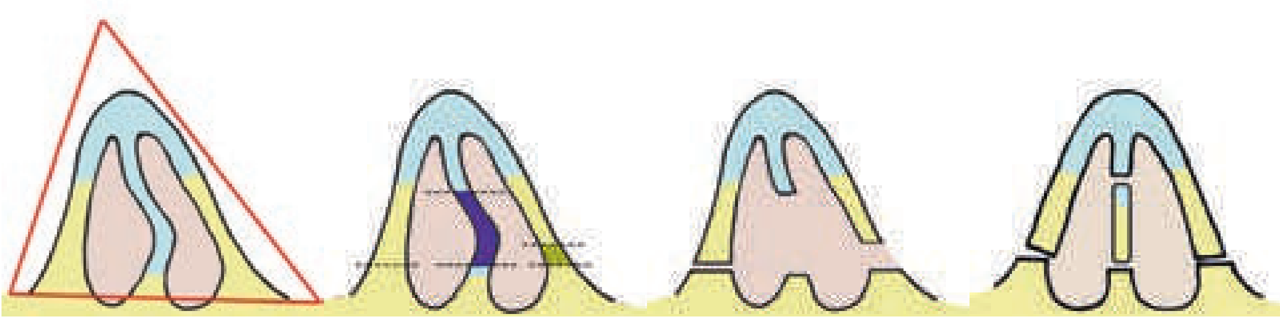
We fix the caudal-ventral border of the quadrangular cartilage according to the dorsal height after the pyramid descent and the excised septal pieces will be reinserted and fixed with transseptal sutures of 4-0 plain catgut.



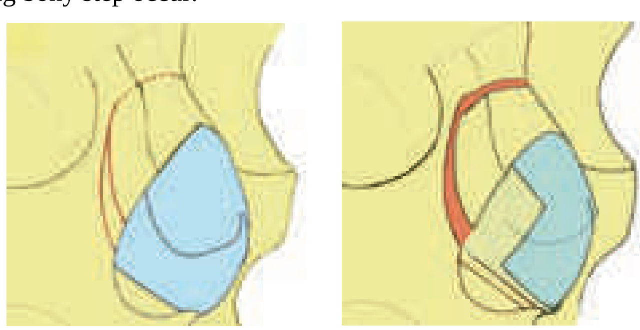
Step #4 – Osteotomies & Let Down

After the septal work is completed, we continue with mobilization and descent of the dorsum as well as alignment of the pyramid. Using a #15 blade, 4 mm incisions are made cutting the vestibular skin followed by blunt dissection of the muscles with the Iris scissors. There is very little bleeding due to the blunt dissection and cauterization. The frontal process of maxilla and pyriform aperture are exposed. Under direct visualization, a #15 blade is used to scratch the bone followed by release of the periosteum from the caudal border as well as the internal and external surface of the lateral bony wall. A 1cm wide subperiosteal tunnel is made with Cottle dissector along the nasofacial groove up to the medial canthal ligament. For resection of the bony wedge, there are two methods - a rongeur resection or removal of an intervening wedge between two lateral osteotomies. We prefer to resect a triangular wedge of bone using Rongeur forceps. After removal of the bony wedge, the *lateral osteotomy* is completed up to the medial canthal ligament using a curved 3 mm laterally guarded osteotome or a 2 mm double guarded curved chisel (López-Infante). The lateral *superior* osteotomy is completed first followed by the *inferior osteotomy* which joins the superior osteotomy.

If the pyramid is symmetrical and tall, then the traditional let down is done bilaterally. If the pyramid is deviated, we would do a double osteotomy on the longer side with resection of the bony wedge fragment which will allow the pyramid to fall, and on the opposite side a smaller wedge or only a lateral conventional osteotomy.



Once the lateral osteotomies are completed, a 2mm chisel is used to make a percutaneous *transverse / radix osteotomy*, either in a *greenstick* configuration which will work as a hinge or a *complete* fashion which would allow us to mobilize the bony pyramid as a block, toward the midline and downward. The advantage of the hinge is that height will not be lost in that area, nor will a big bony step occur.



The combination of osteotomies plus the septal release and resection gives us the freedom to mobilize and relocate the entire nasal pyramid without modifying the structure and integrity of the dorsum. Thus, one can avoid the complications produced by resection of the nasal dorsum which include an open roof defect with its physiologic and vasomotor disturbances and / or the ULC collapse producing an inverted-V deformity (Cottle, 1954).

The degree of downward displacement is directly related to the adjustment of the height which is chosen when anchoring the septum cartilage to the ANS and to the width of the osseous wedge resected.

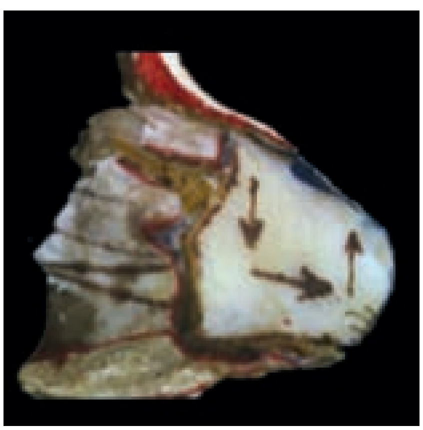
Step #5 – Dorsal Height Adjustment

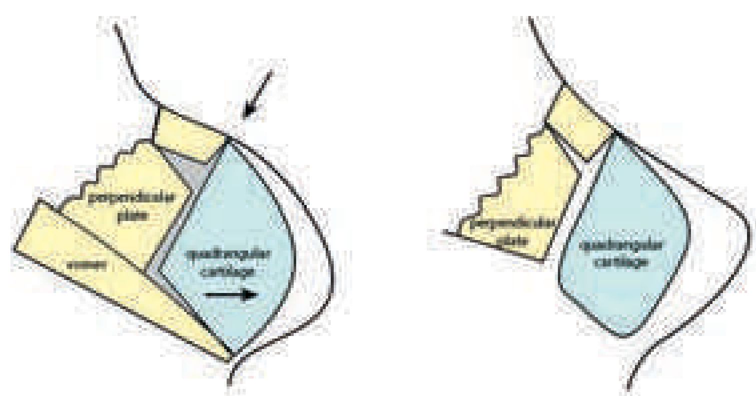
After the wedge resection, the osseocartilaginous septum can be displaced downward to achieve the desired descent of the nasal pyramid. The length of the quadrangular lamina is adjusted according to the height we want for the dorsum and the associated tip projection by resecting an inferior strip of cartilage where it articulates with the maxillary crest.

Then, the septal cartilage is fixed to the ANS with a figure of eight suture (3-0 PDS) without tension. If necessary, a vertical caudal strip can be removed.

Sometimes the hump relapses after the wedge resection probably from the flexibility of the keystone area even though the correct size of inferior strip of cartilage had been resected. If that occurs, we remove a small triangle anterior to the junction between the perpendicular plate and the septal cartilage, similar to the concept of the triangle resection of the Tetris Segmental Preservation Rhinoplasty technique (see chapter by Neves & Arancibia).

The septal work is an essential part for the success of the Let Down rhinoplasty with Cottle modified technique. Thus, septal adjustment determines the final height of the retained natural dorsum.





In the area of the nasal bones, we preserve a house-shaped structure with its roof and walls intact on both sides, thus maintaining the width of the dorsum intact. If partial remodeling is required, it can be done using a Maltz rasp or scalpel. It is important to preserve the natural dorsum and keep the intranasal space isolated from the subcutaneous tissue and skin thereby avoiding an open roof.

Even when the pyramid has been freed and is movable, it can be lowered gently, holding it firmly between the thumb and index fingers of the surgeon's left hand. This procedure also preserves the junction of the nasal bones with the ULC, thus avoiding their separation and collapse which can lead to pinching and formation of an inverted V.

Step #6 – Closure

After years of performing this surgical technique, we have realized that it doesn't matter how much septum is removed, but how much is replaced. The excised pieces of septal cartilage and bone are modified and straighten for replacement and fixation as mentioned before.

The M- plasty is performed and sutured with a double-armed chromic catgut 4-0 with a 12 mm cutting needle. Following the precepts of the Z-plasty for the rotation of the skin flaps, it is very important that the corners of the M-plasty are not taken to the cutaneous angles formed by the incisions, but rather that they be approximated without tension, leaving a rhombus which will heal by secondary intention. Also, the flaps can be modified if we want some permanent rotation of the lobule or shortening of the nose (Schulte et. al, 1999).

Then, one or two stitches are inserted in the intercartilaginous incision and three or four are placed in the hemitransfixion incision. Transseptal sutures are done with a 4-0 plain cat gut followed by insertion of nasal splints.

The splints are left in place for 48 hours as well as a Penrose surgical drain which is placed through the vestibular incision. We apply an external big nasal dressing with Micropore and an Aquaplast cast. This dressing will remain in place for 7 days, then removed entirely and replaced by a small nasal dressing of Micropore for another 10 days. It is important to clearly instruct the patient regarding their sleeping position which will be strictly semi-Fowler with the head facing forward. There should be no physical strain. A cold mask should be applied intermittently. Additional postoperative care includes routine analgesic, anti-inflammatory and antibiotic medication.

INDICATIONS

- Reduction rhinoplasty. One can modify the nasal pyramid while preserving the dorsal structures. Functionally, one can improve the nasal airway without changing the anatomical relationships within the valve.
- Tension nose, cases with narrow airway that require large hump resection is a mjaor indication.
- Severely deviated septum.
- Twisted and Asymmetric nose.
- Osseocartilaginous humps with lobule ptosis.
- Short nasal bones with cartilaginous hump plus natural supratip and normal radix position.
- Thin skin envelope.

CONTRAINDICATIONS

- Secondary rhinoplasty previously operated with a Joseph resection technique.
- Saddle nose requiring dorsal augmentation.
- Deep radix with open nasofrontal angle.
- Normal dorsal height with wide nasal bones.

CASE #1 – Functional Obstruction

On frontal view, the nasal pyramid is a twisted to the right (different length of the frontal process of the maxillary bone), with long LLC. On profile view the dorsum has a hump caused by an osseocartilaginous component and a tension nose with a narrow high dorsum and prominent septum supratip and ptotic lobule.

This case was treated with an integrated endonasal approach and Let Down Cottle modified technique. Tip-plasty with resection included a middle crura strut graft and a supradomal morselized septal cartilage. Preoperative and postoperative photos at 1 year.

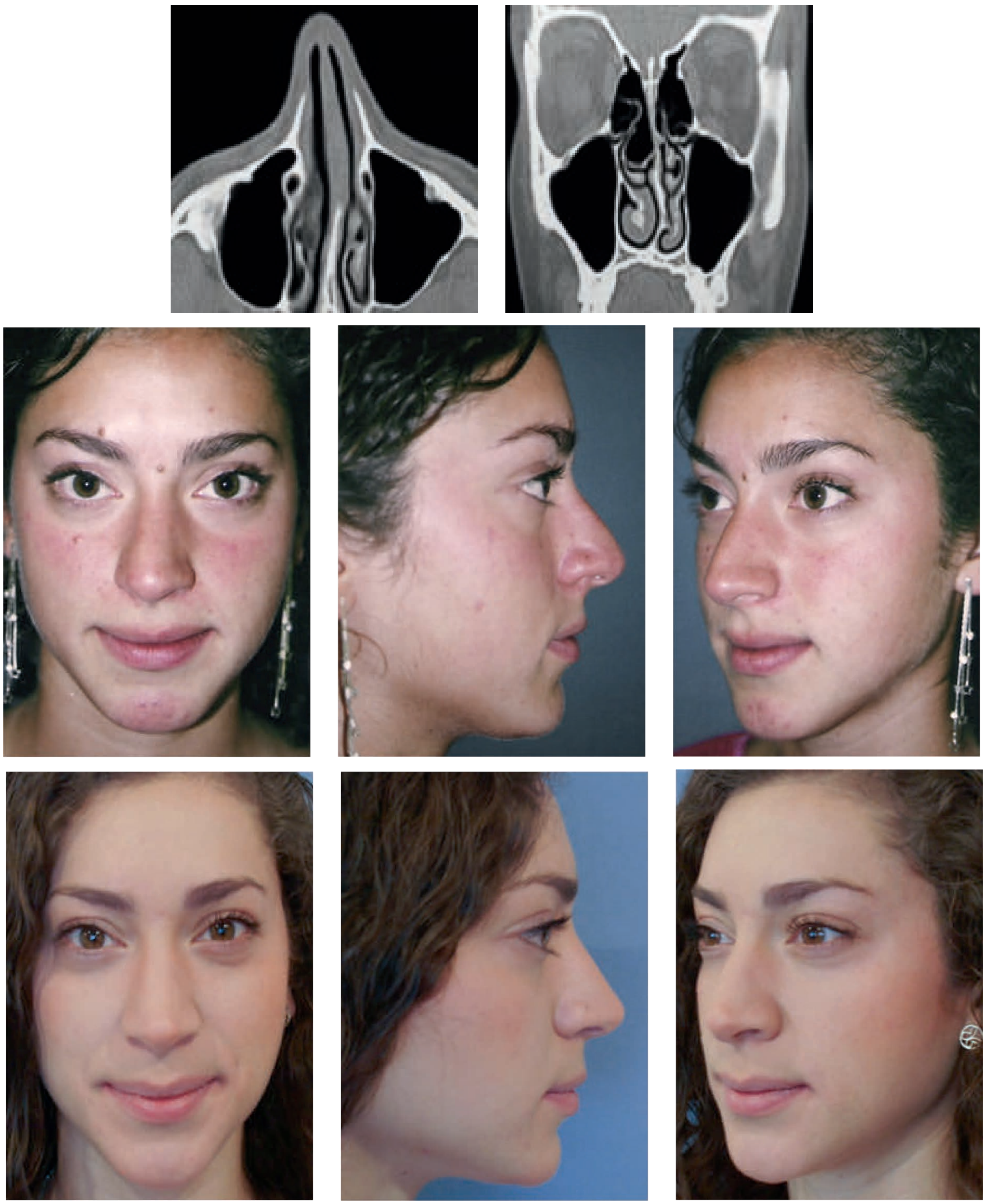
CASE #2 – Asymmetric nasal pyramid, oral breather facies

On front view, the nose is deviated to the left, the right side is longer, and wide K area is wide. On profile view, the dorsum has a hump caused by an osseocartilaginous component, with normal LLC and a little under rotation. This case was treated with an integrated endonasal approach and Let Down Cottle modified technique including asymmetrical bony wedge resections, right greater than left. The length of the septum was adjusted by resecting the anterior caudal angle to achieve nasal tip rotation. Retrograde resection of 2m cephalic border LLC and an intercrural strut. Preoperative and postoperative photos at 4 years.

CASE #3 – Asymmetric / Crooked Nose

On frontal view, the nose is deviated to the right. CT scan confirmed asymmetric frontal process of the maxillary bone and severe obstructive septal deviation. On profile view, the dorsum has a hump caused by an osseocartilaginous component, normal radix position and supratip due to a tension septum producing a hanging columella tip.

An integrated endonasal approach and *Let Down modified Cottle* technique was done. Asymmetrical bony wedges were resected, the left side bigger than the right side which allowed mobilization and lowering of the pyramid. Fixation of the septum permitted adjustment of tip rotation and position. Preoperative and postoperative photos at 10 years.



CASE #4 – Asymmetric nasal pyramid, oral breather facies

On frontal view, the nose is deviated to the left with, wide nasal bones and cartilages plus a bulbous tip. On profile view, the dorsum has a hump caused by an osseocartilaginous component, round lobule, and some alar retraction.

This case was treated with an integrated endonasal approach and Let Down modified Cottle technique. Asymmetric bony wedges were resected, the right side bigger than the left side. Softening of the nasal dorsal lines was achieved by rasping the bony hump and shaping the cartilaginous vault the ULC with a # 11 blade thereby achieving a natural round dorsum without opening the nasal roof. Preoperative and postoperative photos at 3 years.

REVISIONS & COMPLICATIONS

The most common revision for Let Down is managing a recurrent hump. About, 4-6% of case develop a recurrent hump which is usually less than 2 mm at the junction of the bones and cartilages. It can be corrected by rasping and smoothing out of the dorsal lines.

- An insufficient descent of the hump would be the most common complication of this technique (4 - 6%). Its occurrence is due to the following: 1) an inadequate or insufficient septal management which creates internal resistance to achieving the desired degree of displacement, or 2) to an insufficient resection of the frontal process of the maxilla.
- Saddle nose due to over resection of the ventral border of the quadrangular cartilage (2%).
- Failure in the bony wedge resection area can be due to overlapping of the osseous fragments, or the wedge may not have been completed all the way to the cephalic end of the osteotomy thus limiting the inferior movement of the nasal pyramid.
- Irregularities in the fracture line of the lateral osteotomies and a visible or palpable dent in the base of the pyriform aperture. This problem can be avoided by verifying that the incision is precisely in the nasofacial groove when cutting while lowering the fracture line as much as possible. These steps keep the osteotomy lines from being palpable and keep the fragments from resting in a misaligned position.
- Residual deviation and deformity of the septum. This occurrence can be avoided by doing an extended resection taking into consideration the coronal and the axial planes, repositioning the osseocartilaginous fragments after working with them, aligning them as much as possible, and anchoring them with transseptal sutures, which should not be tightened excessively.
- Widening of the base of the nose, which is a relative complication since it can be fixed with Weir alar resection.

CONCLUSIONS

All the preservation techniques have the same purpose which is the preservation of the normal relationship of the nasal anatomy. Dorsal Preservation (DP) includes the relationship between the septum and the nasal bones, the septum and the ULC, the septum and the LLC, including dorsal aesthetic lines, soft tissues envelop, form and symmetry of the pyriform aperture. DP will prevent the classical stigmas of resection techniques - midvault collapse resulting in an inverted-V deformity and valvular collapse with a pinched nose and nasal obstruction. Since we modify the nasal pyramid and septum at their foundation, we preserve the normal anatomy which insures optimal function and aesthetics. The Let Down Rhinoplasty with Cottle Modified Technique using an endonasal approach allows one to treat all the nasal pathology including septal deviations, internal and external valve collapse, asymmetric or twisted nose. One avoids tissue injuries while achieving natural, long lasting results. All techniques must be mastered if rhinology surgeons are to achieve better aesthetic results with no functional sacrifice.

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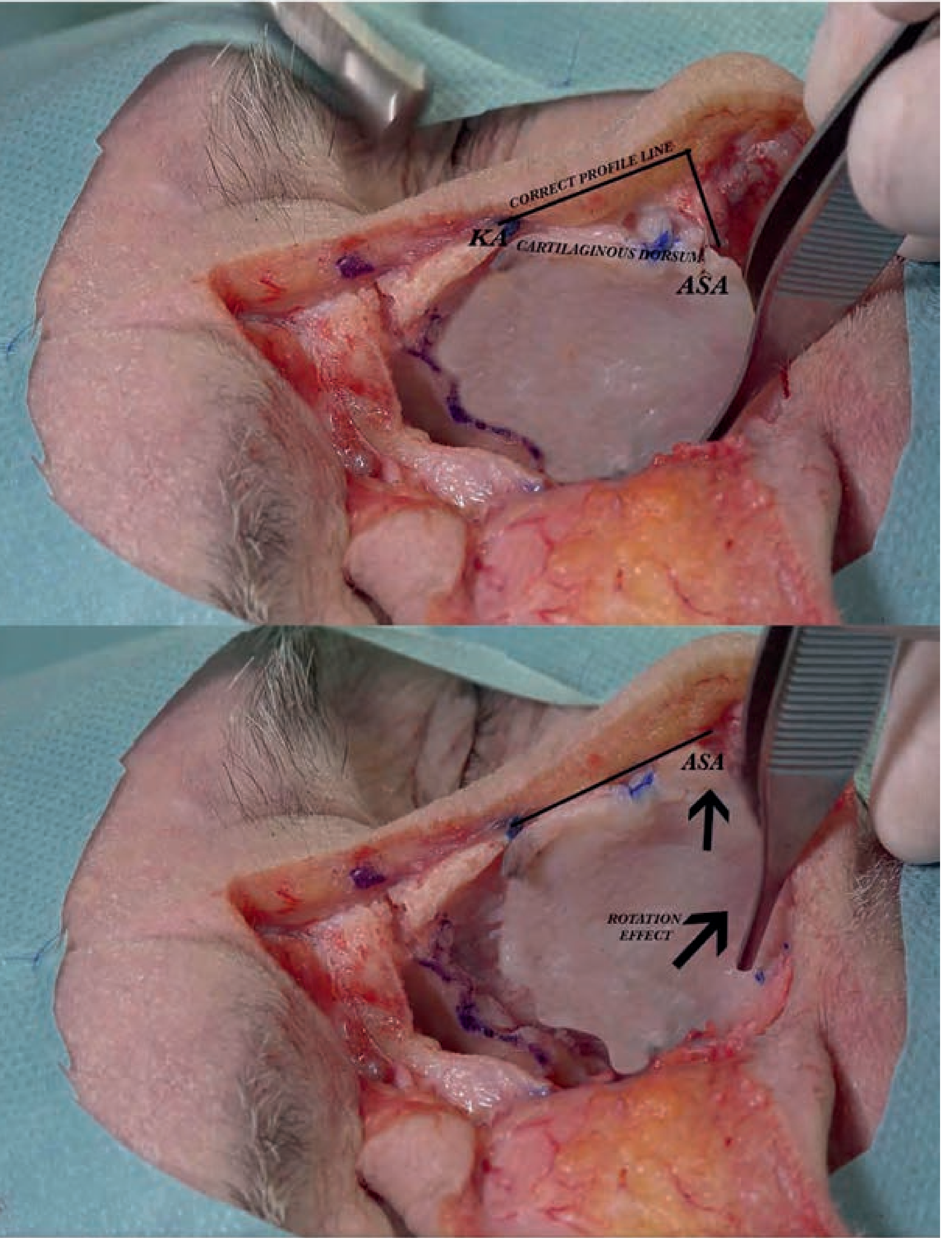
CORRECT PROFILE LINE
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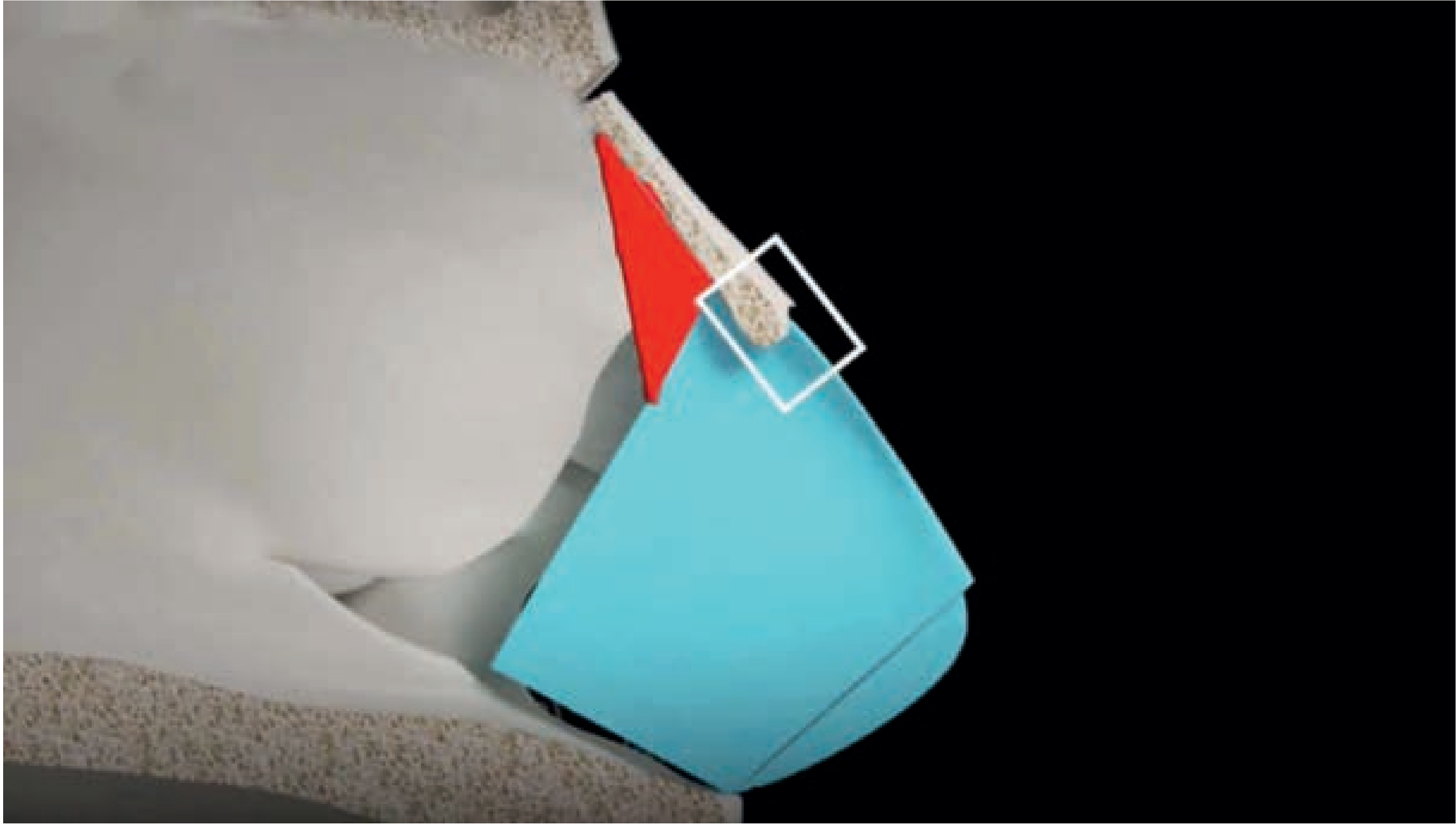


Modified SPQR Cottle Rhinoplasty

Valerio Finocchi, Rollin K Daniel, Peter Palhazi

After performing 150 High Septal Strip Dorsal Preservation (Saban) operations with its subdorsal longitudinal septal strip excision, why did the lead author (VF) switch to the Cottle Operation with its inferior septal strip excision? In addition, why did he modify the Cottle procedure and develop the *Simplified Preservation Quick Rhinoplasty* (SPQR) operation? SPQR is an advanced technique. It is definitely not a technique for the surgeon who is just beginning to learn dorsal preservation surgery. Yet, it is an extremely valuable and versatile procedure for dealing with complex cases, especially those with significant septal deformities. During a one year period, the lead author performed 200 primary rhinoplasties of which 170 were SPQR procedures, 8 were High Septal Strip Dorsal Preservations (Saban), 14 were Cartilage Only Dorsal Preservations (Ishida), and 8 were conventional dorsal resections with associated reconstructions. Based on this experience, the principles of the SPQR operation will be discussed in-depth with emphasis on surgical techniques, indications, contraindications, the learning curve and some final considerations about the boundaries between the various Dorsal Preservation techniques.

INTRODUCTION

The SPQR technique is an acronym for **S**implified **P**reservation **Q**uick **R**hinoplasty. Essentially, it is a method of dorsal preservation based on a "swinging door" septoplasty with a low septal strip excision which allows one to preserve the connection between the septum and the dorsum.

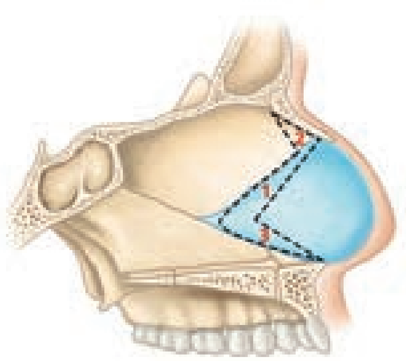
Simplified. Why is the SPQR simpler compared to alternative techniques? First, it is a dorsal preservation procedure which means that there is no need for midvault reconstruction thereby eliminating the need for spreader flaps or spreaders grafts. Second, it's simplicity is evident in dealing with difficult septal and nasal deviations without resorting to an extracorporeal septoplasty. By maintaining the connection between the quadrangular cartilage and the dorsum, major septal corrections can be done and significantly deviated noses straightened.

Preservation. This technique respects the main principles of Dorsal Preservation (DP) procedures. The swinging door septoplasty and the creation of a quadrangular cartilage flap (QCF) creates great flexibility. One is able to have greater dimensional control over the dorsum by preserving the cartilage vault to septum connection.

Quick. Once again, preserving the dorsum means there is no time spent on midvault reconstruction nor harvesting septum for spreader grafts. In addition, the amount of soft tissue envelope (STE) dissection is variable which further reduces both invasiveness and operative time. The SPQR procedure can be divided into 3 groups based on the extent of STE dissection: 1) SPQR with wide nasal STE dissection (79%), 2) SPQR without any dorsal dissection, only tip exposure is done to perform tip plasty (20%), and 3) SPQR without any STE dissection, when there is no tip deformity (1%).

COTTLE TECHNIQUE

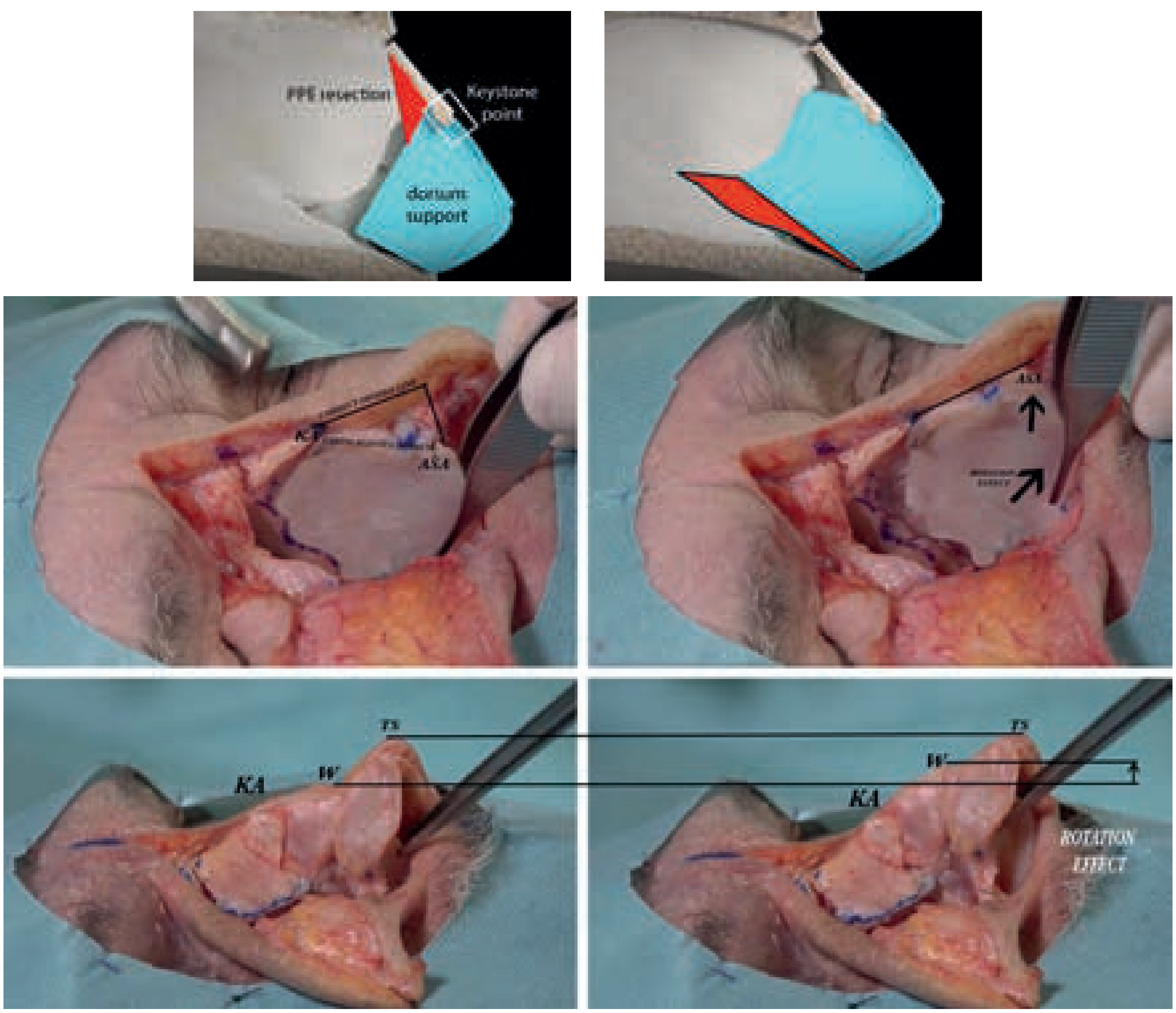
The surgeon must understand why the SPQR technique is different from the Cottle technique. In his 1954 publication entitled Nasal Roof Repair and Hump Removal (Cottle, 1954), Cottle made the following statement "To eliminate the hump without any removal of the roof tissues entails a mobilization of the whole nasal pyramid and the pushing down of the pyramid into the nose. The septum, of course, must permit this." The critical steps of the septal surgery in the Cottle operation are as follows: 1) the mucosa is elevated over the entire left side, then a cross-over incision is made 2.5cm from the caudal septum with exposure of the posterior septum on the right, 2) a 4mm wide *vertical strip* of septal cartilage (#1) is removed along the junction of the quadrangular cartilage and the perpendicular plate of ethmoid (PPE), 3) a t*riangular wedge* of PPE (#2) is excised directly under the nasal bones, 4) the inferior border of the quadrangular cartilage is dissected free from the maxillary crest, 5) the bony vault is mobilized with lateral , transverse, and radix osteotomies, 6) the nose is then pushed down and a *longitudinal inferior strip* of septal cartilage (#3) is removed to achieve the desired dorsal height, and 7) the quadrangular cartilage rests in the groove of the maxillary crest and is sutured to the ANS. Thus, the septum maintains continuity only with the dorsum. As will be discussed subsequently, the author has extensively modified the Cottle procedure.



SPQR TECHNIQUE

The basic steps of the SPQR consist of the following. 1) A unilateral low trans-septal incision is performed followed by bilateral subperichondrial exposure of the septum. 2) A *swinging door septoplasty* is done, with or without resection of the posterior septum depending upon the septal deformity to be corrected. 3) Based on the location of the desired pivot point for eliminating the dorsal hum, the quadrangular cartilage is released from the E point to the Rhinion with the R-E segment release completely freeing the KA joint. 4) A subdorsal segment of septal cartilage and / or PPE is resected cephalically to create space for downward dorsal impaction and to achieve a better joint release thereby avoiding the coat hanger effect (see complication section). 5) Optional Lateral Keystone Area (LKA) dissection is performed to release fibrous connections between nasal bones and ULC. 6) Dorsal mobilization is achieved with continuous complete perimetric osteotomies (low-to-low osteotomy / lateral bony wedge resection plus transverse and radix osteotomies). 7) Downward impaction is finalized by removal of an inferior septal strip with or without vertical strip resection. 8) Profile change is performed by rotation of quadrangular cartilage flap at the planned KA pivot point. 9) The caudal septum is fixed to the ANS at the desired point without any tension – a mandatory step.

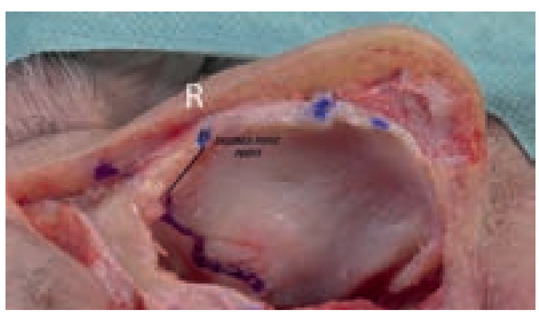
The *swinging door septoplasty* achieves a full release of the quadrangular cartilage from the maxilla, vomer and PPE. The quadrangular cartilage maintains its connection to the dorsal vault. Once the swinging door septoplasty has been completed, the subdorsal cephalic tissue (PPE or septal cartilage) is resected to create space and to better release the joint. Downward impaction is finalized by removal of an inferior septal strip. Notice the excisional cut direction. More cartilage should be resected posteriorly because the tail of the QC flap can block its rotation during the movement.



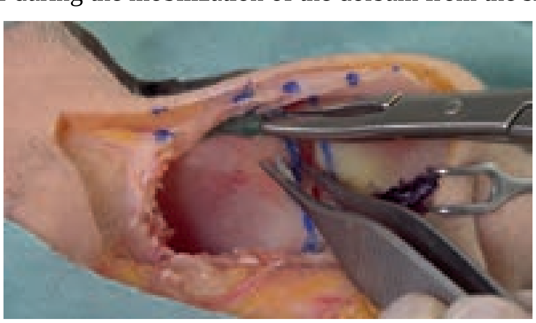
Flap rotation stabilize the desired profile curvature, it controls the supratip break point and therefore the relationship between dorsum and tip by fixing the position of the anterior septal angle (ASA) compared to the most projected point of the tip (Ts). The caudal septum is fixed to the ANS. It is *mandatory* to release any tension at the level of the QC flap.

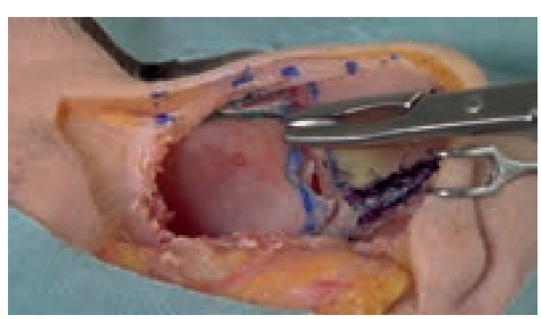
DIFFERENCES: SPQR VS COTTLE

Therefore, how does the SPQR technique differ specifically from the classic Cottle*? First, the septal surgery* is approached differently as to exposure, sequence, method and point of quadrangular cartilage release (location, incision not excision), mobilization of the septum from the maxilla (early not late), plus no attempt to preserve the joint fascia/sling. Cottle usually did an extensive two tunnel maxilla-premaxilla exposure of the septum from a right transfixion incision. A cross-over incision was then made near the junction of the QC and the PPE, followed by excision of a vertical strip of cartilage. Exposure of the caudal septum and release of the inferior septum from the premaxillary groove was performed following the vertical division. In contrast, we prefer a “swinging door” septoplasty done through a right unilateral transfixion incision with bilateral subperichondrial exposure of the septum back to and beyond the QC-PPE junction. QC is first released from the maxilla until the chondro-vomerian joint, then we start to fully release the QC-PPE junction with the use of a Cottle elevator. Once the QC is freed, it is critical to assess the exact location of the dorsal pivot point (where we want to mobilize the joint and change the profile line) and mark it with a surgical pen on the septum. Usually, this point corresponds to the KA junction (Rhinion). As shown below, the septum should be totally released in a caudo-cephalic direction to reach the QC-PPE junction at the level of the E point. *Second, the creation of a distinct Quadrangular Cartilage Flap (QCF)*. After the QC is released from the PPE, the planned pivot point is connected until the end of the dissected QC-PPE junction (E-point).



At this point, the QC connects the dorsum from the Rhinion (R) to the ASA and is designated as the QCF. Rather than a routine vertical strip excision, a simple release from the desired pivot point is made up to the QC-PPE junction. Depending on the patient’s anatomy and surgical planning, a portion of remnant septal cartilage or PPE just beneath the bony dorsum is resected to fully release the joint. This resection creates space for bony dorsal impaction. One must avoid any force on the PPE during the mobilization of the dorsum from the skull.





Once the septoplasty is completed, it is important to make sure that the mobility of the QCF is complete. Additional maneuvers can be done to facilitate *hump flattening* including release of the fibrous attachments in the lateral keystone area (LKA) as advocated by Göksel and release of the Pyriform Aperture Attachments (see the Anatomy Chapter). The dissection in the LKA essentially releases the fused periosteum-perichondrial fixation and thus allows the cartilage vault to hinge and descend. Although not a routine step in the V-shape dorsum, LKA dissection is an important step in the asymmetric nose, the post traumatic nose, and the S shape dorsum when major bone reshaping is planned. The goal is to separate the rigid adherence between the overlying nasal bones and the cartilage vault allowing them to separate and flex but at the same time maintaining the dorsal key stone area (DKA) attachments.

Third, the osteotomies are done differently. As regards the transverse osteotomy, Cottle essentially combined the transverse and radix osteotomy into one maneuver and did it either as an extension of the lateral osteotomy or as a percutaneous osteotomy at the midline of the nasofrontal angle. We prefer a more conservative controlled fracture at the Nasion which leads to more of a "hinge movement" rather than a routine "disarticulation" with the latter reserved only for patients with a high radix. Cottle wanted a direct downward descent of the dorsum. If resistance is encountered, then an additional 1mm strips of cartilage is removed inferiorly as well as additional subdorsal PPE as necessary until the desired height is achieved. As previously stated, our goal is a gentler hinge rather than a downward disarticulation.

Once the desired profile is achieved, Cottle would stabilize the caudal septum in the premaxillary groove with the fascial sling providing support and optional fixation to the joint fascia with a 5-0 suture. In contrast, we developed the concept of a *Quadrangular Cartilage Flap (QCF)* which gives enormous flexibility to the surgeon to change the aesthetics of the nose while preserving function. Since, the septum is exposed subperichondrially on both sides and completely mobilized, the QCF can be advanced caudally and rotated upwardly as a flap in the sagittal plane and lateral to the midline in the coronal plane. The surgeon is able to pull on the QCF and place it in the desire position as there is no mucosal restriction as would occur if the mucosa had been maintained on the right side as in a Cottle procedure. As will be discussed in-depth, the creation of a QCF is major advance with important technical implications. The QCF is able to change the dorsal profile line without resection thus preserving a natural dorsum.

INDICATIONS

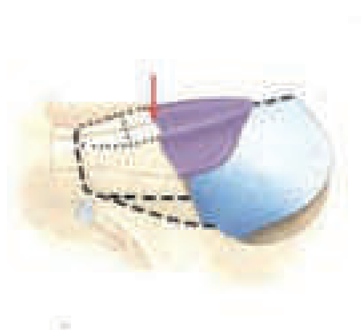
- complex septal deviations, especially those with a high bony septal deviation
- post traumatic noses with good dorsal aesthetic lines
- post-traumatic cases where the cartilaginous vault is preserved but not aligned with the bony vault
- asymmetric noses with bony vault deviation but good dorsal aesthetic lines

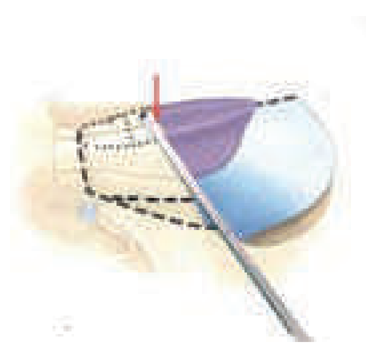
When dealing with common dorsal humps having a V-shape, it is quite easy to preserve the entire osseocartilaginous vault. In an S-shape dorsum, it is necessary to convert the S-shape to V-shape dorsum by rasping, Piezo, or mosaic osteotomies. If the DKA needs major reshaping, we often prefer the Ishida approach. SPQR allows correction of straight or complex deviated noses without any disruption of the connection between dorsum and septum as would occur in a longitudinal high strip excision procedure. The impact of this technique is not only aesthetic, but also functional as the internal nasal valve area is not disrupted but improved with longitudinal traction. As mentioned before, there are 3 variations depending upon the extent of soft tissue envelope (STE) elevation. If the dorsal surface requires a major change, then a wide nasal pyramid STE dissection is mandatory. In selected cases where the dorsal surface and aesthetic lines are ideal, then it is possible to avoid elevating the STE over the osseocartilaginous vault or even the entire nose if there is no need to change the tip. These STE dissection variations reduce the possibility of STE thinning and visible irregularities.

SPQR V1 allows one to perform any dorsal surface corrections because is possible to reach the entire dorsal surface and tip. In the SPQR V2, the dorsum has good anatomy with a flat bony cap and we can avoid dorsal dissection because QCF, pyriform attachment ligament dissection, and letdown will be enough to fully mobilize the joint and therefore change the profile line. Tip plasty is often essential. SPQR V3 is done infrequently as the tip must be ideal and the dorsal aesthetic lines beautiful. In SPQR V3, the goal is a profile reduction of a V-shape dorsum with a flat bony cap, QCF and PAL dissection plus let down will be enough to fully mobilize the joint and therefore change the profile line.

Indications	Dissection	Dorsum	Bony cap
dorsal surface requires a major change (V1)	dorsum, tip, septum	need to be corrected	prominent
dorsal surface, aesthetic lines are ideal (V2)	only tip and septum	V-shape dorsum	flat or prominent
dorsal surface, aesthetic lines, tip are ideal (V3)	only septum	straight	flat

The *"Mosaic Osteotomy"* is a variation of the SPQR V2 for bony cap / dorsal cap modification (Mattioli 1988, 2019). In some cases, with good dorsal aesthetic lines and a slight hump, it is possible to avoid dorsal STE dissection by performing bony cap osteotomies to flatten the bony dorsum. The osteotomies are performed from the internal side of the bone using a 2mm osteotome between the muco-perichondral flaps and placing it in an oblique direction to create small fracture lines along the edges of the bony cap as well as under the center of the bony cap to break its curvature (Finocchi, 2020). The bone at this level is usually very thin and easy to break resulting in a "mosaic" of bony cap fragments. The fragments will not move because the periosteum keeps them in position. As seen in the photo below right, a piece of glass covered in plastic film demonstrates the conversion from convex to flat while all the broken fragments remain in position. Treatment of the bony cap modification is followed by impaction of the bony vault using a classic Let Down to lower the entire dorsal pyramid. For this reason, we perform Push Down of the bony cap followed by Let Down of the bony vault.





CONTRAINDICATIONS

If the septum is straight and it is possible to preserve the dorsum, we consider this technique too aggressive and recommend a high septal strip resection instead. We strongly advise to avoid starting dorsal preservation impaction surgery using the SPQR technique. The reason is that most surgeons are comfortable performing the "L-strut" septoplasty which is one of the steps in a high strip Saban technique. At the beginning of the learning curve for Dorsal Preservation surgery, we recommend that surgeon select cases with a V shape dorsum that have good aesthetic dorsal lines and perform a high strip Saban technique. With additional experience, the surgeons can progress to complex cases with major septal deviations and asymmetric osseocartilaginous vaults. These cases will require mastery of the swinging door septoplasty and asymmetric treatment of the lateral bony walls utilizing the Pisa Tower concept (see after).

PREOPERATIVE ANALYSIS

The surgeon must do a preoperative analysis of the patient that is both different and in greater depth to facilitate operative planning. The specific differences will be discussed.

Inspection. Are the aesthetic dorsal lines beautiful? Is it possible to keep this dorsum intact or partially intact? Is it a V-shape or an S-shape dorsum?

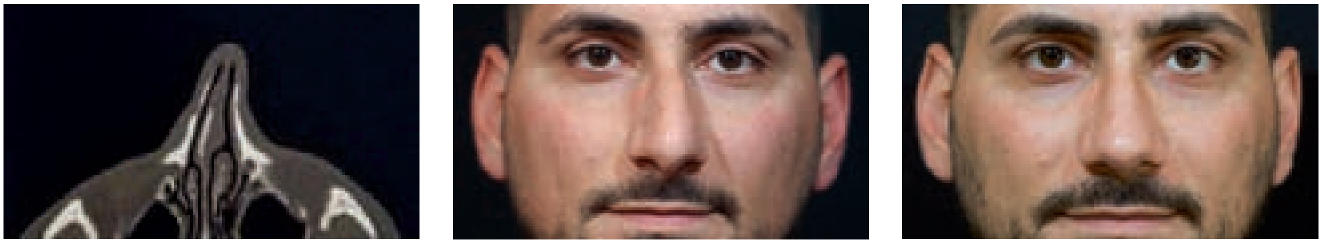
Rhinoscopy. Is the septum in the midline? In the case of septal deviation, is it a low septal deviation, a high septal deviation, or a mixed deformity? The position of the deviation can be also documented following Cottle principles as to area involved, (Area 1,2,3,4,5a,5b), premaxillary spurs, and posterior bony septal deviation.

Palpation. It is important to touch the keystone area and feel the osseocartilaginous components. The degree of flexible movement of the KA joint is important in eliminating the dorsal hump. In addition, it can provide a relative indication of the location of the PPE-QC junction – hard resistance indicates that the junction is at the same location while a soft response indicates that the junction is located cephalic to the KA. Every keystone area is different due to its bony component and connective tissue adherence. For example, in case of major bony component with S-shape dorsum it will be necessary to reshape the bony dorsum and the Ishida technique may be more suitable. It is also important to palpate the bony cap and decide which type of exposure – convex (SPQR V1) or flat (SPQR V2).

High-resolution Ultrasonography. As recommended by Kosins (Kosins, 2017), sonograms can give valuable information about the soft tissue envelope as well as the underlying cartilaginous and bony structures which facilitates selection of the appropriate technique. Also, one can evaluate the nose postoperatively as regards dorsal shape, osteotomies, DCF grafts, and tip correction.

Photographic Analysis. Preoperative photographs are important not only for medical-legal matters, but also during surgery to visualize anatomical details that can be obscured by edema. Computer morphing is done to determine the amount of dorsal reduction and the range of motion that the KA joint must change from convex to straight to concave.

Cone Beam CT Scans. CBCT is an X-ray computed tomography where the X-rays are divergent, thus forming a cone. Total radiation doses from 3D dental CBCT exams are 96% lower than conventional CT exams and are comparable to the radiation of a chest x-ray. During the exam, the CBCT scanner rotates around the patient's head providing nearly 600 distinct images. The scanning software collects the data and reconstructs it, producing what is termed a *digital volume* composed of three-dimensional voxels of anatomical data that can then be manipulated and visualized with specialized software. CBCT has been described as the gold standard for imaging in the maxillofacial area. It provides valuable insight into the anatomy of the septum and the relationship between the nose, skull base and maxilla. The areas evaluated include the following: nasal bone length, bony cap shape, anterior nasal spine position, QC-PPE relationship with the keystone area. In the asymmetric nose, these findings are very important for planning septoplasty and asymmetric osteotomies/ostectomies. CT scan below shows a high septal deviation at the level of the PPE. As seen at 6 months postop, a swinging door septoplasty allows direct access to treat the PPE deviation which facilitates alignment of the pyramid onto the midline. With an L strut procedure, the PPE deviation would have been more difficult to treat and perhaps limit centralization of the pyramid.



SURGICAL SEQUENCE

Step #1 – Access and Soft Tissue Elevation

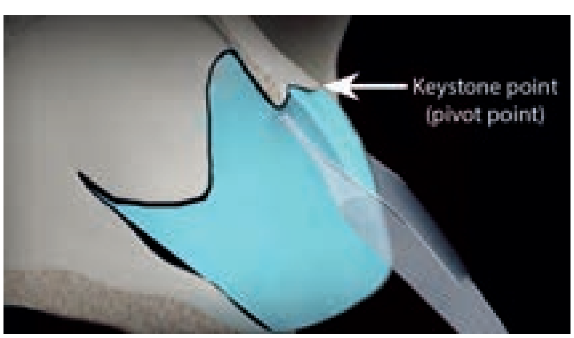
The surgeon can choose either a closed or open approach depending upon their preference. The author routinely uses an endonasal approach with a marginal incision plus a full subperichondrial-subperiosteal dissection over the alars and osseocartilaginous vault plus a unilateral low transfixion incision for septal access (SPQR-V1).

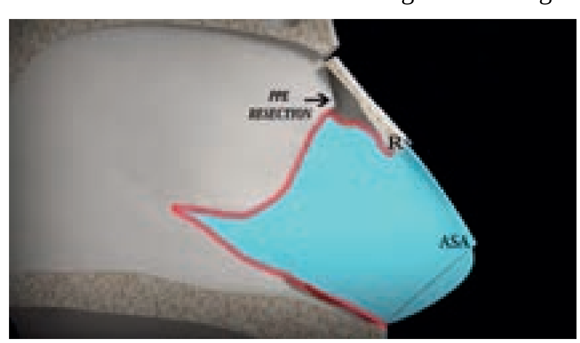
Step #2 – Modified Swinging Door Septoplasty

A unilateral trans septal incision is made 2mm cephalic to the caudal end of the septum which leaves a 2 mm strut (the Cakir "posterior strut" maneuver) within an intact membranous septum. Mucoperichondrial flaps are dissected bilaterally from the caudal septum back to the PPE. If a CT scan was not done preoperatively, it is mandatory at this point to analyze the septal anatomy including the location of the QC/PPE junction and any fixed deviation that will require resection. We perform the septoplasty according to the intrinsic septal anatomy, the severity of the deviation, and location of the desired pivot point. The next step is to release the QC from the premaxillary groove back to the chondro-vomerian junction. At this point, the quadrangular cartilage is released from the perpendicular plate of the ethmoid up to the dorsum.

At this point, it is necessary to decide the exact location of the dorsal *pivot point* in order to achieve the desired profile change (see figure below left). Usually the pivot point corresponds to the Rhinion – specifically, the most caudal point on the bony nasal dorsum. The position of desired pivot point is marked on the septum by the use of a dermal pen or by using forceps' teeth to make an internal sign at the level of QC. Then the QC flap is completed by disarticulating the QC from this point to the most anterior part of the QC\PPE junction.

Thus, the QC is released at its base, posteriorly and superiorly. It remains connected only to the dorsal cartilage portion from the Rhinion to the Anterior Septal Angle (the *R-ASA segment*), creating a QC Flap (QCF). This dissection and septoplasty provide wide access to the cephalic and posterior septum allowing easy correction / resection of any septal deformity. This dissection results in a "*a swinging door*" configuration with total mobility of the QC in the sagittal and coronal plane. Midline adjustments can be made including even the most difficult high septal deviations because the PPE doesn't restrict the QC. In the sagittal plane, the QC becomes a flap that can be advanced downward and rotated anteriorly. The radix osteotomy and the shape of the PPE resection influences how the radix and nasofrontal angle will change.

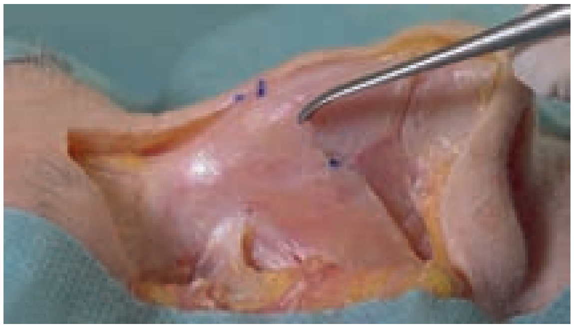


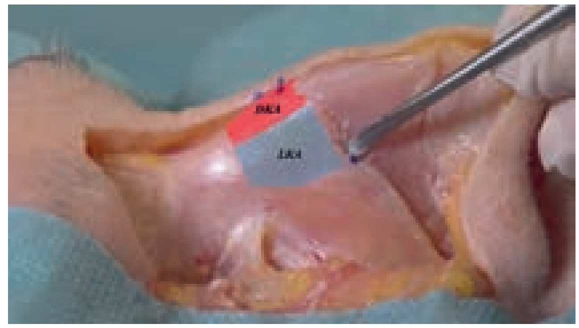


Step #3 – Lateral Keystone Area (LKA) Dissection

LKA dissection is an optional maneuver which helps to improve the keystone area (KA) range of motion. It is NOT mandatory in all cases. It is our opinion that this maneuver is not necessary in V shape dorsum to flatten the dorsum as the KA range of motion is short. However, it is very important in S-shape dorsum where major bony reshaping is necessary. Obviously, if the dorsal profile is already straight there is no reason to release the LKA area.

The technique for releasing the LKA is as follows: 1) a Daniel-Cakir subperiosteal elevator is used to scratch the bony edges by placing the instrument perpendicular to the bone, and 2) the curved end is then used to separate the fibrous tissue while always staying in contact with the bone which avoids damage to the ULC. As ULCs underlap the nasal bones 6-8 mms, there is relatively little risk of damaging the underlying cartilaginous vault.

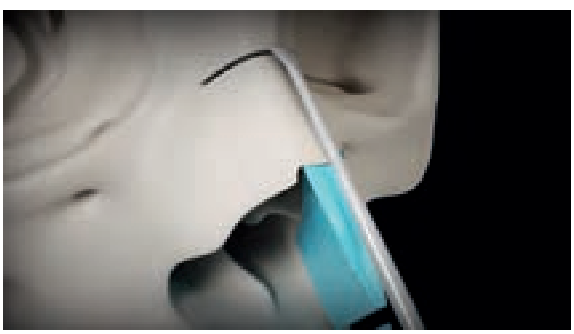




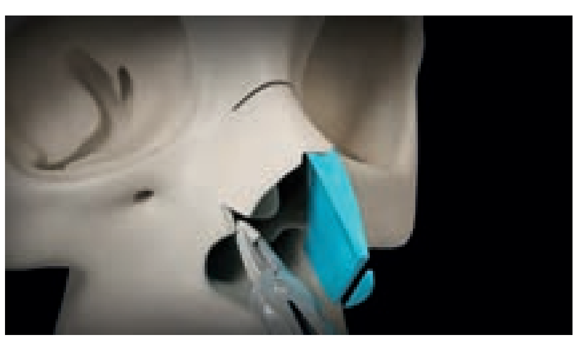
Step #4 – Complete Circumferential Osteotomies

To mobilize the osseocartilaginous vault, we need to release/disconnect the nasal pyramid from the cranium transversely, laterally and at the level of the radix.

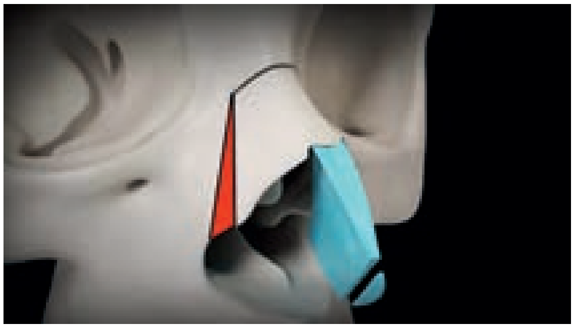
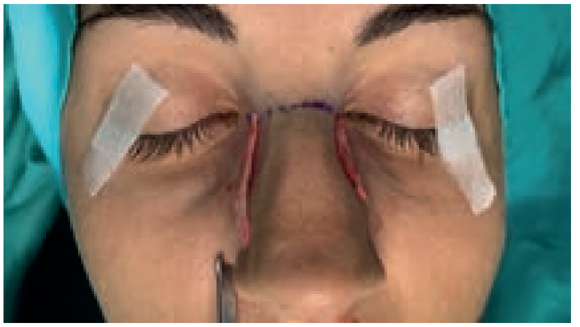
Transverse Osteotomy. If the skin has been completely elevated, then a Tastan-Cakir saw is used for *transverse* osteotomies. These saws make a precise cut and is done with a twisting motion of the wrist. If dorsal STE dissection was not necessary, then the transverse osteotomy is performed percutaneously with a 1-2 mm osteotome.



Webster Triangle Resection. If the nasal fossa is narrow or the head of the inferior turbinate is located at the level of the pyriform aperture, it is recommended to perform a small resection of Webster triangle to prevent any narrowing of the nasal airway. Otherwise, the mobilized lateral nasal wall could impact the head of the inferior turbinate thereby reducing the internal nasal valve space.



In major reduction cases (>6mm), a resection of the ascending process of the maxilla is recommended using a Let Down procedure as shown below. A triangular shape bony wedge resection is done with the base toward the pyriform aperture. Asymmetric resections are normal due to the asymmetric skull. If the surgeon does not feel comfortable with the osteotome, it is possible to remove the triangle in a piece by piece fashion with a Rongeur instrument.

Lateral Osteotomies. The type of lateral osteotomies will depend on the preferred method of bony impaction – Push Down or Let Down. A standard Push Down operation is achieved with a low to low lateral osteotomy using a straight 4mm guarded osteotome. Let Down operation can be done in one of two ways according to the surgeon's preference. In a Let Down DP, we plan the exact amount of bony wedge to resect which reflects the anticipated dorsal reduction and it is drawn on the skin. Average resection is 5-6mm at the level of the Webster triangle which progressively reduces toward the medial canthal region as shown below. The resection can be done via an open approach using a Piezo saw or via a closed approach employing a guarded osteotome or a small Rongeur. For beginners we suggest a baby Rongeur which is slower but gives more control on the amount of bone to be removed. It is very important to avoid any twisting motion in order to prevent unwanted fracture lines. Instead, one should do very small bites similar to a nail clipper. As the surgeon gains self-confidence with the use of the guarded 4mm osteotome, it is possible to perform clean wedge resections with the upper osteotomy done first and then the lower osteotomy which follows the nasofacial groove.

As seen above left, the bony wedge resection for the Let Down has a triangular shape with the base toward the pyriform aperture. If one does not feel comfortable with osteotomes, then one can resect the bony wedge with a Rongeur.


Radix Osteotomy. The method of performing the radix osteotomy needs to be planned in great detail preoperatively. Radix position and osteotomy direction determines the type of the osteotomy technique – disarticulation vs hinge. If radix lowering is planned, then a concave Tastan-Cakir saw is used to perform a right-angled orthogonal cut which allows the radix to drop via *disarticulation*. Alternatively, the radix osteotomy can be done with a straight 4 mm osteotome employing an *inside-out* approach. As seen below left, one first measures the distance between the nostrils and the radix. Then, one precisely places the osteotome between the mucoperichondrial flaps, with the left hand monitoring the exit of the osteotome tip from the bone.

If a hinge effect is planned, then an oblique osteotomy is more suitable to prevent radix drop. The *hinge* radix osteotomy is done either percutaneously with a 2mm osteotome or using an inside-out osteotomy with a 4mm straight osteotome. If the latter way is chosen, it is important first to measure the distance between the nostril and the radix in order to be sure that the osteotome is in line and in the correct position. Then, it is inserted between the mucoperichondrial flaps. One finger of the non-dominant hand presses the radix to feel the tip of the osteotome when the instrument completes the cut.

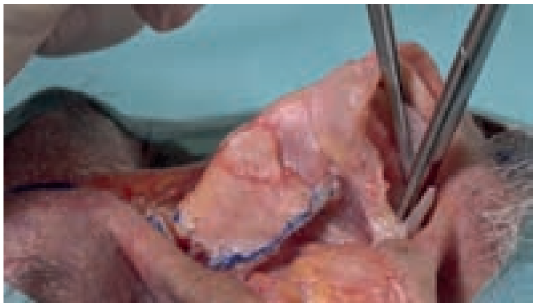



Step #5 – Release of Possible Blocking Points

Once the bony vault is released, it is pushed down and the dorsal profile is checked. There are 4 potential blocking points which include the following: 1) septum including PPE, 2) retained septum on the undersurface of the hump, 3) incomplete osteotomies especially at the junction of transverse and lateral osteotomies, and 4) periosteal restraints. Dissection of the internal maxillary periosteum is important to create space for bone sliding if s Push Down or Let Down is planned. If a Let Down is done, it is better to perform internal nasal wall periosteal dissection to facilitate bony wedge removal. The anterior limb of the medial canthal tendon ligament must be released if a major dorsal impaction is planned. If a radix hinge maneuver is planned, then preservation of the radix periosteum is done. In the SPQR V2, dorsal STE is not dissected in order that the radix soft tissues are preserved giving further stability at the level of the osteotomy line.

Step #6 – Inferior Strip Removal

The septum is one of the three pillars which supports the entire dorsum. In contrast to the Saban variation which removes a subdorsal septal strip, the septal strip in the SPQR technique is removed at the level of the septal foundation just above the maxillary groove. The greater the amount of inferior septal excision the greater the dorsal reduction. As the QCF rotates from cephalic to caudal, the tail of the QC often impacts the maxillary groove blocking its rotation and therefore affecting negatively the dorsal flattening effect. As shown below, the excisional cut should be done in a triangular fashion, less caudally and more cephalically. The excised inferior strip can be shaped and used as a columellar strut for tip surgery if necessary. As demonstrated in the cadaver dissections, the angle of the scissors parallels the premaxillary groove in an oblique direction which results in a triangular septal strip.



Step #7 – QC Flap Rotation

Range of Motion in the KA Joint. Rotation of the QCF results in important anatomical and aesthetic flattening of the dorsum. The ROM of the KA joint goes from flexion to extension resulting in elimination of the dorsal hump.

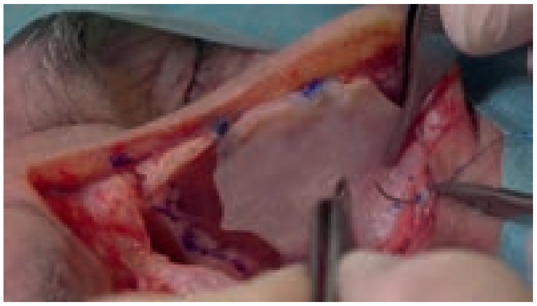
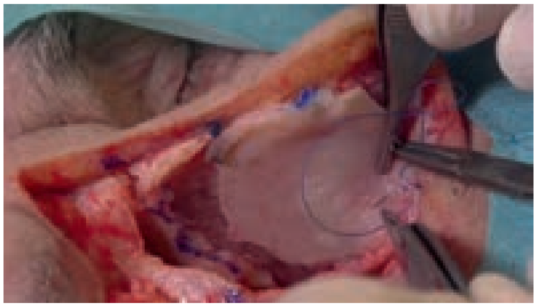
Longitudinal Stretching of ULC. QC flap rotation puts tension on the ULCs with a narrowing effect in the middle third on frontal view. Thus, it is an advantage compared to high septal strip technique because SPQR doesn't jeopardize the septal T junction between the septum and the cartilaginous vault. As the QCF is rotated caudally, the pulling effect improves the internal nasal valve because the upper lateral cartilage (ULC) are stretched longitudinally. The 15° angle is preserved at the level of the internal valve area and the 80°angle is preserved at the level of the KA. During the QCF rotation, the ULCs are placed under tension creating more defined and narrower aesthetic dorsal lines. In the asymmetric nose, the QCF rotation can be combined with LKA dissection to correct middle third asymmetry.

Caudal Septum / ANS Effect. Rotation of the QCF produces an inherent lengthening of the septum which results in a caudal septum excess. This excess can be used in the following ways: 1) as a septal extension flap (SEF) which gives more support to the tip and eliminates the need for a separate septal extension graft (SEG) , 2) achieving the desired nasolabial angle changes (tip rotation and columellar show correction), and 3) the position of the ASA in relation to the tip/supratip area. Excision and shaping of the caudal septum are done to achieve the above goals.

Step #8 – Stabilization Maneuvers

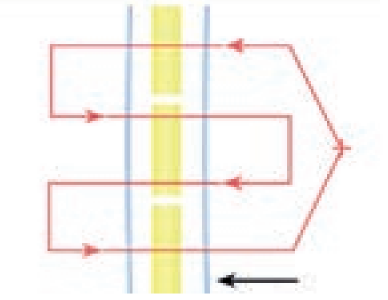
Once the ideal dorsal profile line has been established and there is no tension on the QCF, then stabilization maneuvers are done to ensure a long-lasting result and to counteract any potential distortions during the healing process.

QCF Fixation to ANS. As mentioned previously, there must be *no tension* on the QCF as it is fixed to the ANS periosteum. A simple figure of eight suture is enough to ensure centering of the septum onto the midline. An additional stitch can be used to maintain the QCF in the maxillary groove. If the posterior septal deviation was removed, it is possible to lightly crush the cartilage remnants and place them in between the septal mucosal flaps. These septal remnants will help to counteract any problem caused by the healing process (fibrosis, perforation).

Posterior Strut Fixation. The dead space between the QCF and membranous septum is closed by suturing the posterior strut to the septum with 3 to 4 single stitches (4/O PDS suture). This simple fixation reduces any adverse effect caused by scar contraction.

Septal Quilting Sutures. The septal dead space is closed with a 4-0 Vicryl Rapid suture. It effectively closes any dead space between mucoperichondrial flaps. It is important to focus in the area cephalic to the key stone area because this is the area where the septum would displace in case of backward rotation.

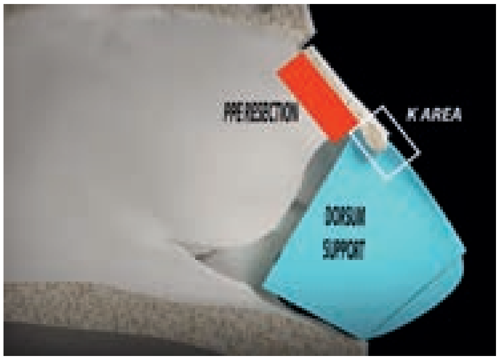
CRITICAL STEPS

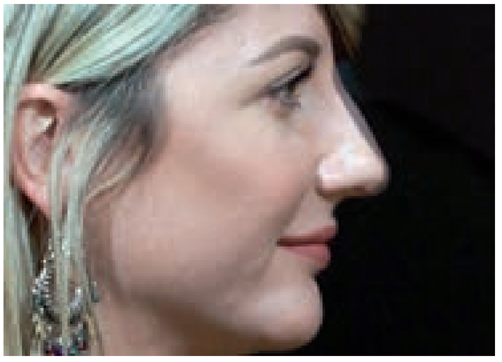
Avoid Tension on Closure. If after maximal rotation, the QCF doesn't fill the supratip area or if there is too much tension to reach the ANS, it means that KA joint is not sufficiently released (check septal pivot point area, subdorsal cephalic components, and LKA dissection). If there is insufficient elasticity of the KA joint for the hump to flatten, it is possible to perform a vertical cut in the QCF which results in a bipedicle flap composed of two columns that release the tension at the level of ANS. One should never close a nose in the presence of tension. If there is tension on the operating table, it will be an illusionary result. If the QCF is sutured to the ANS under tension, the constant forces will pull the QCF backwards resulting in a hump recurrence, ASA collapse with an excessive supratip breakpoint, and tip ptosis. The goal is to close a nose without any tension.

Vertical Strip Excision. QCF rotation creates space in the posterior septal area which allows one to avoid a vertical strip excision which was a routine part of the Cottle operation. If a major reduction (>6mm) is planned, then a vertical septal strip can be removed to create more room for downward impaction. This additional excision avoids an intraoperative overlapping blocking point as well as a postoperative "spring effect" which results in a hump recurrence.

PROFILE TRANSLATORY IMPACTION

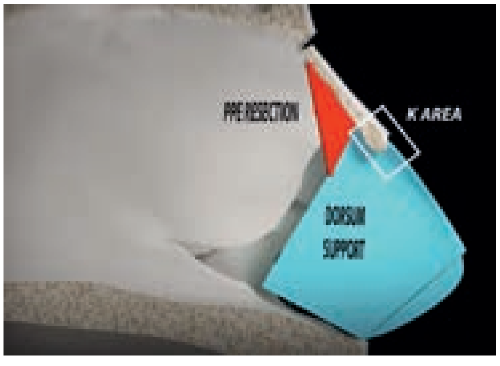
In engineering terms, translatory motion is a movement in which all points of a moving body move uniformly in the same line or direction. In rhinoplasty terms, a *translatory impaction* means that the dorsum translates without changing the nasofrontal angle. In surgical terms, it means that we have to deepen the radix at the Nasion and drop the dorsum downward. If we perform the resection of the sub bony dorsal component in a rectangular shape with a sagittal radix osteotomy, then the radix position will change in height without changing the nasal frontal angle. Often, the preoperative analysis indicates a radix impaction and therefore a PPE resection in a rectangular fashion. The transverse osteotomy needs to be complete, not a hinge, and is therefore done with a Tastan-Cakir saw or in a perpendicular external fashion with a 1-2mm osteotome. The dorsal height will depend on what is done to the 3 dorsal pillars – the amount of septal resection (inferior strip and PPE) and the amount of downward impaction. Usually, if the profile is already straight, then the aim is to reduce the nose evenly and there is no need for QC flap rotation nor LKA dissection. In these cases, the morphing demonstrates an almost straight dorsum and the radix should drop. The subdorsal septal resection should be rectangular and the amount resected usually corresponds to the desired dorsal reduction. A small rongeur is used to resect the PPE in a very controlled progressive fashion. See Case Study #3 for a clinical example.

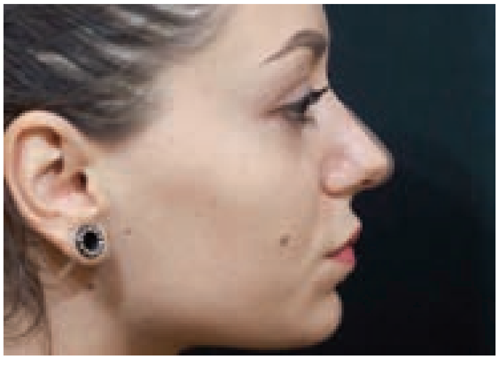




PROFILE ROTATIONAL IMPACTION

A *rotation impaction* with a radix hinge differs completely from a *downward displacement* with a radix disarticulation. It is a more challenging impaction because the radix is already low and it must not descend. The dorsum represents the radius of a circle with a pivot point at the Nasion point (N) in the radix area. If we perform the resection of the sub-bony dorsal component in a triangular fashion with an associated oblique radix osteotomy, the dorsum will have a controlled descent which will occur with a hinge motion. The radix will not drop thus resulting in a change of the nasofrontal angle. This is particularly important in those cases with a preexisting low radix height. Stability of the radix is even improved if a periosteal bridge between bones at the radix osteotomy level is preserved. If no dorsal dissection is performed and the radix osteotomy is done in *inside-out* fashion, then continuity in the radix area is easily preserved. We believe that Let Down is more suitable for these cases because the wedge resection facilitates the hinge motion. (C.S. #4)





THE ASYMMETRIC NOSE

The causes of nasal deviation on frontal view can be multiple. Careful analysis is essential for designing the optimal operative plan. Each of the anatomical components must be evaluated including the facial skeleton, bony vault, cartilaginous vault, and septum. Asymmetries are often present in the nasal fossa, lateral bony walls, cartilaginous vault/septum, or mixed. The asymmetrical face is present in virtually every patient, often with one side strong and the opposite side weak. Most people do not notice any asymmetry unless the difference in the two sides is >3-4mm. However, it is important to show the patient their own facial asymmetry and to explain that “the asymmetrical nose is always on an asymmetrical face.” To simplify these complex cases, we have divided them into two types.

Type #1 – Straight deviation of both the bony and cartilaginous dorsum

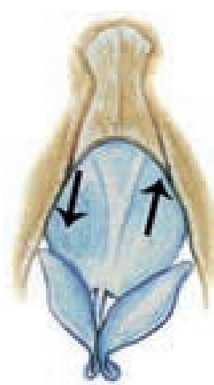
The anatomy of a straight dorsal deviation resembles the *Pisa Tower*. One side of the tower is longer and therefore to straighten the tower, the longer side should be shortened. For the bony vault, we apply an asymmetric Let Down / Push Down. For the case below, a segment of bone (tapered 10mm) is excised using a Rongeur) from the right frontal process of the maxilla to obtain greater impaction on the right side compared to the left. Precise measurement of the distance from the R point to the pyriform aperture is made to calculate the amount of bone to resect. Average normal distance of the lateral bony wall is between 2-2.5cm. The amount of bone to be resected laterally is based on the planned dorsal reduction and straightening to be done with the aim to obtain two lateral bony walls of equal length. In summary, the basic steps are the following: 1) swinging door septoplasty, 2) asymmetric bony wedge resection (Let Down) done on the long side of the deviation to make the lateral bony walls of equal distance, 3) wide ipsilateral internal periosteal dissection to facilitate bone removal, and 4) contralateral side treatment depends on the amount of expected reduction. If minimal, then a low-to-low osteotomy with no periosteal dissection is mandatory (this side act as a pivot point). In cases of major reduction, a minimal Let Down may be necessary on the contralateral side because a simple Push Down will not be sufficient to allow the necessary degree of impaction. By removing the bony wedge, we also avoid internal nasal valve narrowing during impaction motion because the nasal wall will not slide in toward the inferior turbinate head. (See Case Study #5)

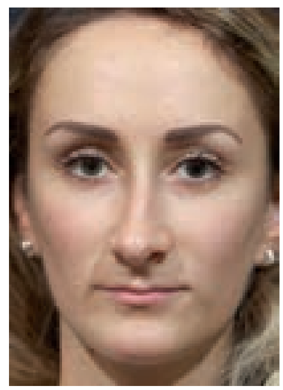
Occasionally, *ostectomy* with a 90 Cakir instrument or Piezo is also necessary in order to sculpt lateral bony polygons as bony thickness can be different from one side to the other. Tansverse osteotomies can be done endonasally with a Tastan-Cakir convex saw or percutaneously with a 2mm osteotome. Radix osteotomy may vary according to the case plan. Following the circumferential mobilization of the dorsum, it may be necessary to correct a slight rocker deformity on the side contralateral to the deviation. In combination with swinging door septoplasty, it is possible to correct very difficult crooked nose without the need for an extracorporeal septoplasty.

Type #2 – Straight bony dorsum, deviated cartilaginous dorsum

In these cases, the bony vault is relatively straight while the cartilaginous vault appears deviated. The two main anatomical characteristics are that the septum is deviated and the upper lateral cartilages (ULCs) are asymmetrically positioned under the LKA. Normally, the ULCs underly the bones in a relatively symmetrical fashion.. However, in these cases the ULC on the concave side, contralateral to the deviation, extends further under the bone. In contrast, the ULC on *the convex deviated side, is more exposed and less covered.*

In these cases, our treatment is focused on the cartilaginous vault and septum. LKA dissection is a critical component of the surgical plan as it allows the ULCs to settle in the right position. The goal is for the ULC on the concave side to slide caudally and for the ULC on the convex side to slide cephalically. In this way, the septum has space to shift to the midline. After dissection, the ULCs are free to slide under the nasal bone cephalically on the long side and caudally on the short side with the septum rotating toward the midline in a “push-pull” sliding movement. (see Case Study #6)





INTRAOPERATIVE COMPLICATIONS

Keystone Area Depression

If a modified dorsal preservation was performed where the dorsum was shaped with a rasp or Piezo instruments, it is advisable to harvest some bone dust prior to performing osteotomies. This harvest is best done with a 90 degree Cakir instrument which can be used to scrape the frontal process of the maxilla before the osteotomies are performed. Bone dust is done to camouflage any irregularities and ensure a smooth dorsum.

Keystone Area Curvature

Following joint mobilization and impaction maneuvers, it is possible to see a slight hump. This pitfall can be caused by multiple factors which should be investigated in the following order:

1. Residual Bony Curvature. Gently rasp the bony cap even after impaction.
2. Coat Hanger Effect. Residual subdorsal bony or cartilaginous septum cephalic to the QCF release can be the cause of a coat hanger effect. It means that the joint was not well released and therefore the hump is still present because the joint is not flattening. Any residual tissue should be weakened or removed followed by QCF rotation. Fixation to the ANS should be checked again making sure there is no backward tension.
3. Paraseptal Cleft Excess. Sometimes cartilage clefts at the level of the KA can create a residual hump. One should first check that the LKA dissection was done completely and repeat it as necessary. If the paraseptal cleft excess persists, then the excess can be trimmed with a #15 blade.

Spring Effect

The “spring effect” is a dynamic phenomenon that can be seen after impaction where the dorsum is coming back up after the impaction maneuver is performed. There can be multiple causes. The common “*blocking points*” include the periosteum and medial canthal tendon that can stop descent of the dorsum. Another possible cause is bony contact at the osteotomies/ostectomy sites. Usually, these bony obstructions can be detected on palpation. A rongeur can be used to remove any bony impediment which is creating the block. Since the septum is the main pillar supporting the dorsum, it must also be checked. A *pressure test* can be done to evaluate the adequacy of the septal resection. A speculum is inserted, and the septum visualized. Finger pressure is then placed on the dorsum, and movement of the QCF is evaluated. If the QCF is bending during pressure on the dorsum, it means that QCF is still excessive and an additional strip excision done. In most cases, the posterior portion of the QC is the first part of the flap that touches the maxillary groove during rotation. Particular attention should be paid to the posterior portion of septum that can stop the rotation of the flap. Resection of the excess fixes the problem and the QCF fits precisely in the maxillary groove without any bending during the pressure test.

Saddle Deformity

Thus far in over 175 SPQR cases, I have not had an intraoperative saddle deformity. However, I assume that it could occur due to over resection of the three pillars of the dorsum - the cartilaginous septum and the two lateral bony walls. In order to avoid over resection of the bony wedge, it is better to start with a rongeur instruments which ensure more control compared to an osteotome. For the cartilage septum, over resection can be avoid by resecting the septal strip progressively instead of one large piece. In this way, it is possible to trim profile height safely. If a severe saddle deformity occurs due to a septal disjunction, it is possible to save the situation by the use of a Kirschner wire inserted percutaneously side to side caudally to the Webster triangle and passing through the QC. The wire suspends the QCF and therefore the dorsum at the desired level. Doyle splints are inserted to stabilize the new dorsal position. Wire and splints are removed after one week. In case of a lack of the Kirschner wire, it is possible to use a BD YALE spinal needle which works perfectly and it should be bent at the ends to avoid any skin damage. As shown in the case below, an intraoperative saddle deformity occurred with a high septal strip excision and the surgeon was able to fix it. It followed a high septal strip excision with its associated L-shape strut which became destabilized while fixing a high septal bony deviation.

Supra Tip Depression / ASA Collapse

If the KA joint was not well released and the QCF was sutured under tension to the ANS, then the septum (ASA) will not fill the supratip area which leads to a supratip depression. It is important to suture the QCF without any tension in order to rotate it at the right level and for it to stay there long-term. If all the maneuvers where properly done and the deformity is still present, it is possible to camouflage the area with a crushed cartilage graft. This complication can be seen postoperatively.

POSTOPERATIVE COMPLICATIONS

Based on our experience with dorsal preservations techniques, all revisions are easier to perform without the need for major surgeries especially rib graft reconstructions. Whenever possible, it is always better to wait one year before performing a revision as the soft tissue dissection is much easier without the influence of edema and fibrosis. We want to emphasize that the SPQR technique is a dynamic technique which respects the anatomy of the nose. If the forces that keep the nose in a defined position are not well released and if its anatomical components are not dealt with, then the tension and the tissues excess will change the 3D structure of the nose. It doesn't matter if the nose was beautiful at the end of surgery, ongoing contractual forces will downgrade the final result.

Residual (Early) Humps

A change in the profile height that was ideal at the end of surgery can occur after a few weeks. These humps that appear in a matter of weeks following surgery are designated as "residual humps" by Uncel et al. Their occurrence reflects insufficient intraoperative correction and thus are largely avoidable with experience. Moreover, the healing process with postoperative fibrosis can change the position of the structure. For this reason, is very important to perform all the stabilization maneuvers and close the dead spaces as much as possible.

Recurrent (Late) Humps

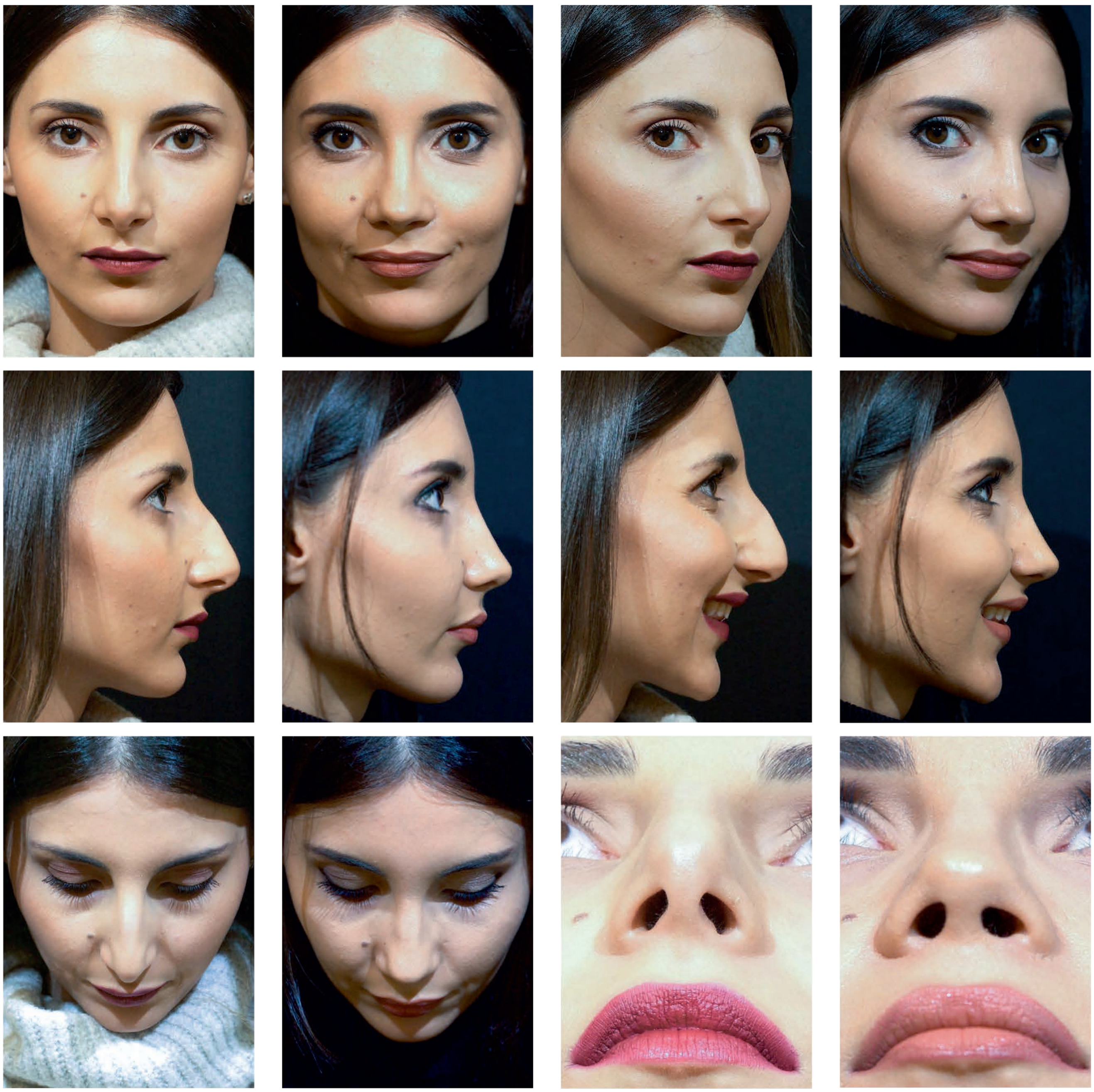
These types of humps occurring in the first year following an SPQR procedure are caused by a *"QCF Backward Rotation."* It's occurrence leads to the visual combination of a hump recurrence and a supratip depression. Although the dorsum at the end of surgery was perfectly flat, a supratip depression with a slight hump at the KA develops over time. Although the cause can be multiple, the primary ones are insufficient trimming of the 3 pillars and inadequate intraoperative joint release.

Insufficient Trimming of the 3 Main Pillars. Insufficient resection of the septum must be checked in both the PPE area and the inferior septum. Also, additional resection may be necessary in the lateral bony wedge area.

Inadequate Joint Release. The basic etiology is that the QCF was sutured under tension to the ANS. The constant tension causes the QCF to rotate backwards with consequent hump recurrence at the flexion point of the joint and ASA collapse. The treatment can be done in two ways. First, a simple rasping of the hump and a camouflage graft to the supratip area is a far simpler revision than a rib graft reconstruction. Second, it is possible to repeat the release of the joint by a new septoplasty and fixing it again to the ANS without bone reshaping or by direct hump removal (rasping, mosaic osteotomies). Usually, it must be associated with new circumferential osteotomies and according to the reduction one must choose between Push Down or Let Down. Certainly, Let Down give more guarantees of avoiding a relapse of the hump. In my series of 175 SPQR cases, I have had 15 cases of QCF backward rotation deformity. This recurrence has decreased progressively thanks to a better comprehension of the anatomical biodynamic of the pyramid-septal structure and it currently occur in only *1-2% of cases*. Complications are part of the learning curve process. Though they are very stressful for the patient and the surgeon, they teach us a lot and with experience they can be avoided.

CASE #1 – No dorsal dissection

Preoperative and postoperative 12 months photographs. On front view, there are good aesthetic dorsal lines with wide radix and tip bulbosity with a pseudo cephalic malposition. On profile view, there is a V-shape dorsum with a high radix. Treatment consisted of the following: no STE dorsal dissection (SPQR V2), swinging door septoplasty, Let Down impaction technique, progressive inferior septal strip resection plus vertical strip quadrangular cartilage resection in order to gain internal space for impaction (SPQR). The high radix was treated by external osteotomies and disarticulation / impaction. The QCF was advanced, rotated, and fixed to ANS with 5/0 PDS. The caudal septum was trimmed. Tip plasty.

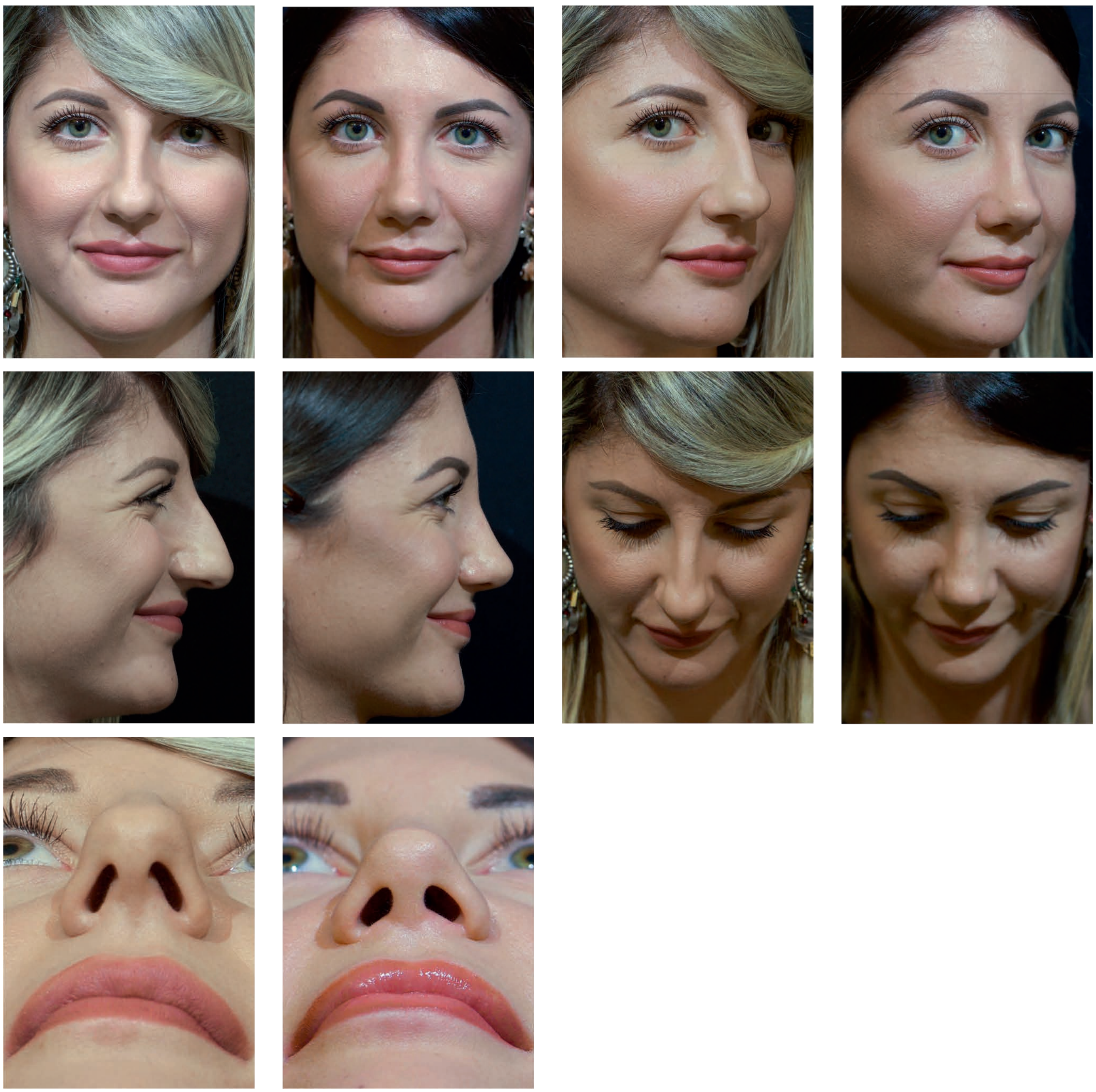


CASE #2 – Dorsum, tip, septum dissection

Preoperative and postoperative 12 months photographs. On frontal view, this patient has an obvious axis deviation to the left side caused by the septum. Bones are symmetric and the tip is bulbous. Profile shows an S-shape dorsum. This type of deviation was fixed by a swinging door septoplasty, a triangular shaped PPE resection, and LKA dissection. These maneuvers increased the range of movement of the keystone area joint. The bony dorsum was rasped focusing on the right side in order to smooth the transition by removing the DKA right spur. The entire osseocartilaginous vault was then mobilized with Let Down technique using circumferential osteotomies / ostectomies. A 6mm low septal strip was removed. The QCF was advanced, rotated, and fixed to ANS with 5/0 PDS. Caudal septum was trimmed. Tip plasty.

CASE #3 – Profile Translatory Impaction

Preoperative and postoperative photos at 12 months. This patient has beautiful dorsal aesthetic lines with a slight hump, but the bony cap is flat. It can be classified as a V-shape dorsum. Bulbosity of the tip is obvious. Swinging door septoplasty was performed plus a rectangular shaped PPE resection; Dorsal STE dissection was not performed. The entire osseocartilaginous vault was mobilized by circumferential osteotomies\ostectomies in Let Down fashion - endonasally for the low to low osteotomy and percutaneous for the transverse and radix osteotomies. The direction of the osteotome for the radix osteotomy was vertical to obtain a radix drop. A 5mm low septal strip was removed. The QC flap was advanced and rotated and fixed to ANS with 5/0 PDSP. Tip plasty.

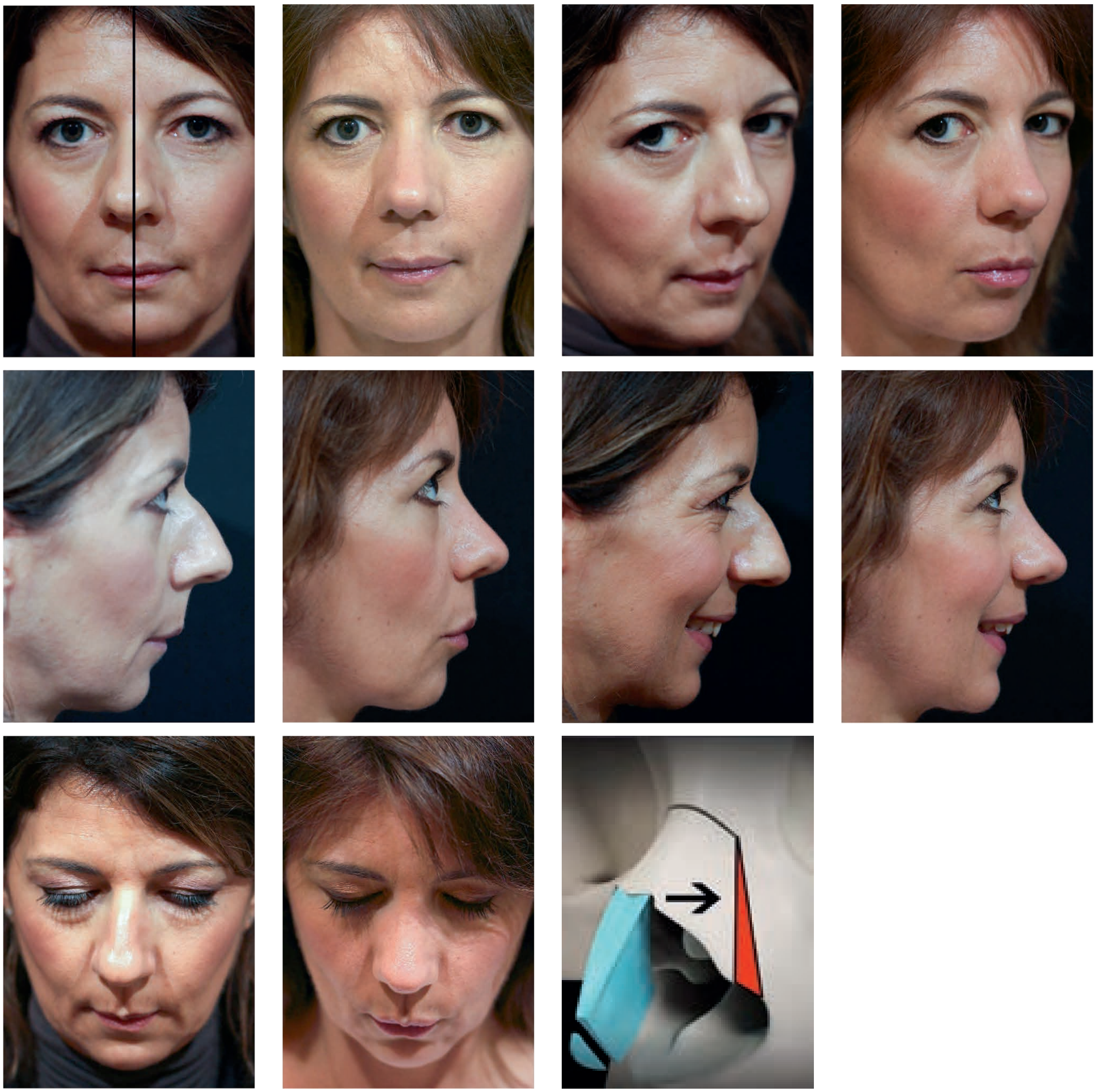


CASE #4 – Profile Rotational Impaction

Preoperative and postoperative photos at 12 months. This patient has thick skin, a wide dorsum and a bulbous tip on front view. The profile shows a deep radix with a slight hump. It can be classified as a V-shape dorsum. Swinging door septoplasty is performed, with triangular shaped PPE resection. Dorsal STE dissection was performed just to shape the LKA and DKA, but leaving the periosteum attached at the level of the radix. The entire osseocartilaginous vault was mobilized by circumferential osteotomies\ostectomies in PDO fashion - endonasally for the low to low osteotomy and percutaneous for both the transverse and radix osteotomies. The direction of the osteotome for the radix osteotomy was oblique in order to obtain a hinge motion of the radix. A 4 mm low septal strip was removed. The QCF was advanced and rotated and fixed to ANS with 5/0 PDS. Tip plasty. Alar base resection was also performed.

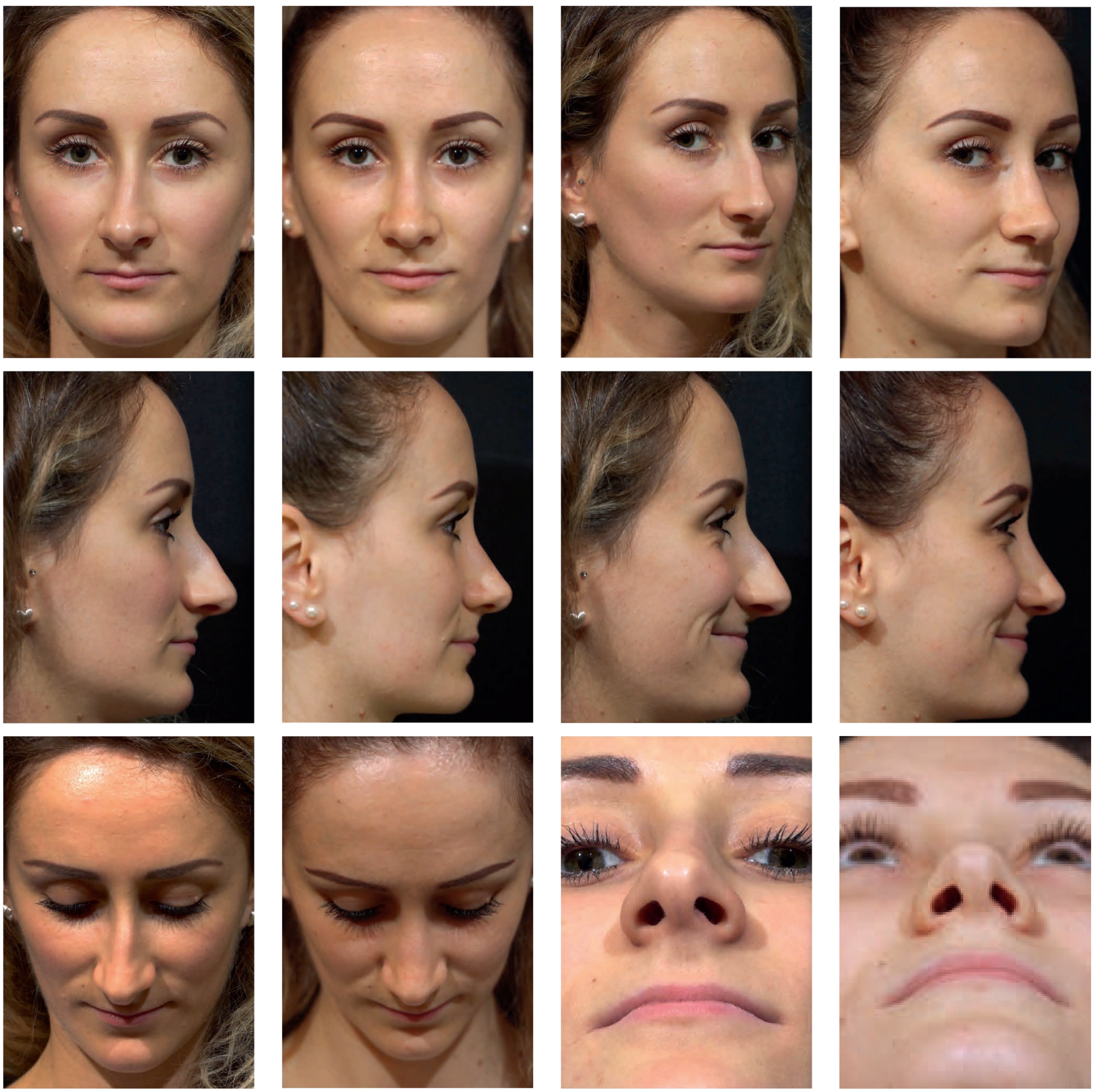
CASE #5 – Straight deviation (Pisa Tower Deformity)

Preoperative and postoperative photos at one year. Asymmetrical face with nasal fossa decentralized to the right, longer left nasal bone, shorter right nasal bone, septal deviation, asymmetric tip. Asymmetric left Let Down / right Push Down and low septal strip resection was performed. Swinging door septoplasty with the QCF completely mobilized and brought to the midline. Asymmetric left Let Down / right Push Down helps to adjust lateral bony wall length and bring the bony vault unit toward the midline. Tip plasty.



CASE #6 – Straight bony dorsum, Deviated cartilaginous dorsum

The bony dorsum is straight, but the cartilaginous vault is deviated. The profile shows a deep radix with a slight hump. It can be classified as a V-shape dorsum. SPQR was performed with dissection over the dorsum, tip and septum. LKA dissection. Then, slight rasping to flatten the bony cap. Dorsum alignment was achieved by swinging door septoplasty and symmetric Push Down. LKA dissection played an important role in the cartilaginous vault settling. The sliding ULCs are free to move into the correct position. Swinging door septoplasty frees the QCF from the PPE and this freedom allows a total cartilaginous vault repositioning.



CONCLUSIONS

SPQR is an advanced Dorsal Preservation impaction technique which exploits the biodynamic motion of the pyramidal-septal structure to change nasal aesthetics and function. Its advantages include the following: 1) KA joint mobility, 2) manipulation of the three main dorsal pillars, and 3) use of the QCF rotation to change all 3-dimensional position of the individual nasal components. A clear comprehension of the dynamic motion of those structures is critical in order to perform this technique and to minimize any complication. A clear understanding of the biodynamics and blocking points is mandatory or the final result will be compromised. We suggest that those surgeons beginning to perform Dorsal Preservation should begin with simple cases (V-shape dorsum with flat DKA). As experience is gained, it is possible to operate on more difficult cases (S-shape dorsum with more kyphotic hump). By mastering the SPQR technique, it is possible to achieve beautiful and longer lasting results with a natural preserved dorsum even in deviated asymmetric noses.

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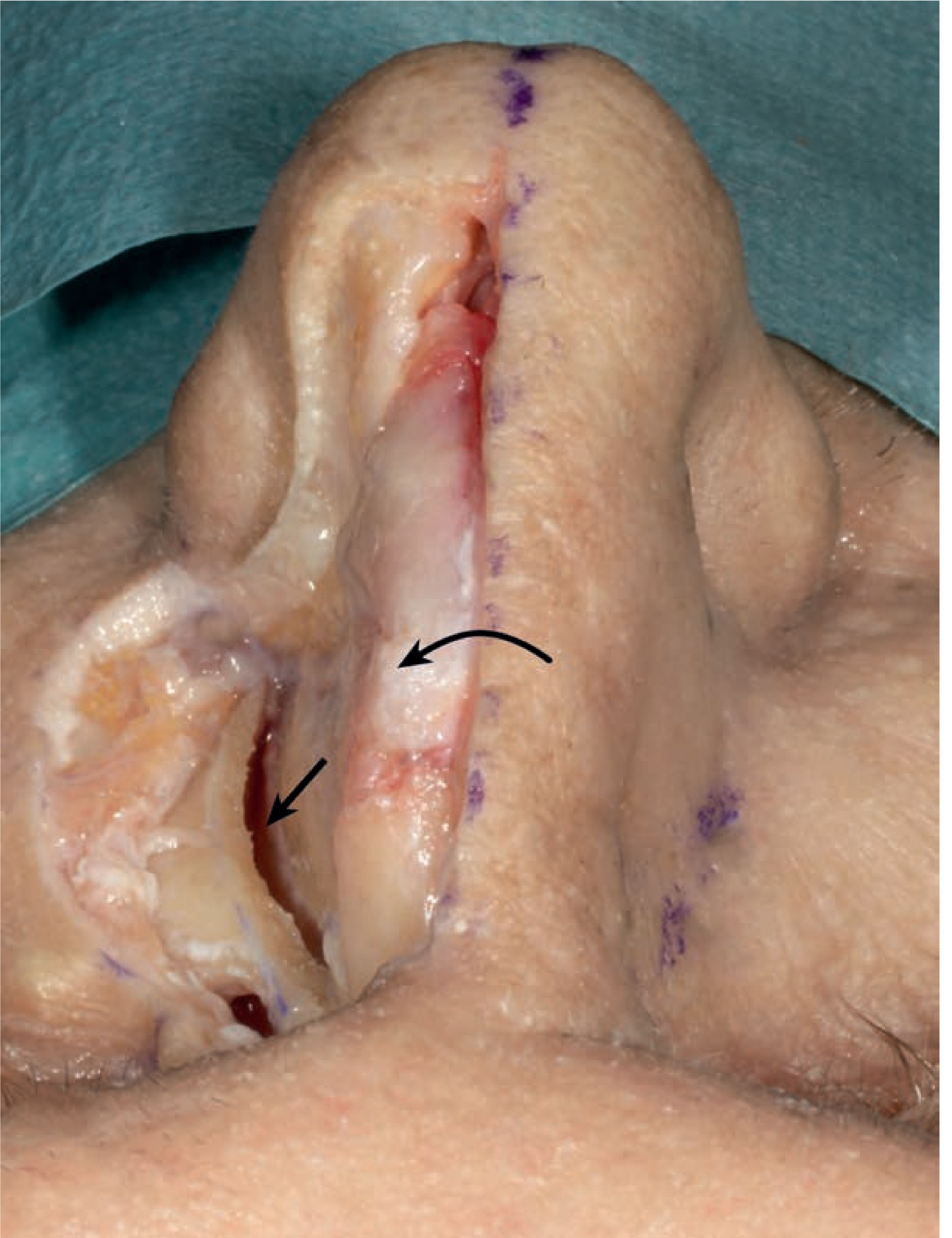
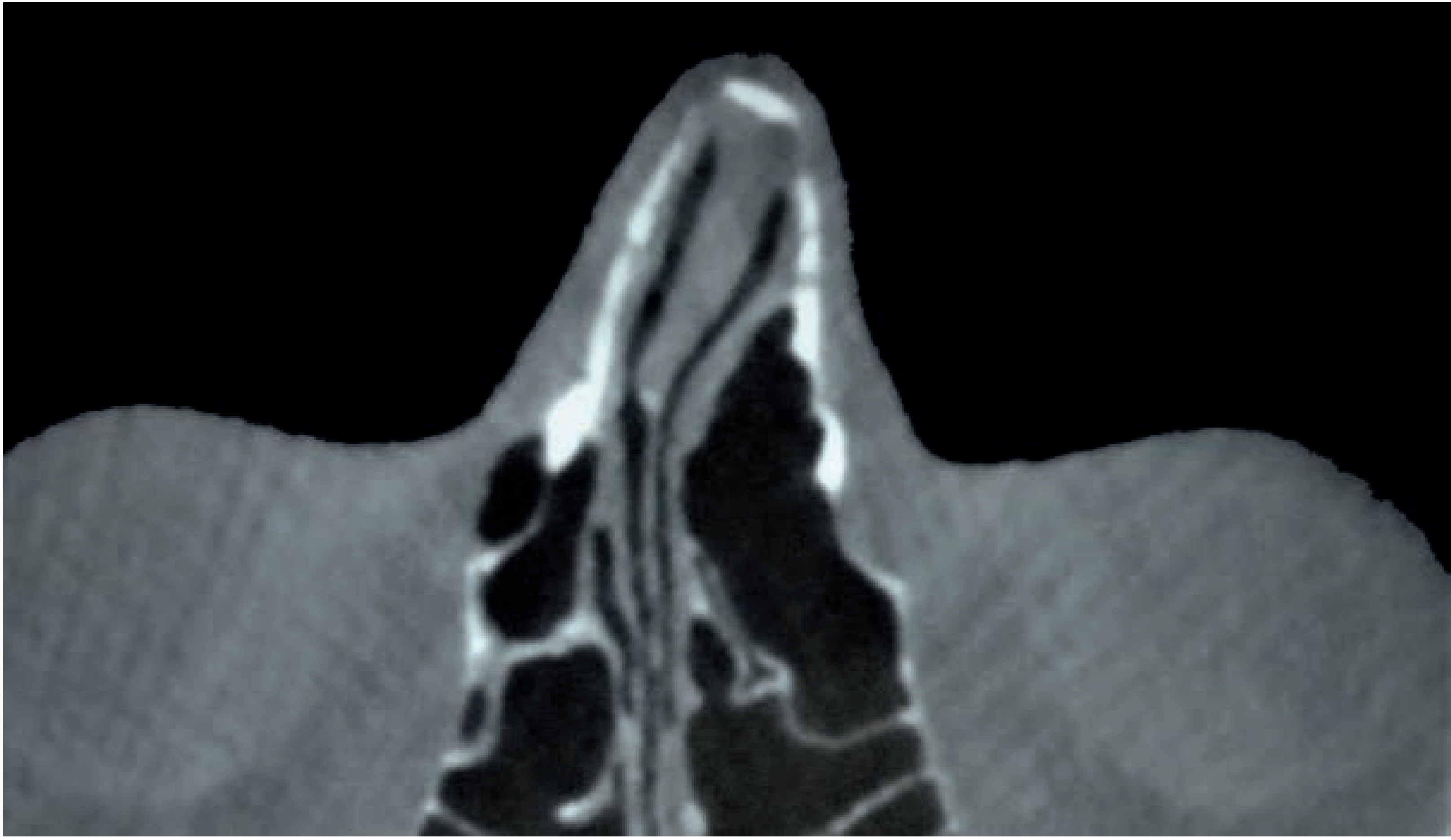




Preservation Septoplasty & Rhinoplasty in Deviated Noses

Yves Saban

Deviated noses often represent a surgical challenge for the rhinoplasty surgeon who will have to face asymmetric anatomic structures and transform them into natural, symmetric, attractive noses. The nasal septum is always deviated or distorted in these cases. These are difficult septorhinoplasties requiring surgical corrections. In classic techniques, a "component composite septorhinoplasty" is the unique solution that can offer stable results. However, these procedures are usually done in open approach and may require extracorporeal septoplasty with perpendicular plate transfer as graft supporting and straightening the anterior septum. In addition, septal extension grafts may be required to support the tip, spreader grafts to stabilize the dorsum, asymmetric equalizing osteotomies, crisscross trans-osseous sutures, and dorsal camouflage grafts.

INTRODUCTION

Compared to the complex procedures required for open structure rhinoplasty, preservation rhinoplasty is simpler, easier and quicker, without any loss of quality while achieving very good results. Nevertheless, a learning curve exists and cannot be skipped, even for experts in classic techniques. This chapter will cover the technique generally used for most of the deviated noses encountered in practice.

To decide which procedure will be required, the main question becomes: “Would I like to keep this dorsum intact even if deviated?”

In case of major distortions of the dorsal framework, preservation will not be possible, and one must choose classic structure rhinoplasty technique. Thus, there is no conflict between these techniques: they are complementary. The surgeon’s skill and experience will guide the cursor to the technique of choice for specific patients. Therefore, indications are the key determinant of the quality of the result.

Nevertheless, very experienced surgeons can perform total septal extracorporeal reconstruction, even endonasally, together with dorsum preservation rhinoplasty (see Jurado’s chapter).

In choosing preservation rhinoplasty, structure rhinoplasty, or component rhinoplasty, the cursor position depends on the rhinoplasty surgeon’s skill and the answer to the question: “Would I like to keep this dorsum intact?”

BASIC PRINCIPLES

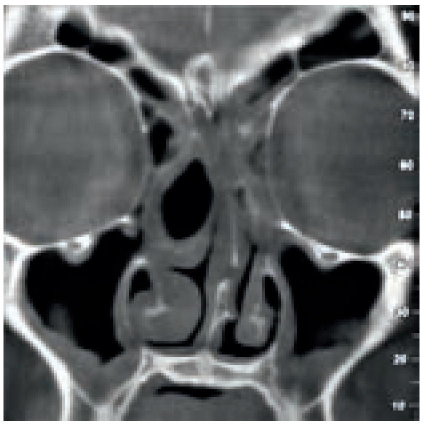
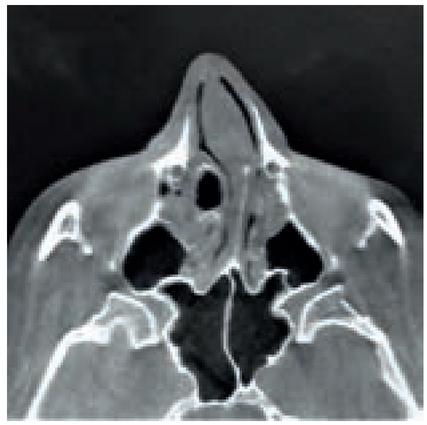
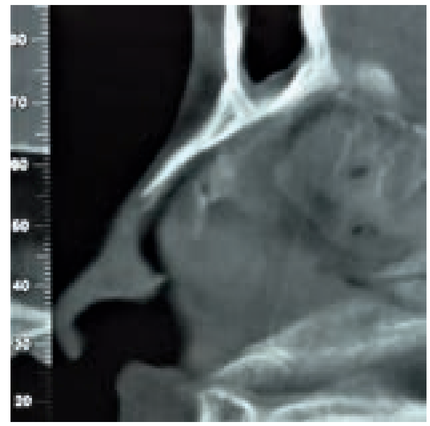
Deviated noses share a common deformity: deviation of the bony pyramid and deviation of the cartilaginous vault together with the septum. Sometimes, the deviation is only cartilaginous, as the bony pyramid is straight; care must be taken when checking the patient during facial analysis to assess the true shape of nasal bones and the frontal process of the maxilla. If the bony and cartilaginous deviations are on the same side, then we talk about straight deviated nose (an ipsilateral deviation). If the septum and bones are deviated in the opposite direction, then the nose looks like a C-shaped deformity (contralateral deviation). Sometimes, depending on the nasal tip position, the patients can present with a S-shaped deformity.

PATIENT PREOPERATIVE ASSESSMENT

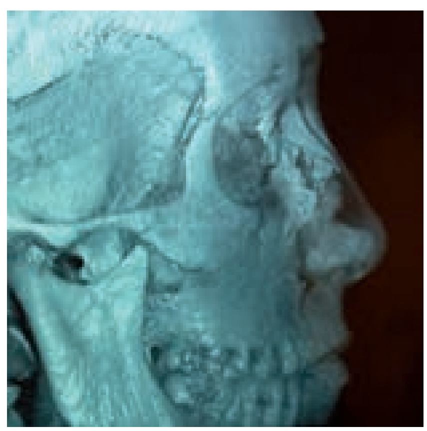
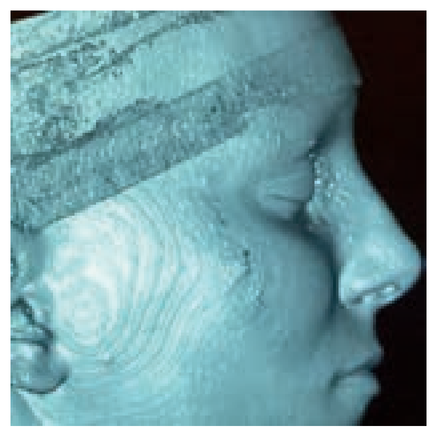
- Patient history: nasal or facial trauma, previous nasal or septal surgery, sinusitis, allergies and asthma.
- Clinical examination will follow the general principles of inspection and palpation. In front view, the 2 main features to analyze are the look and the smile: considering how humans communicate with each other, generally one observes how people are looking and smiling. Thus, the bony-cartilaginous pyramid is just part of the eyes, while the lower nose tip and nostrils work together with the lips and the smile. External examination will look for facial asymmetry, facial harmony, orthognathic pathologies, external nose shape, skin thickness, nostril, and nasal vestibule, before any internal examination. Palpation will check the nasal bones’ length and the exact location of the anterior nasal spine.
- If available, an endoscope is used to assess the turbinates, the nasal valves, and the septal deformities.
- Patient’s photos for further computer simulation and for patient documentation.
- Cone beam CT (CBCT) scan should be systematic in deviated noses (see below).
- Information and consent are obtained.

CONE BEAM CT SCAN & DEVIATED NOSE

This exam allows perfect analysis of the entire nose, any sinus abnormalities, concha bullosa, perpendicular plate deviation, perpendicular plate anterior angle location, lamina cribriformis weakness or dehiscence, frontal sinus prominence, post-trauma deformities, and sinusitis, which all must be known before surgery.

CBCT allows for perfect 3-D examination, nasal valve analysis and facial reconstruction layer by layer. Also, it provides documentation and serves as a medicolegal document.

This patient complained of chronic nasal obstruction and posterior discharge, headaches, and aesthetic deformity of her nasal pyramid. The CBCT shows the following: a chronic diffuse bilateral sinusitis, septal deviation, compensatory right inferior turbinate hypertrophy, perpendicular plate and maxillary crest deviations to the left, the right concha bullosa, and compression of the left ethmoid. Moreover, looking at the septoplasty procedure's safety, one can measure the distance between the Rhinion and the skull base (safe distance), the lamina cribriformis aspect, asymmetry and partial dehiscence.

SURGICAL SEQUENCE

In practice, surgical procedures are performed "from depth to surface" to avoid the bleeding related to the rhinoplasty which makes video-endoscopic surgery difficult. The recommended surgical sequence is: (1) endonasal endoscopic procedures; (2) "preservation" septoplasty; (3) asymmetric dorsum - "lateral push over"; (4) tip surgery, if required, and (5) ancillary procedures.

ENDONASAL PROCEDURES

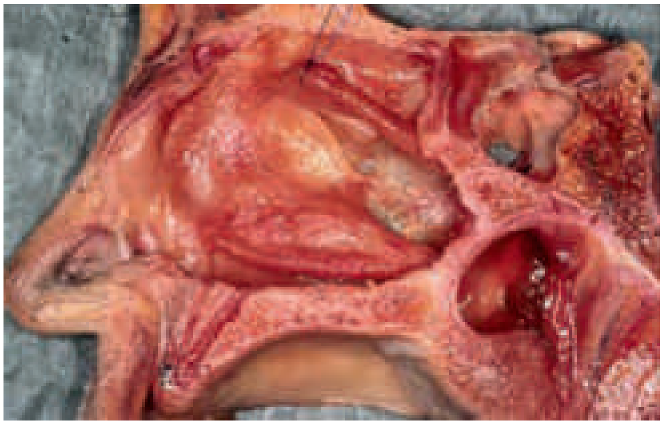
The endoscopic procedures include turbinoplasties, and sometimes simple sinus surgery (middle meatotomy, anterior ethmoidectomy) is performed by experienced rhinologic surgeons. Deviated noses are responsible for endonasal asymmetries that involve also the turbinates (see the patient's CBCT above). On the "wide" side, an inferior turbinate compensatory hypertrophy is often seen, which will require further correction. Many times, a concha bullosa (middle turbinate bulla deformity) is associated with a deviation of the ethmoid perpendicular plate that appears pushed to the contralateral nasal fossa.

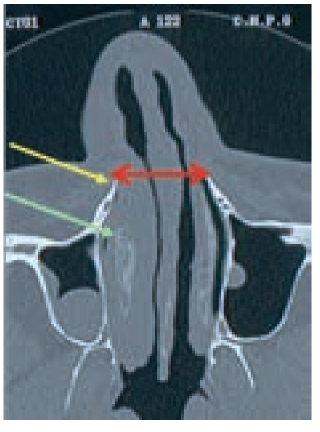


This endoscopy constitutes the first step of the septorhinoplasty performed on the patient whose CBCT scan is shown above. The nasal septum is most of the time blocking the nasal fossa *opposite* the dorsal deviation, leaving a free space in the contralateral nasal fossa where the turbinates' "compensatory" abnormalities are observed.

The *inferior turbinate* can be divided into three portions: the anterior head, the body, and the posterior tail. On the anatomic pictures below, the inferior turbinate is shown with these three portions: head, middle third, tail. The anterior portion is directly related to the frontal process of the maxilla, forming here the pyriform aperture. No lateralization is possible. Two pathologies can reduce the airway just posterior to the nasal vestibule:

(1) Stenorhinia corresponds to a too narrow pyriform aperture, including the inferior turbinate head's bony attachments to the maxilla. Generally, this is a bilateral deformity. This abnormality is often seen is leptorhine patients, mainly in cases of endomaxilla and hypodevelopment of the maxilla. On the CT-scan below, the red arrow indicates the pyriform aperture width. The correct cross-section passes exactly where the inferior turbinate bone (conchal bone) is attached on the frontal process of the maxilla.





In case of stenorhinia (see figures below), the only surgical option will be to open the bony passage through an ostectomy, including the frontal process of the maxilla and the bony head of the inferior turbinate.

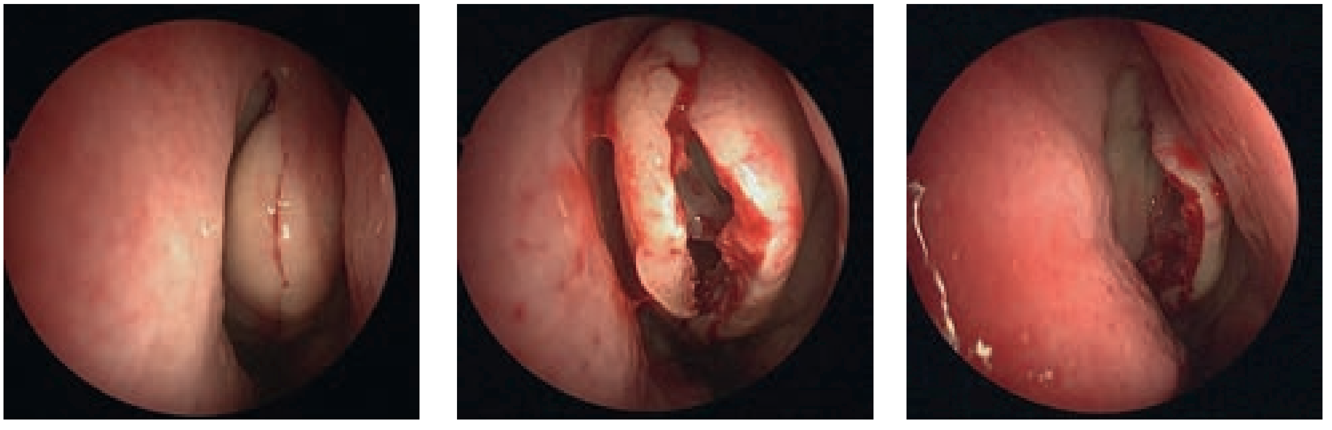
(2) Mucosal hypertrophy of the head of the inferior turbinate is another pathology that can reduce the airflow; it can be improved via a cauterization or partial resection of the excess mucosa.

On leptorhine patients, when a let-down technique is performed during a preservation rhinoplasty, the resection must take off this bony portion that corresponds anatomically to Webster's triangle. The lowering of the bony pyramid will not reduce the width of the nasal vestibule where the basal ostectomy will be done.

The inferior turbinate mid-portion is just medial to the maxillary sinus, where the sinuso-nasal wall is concave, thus freeing a space where the inferior turbinate body could be luxated laterally. It can be done with or without any mucosal volume reduction of the turbinate.

The tail presents different problems: generally, one can observe a mucosal degeneration that can be directly resected under endoscopic vision. No lateralization is possible, as the lateral wall consists of the hard-bony palatine process.

(3) The middle turbinate belongs to the ethmoid bone, together with the perpendicular plate, the sinus cells and the lamina cribriformis. It is dangerous to pull downward the middle turbinate, as this could strip the skull base and create a CSF leak. In case of concha bullosa, a sagittal division will be performed, associated with the resection of the lateral wall; the sphenopalatine foramen, where the sphenopalatine artery runs, is in the attachments of the middle turbinate tail on the lateral wall. This concha bullosa reduction is mandatory to allow the septum to reposition on the midline. Squeezing the turbinate is not enough, since the inner part of the concha bullosa is always covered by mucosa.



PRESERVATION SEPTOPLASTY

It is generally performed following a modified "swinging door" technique. General principles are the following:

- Preserve the septal cartilage integrity - avoid unnecessary cartilage resection
- Preserve the septal cartilage vitality - keep intact the mucoperichondrium attachments on one side
- Allow sagittal repositioning on midline - free the osseocartilaginous junction
- Use the endoscope for precise dissection in depth

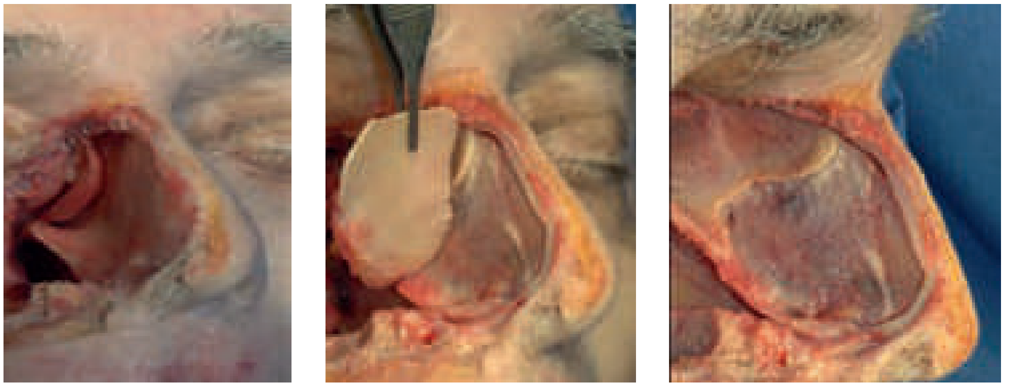
Principles & Objectives

The quadrangular cartilage is generally not considered an important structure in septorhinoplasty procedures and suffers from excessive and unjustified resections. The surgeon's only concerns are generally to preserve or reconstruct the anterior L-support and to decide the amount of cartilage to be harvested, without weakening the nasal middle third. However, the most important principle will be to preserve as much cartilage as possible.

The main goal is to preserve as far as possible the whole quadrangular cartilage, just repositioning it on the midline onto the maxillary crest; partial resections are performed to allow for adjusting its height to the nasal height. This will give support to the "new" dorsum and avoid any further septal perforation.

Preserve the mucoperichondrium attachments on one side to stabilize the cartilage.

Disarticulate the septal cartilage from the bony framework is a must in preservation septoplasty: the bony framework of the nose is responsible for the cartilage deformity and must be corrected by disarticulation, resection or reposition.



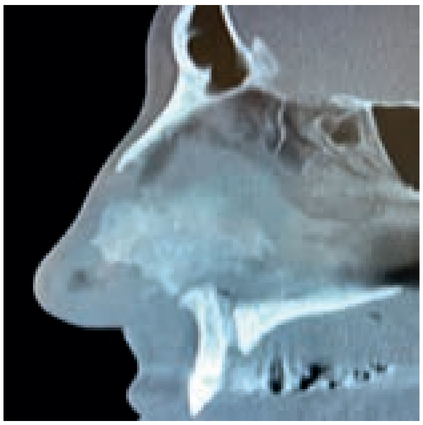
Septoplasty Classification in Septorhinoplasty Procedures

Type 1: Modified swinging door technique. No upper septum/ULC division. Keep attached a complete unilateral mucoperichondrium; disarticulation of quadrangular cartilage from bony septum (ethmoid perpendicular plate, vomer, maxillary crest and nasal spine); partial resection of the bony septum and sagittal repositioning of the quadrangular cartilage on midline. Rasping can be performed on a convex bony cap. In straight high noses, a cartilaginous septal strip can be removed inferiorly, to lower the dorsum together with the septum. There is no weakening of the septal central pillar.

Type 2: Corresponds to Type 1 + septal subdorsal strip resection, in cases where the necessity of dorsum lowering is more important, mostly in more convex dorsum or in high straight deviated noses. The perichondrium is still left attached on one side and the cartilaginous septum is preserved and acts as a central pillar. Stability of the nasal pyramid will be provided by the lateral walls together with the septum.

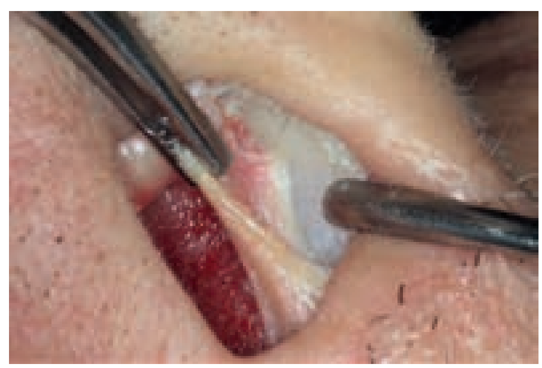
Type 3: Cottle's technique. Mucoperichondrium and periosteum are undermined on both sides of the septum; complete disarticulation of the cartilaginous septum from the bony septum; anterotation of the quadrangular cartilage allows for dorsum lowering.

Type 4: Total septal repositioning and, if required, extracorporeal septoplasty. These procedures are indicated in post-traumatic noses where the septum distortions do not allow any conservation nor direct repositioning. Even in these difficult situations, it is possible to preserve the vaults. Nevertheless, the septal median pillar must be reconstructed, often using the bony septum (see clinical case below, with central septal pillar reconstruction).

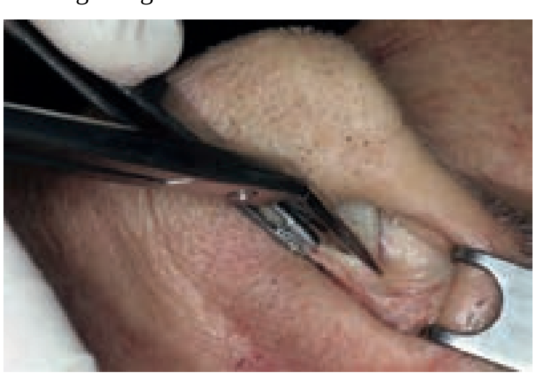
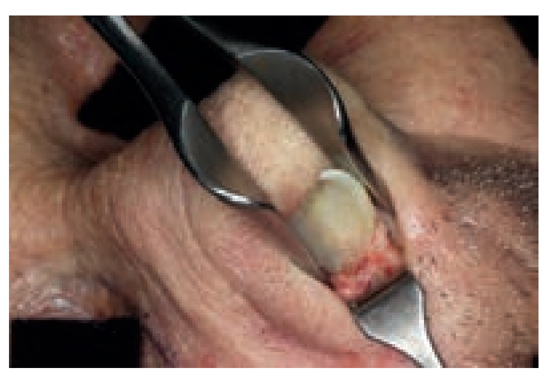


Preservation Septoplasty: An Anatomical Study

Approach: endonasal incision on the caudal septum. Undermining: subperichondrium on the right side.

ANS extraperiosteal approach; section of the ligament attachments (Latham's ligament). Prespinal and premaxillary plane undermining using Converse scissors.

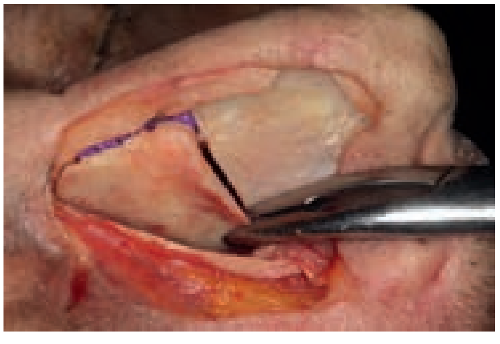



Bony septum maxillary crest undermining following the nasal floor on the right side, on the rough bony contact.


Superior cartilaginous septum undermining following the smooth cartilaginous vault.


Joining the two undermining requires division of the fibrous attachments between the cartilaginous septum and maxillary bony crest. In case of deviation or spur, this suture line junction is always located at the most prominent portion, which constitutes an easy landmark during the undermining and reveals the bony cartilaginous suture.


Bony cartilaginous suture line disarticulation will be the next step. Resection repositioning of the bony septum is an important part of preservation septoplasty.




Keeping intact the quadrangular cartilage allows either for further subdorsal septal strip section/resection if a hump reduction is planned, or for only direct reposition on the midline if no profile lowering is desired. This correction of subdorsal deviation is often required in deviated nose surgery.

In severe septal deformities, the perpendicular plate of the ethmoid will be harvested and used to stabilize the anterior septum, with a fixation on the anterior nasal spine (Gubisch).

PRESERVATION SEPTORHINOPLASTY IN DEVIATED NOSES

Below appear drawings of Type 2 septoplasty in septorhinoplasty for deviated noses. A sub-dorsal septal strip is resected to allow for dorsal lowering after bony pyramid lateral push over. This resection/division does not weaken the septal central pillar if a preservation septoplasty is performed. Resection of the bony lateral base on the “long side” frees a space for further pyramid rotation, while on the “short side” a simple osteotomy is sufficient.

Surgical Technique. Osseocartilaginous pyramid mobilization follows preservation septoplasty. On the *long* side, subperiosteal undermining inside and outside to allows for lateral push over of the bony pyramid. This periosteal undermining removes an obstacle to the bony pyramid’s mobilization.

On the *short* side: no periosteal undermining; direct percutaneous osteotomy. This direct osteotomy prevents excessive movement and works like a rotation axis that allows for bony pyramid tilting.

If more than 6 mm of rotation and lowering are desired, a unilateral let-down will be performed with unilateral bony base resection on the long side.

Dorsum profile alignment. Once the bony pyramid is straight on the midline, one must adjust the profile line. Different clinical situations can be encountered (see Clinical Cases).

PRESERVATION SEPTORHINOPLASTY IN DEVIATED NOSES: AN ANATOMICAL STUDY

This dissection shows step-by-step how the osteotomies allow for tilting the nasal bony cartilaginous pyramid, following the described surgical technique. Type 2 septoplasty has been done previously.

A subperiosteal undermining followed by soft tissue dissection has been performed on the long side (left side) to allow direct analysis of nasal biomechanics. Direct percutaneous osteotomy is done on the short right side, as well as bilateral transverse and radix osteotomies.

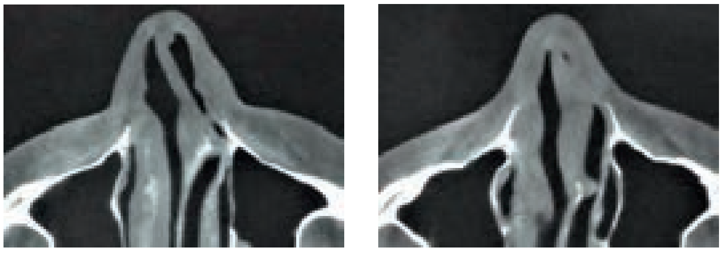
Bony pyramid mobilization and tilting on the long side (left side). The fracture line opens on this side as the nose becomes straight. The osteotomy line on the short side is acting like an axis of rotation. During this lateral push over, generally the nasal profile line is lowering by 2-3 mm due to the rotation itself.

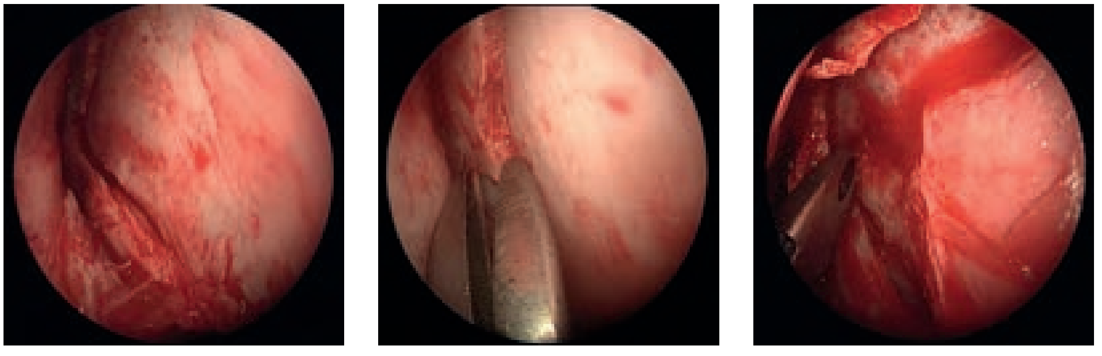
CASE #1

Straight deviated nose in a male patient. No tip surgery. No hump reduction. Easy case. Endoscopic preservation septoplasty type 1 is the first step. Preservation rhinoplasty is then performed following simple complete osteotomies and subperiosteal undermining on the long (right) side. An endonasal osteotomy is done on this long side. Preoperative photos and postoperative results after 15 months.

CASE #2 – C-shape deviated nose, preservation septoplasty Type 1

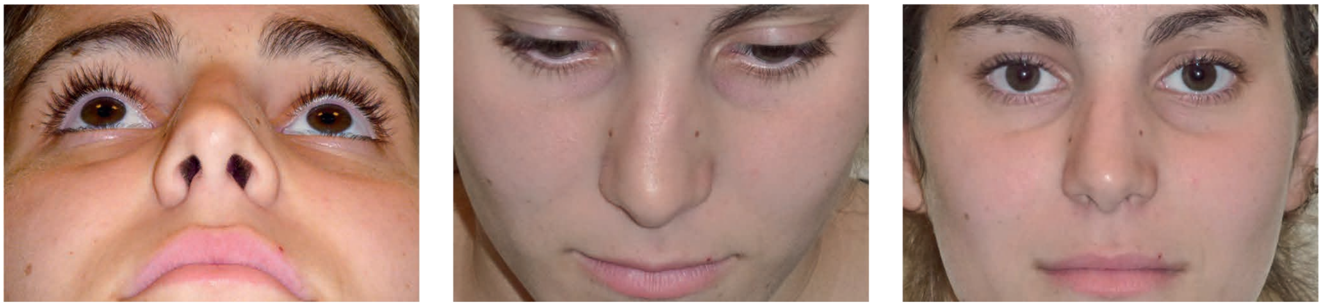
Facial asymmetry. Small bony hump rasping. No tip surgery. Septoplasty following the modified swinging door technique, keeping intact the mucoperichondrium attached on the left side. No septum-ULC division and no subdorsal septal strip resection. Pre- and post-ops are seen below. Pre-operative CT scan shows a large deviation on the left side, including vomer, perpendicular plate and maxillary crest. Then an endonasal preservation rhinoplasty is performed; lateral osteotomies are done after inner and outer subperiosteal elevation on the left side (long side); direct percutaneous lateral osteotomies are performed, as well as transverse (on both sides) and radix osteotomies.

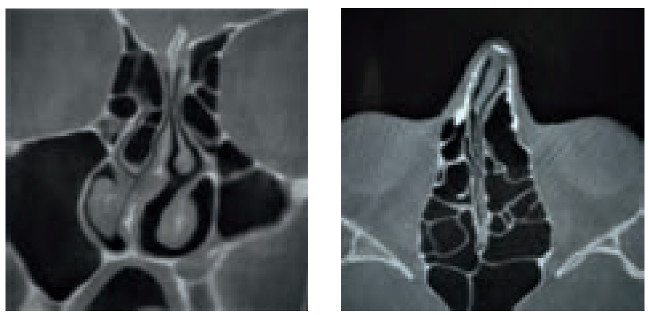




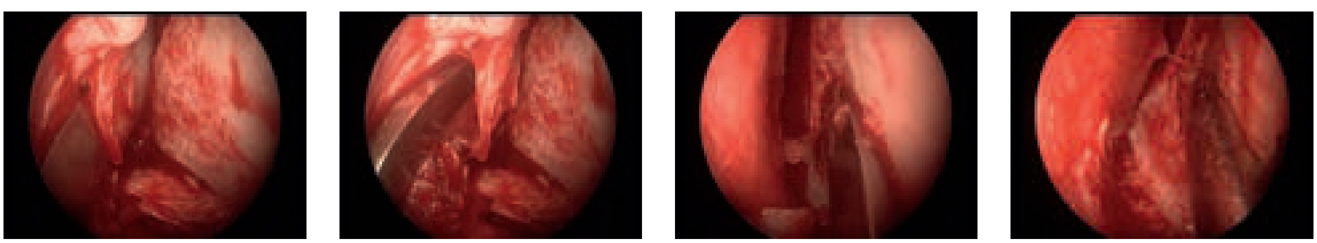
CASE #3 – S-shaped deviated nose, endoscopic preservation septoplasty Type 1

Thirty-year-old woman, S-shaped deviated nose, nasal trauma in childhood; septal body deviation into the right nasal fossa. Endoscopic preservation septoplasty type 1. Preoperative and immediate postoperative results.

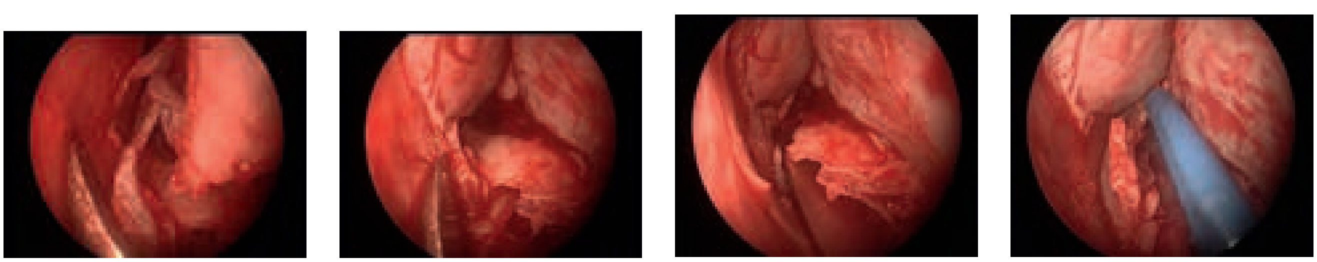




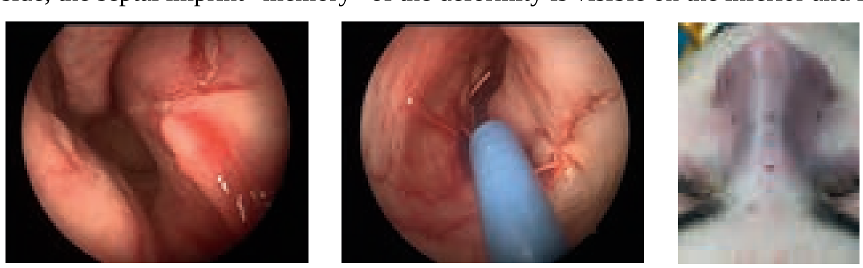
After subperichondrial undermining, the fracture is revealed, and the posterior fragment is undermined on both sides, to be resected or repositioned (left sided). The undermining extends to the septal bones. Next, the ethmoid perpendicular plate as well as the vomer are divided from the quadrangular cartilage (right sided).



The septal deformity is fully exposed, to be corrected under video-endoscopic vision. The maxillary crest is visualized luxated on the right side and resected using a fine bone rongeur.



On the right side, the septal imprint "memory" of the deformity is visible on the inferior and middle turbinates.



CASE #4

Thirty-year-old man; history of trauma and S-shaped deviated nose. Type 4 septoplasty: endonasal total reconstruction; endonasal dorsum preservation rhinoplasty; tip diamond sutures by marginal approach. Preoperative and 1 year postoperative results are seen. Percutaneous incisions for transverse, radix and right side (short side). On the long left side, endonasal osteotomies were done. Left concha bullosa; maxillary crest deviation to the left. Total nasal obstruction related to septal S-deformity. Preoperative CBCT (below on the left) and postoperative CBCT shows a straight septum and the radix osteotomy line (below on the right).

CONCLUSIONS

Deviated noses represent excellent indications for preservation rhinoplasties. Preservation will be applied to septoplasty, as well, following the modified swinging door principle. The decision to perform a preservation procedure depends on the answer to the fundamental question: Would I like to preserve this dorsum? Even highly deviated “Pinocchio noses” are excellent indications. If your answer is yes, then the following steps must be applied:

- Endonasal surgery, concha bullosa reduction, inferior turbinate reduction, sinus surgery.
- Preservation septoplasty, modified swinging door technique (cartilaginous preservation).
- Preservation rhinoplasty of the osseocartilaginous vault. Long side: subperiosteal undermining inside and outside to allow lateral rotation of the pyramid. Short side: no periosteal undermining, percutaneous osteotomies.
- If more than 6 mm rotation is required: lateral let down (push over) and dorsal height reduction. Preservation septoplasty type 2 with inferior correction and septal strip resection. Lateral wall base resection on the long side, after inside and outside undermining. Periosteal undermining on the short side and endonasal lateral osteotomies.

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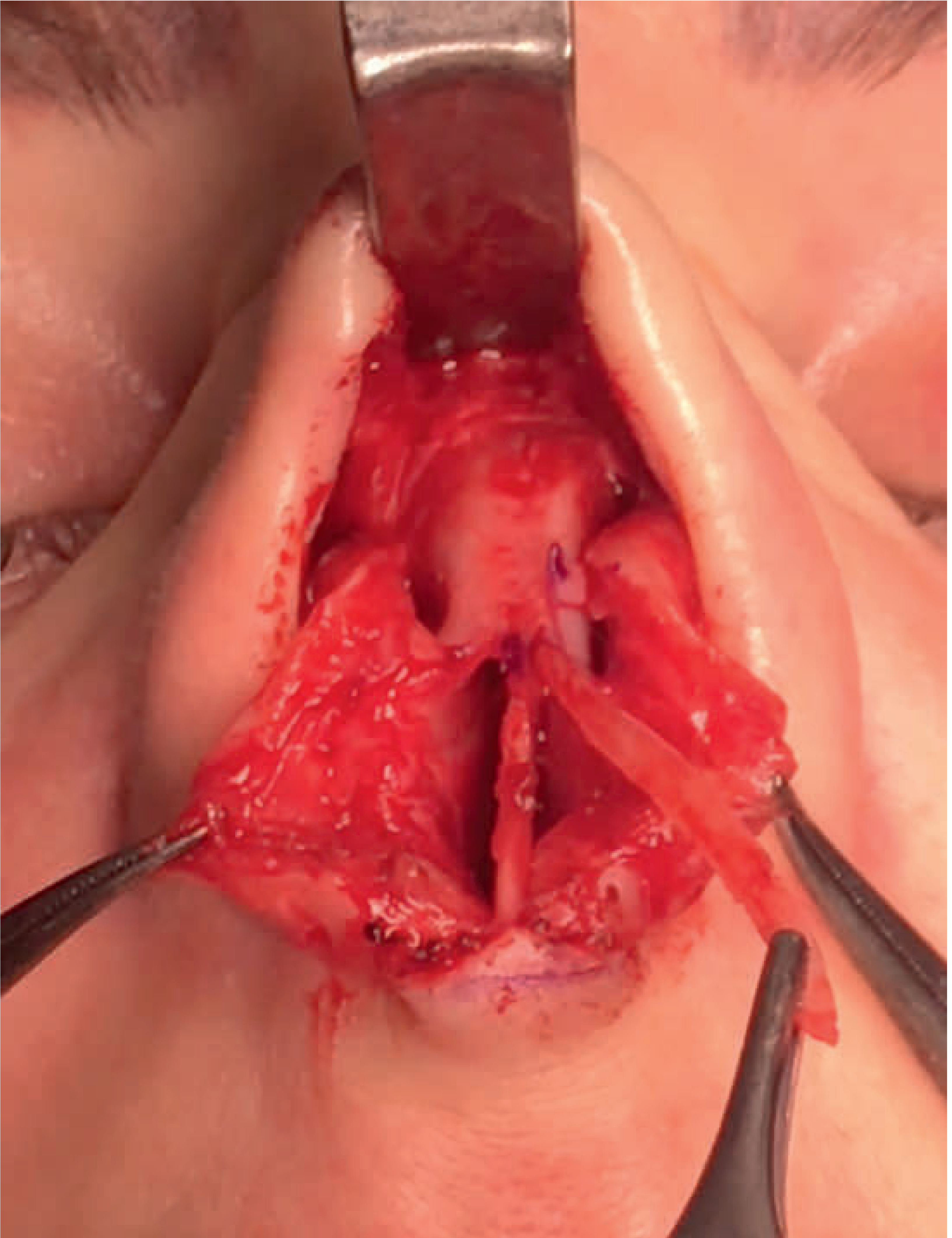
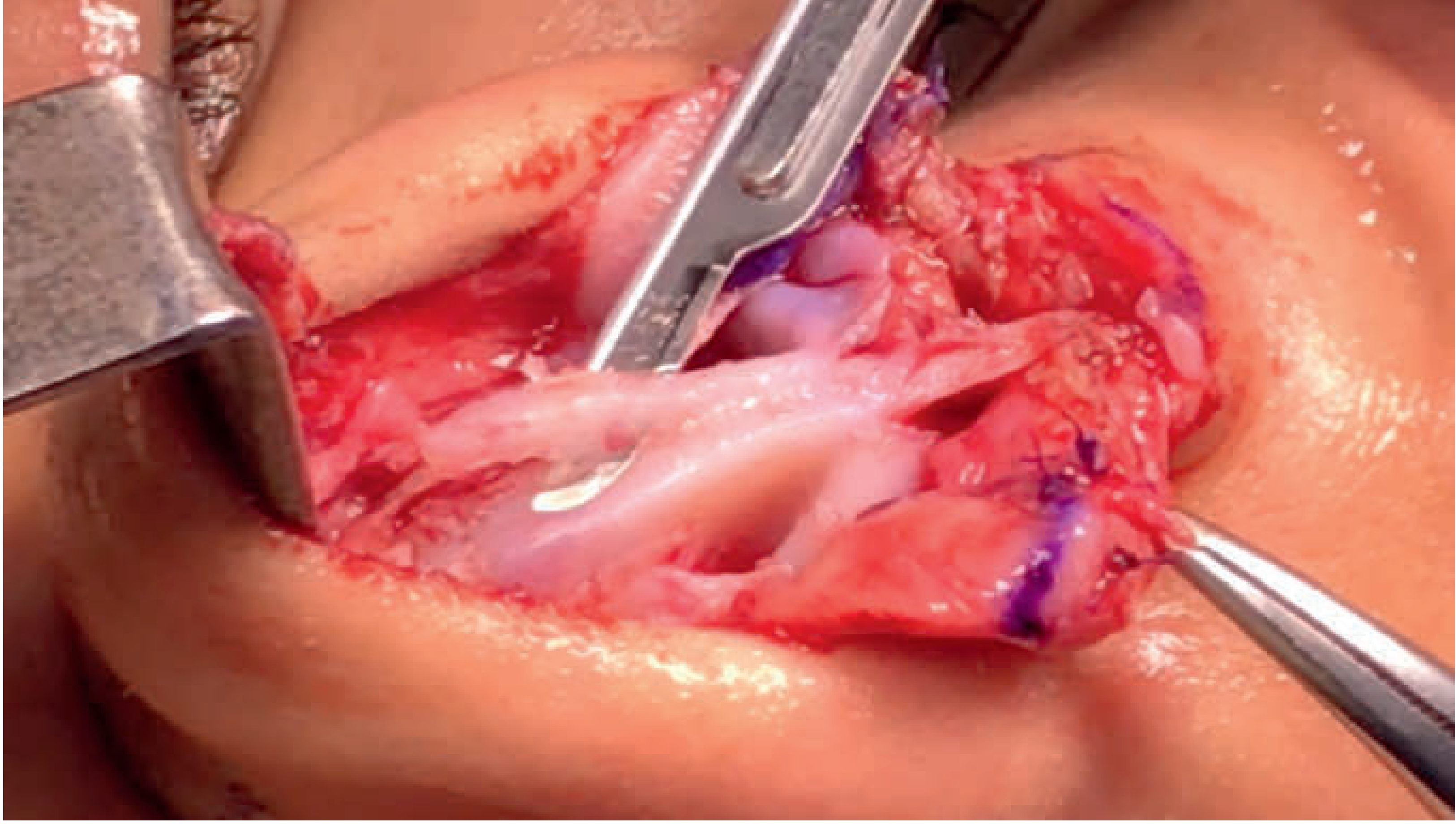




Cartilage Conversion Techniques for Dorsal Preservation Surgery

Aaron M Kosins

As a surgeon gains experience with Dorsal Preservation (DP) techniques, one begins to ask themselves in every consult - “Can I preserve this dorsum?” Currently, two Dorsal Preservation (DP) *impaction techniques* are most commonly performed with either a high or low septal strip being removed from the septum followed by mobilization of the bony pyramid via osteotomies and either a push down or let down procedure at the base of the nose. In cartilage conversion *surface techniques,* the cartilaginous hump is separated from the bony pyramid and pushdown of the *cartilaginous hump only* is performed with the bones being modified separately. The osseocartilaginous hump is not impacted; rather, *only* the cartilaginous hump is lowered centrally. We refer to these surface techniques as *dorsal modification techniques*. The dorsal modification techniques include the *cartilage-only dorsal preservation technique or cartilage vault preservation* (hereafter CVP) as well as the *cartilage vault modification (*hereafter CVM). These techniques are an easy way for surgeons to incorporate and expand indications for Dorsal Preservation in their rhinoplasty practice.

PATIENT SELECTION

The concept of traditional dorsal preservation is attractive as the nose is lowered while maintaining the natural osseocartilaginous vault. With this approach, the keystone area is preserved, mid-vault reconstruction is avoided, and septal cartilage grafting is minimized. In previous publications, patient selection has been stressed to ensure a good aesthetic result. Many patients are not good candidates for traditional DP. Initially. the author's experience was limited to only 31% of patients being suitable for the high septal strip DP technique (Kosins, 2020). As previously stated, the question of "Can I preserve the dorsum," becomes important during every initial primary rhinoplasty consultation. Equally important is how to expand the indications for DP.

When selecting patients for DP, the initial decision is made by inspecting the natural dorsum in terms of the aesthetic shape and width of the dorsal aesthetic lines on frontal view. Selection will be different for each surgeon depending on their tolerance for dorsal asymmetries, deviation, and width. Initially in the author's experience, if the dorsum was not totally ideal in terms of the shape and width of the dorsal aesthetic lines, then a traditional reduction method was chosen. However, it became apparent that the critical factor in most noses is the *cartilaginous vault*. If the cartilaginous vault is ideal, then the bones can be dealt with separately. Bones can be narrowed, lowered, removed, and/or sculpted. If a nasal dorsum can be converted by incremental bony cap modification and/or removal (which is done in every reduction surgery as an initial step), then the surgeon can examine the cartilaginous vault and decide whether to preserve it or not. This is the fundamental point: *the cartilaginous vault is the key* for deciding on the appropriateness of a DP procedure. When bone is modified, it is unlikely to move after 4-6 weeks and at this point the bony pyramid is fixed in position. However, once the cartilaginous vault is opened (with or without structural reconstruction), it becomes part of the post-operative healing process. To avoid this uncertain healing sequence, the attachments of the ULCs to the dorsal septum and the underlying mucosa becomes the most important part of the dorsum to preserve.

OPERATIVE PLANNING – Position of the Radix

With impaction techniques (high or low septal strip), the radix can lengthen in the longitudinal plane and the starting point of the nose (Nasion or radix point) can move caudally. Ideal patients for DP procedures have a normally positioned or slightly high radix. Patients with a low radix, a strong glabella, and/or a prominent premaxilla must be approached more carefully and a radix graft considered. In these patients, traditional DP may result in a short nose. In contrast, the position of the radix does not change with the dorsal modification techniques - CVP or CVM. Bone is only removed to align the bony profile and no osteotomies are done at the radix. Therefore, no hinge or drop can occur at the radix. If the post-operative result would be negatively impacted by lowering of the radix, then a CVP or other CVM technique should be considered. If the patient has a pseudohump because of a low radix and/or an under projected tip, then a CVP or CVM technique can be utilized with a radix graft and an increase in tip projection. This approach has been especially useful in the Hispanic nose as shown below.

OPERATIVE PLANNING – Type and Size of Hump

Ideal patients for traditional DP have beautiful dorsal aesthetic lines and a straight, over projected dorsum. In these cases, one can lower/impact the whole dorsum without worrying about flattening the osseocartilaginous joint. However, most patients have a V or S-shape hump. Understanding these humps is critical to choosing patients for dorsal preservation (Lazovic, 2015). It is technically easier to “flatten” the osseocartilaginous vault in patients with a V-shape hump as they have only 1 locus of angulation. S-shape humps are more difficult as they tend to have an acute takeoff of the hump from the Nasion resulting in a high Kyphion point and a second locus of angulation. S-shape humps are much harder to flatten because they have anterior convexity of the nasal bones, and bone will not flatten like cartilage. Initial dorsal preservation patients for traditional dorsal preservation should be chosen that have an over projected straight dorsum, a small hump, or V-shape nasal bones. With careful selection and experience, humps >3mm are good candidates for traditional DP and humps >10mm can be removed without issue.

The cartilage-only pushdown technique (CVP), as well as the cartilage vault modification technique (CVM), work well in both V and S-shape humps because the bony cap can be removed if it is not flat. By converting these humps to a predominately cartilage composition, flexion of the osseocartilaginous vault is simplified. In fact, removing bone can convert many S-shape humps into V-shape humps with the result that only the cartilage must be lowered. Thus, the dorsal reduction is greatly simplified. An important point is that CVP does not work as well in humps over 3.5 mm and is best in humps <3mm. Smaller humps require less removal of bone, less release of the cartilage from the bony vault, and therefore less chance of a step-deformity at the keystone area. Bigger reductions require a large amount of disarticulation that is destabilizing and then requires fixation. The idea of Preservation Rhinoplasty is to preserve structures and to simplify surgery, not to take more apart. The CVM technique works well in humps 1-2mm or humps where the “shoulders” of the upper lateral cartilage appear prominent after bony cap removal. The patients below are good candidates for traditional Dorsal Preservation.


The patients below are good candidates for Dorsal Modification (CVP or CVM).


OPERATIVE PLANNING – Length of bony vault

With subdorsal strip DP, bony vaults (nasal bones) are more difficult to flatten because cartilage is easier to flex than bone. Initial DP patients should be chosen who have primarily cartilaginous noses. Alternatively, the bony cap can be removed in long bony vaults, which transforms the dorsum into one that is more cartilaginous. This conversion aids in reduction using both the traditional DP techniques as well as the dorsal modification techniques (hereinafter DM).

OPERATIVE PLANNING – Width of Bony Vault and / or Bony Base

Wide bony vaults are unsuitable for traditional DP. If the bony dorsal aesthetic lines are not good, they should not be preserved. However, with *dorsal modification techniques* (DM), the bones are treated separately from the cartilage. While the cartilage is preserved, the bony vault can be managed as in traditional reduction methods with osteotomies or piezoelectric rhinosculpture. Wide bony vaults can be narrowed whereas asymmetric bony vaults can be sculpted. Patients with a narrow pyriform aperture are also good candidates for DM because the bony vault is not lowered into the pyriform aperture.

OPERATIVE PLANNING – Width / Symmetry of Cartilaginous Vault

If the cartilaginous dorsal aesthetic lines are not good, they should not be preserved. Wide cartilaginous vaults are traditionally unsuitable for traditional DP because often the cartilaginous vault widens and lengthens as it is flattened. Thus, it can happen that the middle vault widens. This change is aesthetically pleasing in some patients, but not when the dorsal aesthetic lines in the middle vault are already wide. Patients with excessive width or asymmetries are best treated with the high septal strip cartilage-only pushdown (CVP) because the cartilage vault is incrementally sutured to the septum. Fine tuning and narrowing of the dorsum can easily be performed with sutures. Additionally, with a DM procedure, the profile has been lowered but the septum remains intact. If an asymmetry is present in the middle vault, an endonasal spreader graft can easily be placed. A narrow dorsum can likewise be either preserved or widened as indicated with this technique.

OPERATIVE PLANNING – Crooked Cartilaginous Vault

If patients have axis deviation, they are good candidates for traditional DP. If the entire osseocartilaginous vault is deviated, the author prefers impaction techniques. However, if only the cartilage vault is crooked and the hump is less than 3.5mm, a CVP works well and is simpler to perform. Technically, low septal strip CVP (modified Cottle) is simpler to straighten because the septal flap is lowered and straightened at the same time.

OPERATIVE PLANNING – Amount of Cartilage Harvest

If a large amount of cartilage is needed for tip surgery, then a high septal strip technique is considered. Strut maintenances can be adhered to just as in component reduction, and the author regularly harvest cartilage for septal extension grafts, etc. leaving at least a 15mm L-strut of septum.

SELECTING THE OPTIMAL SURGICAL TECHNIQUE

The inclusion of *Dorsal Modification* techniques to the traditional foundation techniques has expanded the indications for Dorsal Preservation. Using the above analysis, I can now be preserved the dorsum in over *50% of my primary rhinoplasty* patients. Incremental modification and/or removal of the bony cap allows for the separate treatment of the bony and cartilaginous vaults while keeping them structurally intact. In effect, the indications of DP have been expanded to more patients and types of dorsal deformities. The high septal strip CVP is a hybrid technique that is a modification of both the subdorsal strip technique as advocated by Saban (Saban, 2018), and the SPARE roof technique described by Ferreira (Ferreira, 2016). Unlike the high septal strip impaction technique, the osseocartilaginous pyramid does not have to be separated from the face, nor is the osseocartilaginous vault completely separated from the septum (no PPE is resected). This modification maximizes stability, allows for large and safe submucosal resection of the septum for structural tip surgery if required, and is an easy procedure for surgeons to learn. With reductions of less than 3.5mm, minimal dissection is done at the lateral keystone area (and only if necessary) to sew down the cartilaginous vault to the septum at multiple points. This suture fixation insures maximum stability of the osseocartilaginous vault. Bone dust or camouflage of the keystone area is rarely required. Ferreira et al. should be congratulated for his large experience with this technique as well as his functional studies that validate its airway preservation (Santos, 2019). As stated above, this technique can be applied to larger humps. However, the author does not utilize CVP techniques in larger humps because of the potential step deformities at the new keystone area. In larger humps, the author prefers traditional push down or let down procedures.

SURGICAL TECHNIQUE

Rhinoplasty surgery of the nasal dorsum is variable and includes multiple well-studied surgical techniques. The following description reflects the author's current techniques of traditional high septal strip dorsal preservation (traditional low septal strip dorsal preservation is discussed in other chapters), as well as the CVP and CVM techniques. It will detail a spectrum of dorsal preservation techniques used by the author for specific indications. As shown below, there are 4 types of dorsal preservation, which are ranked by increasing order of complexity: type 1 – bony cap removed; dorsum shaved without opening middle vault mucosa, type 2 – bony cap removed; cartilage only push down, type 3 – subdorsal strip (Saban), type 4 – low septal strip (SPQR – Finocchi)

PRESERVATION OF THE DORSUM (Traditional Dorsal Preservation)

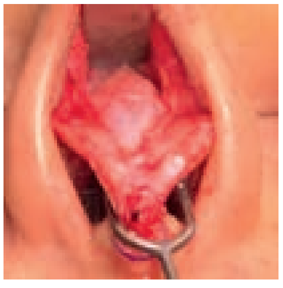
After elevating the STE, a wide submucosal dissection of the subdorsal septum is performed as well as dissecting for at least 5mm under each of the ULCs. Two anatomical points must clearly be delineated – anterior septal angle *(ASA)* and W-point. The *W-point* may be defined as the point of the separation caudally of the ULCs from the dorsal septum. The intervening area between the ASA and W-point is called the *W-ASA segment*. Sub-dorsal strip DP consists of 2 parts – 1) septal strip resection (either high underneath the septum or low along the vomerine floor) to flatten the dorsal hump and separate the dorsum from the septum, and 2) osteotomies to mobilize the bony pyramid, to separate the bony vault from the face, and to lower the dorsal profile via impaction into the pyriform aperture. Thus, this is an *impaction technique* whereby the entire osseocartilaginous vault is lowered as a unit.

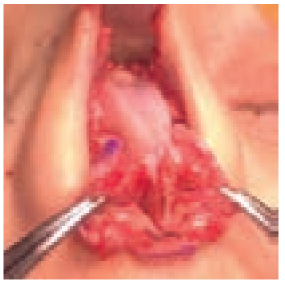
PRESERVATION OF THE CARTILAGINOUS DORSUM (Dorsal Modification)

The following describes the author's techniques for a high and low *cartilage-only push down (CVP)* in detail.

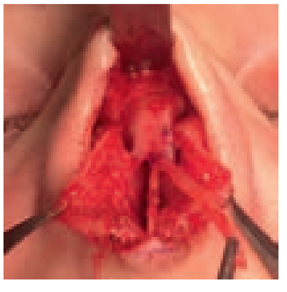
High Septal Strip CVP. After elevating the STE, a wide submucosal dissection of the subdorsal septum is performed as well as dissecting for at least 5mm under the upper lateral cartilages. Two anatomical points must again be clearly delineated – anterior septal angle (ASA) and W-point. Cartilage-only high septal strip DP is a hybrid technique that consists of 4 steps– 1) modification/ostectomy of the bony cap including the lateral keystone area to convert the bony dorsum to cartilage for a cartilage-only pushdown, 2) high septal strip resection under the dorsum to flatten the dorsal hump, 3) precise fixation of the cartilaginous vault to the underlying septum, and 4) piezoelectric rhinosculpture and osteotomies to narrow and to sculpt the bony pyramid. Thus, only the cartilaginous vault is lowered. The bones are dealt with separately (as in a component reduction) and no impaction of the osseocartilaginous vault into the pyriform aperture is performed. Alternatively (as described by Ishida), in step 1 the surgeon may preserve the bony cap and release it from the surrounding bone with paramedian osteotomies that are connected cephalically with a transverse osteotomy (Ishida, 2020). If the bony cap is flat, it can be preserved and lowered with the cartilage vault. If it is curved (convex), it is better to remove the bony cap or modify it for lowering along with the cartilage vault.

Bony Vault Modification. As previously described, there is no bony hump on the dorsum (Palhazi, 2015). Rather, a *bony cap* exists that overlaps the cartilaginous vault. If the bone is convex, it can be removed with a piezoelectric scraper incrementally thereby exposing the underlying cartilaginous vault. This maneuver effectively changes the proportions of the dorsum by increasing the amount of exposed cartilage while removing excess bone – more cartilage, less bone. This procedure helps to create a more flexible osseocartilaginous joint, to decrease the convexity/kyphosis of the nasal profile, and to widen the bony dorsal aesthetic lines. Bone is removed until the cephalic profile (area above the caudal end of the nasal bones) fits the desired post-operative profile. After incremental cap removal, only the cartilage vault must be lowered. If the bony cap is convex, it is better to remove the bony cap or modify it for lowering along with the cartilage vault.

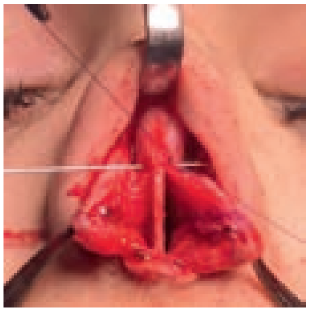


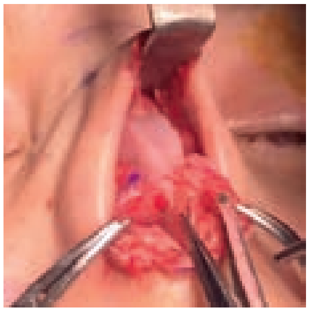


High Septal Strip Resection. As in traditional DP, the initial strip resection starts approximately 8-10mm cephalic to the ASA at the W-point. Initially, only 1.5-2mm of septum is resected directly under the dorsum. The initial cut is done to break the tension of the osseocartilaginous joint so it can be easily flattened. Curved scissors are used for the anterior cut in order to stay immediately under the dorsum and straight scissors for the posterior cut to ensure a straight cut. Any remaining septum on the undersurface of the osseocartilaginous vault can be scored with scissors to help further break the tension of the chondro-osseous joint. No PPE is removed as bony impaction is *not* part of this technique.

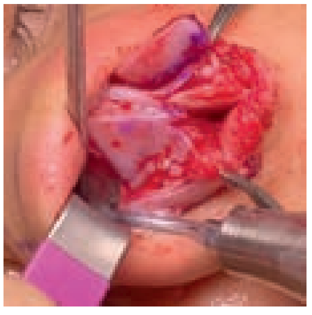


Suture Fixation of Dorsum. The cartilaginous vault is now sewn down to the underlying septum. Two 25 gauge needles are used to pin the cartilaginous vault in place. Then, sutures are used to secure the natural dorsum down into its new desired position. Sutures are placed from each shoulder of the ULC down to the underlying septum independently. In this way, the cartilaginous vault width and shape can be modified incrementally. If more than 2 mm of reduction is required, the cartilaginous vault must sometimes be partially released from the lateral keystone area to allow descent. At no time is the cartilaginous vault disarticulated completely from the bone. Only enough LKA release is done to allow fixation. The ULCs are assessed for stiffness, as stiffer cartilage requires more release from the LKA. Humps larger than 3.5 mm are *not* done routinely with this technique because a large amount of release/disarticulation is required, which can be destabilizing and create more irregularity on the dorsum.



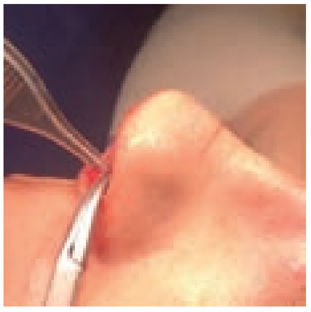


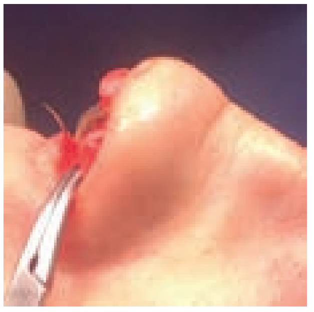
Refining the Bony Pyramid. After the cartilaginous profile is lowered to the point of harmony with the bony vault, then the bony vault will be refined. Lowering of the cartilage vault will create the dorsal and lateral aesthetic lines. No open roof deformity needs to be closed as the middle vault has been maintained (with or without the bony cap). In this way, the lateral bone is treated separately from the entire cartilaginous vault that remains intact. Narrowing / modification of the bony vault can be easily done with traditional osteotomies and instruments. However, I have found that Piezo electric instruments (PEI) makes uncapping and osteotomies easier and more predictable (Gerbault, 2016).



Low Septal Strip CVP. After elevating the STE, a wide submucosal dissection of the septum is performed as well as dissecting for at least 5mm under the upper lateral cartilages. Two anatomical points must clearly be delineated –the kyphion (K) point (most prominent portion of the hump) and the anterior nasal spine (ANS). Cartilage-only low septal strip preservation is a hybrid technique that consists of 4 parts – 1) modification/ostectomy of the bony cap including the lateral keystone area to convert the bony dorsum to cartilage for a cartilage-only pushdown (CVP), 2) septal strip resection along the vomer to flatten the dorsal hump, 3) precise fixation of the septal -cartilaginous vault unit to the ANS, and 4) piezoelectric rhinosculpture and/or osteotomies to narrow and to sculpt the bony pyramid.

As in any low septal strip technique (See Finocchi Chapter), the first cut is made vertically down from the kyphion point underneath the dorsum to the vomer. A 30 gauge needle is placed through the skin at the kyphion point to visualize endonasally the starting point of the vertical cut. A Cottle elevator is used for this cut that starts immediately under the dorsum and extends down to the vomer fading cephalically towards the PPE. No PPE is removed as bony impaction is ***not*** part of this technique. Next, the quadrangular cartilage is released from the ANS and vomer to create a quadrangular cartilage flap. Initially, only 1.5-2mm of septum is resected directly along the floor of the septum and the flap is rotated caudally and anteriorly. Once enough septum has been removed along the vomer, the quadrangular septal flap (and the attached cartilaginous vault) is fixed at the ANS via a drill hole. The quadrangular cartilage flap should rotate easily into position and absolutely no tension should be placed at this fixation. Unlike the high septal strip cartilage-only push down technique, this technique mandates that the cartilaginous vault be extensively released from the lateral keystone area to allow for the cartilaginous vault to descend without tension. Often times, the cartilaginous vault is almost completely released / disarticulated from the bone, which can be destabilizing.

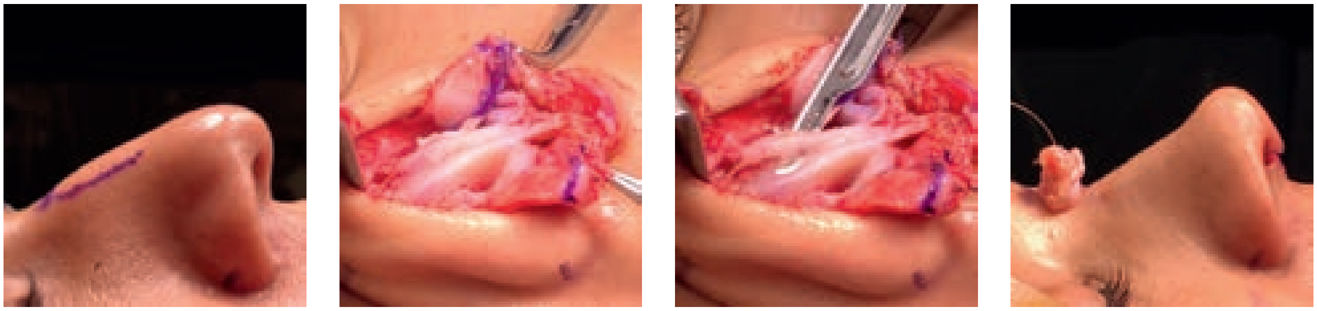




With this low septal strip CVP technique, only the cartilaginous vault is lowered and the bones are dealt with separately, as in a component reduction. Alternatively, in step 1, the surgeon may preserve the bony cap (just as in the high strip CVP technique) and release it from the surrounding bone with paramedian osteotomies that are connected cephalically with a transverse osteotomy (Ishida Technique). If the bony cap is flat, it can be preserved and lowered with the cartilage vault. Alternatively, if the bony cap is to be preserved, 2 paramedian cuts are made until the cephalic profile fits the desired post-operative profile. At this point a transverse osteotomy connects the two paramedian osteotomies and the bony cap is released and separated from the surrounding bone with digital pressure applied externally.

MODIFICATION OF THE CARTILAGINOUS DORSUM (Dorsal Modification)

The following describes the author's techniques for a *cartilage vault modification (CVM)*, i.e. for preservation of the cartilaginous dorsum via direct cartilaginous vault modification. After elevating the STE, a wide submucosal dissection of the subdorsal septum is performed as well as dissecting for at least 5mm under the upper lateral cartilages. Cartilage dorsal preservation using modification is also a hybrid technique that consists of 4 parts – 1) incremental modification and ostectomy of the bony cap including the lateral keystone area to convert the bony dorsum to cartilage, 2) shaving the upper lateral cartilage shoulders and dorsal septum WITHOUT opening the mucosa, 3) piezoelectric rhinosculpture and osteotomies to narrow and to sculpt the bony pyramid, and 4) closing any cartilage defect over the underlying mucosa and shaping the upper lateral cartilages. Thus, this is also a surface technique whereby only the cartilaginous vault is modified/lowered. The bones are dealt with separately (as in a component reduction) and no impaction of the osseocartilaginous vault into the pyriform aperture is performed.



INDICATIONS / CONTRAINDICATIONS

The author utilizes the high septal strip CVP in the majority of dorsal modification procedures. It is simple and allows for fixation at multiple points. It is pertinent to mention caution with a CVP utilizing low strip removal because it requires a large (and sometimes complete) release of the upper lateral cartilages from the nasal bones. Extended LKA release can be quite destabilizing.

To summarize, the cartilage-only preservation techniques (push down and modification) described here allow the surgeon to preserve the cartilaginous structure of the dorsum without separating the upper lateral cartilages from the dorsum. In addition, bony deformities can be treated separately with piezoelectric surgery and fine turning of the cartilaginous vault can be done with sutures. This represents an easy bridge for surgeons wishing to incorporate DP into their rhinoplasty armamentarium. In addition, impaction of the bony vault into the pyriform aperture is not performed in these surface techniques. Unsuitable candidates for CVP are patients with major mid-vault asymmetries, C-shaped dorsal deviations, humps larger than 3.5 mm, and cephalically based humps. Ideal patients have humps less than 3.5 mm, V or S-shape nasal bones, and pseudohumps. Patients with asymmetric nasal bones and wide nasal bones can also be treated because the osteotomies are done separately.

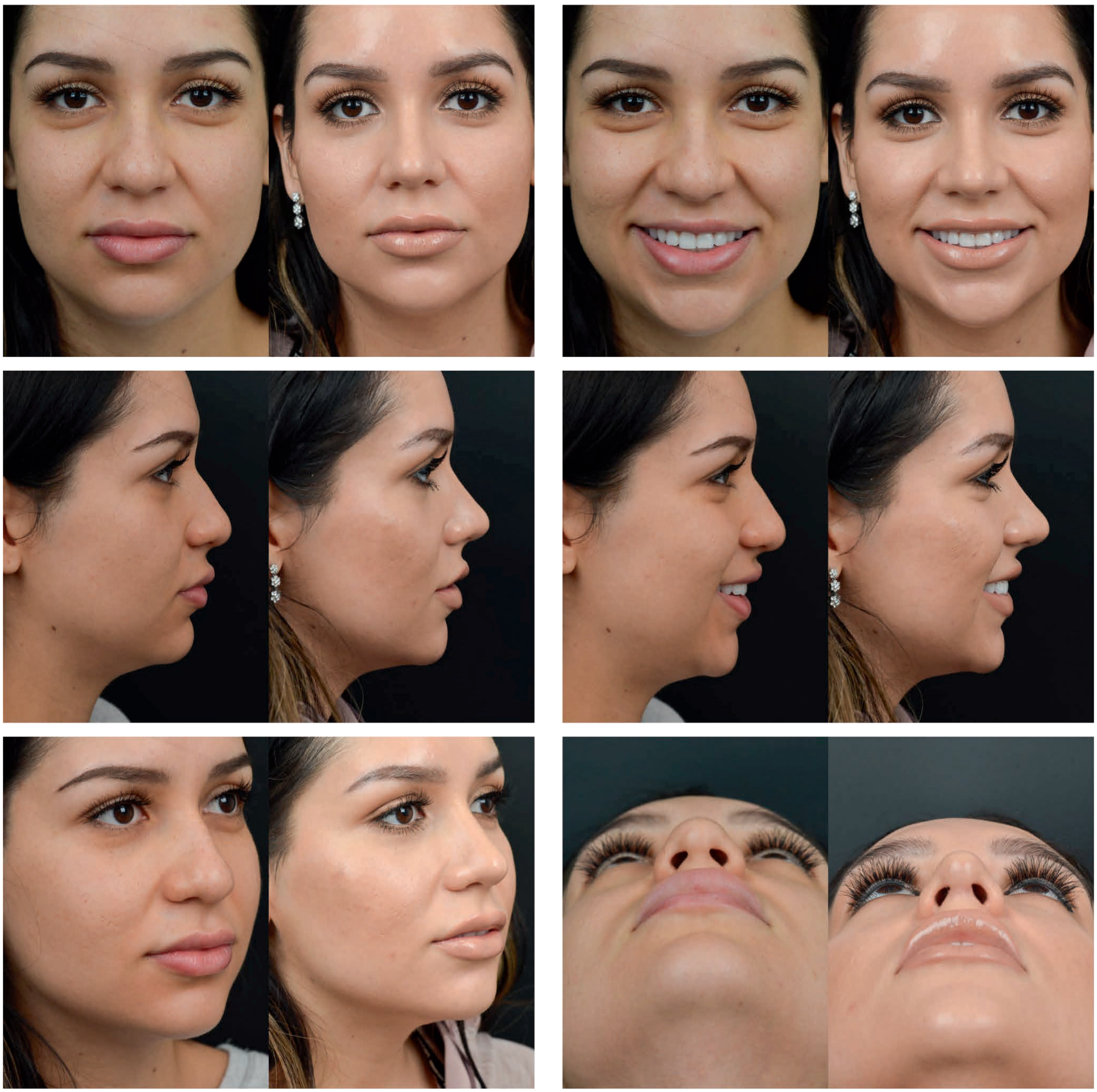
MORBIDITY & COMPLICATIONS

The morbidity and complications with these techniques are very low. Likewise, the learning curve is very fast. The bone is treated the same way as component reduction techniques, and the osteotomies are familiar to every surgeon. Both dorsal modification techniques are suitable for patients who have an easier dorsum to start with, and therefore, the operation is simpler and faster. Initially, patients with S-shape nasal bones and a small hump were the best candidates when compared to traditional dorsal preservation. With incremental bony cap removal, the surgeon can assess whether a CVP or CVM will be beneficial. If not, it is easy to convert to traditional component dorsal surgery.

I have yet to revise one of these procedures and I have done several hundred. The reason is that the cartilaginous vault is preserved and fixed into position, while piezo surgery is used on the bone. These techniques have proven to be reliable. The one facet that I feel can be suboptimal is a low strip CVP for a crooked nose. The nose does become straighter, but a traditional low strip DP procedure (Finocchi SPQR) has better outcomes in terms of straightening in my hands. Moving the bone and cartilage in one flap seems to straighten the nose much better than moving the cartilage and bone independently in the asymmetric nose.

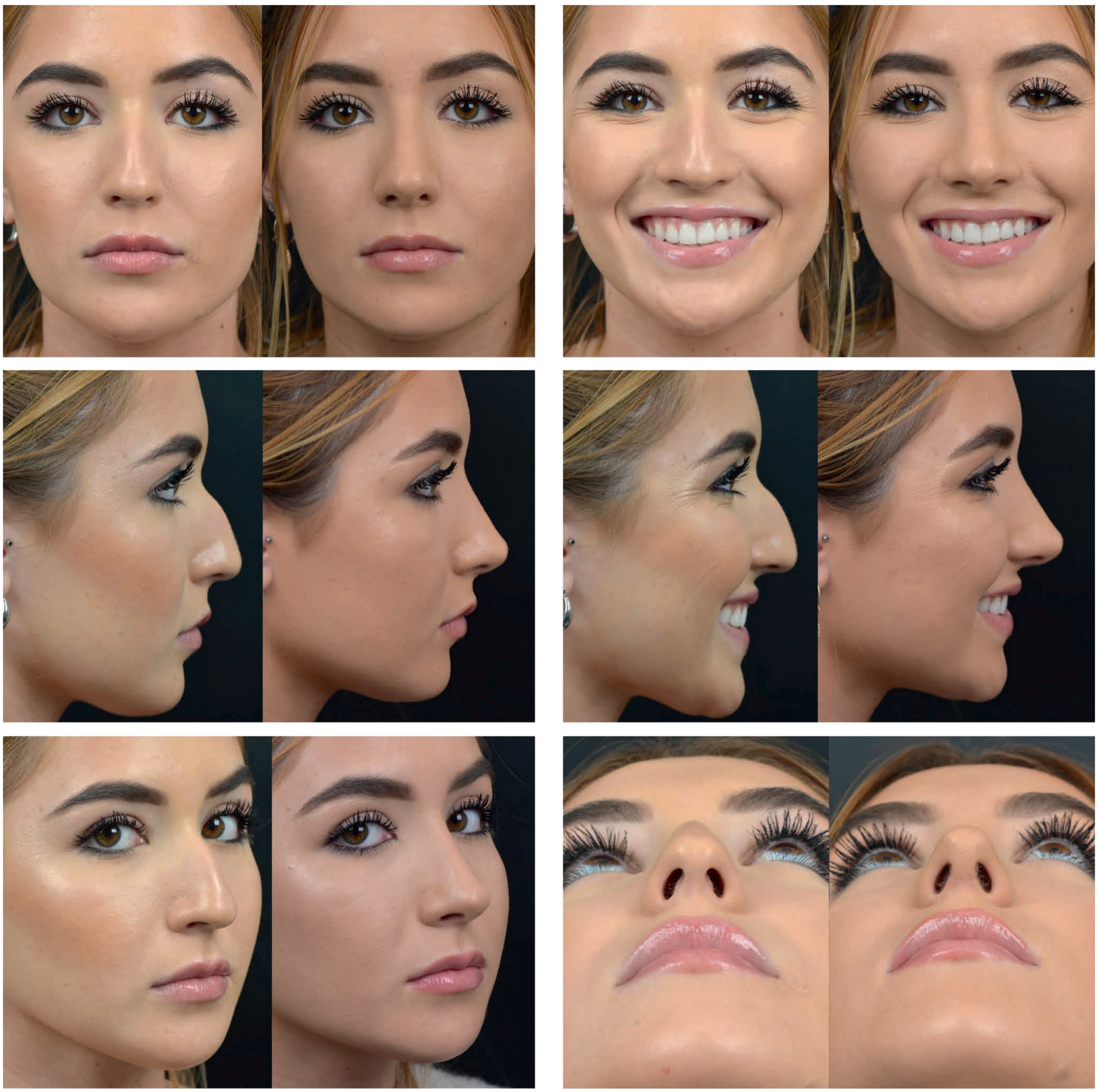
CASE #1 – Cartilage Vault Modification Only

A 26 year old female of Hispanic descent presented with a 1.5 mm dorsal hump and a bulbous tip. After piezoelectric removal of the bony cap, approximately 1mm of the ULC was shaved bilaterally. Piezoelectric rhinosculpture was performed to narrow the lateral keystone area. No alar cartilage was removed. Because the patient had very weak cartilage, a septal extension graft was used to project the lower LLCs against the soft tissue envelope to gain projection and definition.



CASE # 2 – Cartilage Vault Push Down & High Septal Strip

A 23 year old female of Hispanic descent presented with a 3.5 mm dorsal hump, a bulbous tip with under projection and plunging on smiling. The patient had a high septal strip CVP. After piezoelectric removal of the bony cap, 3.5mm of cartilage was removed incrementally from under the osseocartilaginous vault (no PPE was removed). This was followed by a limited lateral keystone release and the cartilage vault was sewn to the underlying septum at 4 points. Piezoelectric medial oblique, transverse and low-to-low osteotomies were performed. A radix graft was also placed. No alar cartilage was removed. A septal extension graft was used to gain projection and definition. All ligaments were preserved.



CASE # 3 – Cartilage Vault Push Down & Low Septal Strip

A 20 year old female of Hispanic descent presents with a 2.5 mm dorsal hump, a bulbous tip with a plunge on smiling, and axis deviation to the right. Due to her significant axis deviation, the patient had a low septal strip CVP. After piezoelectric removal of the bony cap, 4 mm of cartilage was removed incrementally from the posterior portion of the septum (no PPE was removed). This was followed by a more extensive lateral keystone release and subsequently the quadrangular cartilage flap was rotated and advanced. A drill hole was placed in the anterior nasal spine and the caudal septum was secured. Piezoelectric medial oblique, transverse and low-to-low osteotomies were performed to straighten the nose. Although the profile is ideal, the frontal view reveals a slight persistent axis deviation of the middle vault.

CONCLUSION

Preservation Rhinoplasty is a paradigm shift in rhinoplasty. With experience, one becomes more comfortable with the different techniques available. Surgeons will find themselves asking in every situation whether or not they can preserve structures. In the majority of patients, the dorsal soft tissue envelope can be preserved as well as the nasal ligaments and lateral crura. Dorsal Preservation is a reliable technique if patients are chosen properly. With bony cap modification, more dorsums can be preserved and dorsal aesthetics can be improved. No dorsum looks as good as a natural dorsum, and long-term issues with the middle vault and keystone area can hopefully be avoided.

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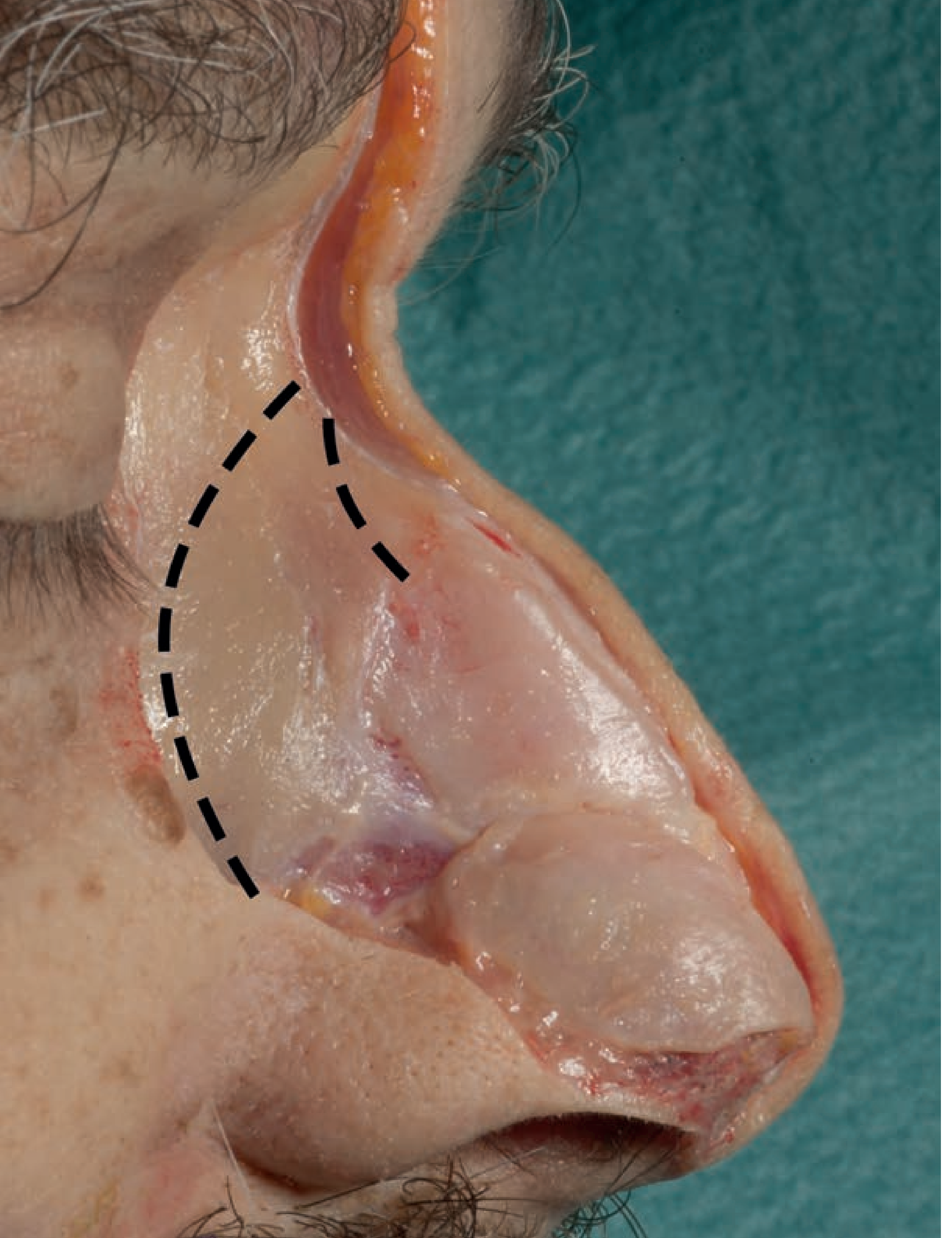
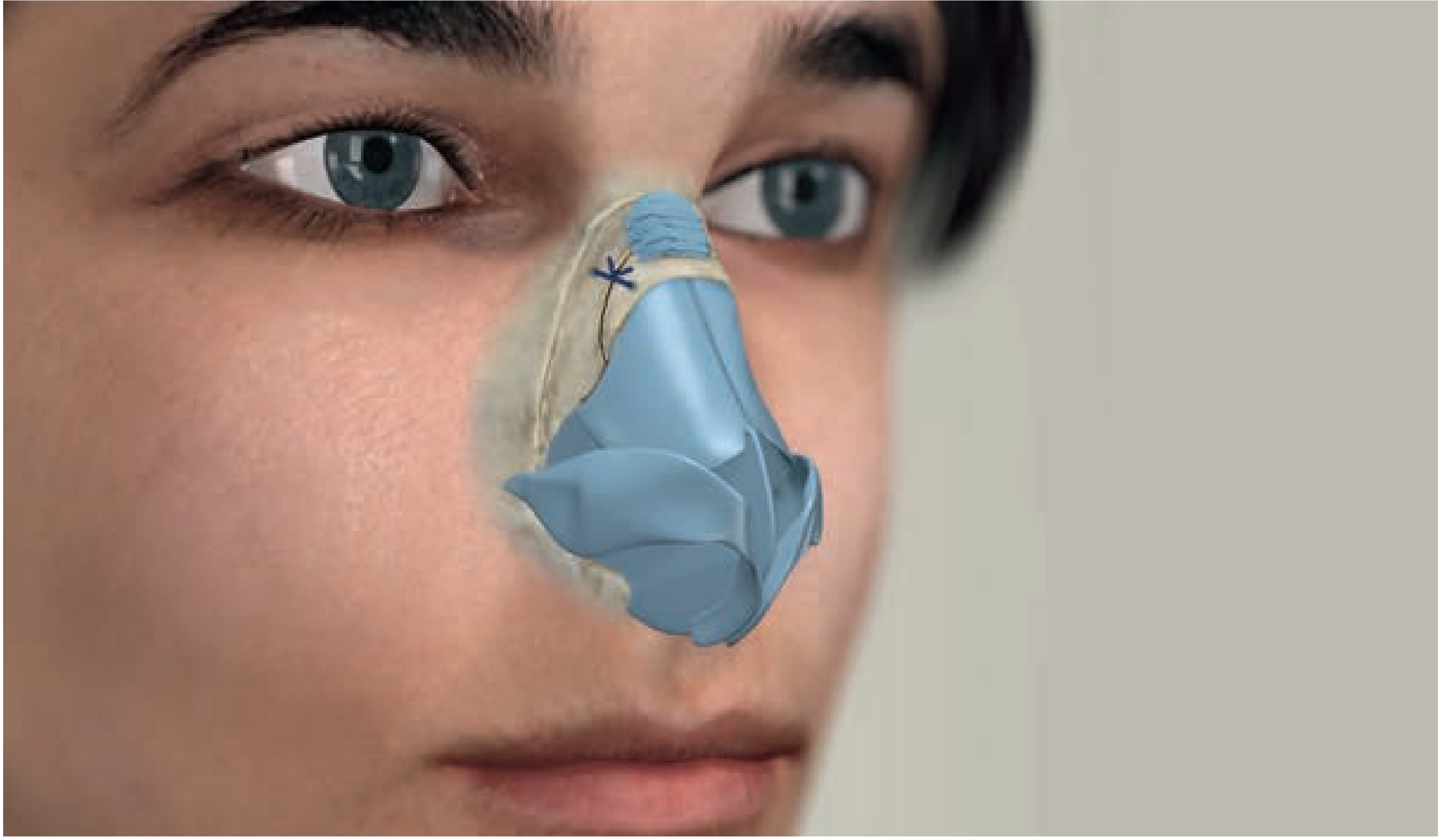




Refinements in Dorsal Preservation

Milos Kovacevic

As in all surgery, certain techniques are used for years only to be replaced by better ones. In Rhinoplasty Surgery, we are now seeing an older technique being reinvented with important improvements thereby leading to a renaissance in acceptance. The classic Push Down Operation (PDO) has been reborn thanks to crucial modifications by Saban. His first modification was to remove a *strip of septal cartilage and bone directly under the hump* allowing better control of residual hump shape His high septal strip excision combined with both a PDO and LDO (Let Down Operation) permitted preservation of the patient's own natural dorsum (DP: Dorsal Preservation). Since the dorsum is maintained, there is no need for reconstruction with spreader grafts or spreader flaps which can over the long-term observation lead to a significant number of unsatisfying results due to lack of complete control of the healing process. Saban's second modification was to make a horizontal cut in the septum approx. 2.5-3 mm below the hump. In the case of a less convex hump, a small strip of underlying septal cartilage of approx. 2.5 mm should remain to "keep the shape." If the hump is more convex, it is useful to incise the strip perpendicularly to decrease the tension thereby allowing further flattening of the dorsum. These two important modifications give the surgeon more control in DP. When do I use this technique? Preserving the dorsum is the smartest in tension noses where the goal of the surgery is just to decrease the dorsal height. The best, most natural dorsum with the fewest revisions occur if we preserve and deproject the patient's own dorsum.

PRINCIPLES

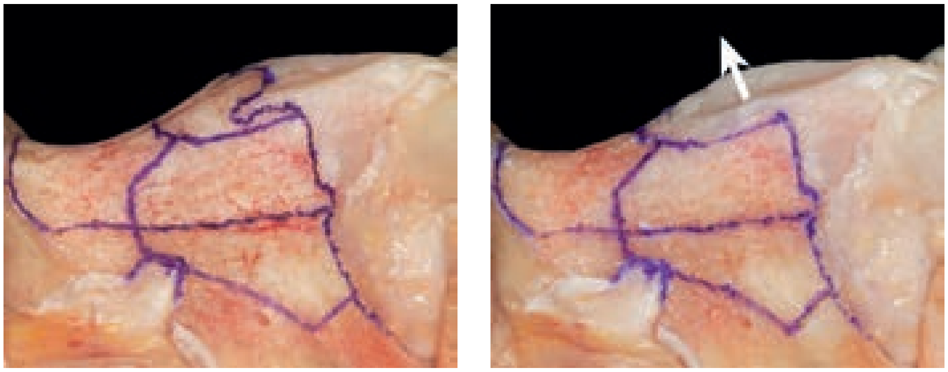
Our standard surgical procedure begins after disinfection and local anesthesia (Ropivacaine) combined with vasoconstriction (Adrenalin). A *hemitransfixion* incision is done with a wide dissection of the perichondrium, so the septum with all potential irregularities can be estimated from this view as well. The underlying mucosa of the ULCs and bony hump are dissected 4-5 mm laterally from their highest point, thereby permitting direct endonasal observation of the osteotomy line at the highest point of the bony dorsum and their extension in the superior part of the perpendicular plate. After treatment of the turbinates, if necessary, an inverted-V incision on the columella is done, followed by a full open approach where we can directly visualize the entire bony pyramid. We start usually with piezo-assisted *lateral osteotomy* on the right side, then extending this line into a transverse osteotomy through the bone, and around to the level of the nasion. Doing the surgical sequence in this manner allows us to see exactly endonasally the location of our desired connecting cut through the Perpendicular Plate with maintenance of the stability of the osseocartilaginous vault (OCV).

After these osteotomies, a cartilaginous strip is removed from under the hump (usually 2-4 mm) followed by a sharp cut with a piezo saw or Caplan scissors through the perpendicular plate towards the osteotomy line at the nasion. Endoscopic inspections should make sure that those two osteotomy lines are connected to each other.

Next steps are the transversal and lateral osteotomies on the left side of the pyramid. The pyramid should become mobile after this and descend vertically into the gap in the upper part of the septum. If a bigger resection (more than 3 mm) is necessary, then the so-called “Hockey Stick Piezo Rasp” is inserted in the lateral and transversal osteotomy line, and incremental gap widening is done, or alternatively one can remove a bone strip. This technique can be used especially on the longer side of the bones in patients with slightly crooked noses. The gap is asymmetrically increased until there is no resistance from the bony edges. In this case, it is useful to retain an underlying cartilaginous strip under the hump, so one can suture it on the right or left side of the septum (depending on the desired position).

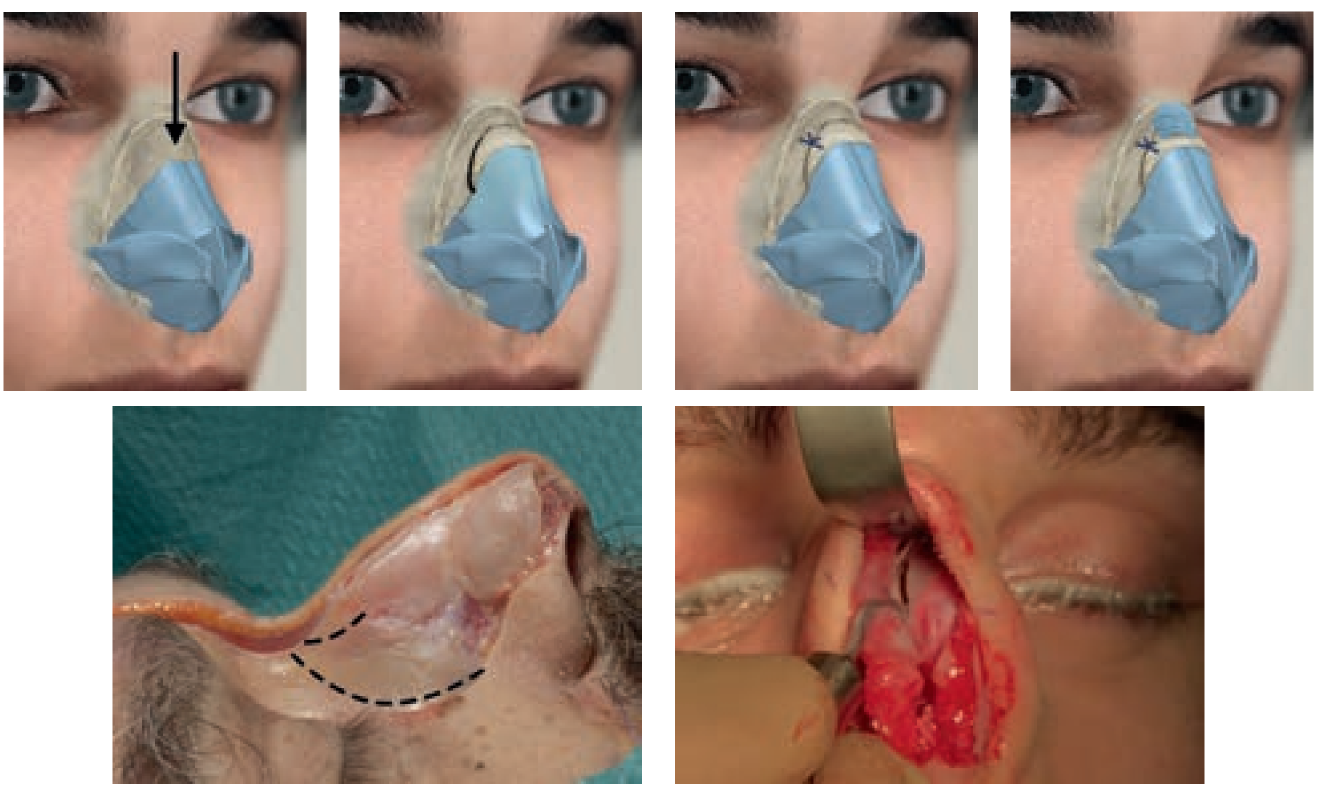
PARTIAL SPREADER FLAPS

In cases of small residual hump and slightly wide nasal bridge after DP, the following procedure is recommended. At first, the bony cap is removed with piezo electric rasp that prevents large movements of the pyramid and does not cause any harm to the underlying cartilaginous vault (see figure below). Following bony cap removal, one can very often see the *Y-shaped configuration* of the middle vault with its two defined round protrusions of the cartilaginous arches, also known as rhinion horns. In these situations, unilateral or bilateral partial spreader flaps may provide a solution for creating a more pleasing nasal dorsum. If necessary, one can partially divide the ULCs from the septum in the area of protrusions to allow narrowing and recreation of the dorsum. Note: The caudal attachments of the ULC to the Septum remain intact. The arches of the divided ULC are gently pushed in the gap with a rotational movement to restore the desired shape. Horizontal mattress sutures (5-0 PDS) are used to secure the new position of the ULC.



DOUBLE-LEVEL LET-DOWN OPERATION

In patients with significant kyphotic hump in profile, the so-called *S-shape nasal bones* (Lazovic et al.), an additional surgical step is often needed to prevent a residual hump. If there is still a residual hump after completing PDO, one can use a sharp, thin piezo saw and make a cut approximately 4-5 mm distal to the most cephalic portion of the osteotomy in the radix. Starting at this point, a secondary osteotomy is done around the nasal bones without dissecting the ULCs. Then, the piezo hockey stick rasp is placed into the gap to increase it until the desired dorsal hump flattening occurs. After palpation and visualization of the new dorsum, two holes are drilled on the residual bony dorsum and nasal bones to secure its position with 5-0 PDS suture. Note: This technique can be used in revision cases as well, when a residual hump remains after DP.



PRF AND CARTILAGE GRAFTS

Due to hump deprojection in DP, radix elongation occurs which leads in some cases to the so-called "infantilization" of the nose (Kosins). In the patient group with S-shaped kyphotic noses, a step can occur at the radix osteotomy line, especially in an attempt to achieve a pleasing aesthetic result. When the bony step is more than 2 mm between the Nasion and the deprojected hump, it may be is necessary to use a radix graft. For this purpose, we use *Diced Cartilage in Temporalis Fascia* (DC-F)- or *diced Cartilage / Cartilage scales embedded in Platelet Rich Fibrin* (PRF). We use the Choukroun protocol which requires only the patient's own centrifuged blood without any addition of anticoagulant or bovine thrombin. With this method, one can obtain a purely allogenic graft very quickly in approximately 8-10 minutes. The preparation is very easy and cost-effective, and the graft easily adapts to the underlying surface.

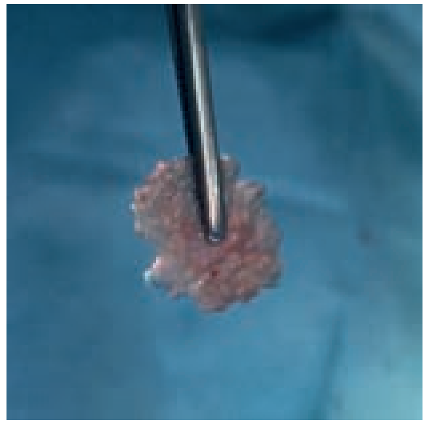
At first the cartilage grafts particles are stuck to each other with the so-called *Injection-PRF* (I-PRF) with very high fibrin concentration. The next step is to integrate them for more stability into a fibrin membrane of *Advanced-PRF* (A-PRF). One needs for the first protocol (I-PRF) two specific I-PRF tubes with approximately 5-10 ml blood from the patient`s peripheral vein. It is centrifuged immediately for 3 minutes at 700 rpm. After spraying it on the cartilage grafts, fibrin coagulation occurs within 3-4 minutes. Residual fluid is squeezed out by applying slight pressure on the graft with Telfa.

In the meantime, two specific A-PRF tubes with blood are centrifuged for 8 minutes at 1300 rpm. Any PRF clot is removed from the tube, and the red bottom segment with erythrocytes is removed using scissors. Then, the PRF clot is placed on the surface of the graft and gently pressed with gauze to ensure that the fibrin membrane can integrate into the cartilage graft. The same process is repeated on the other side. Afterwards, the flexible graft which can adapt to the underlying surface is carefully placed in the radix to smooth the step deformity, thus lowering the risk of a visible deformity. In our experience of the past three years using *PRF/ Diced Cartilage Graft*, there has been no significant graft absorption nor significant volume loss.

Diced Cartilage (DC) connected with liquid PRF is covered with A-PRF gel (Kovacevic, 2017). Light pressure with a gauze presses out the fluid from the gel which creates a fibrin membrane that is integrated in diced cartilage to prevent dissemination of the particles. One can repeat this procedure on the other side of the DC to create an envelope for the graft. This graft adapts to the underlying surface. One has to place the graft in a transverse fashion onto the dorsum to prevent displacement from the midline.

LATERAL ONLAY GRAFT

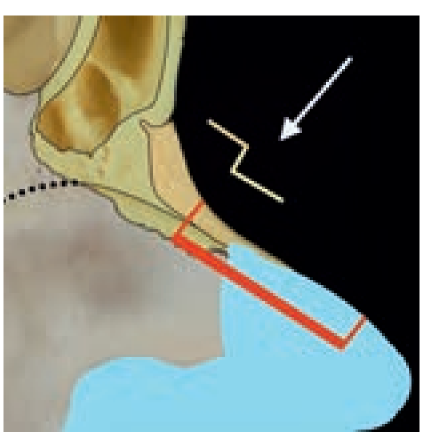
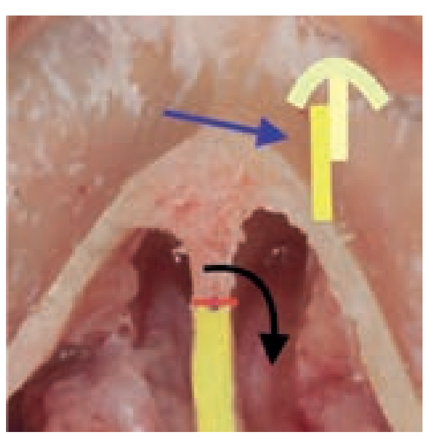
In some rare cases of slight asymmetry in the dorsal aesthetic lines, one can use a cartilaginous onlay graft on the less convex side of the ULC to improve the contour. The cartilage graft (mainly septum) is shaved and placed onto the concave part and secured with 5-0 PDS sutures. In some cases, one can use *Cartilage Scales and PRF* as an onlay graft.

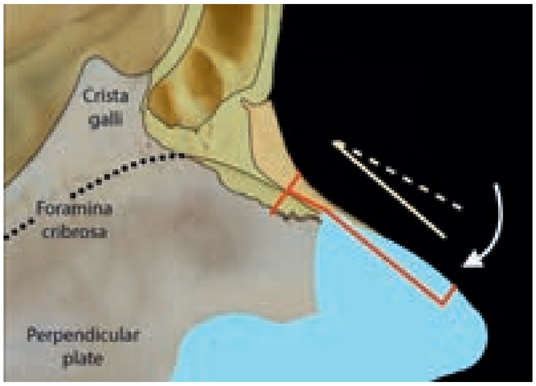

AVOIDING THE RADIX STEP

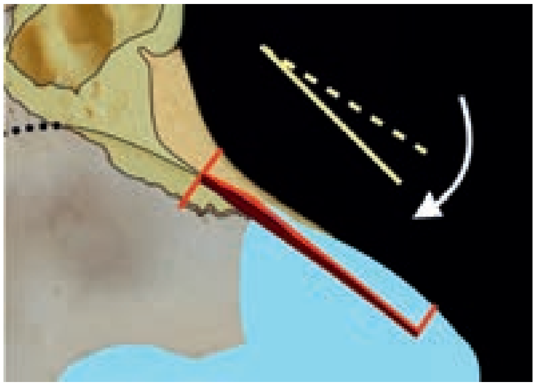
One of the most common problems in DP is the creation of a Radix Step (see on the left). It occurs following the osteotomies and septal resection when the entire pyramid drops creating a visible step in the radix area. This step deformity occurs when the perpendicular plate below the radix is excised excessively. It often happens if the surgeon resects the septum subdorsally in a straight line, especially in patients with more prominent humps. To treat the problem, surgeons remove the highest point of the step which results in elongation of the radix and infantilization of the nose (Kosins, 2019).

The second problem which can occur is the *unintended creation of a deviated nose* (see below, center and right). As the dorsum descends, the septal stump under the dorsum slides down parallel to the septum which pushes the whole pyramid to one side and becomes interlocked in a deviated direction with the remaining septum underneath. The practical solution to avoid this problem is to begin with a subdorsal *triangular resection* rather than quadrangular excision. It is important to remember our sequence of osteotomies and septal strip excision. We start usually with piezo-assisted *lateral osteotomy* on the right side. Then, the lateral cut progress into a *transverse and radix osteotomy* up to the level of the nasion. Doing the surgical sequence in this manner allows us to see endonasally exactly the location of our septal strip excision and the required cut through the PPE.


The modification of the septal strip excision consists of the following 3 steps: 1) begin the septal cut 3.5-4mm cephalad to the W-point, 2) then extend the cut to the highest point where the cartilaginous septum meets the PPE thereby creating *a subdorsal triangle*, 3) a subdorsal cut is made in the bony septum exactly subdorsal. One first does "bony incisions" exactly below the hump with #15 blade to make sure that the fracture goes in desired direction. Then, one takes a sharp 2 mm chisel and connects the transverse bony osteotomy with cartilaginous septum subdorsal.





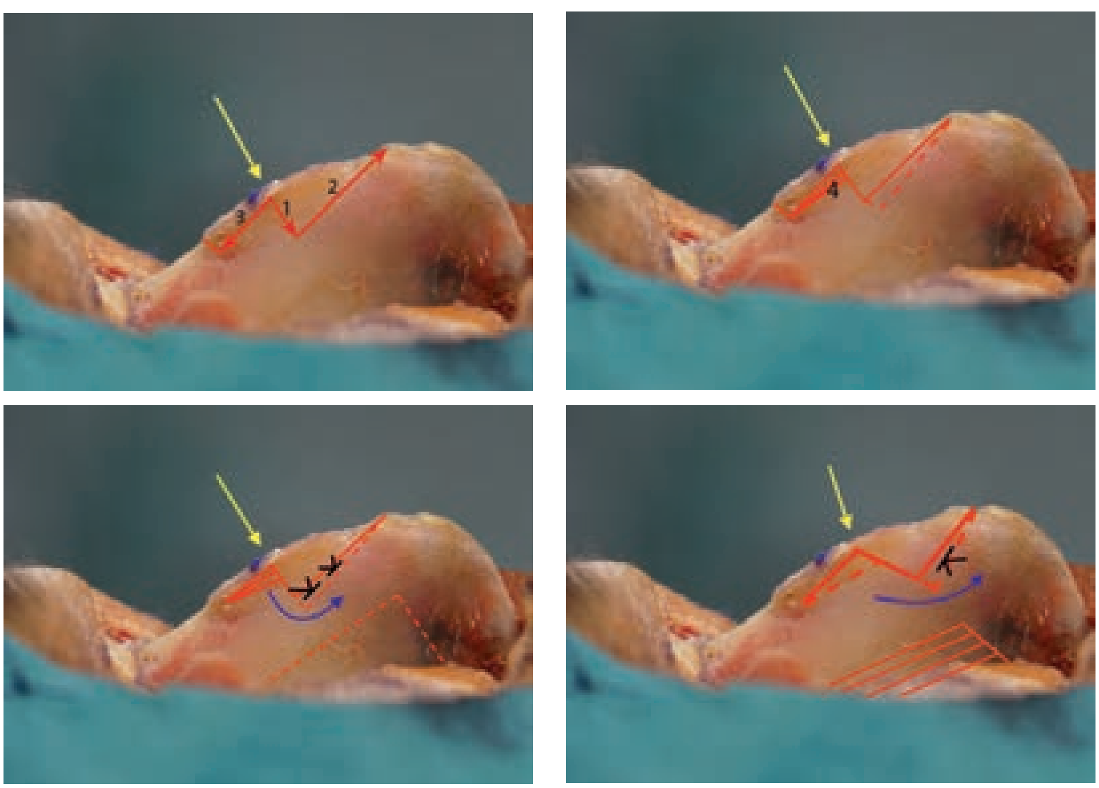
If you do the unilateral transverse and radix osteotomy first, you interrupt the PPE and thus there is no energy transfer to the skull base when one is making a subdorsal cut in the PPE. As shown in the figures above, my radix osteotomy with the Piezo is 4 mm deep through the nasal bone into the ethmoid plate. Since the radix osteotomy is done first, there is no direct energy transfer from the bony septal cut which prevents irradiateding fractures. In addition, one can see endonasally the exact border of subdorsal cut and its relation to the transverse osteotomy. Next. an incremental septal reduction in the PPE is made with a Piezo rasp. After these osteotomies, the mobile nasal pyramid moves like a hinge, with a pivot point close to radix (nasion, N point) and a smooth transition exists in radix area. If a minimal step occurs, one can use a Piezo or electric burr to smooth the subdorsal surface directly and allow descent of the pyramid in the cranial area to the desired position.

SUBDORSAL COTTLE TECHNIQUE

In cases where a large hump is present, a *longitudinal stretching* of the dorsum can be very valuable which is an inherent component of the Cottle technique. In the Cottle procedure, a reverse Z-cut is made through the whole vertical axis of cartilaginous septum. Then, a cartilaginous-bony strip is resected just below dorsum and an inferior partial length strip of septum is removed to lower the dorsum. The septum is then pulled forward and fixed with one stich to the nasal spine. After doing just a few Cottle cases, I realized several problems that could potentially compromise the final result. These problems include a saddle nose deformity due to inadequate suture fixation to the ANS and a limited amount of remaining septal cartilage for graft harvesting. To overcome these challenges, I propose the ***Subdorsal Cottle Technique (SCT)*** that employees the same septal Z-cut, but at a higher more anterior level.

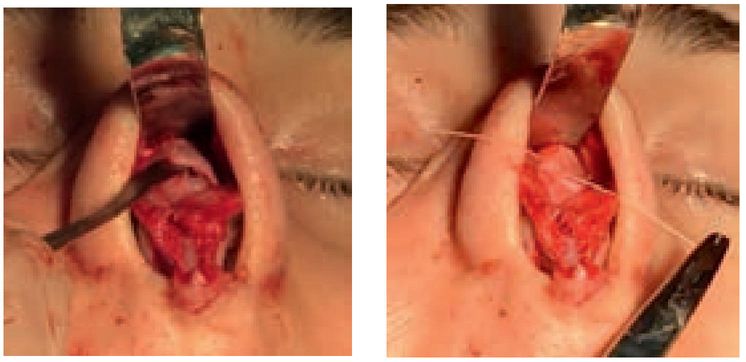
The first part (#1) of the Z-cut cut goes vertically from the highest point of the hump down to the point in the septum which the surgeon can comfortably see. Then, the second cut (#2) connects to the W-point creating a triangle. The posterior third cut (#3) connects the transverse osteotomy with previous vertical cut. Then, a triangular strip of cartilage and bone is removed *subdorsal* (#4) depending on the desired amount of dorsal reduction. Finally, we pull the septum caudally in a longitudinal fashion and overlap it as much as needed. Release of the Lateral Keystone Area (LKA) allows flattening of the dorsum (i.e. Ballerina Maneuver - Göksel, 2019). Then from the external skin surface, a needle is placed through the overlapped septum after we estimate the desired dorsal height. If needed, overlapped septum can be excised. Sutures are done with 4-0 or 5-0 PDS to secure the sepal alignment and to prevent hump recurrence. This suturing technique is similar to that of Ishida (Ishida, 1999) and Dewes (Dewes, 2013). The SPAR method of excising quadrangular pieces of septum matches the residual septum exactly like bricks which can be sutured to each other. If necessary, one can partially rasp the bony cap at the end of the operation. There are at least two advantages of the SCT technique compared to the classic Cottle technique: the amount of retained septal cartilage for grafts is greater and the side by side septal overlap offers improved stabilization. The overlapped septum is fixed with two or more sutures.

If needed, one can change the angle of the incisions to a more obtuse angle thereby making more cartilages available (see the last photo). If the angle of resection is changed to more obtuse, then suturing requires greater surgical skill. Also, this Subdorsal Cottle Technique can be used to straighten C-shape noses because the overlapping on the other side can help to improve aesthetic and functional outcome. Admittedly, Cottle did advocate a similar stabilization method. Ultimately, the Subdorsal Cottle Technique is a safe operation which is very easy to learn and offers more possibilities for reducing larger humps.



DISARTICULATION

In cases where the hump still persists following impaction, one can release the LKA and undermine the bony cap for 4mm. The result is that the cartilaginous vault is released below the bony dorsum; i.e.: disarticulation. After performing this, one drills a hole in the bone on at least one side and sutures the cartilaginous part. This procedure is not recommended in the patient with thin skin because of possible small irregularities. If needed, the KA can be covered with shaved cartilage paste mixed with PRF which creates semi-rigid flexible graft. This paste can be used without fixation. The high concentrated fibrin minimizes the possibility of dispersion. Studies have proven that 85% of chondrocytes survive (Kovacevic, 2016).



CASE #1 – Cartilage/PRF Grafts for Radix & Onlay Graft for the left ULC

A f*ull open approach* with septoplasty and septal relocation was performed. Let-down dorsal preservation was done, using a piezo saw. Bony wedges were removed more on the left than on the right side. A 2-3 mm septal strip was excised from underneath the hump. An overlapping septal extension graft was used. Alar transposition with Caudal Turn-in Flap. Cranial Tip Suture on both sides. Cartilage/PRF grafts for radix and onlay graft for the left ULC.

CASE #2 – Double-Level Let Down

A full open approach and Let-down Operation (LDO) was performed with septoplasty, using piezo. Removal of bony wedges on both sides and removal of a 3 mm septal strip under the hump. Double-level let-down was performed to lower the residual hump with 1.5 mm lateral excision. End-to-end septal extension graft (SEG). Cranial Tip Suture on both sides. Cartilage/PRF graft for the radix. SEG is created by cutting a step in the caudal septum and a comparable cut in the graft, which should prevent sliding of the graft downwards in the long term, as well as loss of projection. Two small cartilage slivers ensure the graft position with additional caudal suture.

CASE #3 – Subdorsal Triangular Resection with Hinge Maneuver

Pre- and postoperative 1 year results. Full open approach, Let Down, subdorsal triangular resection with hinge maneuver, bony vault underwent Ultrasonic Rhinosculpture (URS), septal relocation to the right. Then, overlapping septal extension graft on the right side, cephalic trim of LLC, cranial tip suture and articulated rim grafts on the both sides, radix graft with cartilage scales and PRF.

CASE #4 – Subdorsal Cottle with Septal Relocation

Pre- and postoperative results after 2.5 months. Patient with crooked nose and thin skin. Full open approach with Let Down, Subdorsal Cottle Technique (SCT) with septal relocation to the right. Overlapping septal extension graft right with embracement graft left, cephalic trim of LLC, cranial tip Suture, “Diced Fat“ with PRF on dorsum.

CASE #5 – Lateral Keystone Area Release with Partial Disarticulation

Pre- and postoperative 12 months result. Full open approach with Let Down, LKA release with partial disarticulation / joint Maneuver, septal extension graft end to end, cephalic trim of LLC , cranial tip suture, shaved cartilage with PRF on bony dorsum as camouflage, resuturing of Pitanguy ligament.

CONCLUSION

There are numerous questions regarding indications and limitations of DP. Do we use this technique exclusively in patients with almost perfect dorsal lines and excessive dorsal height? Should we modify the technique and use all preventive measures including spreader grafts and flaps? At the present time, I am performing DP in 60% of my primary rhinoplasties, as the majority of my patients are of Northern European descent and many have high arcing tension noses. However, I have modified the basic techniques to fit 3 challenging groups: kyphotic humps, deviated nose, and moderately asymmetric noses. One of the most important insights and changes for me was a very precise subdorsal cut in a cephalic part of the septal incision, specifically in the bony septum. This precise cut with subsequent overlapping / interlocking of the subdorsal septal flange and the septum has decreased the postoperative occurrence of crooked noses. The kyphotic hump can be flattened by longitudinal stretching of the pyramid with the so called Subdorsal Cottle Technique (SCT) supported by the release of LKA and if needed with partial undermining of the DKA thereby allowing the pyramids to partially separate. The kyphotic hump can be flattened also by the addition of a second high intermediate osteotomy which I have termed the „double let-down procedure". Straight line deviations can be brought back to the midline by suturing the high septal flange beneath the dorsum to the septum in a transposed position in the midline. If the dorsum is deviated to the right, it is sutured on the left side of the septum in an overlapped position, as opposed to a directly vertical position. Asymmetric noses vary in severity, as does their treatment. Certainly, dorsal irregularities in the bony area can be eliminated with piezo rasp, while cartilage irregularities can be excised or repaired as previously described. Partial length spreader flaps, spreader grafts and onlay grafts are an additional alternative.

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Advanced Techniques in Dorsal Preservation

Bart M Stubenitsky

It wasn't the dissatisfaction with results achieved via open structural rhinoplasty that made me embrace Preservation Rhinoplasty. Rather, the effort it took to achieve the desired result was excessive. I found myself resistant to opening a beautiful tip or resecting an attractive dorsum only to be followed by the need to rebuild that tip and dorsum to create a beautiful nose. My introduction to the philosophy of Preservation Rhinoplasty came at the beginning of 2017 through Yves Saban and Baris Cakir. Upon appreciating the concepts of preserving the soft tissue envelope, the dorsum and the tip cartilages, it just seemed to make so much more sense than traditional open structure rhinoplasty. Remodeling the dorsum and tip without aggressive resection, respecting the tissues and structures, all resulting in a more natural result. Preserving structure for the long term becomes especially important in my largely young patient demographic. Less is more. I haven't looked back. In my current practice, I use Preservation Rhinoplasty techniques in all of my primary rhinoplasties. This chapter will focus on the dorsum and Dorsal Preservation (DP). It is one of the three parts of Preservation Rhinoplasty, the others being soft tissue envelope and alar cartilage preservation which are addressed elsewhere in this book. Dorsal preservation is retention of the natural dorsum whilst remodeling the hump and lowering the profile. An overview of the different types of DP is given - addressing both the cartilaginous and bony vault.

SURGICAL PLANNING

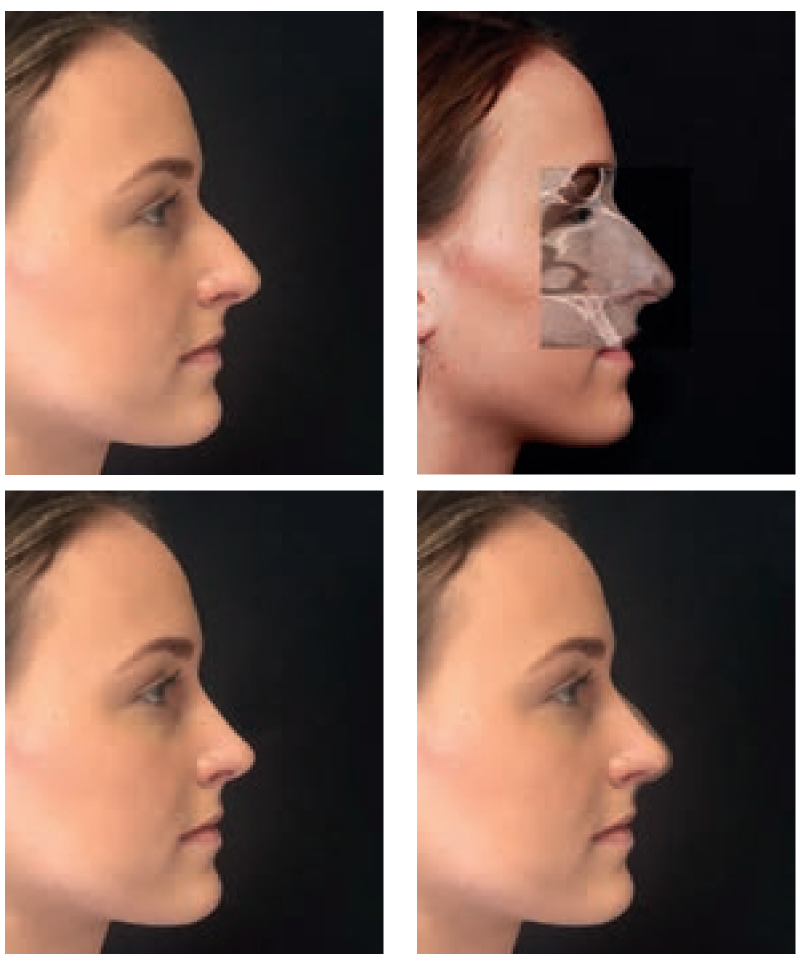
Preoperative planning is key. Without a plan there is no predictable outcome. Without a plan one should not perform surgery. Examine the nose by touching it and evaluate the internal anatomy clinically. A 3D cone beam scan (CBCT) for evaluation of the bony and cartilaginous anatomy can also be done.

When I first started, I measured every facial angle and tried using mathematical ratios to create the desired outcome, but experience has taught me that there are no golden ratios in human beauty. Individual people vary tremendously as regards beauty standards. Unless you cherry-pick published studies, it is very difficult to make sense of the available science in terms of what makes people more or less attractive. There is certainly no evidence that a particular mathematically derived nose shape is somehow a key towards unlocking a universal human beauty response.

An attractive nose has to fit the face, become less obvious in the total picture, be more symmetrical and have measurements similar to the population average.

Nowadays I work solely with facial morphing programs to visualize the patient's desires. It is done together with the patient, making them part of the planning process. It is my opinion that morphing gives both the patient and surgeon the best insight into what is being requested, what is possible, and how to achieve that result.

The preoperative design of the nose is therefore an aesthetic or artistic process, based on the preferences of both the patient and the surgeon. Surgery on the other hand is the technical effectuation of that design. It should be made clear to the patient that the design is the goal towards which we will be working, rather than an absolute commitment to a specific result.



AUTHOR'S APPROACH TO THE DORSUM

If there is a need for dorsal reshaping and lowering, preservation techniques can be applied to either the cartilaginous and/or the bony vault.

CARTILAGINOUS VAULT

The primary question in dealing with the cartilaginous vault, is whether to preserve it using a high septal strip resection as championed by Saban, or a low septal strip resection as advocated by Cottle and more recently Finocchi (see chapter by Finocchi).

High Septal Strip Resection

I use the *High Septal Strip* resection in the majority of my primary rhinoplasties that have no or minimal septal deviation. It allows for precise and controlled changes to be made to the dorsum, with maximal preservation of the septum and mucosa. If a minor septal deviation is present, a corrective basal strip resection can be performed. This can be done through limited subperichondrial tunnels without excessive dissection of septal mucosa.

The high septal strip resection starts approximately 10 mm cephalic to the ASA at the *W-point*. The cut is made just below the dorsum while following its contour. Thereafter, based on the preoperative planning, a lower, second cut is made and the intervening cartilaginous strip is removed. This second cut should be done incrementally in order to avoid over resection while paying special attention to the *W-ASA segment*.

If needed, limited elevation of the mucosa is performed prior to carefully removing a small subdorsal segment of perpendicular plate of the ethmoid (PPE) under the *Bony Cap*, using a small rongeur or microsaw. Excision is continued just below the dorsum towards the level of the future radix osteotomy.

The movement of the dorsum in a high strip resection is essentially only downward. This can create a "spring effect" leading to a residual hump, or sometimes result in midvault widening. These potential complications can be avoided and will be discussed further in this chapter.

Low Septal Strip Resection

My indications for the *Low Septal Strip* resection are either moderate to severe septal deviation and tension noses. Slightly more challenging in my hands, but extremely powerful, low strip septal surgery consists of the following steps:

1) a basal, triangular strip resection along the inferior border of the *Quadrangular Cartilage*, starting 1cm posterior to the *Anterior Nasal Spine* and broadening as one moves posteriorly.
2) a complete vertical septal cut at the bony-cartilaginous junction of the dorsum
3) if needed, an excision of cartilage and /or PPE under the bony cap area
4) final resections of quadrangular cartilage after the bony pyramid lowering, to obtain the desired dorsal height
5) fixation of the septum to the Anterior Nasal Spine (ANS)

In contrast to the high septal strip, a wide septal dissection and a more significant resection of septum is required. When performing a low septal strip excision, there seems to be no bail-out option to a structural rhinoplasty if ever needed. The movement of the dorsum in a low strip is rotational, moving down at the midvault and forward and upwards more caudally, thereby straightening the septum and dorsum in one of the most efficient ways I know. The rotational movement prevents potential midvault widening as seen in the high strip and raises the Supratip Area. Sometimes a widening is seen of the ULC at their caudal border near the Pyriform Aperture due to the rotation. This can be avoided and will be discussed further in this chapter.

Relative Indications for High- and Low Septal Strip Resection

High septal strip resection	Low septal strip resection
straight and slightly deviated noses	deviated noses
narrow midvault	broad midvault
weak septum	tension noses

BONY PYRAMID

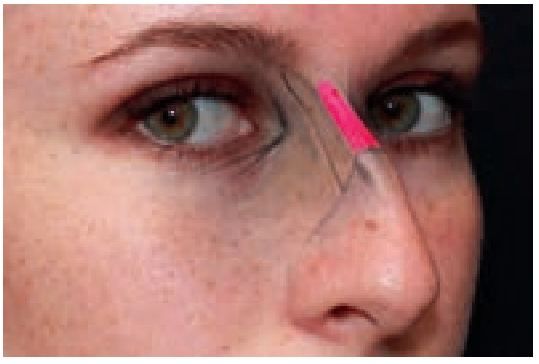
Once the septal approach is decided on, focus turns to the Bony Pyramid. Lazovic et al. (Lazovic et al., 2015) has described two types of nasal bony humps: either V- or S-shape. The V-shape bones have a straight line configuration starting at the *Nasion* continuing through the *Kyphion* towards the *Rhinion*. S-shape nasal bones have a triangular configuration with the Kyphion as the high point (see more details in chapter by Palhazi & Daniel).

It is preferable to convert S-shape humps, as much as possible, into V-shape humps by rasping, or by careful removal of bone at the high point. There are currently 3 types of bony pyramid lowering described not considering the ‘no need for lowering’ (Bony Pyramid type 0). In deciding which type to use, the preoperative anatomy of the nose and the desired result as depicted in the morphed picture play a crucial role.

Bony Pyramid type 1 – Bony Cap Reduction (with or without osteotomies)

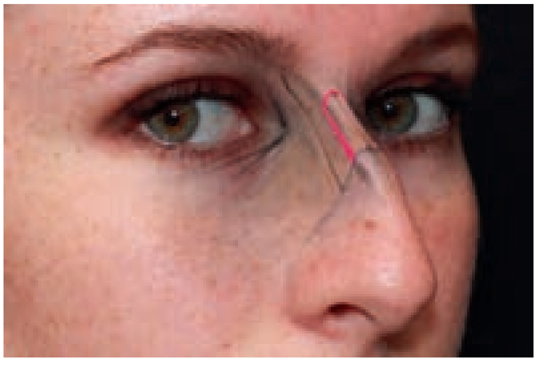
If lowering the bony pyramid 4 mm or less, rasping or removal of the bony cap may suffice to obtain the planned result. For me, this is also the “go to approach” with a narrow bony pyramid or a S-shape bony hump. If desired, this can be complemented with classic osteotomies to narrow the nasal bones at an intermediate or low level.

Sometimes complete removal of the bony cap can potentially lead to a depression or irregularity, creating the need for camouflage grafts. Hence Bony Pyramid type 2 was created.



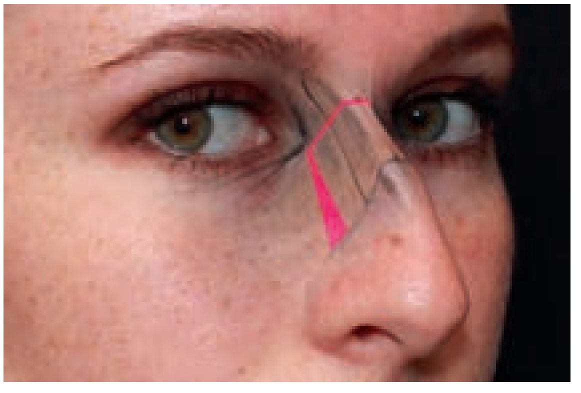
Bony Pyramid type 2 – Bony Cap Lowering (with or without osteotomies)

When using this technique as described by Ishida (Ishida et al., 2020), the bony cap is freed from the rest of the bony vault using an osteotome or saw but left attached to underlying cartilaginous vault. Following push down of the released bony cap and septal strip resection, the protruding edges of the nasal bones are then rasped down to the desired height and width. If needed, classic osteotomies to narrow the nasal bones can be performed. Care should be taken to sufficiently rasp the potential step off in the radix area in order to avoid a visible irregularity.



Bony Pyramid type 3 – Bony Pyramid Lowering (hinge or downward displacement)

In complete bony pyramid lowering by *Let Down*, *Push Down* or a *Hybrid Technique* (in which only the Webster's triangle is removed), the bony pyramid as a whole is lowered and the lateral walls are inside the pyriform aperture to a variable degree. This movement requires transverse osteotomies, a radix osteotomy, and low-to-low lateral osteotomies. These osteotomies can be performed using osteotomes, handsaws, powered micro-saws, or piezoelectric instruments. I mainly use the Cakir-Tastan handsaw for the transverse cut, a 2 mm osteotome for the transcutaneous radix cut, and a 3 mm guarded osteotome for the low-to-low. Once effectuated, there must be separation of the bony pyramid from the skull. This is confirmed by gentle horizontal mobilization of the pyramid from right to left. Then, the pyramid is pinched and pushed down to achieve the desired lowering. The radix osteotomy in Bony Pyramid type 3 can either function as a hinge, or as the site of a downward displacement at the Nasion. This decision will be discussed in the following section. Dorsal preservation can be combined with additional dorsal modifications to optimize the shape of the dorsum. These maneuvers include bony pyramid remodeling by rasp, ULC shoulder shave with the scalpel, hidden spreader grafts (below ULCs), and radix or supratip onlay grafts.



Relative Indications for Bony Pyramid type 1-3

Type 1 bony cap reduction	Type 2 bony cap lowering	Type 3 bony pyramid lowering
bony pyramid lowering < 4 mm	bony pyramid lowering > 4 mm	bony pyramid lowering > 4 mm
kyphotic hump	kyphotic hump	large nose
	broad bony cap (with osteotomies)	moderate hump
	narrow bony cap (without osteotomies)	deviated noses
	hinge at nasion	lowering at nasion

RADIX

The radix or nasofrontal angle requires special attention in rhinoplasty. A high radix makes the nose appear too long, whereas a deep nasofrontal angle gives the illusion of a short nose. During the surgical planning, aesthetic sense will ultimately guide the appropriate position of the nasion, taking into consideration the patient's gender, ethnicity, and overall facial appearance.

In the majority of primary rhinoplasties in my practice, the radix does *not* require adjustment due to appropriate position and projection. As such, changes to the dorsum can best be achieved with Bony Pyramid type 1, 2 or the hinge variation of type 3.

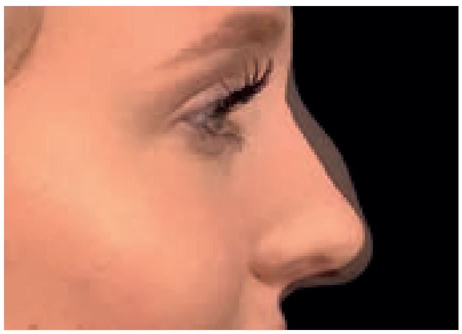
Radix Osteotomy in Bony Pyramid type 3 – Hinge vs Downward Displacement

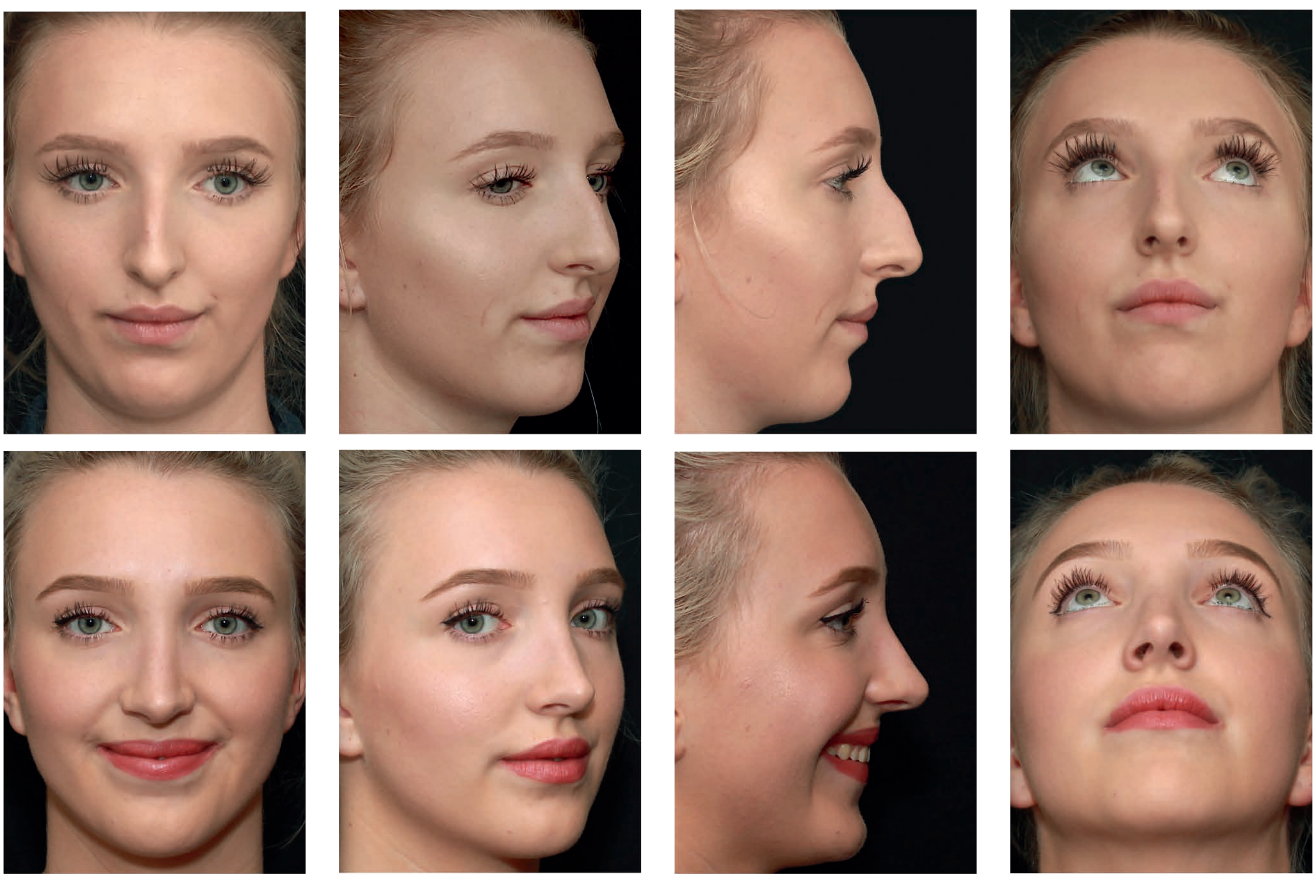
The radix osteotomy in *Bony Pyramid type 3* can either function as a *hinge* or a *downward displacement* of the nasion, depending on the preoperative plan. The actual osteotomy is most often performed at the level of the *Medial Canthal Ligament*, being more caudal than the true *Nasion* point.

If a hinge is required, it is advantageous to perform the radix osteotomy in an oblique direction, aiming towards the chin. With minimal resection of the perpendicular plate at this level and by keeping the periosteum partially intact, a greenstick fracture can be performed thereby preventing downward displacement. My preferred sequence is to first preform the transverse osteotomies, then the radix osteotomy, followed by the low-to-low lateral osteotomies. This ensures the most control of the greenstick at the radix area.

The following photos show a Bony Pyramid type 3 hinge – Bony Pyramid Lowering procedure with high septal strip and polygon tip refinement (Cakir).

One of the most fascinating changes with the *Bony Pyramid type 3* occurs at the radix when a *downward displacement* is required. There is no other maneuver that can influence the dorsal aesthetics as dramatically. It is accomplished by a complete cut through the radix area followed by disarticulation. The level of lowering is determined by the amount of bony septum (PPE) removed from beneath the bony cap. This maneuver creates a step at the radix osteotomy site, which requires either a bony reduction of the cephalic radix area and/or a camouflage radix graft. Bony Pyramid type 3 downward displacement is seen below with high septal strip and polygon tip refinement (Cakir).





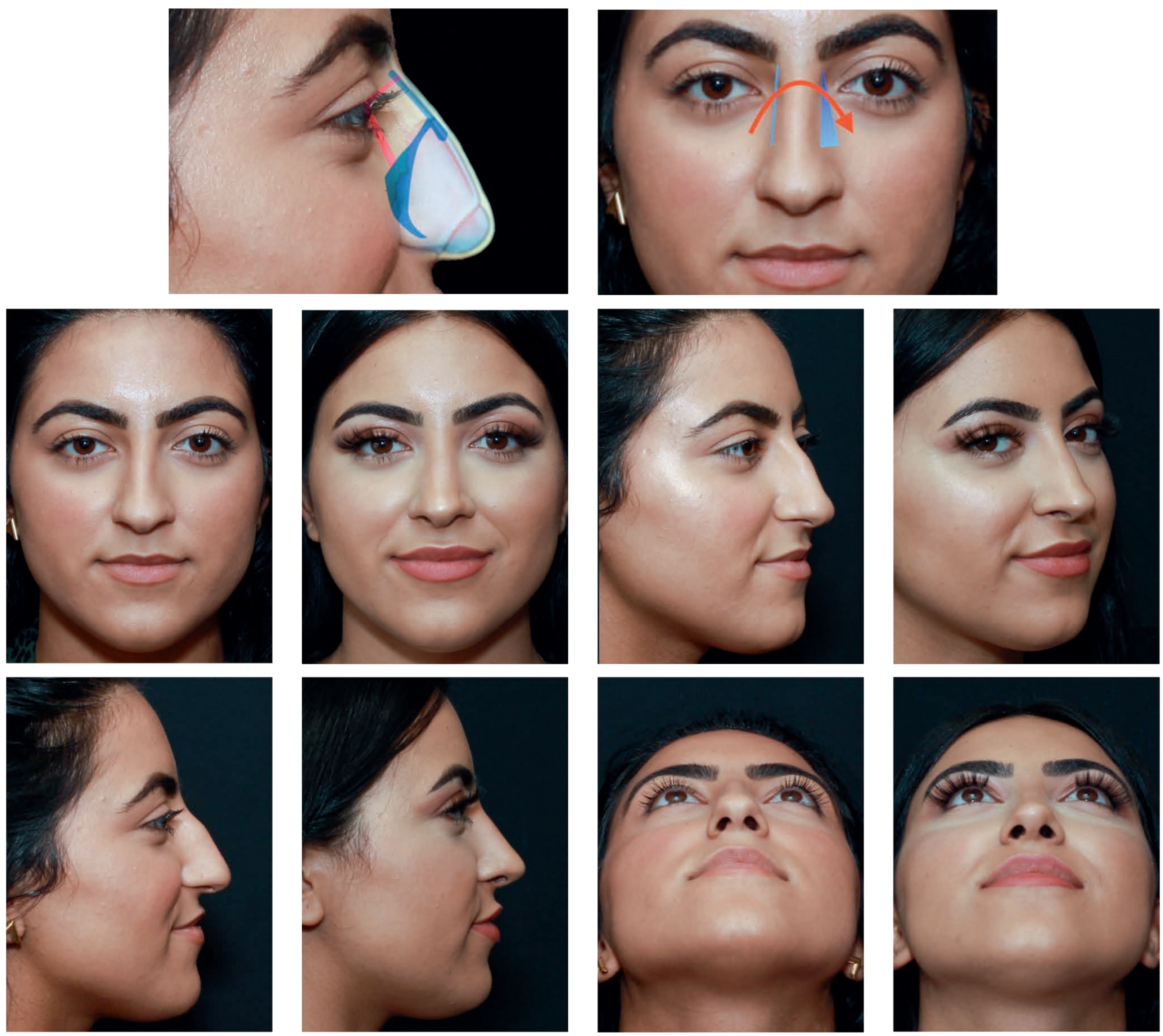
DEVIATED DORSUM – Bony Pyramid

In my opinion, there is no technique as powerful as Dorsal Preservation in dealing with a deviated dorsum.

Asymmetric Bony Pyramid type 3 allows for a complete bony pyramid mobilization and *push over*, rotating the bony pyramid en-bloc over the sagittal axis of the nose thereby correcting the mismatch in length of the nasal sidewalls. On the long side, adequate subperiosteal undermining is required on both sides of the lateral bony wall followed by excision of bone in the low-to-low osteotomy (lateral wall base resection). On the short side, no or minimal subperiosteal undermining is done with limited excision of bone at the Webster's triangle.

DEVIATED DORSUM – Septum

In High Septal Strip resection, the rotational movement of the bony pyramid often moves the septum back into the midline. If necessary, an additional basal strip resection can be used to correct any remaining deviation. I often do this at the beginning of the operation. In a Low Septal Strip resection procedure, straightening the septum occurs by the rotational movement of the quadrangular cartilage as described previously. The following photos show Bony Pyramid type 3 with asymmetric push down, low septal strip, polygon tip refinement (Cakir).



DORSAL SOFT TISSUE ENVELOPE UNDERMINING

In Dorsal Preservation, the dorsal soft tissue envelope can either be completely, partially or not at all released off of the cartilage and bone over the dorsum. The amount of undermining depends on the following:

- *preoperative anatomy.* If the nose is very deviated, complete elevation of dorsal soft tissue seems necessary, as the skin participates directly in maintaining the shape of the deformity.
- *modifications necessary to achieve the desired result.* If the nasal bones or cartilaginous vault are wide at the K area or if there are any irregularities on the dorsum, then limited undermining is required for remodeling of the deformities. This maneuver is also required when transforming a S-shape dorsum into a V-shape` dorsum, or if the LKA has to be released.
- *tools used to do the osteotomies:* The disadvantage of using the piezo saw is the need for an open approach with extensive undermining of the soft tissue envelope. No undermining is needed when using osteotomes or small saws. The best method is probably somewhere in-between.

In my opinion, the overall goal should be to preserve as much of the skin attachment as possible. I always use a closed approach in primary rhinoplasties and mostly make a narrow 4 mm tunnel over the dorsum to rasp the K-area. I like to undermine the soft tissue covering the nasal bones laterally, through an incision at the transition from skin to mucosa just superior to the head of the inferior turbinate. Then, I am able to insert a Cakir-Tastan saw for the transverse bone cuts. This incision can then be used to release the LKA if needed.

NAMING OF COMBINATIONS

	High Septal Strip	**Low Septal Strip**
Bony Pyramid type 1- bony cap reduction	Spare Roof Technique - Ferreira	Mattioli
Bony Pyramid type 2- bony cap lowering	Guner	Ishida
Bony Pyramid type 3- bony pyramid lowering	Saban	SPQR - Finocchi

MOST COMMON PROBLEMS & THEIR PREVENTION

The most common problems seen in Dorsal Preservation (DP) can all be easily prevented and, more importantly, easily corrected postoperatively in no more than 10-20 minutes. There is no need for complex secondary rib graft reconstructions. The following problems are the most common following DP.

#1 Problem – Residual / Recurrent Humps

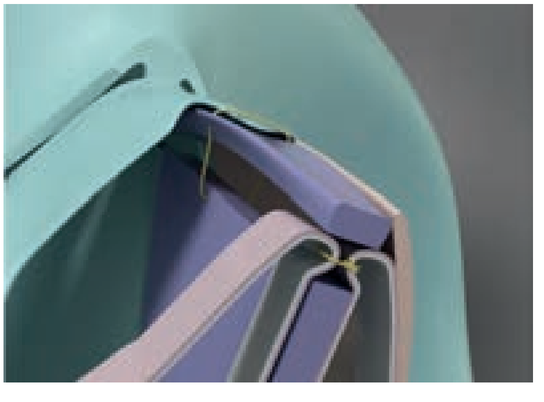
The residual hump is the most common problem encountered in DP. In both high and low strip septal excision it is due to either insufficient release of the septal tension at the K-area and LKA, and/or inadequate fixation. There are specific measures that can be applied during surgery to prevent this from occurring. If despite these measures, a residual hump persists postoperatively, it can be easily corrected secondarily.

- *S-shape bony hump, thick bone at K-area*. Can be prevented by rasping / removing the bony hump at the K-area, thereby transforming it into a more cartilaginous V shape hump
- *Inadequate flexion at the K-area.* In high septal strip resections, scoring of sub dorsal septum can solve this issue. In low septal strip resection making sure the vertical septal cut at the bony-cartilaginous junction goes all the way up to the cartilaginous vault
- *Spring effect at lateral K-area.* Release of the lateral ULC- bony attachment at the K-area (LKA release)
- *Inadequate fixation of dorsum and septum.* In high septal strip resections, the dorsum has to be fixed to the septum at the K-area and 1 or 2 other places. This can be done transcutaneously, or intranasally. In low septal strip resection, the septum has to be fixed to the ANS in a secure fashion to prevent relapse.

#2 Problem – Axis Deviation

Axis deviation is encountered in both high and low strip septal resections and is mainly due to inadequate fixation of dorsum and septum.

- *In high septal strip resection*, the dorsum has to be fixed to the septum at the K-area and more caudally to prevent lateralization. This can be done using a transcutaneous suture at the *Keystone Point* as described by Dogan, and suturing the septal mucosa together in the space between the dorsum and the septum more caudally as described Cakir (see below).
- *In low septal strip resection,* the septum has to be fixed to the ANS in a secure fashion to prevent dislodgement and thereby deviation of the axis.



#3 Problem – Widening of the Midvault

The widening of the midvault is a problem that can occur in both high and low septal strip resections, but at different locations and due to different mechanisms. In high septal strip resection, widening is seen at the junction between septum and ULC. It is purely mechanical due to the downward movement of the dorsum. In low septal strip resection widening of the ULC is seen at the caudal border near the pyriform aperture due to the rotational movement of the quadrangular cartilage. This problem can be addressed in several ways.

In high septal strip resection:

- Incomplete incision on one or both sides of the dorsum at the junction of septum and ULC
- A partial division of the ULCs from the septum can be performed, with resection of the excess ULC (if needed)
- Excision of the caudal edge of the ULC
- Excision of the basal edge of the ULC
- Release of the LKA
- ULC tail transposition (Cakir)

In low septal strip resection:

- Removal of a small triangular amount of ULCs at the caudal border near the pyriform aperture
- ULC tail transposition (Cakir)

#4 Problem – Step Off at Nasion

In Bony Pyramid type 1, complete removal of the bony cap can occasionally lead to an unwanted depression or irregularity at the nasion, creating the need for camouflage grafts. If seen in Bony Pyramid type 2 and 3, the cause is more likely due to removal of the perpendicular plate. During surgery, be conservative with the amount of bony cap or bony septum removed. It is best to remove tissue in small steps, each time checking if the desired result has been accomplished. If a step off occurs and the radix height is adequate, rasping or removing the edge is sufficient. If the radix is too low, a graft can be used for camouflage.

#5 Problem – Supratip Depression

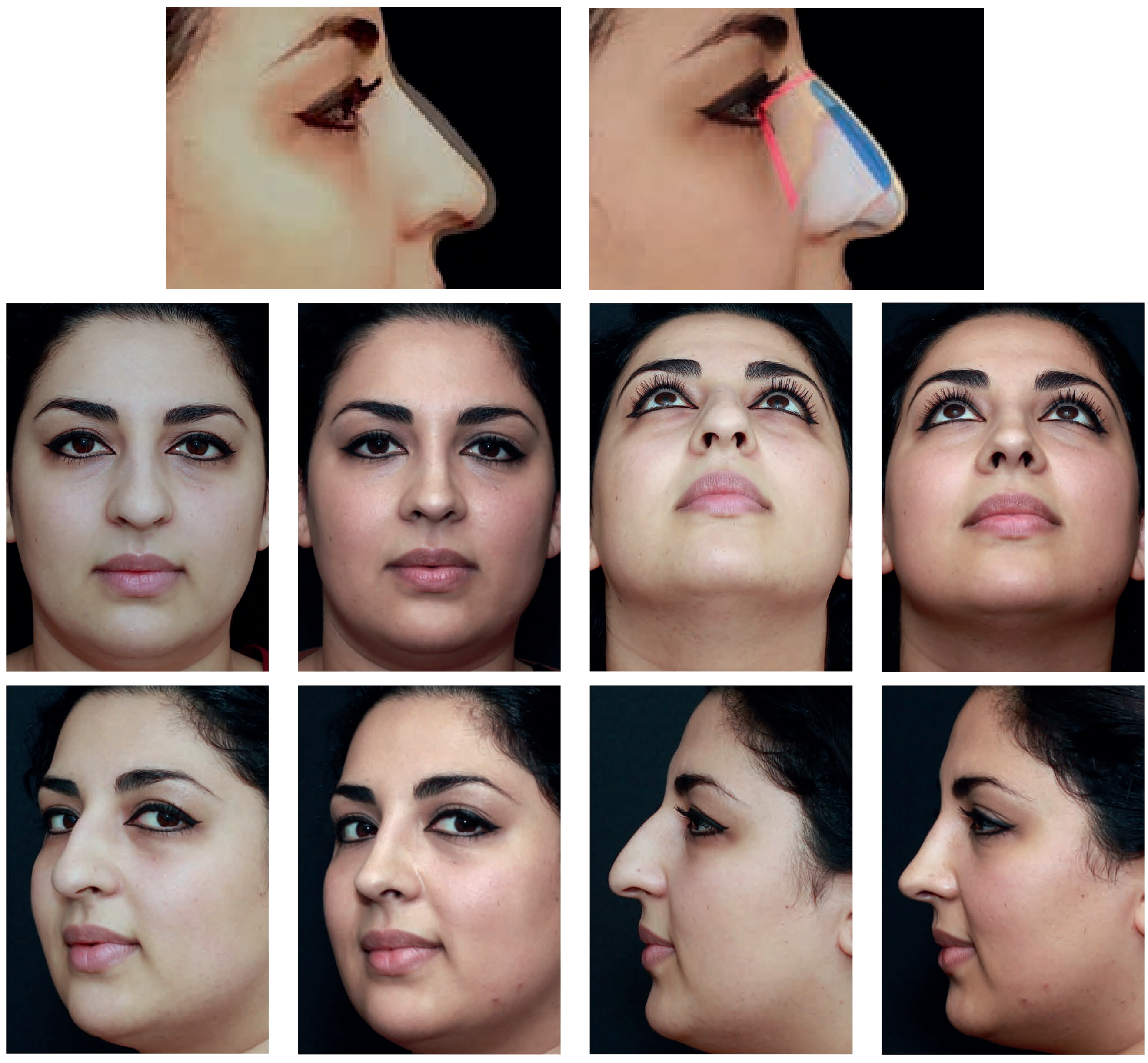
Supratip depression can be seen in both high and low septal strip resection. Incremental resection of the distal septum is essential to avoid this complication. In high septal strip resection, it is due to aggressive lowering of the W-ASA segment. In low septal strip resection, it is due to aggressive resection of the septum at the ANS. Although avoidable, it can be corrected with a supratip graft.

CASE #1 – Bony cap lowering with classic osteotomies

The following patient presented for rhinoplasty. In frontal view the dorsum is fine, in profile view the dorsum has a V-shape bony hump. The following steps were done: basal septal strip resection to harvest strut graft; rasping of the keystone area; high septal strip resection; bony pyramid type 2 – bony cap lowering with classic osteotomies. Release of pyriform ligament and scoring of the subdorsal septum. Cakir tip plasty.

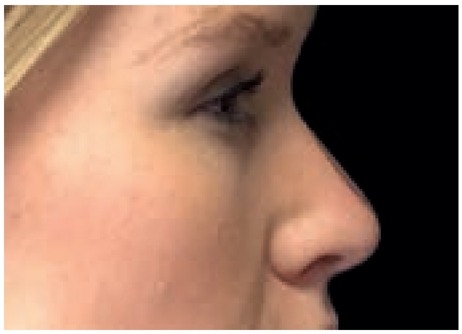
CASE #2 – Push Down with a hinge at the nasion

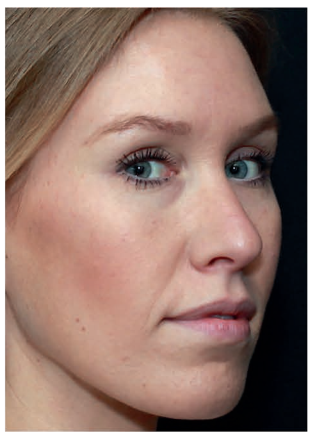
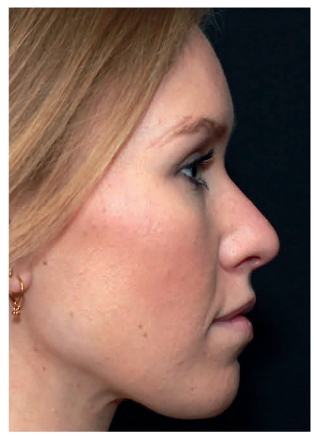
In frontal view the dorsum is long, in profile view the dorsum is long and has a S-shape bony hump. The following steps were done: basal septal strip resection to harvest strut graft, rasping of the keystone area, high septal strip resection, Bony Pyramid type 3 - bony pyramid lowering (push down) with a hinge at the nasion. Release of the pyriform ligament, scoring of subdorsal septum. Cakir tip plasty.

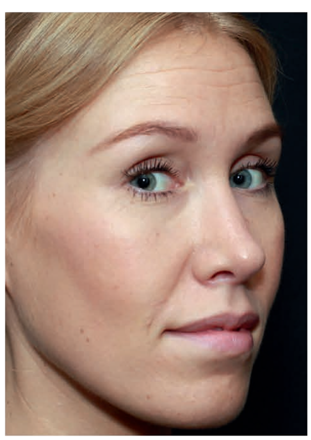
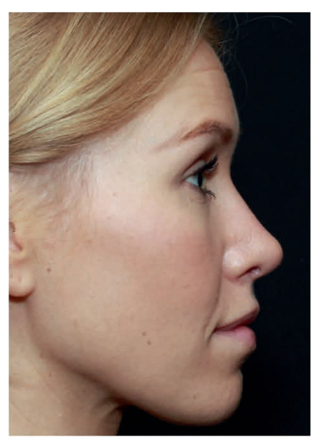
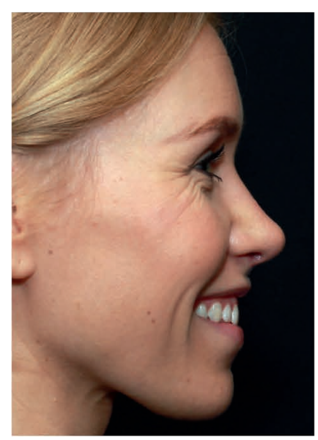


CASE #3 – Bony cap rasping / lowering without osteotomies

In frontal view the dorsum is fine, in profile view the dorsum has a V-shape bony hump. The following steps were done: basal septal strip resection to harvest strut graft, high septal strip resection, Bony Pyramid type 1 – bony cap rasping / lowering without osteotomies. Cakir tip plasty.

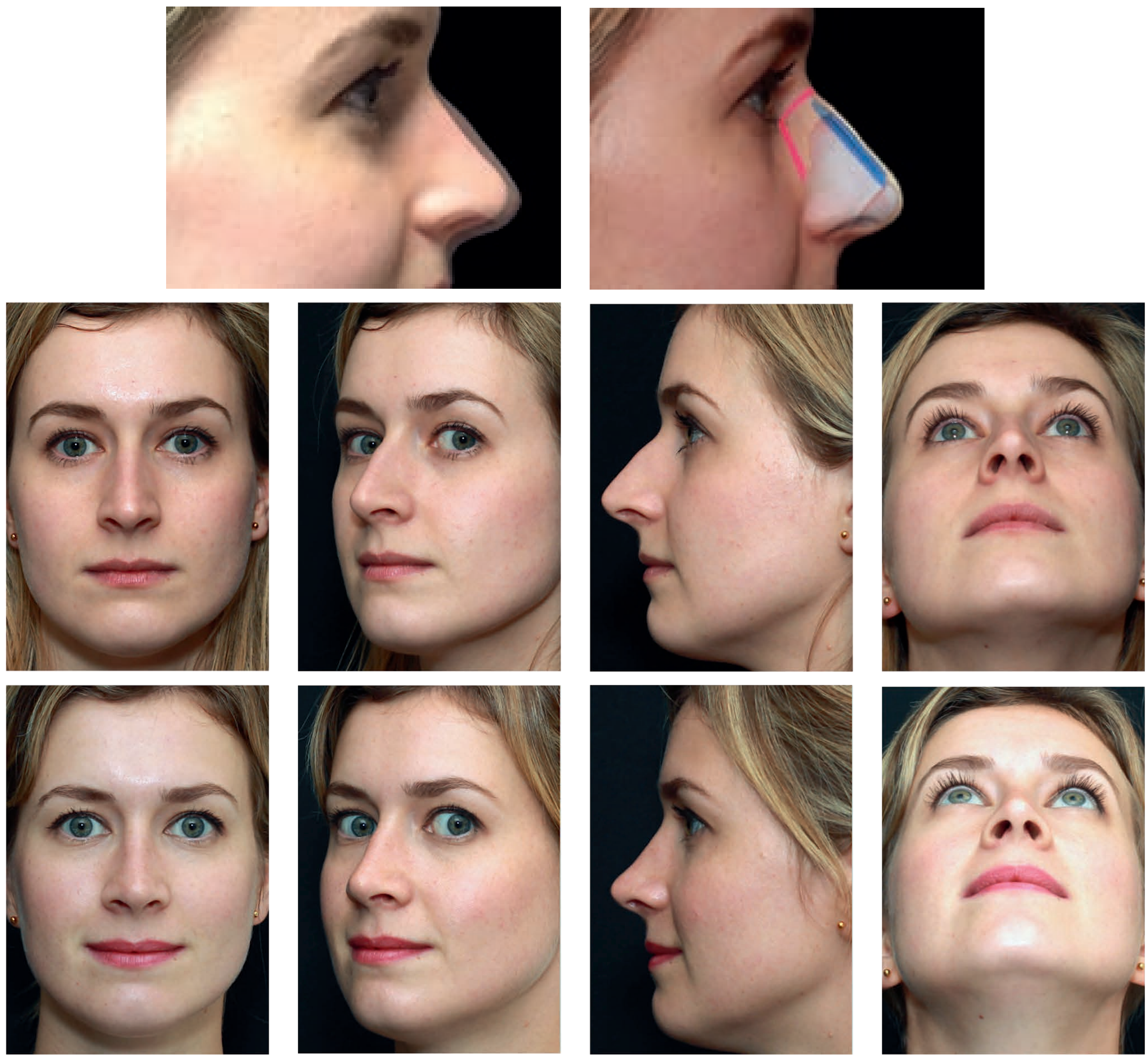


CASE #4 – Let down plus a hinge at the nasion

In frontal view the dorsum is long, in profile view the dorsum is long and has a V-shape bony hump. The following steps were done: basal septal strip resection to harvest strut graft, rasping of the keystone area, high septal strip resection, Bony Pyramid type 3 pyramid lowering (let down) plus a hinge at the nasion, release of pyriform ligament, scoring of subdorsal septum. Cakir tip plasty.



CONCLUSION

Why reconstruct when we can preserve? For me, there seems to be few disadvantages to PR. It has made me a better surgeon, with a better understanding of and respect for nasal structure and function. I now have better, more natural results compared to reduction rhinoplasty and with happier patients!

In addition to superior aesthetic results, it is in my experience that DP is the most powerful tool for severely deviated nose. These deviations can be corrected with the low septal strip resection and a *Bony Pyramid type 3* asymmetric push over. In addition, the high radix nose can be lowered with the downward displacement variation of *Bony Pyramid type 3*.

After performing open reduction rhinoplasty for a decade before switching completely to PR, I feel like I've entered the twilight zone. Many thanks to the giants on whose shoulders I have stood and am still standing!

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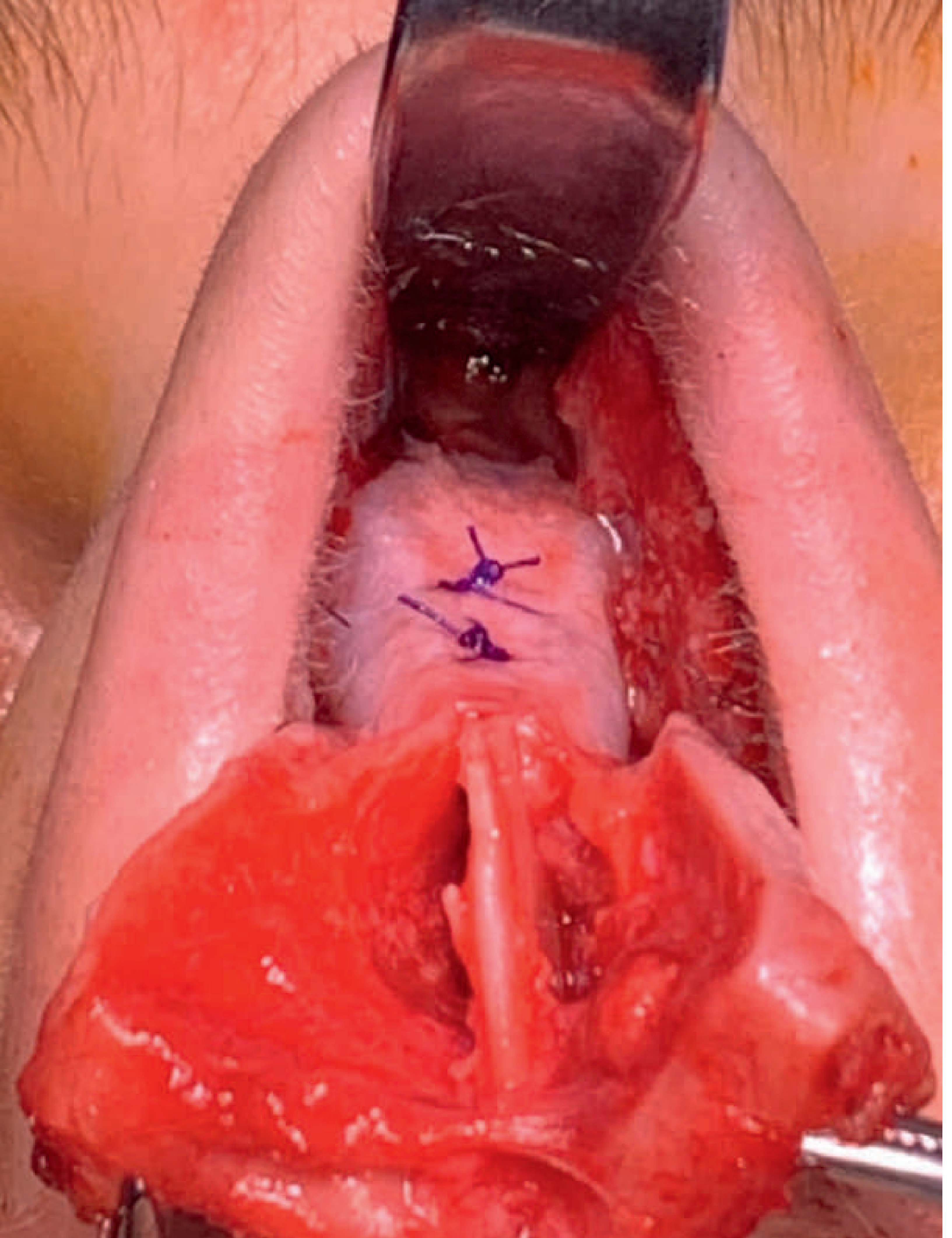
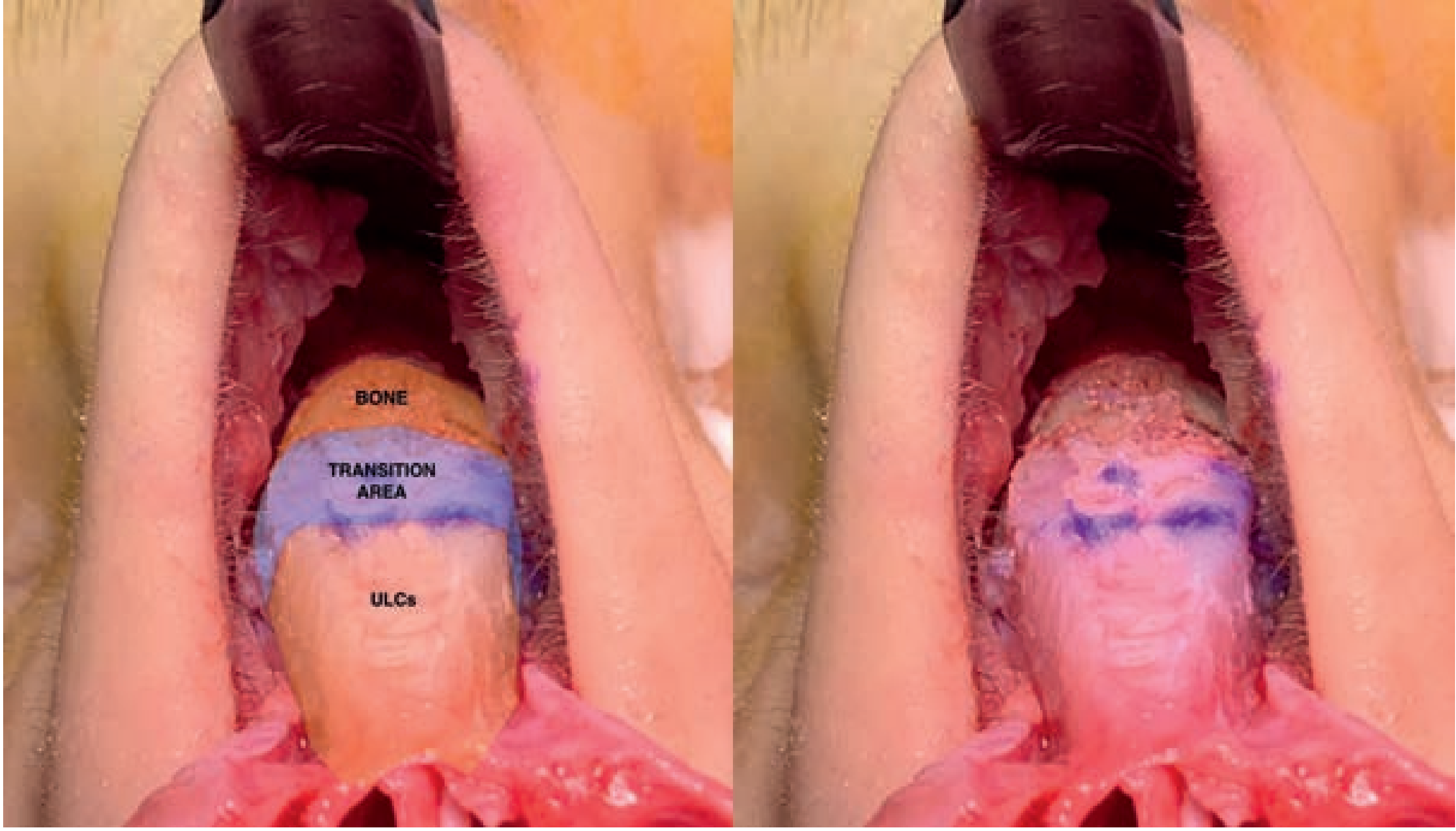




Spare Roof Technique

Miguel Goncalves Ferreira

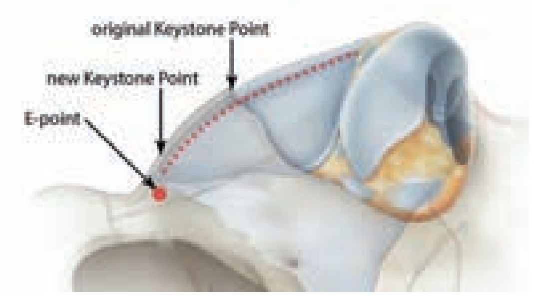
The Spare Roof Technique (SRT) allows reduction of the over projected dorsum while maintaining its anatomical integrity. It has been developed over the past 4 years (Ferreira, 2016, 2019). In this technique, the cartilage vault is completely preserved or improved including its cephalic portion under the nasal bones. This operation is unique in that it incorporates the fundamental principle of dorsal preservation while allowing standard osteotomy and septal procedures including extracorporeal septoplasty. It should be noted that the procedure is very versatile, but mostly indicated for primary rhinoplasty patients with dorsal humps < 5 mm which is the vast majority of my patients. It is also applicable for treating the crooked nose.

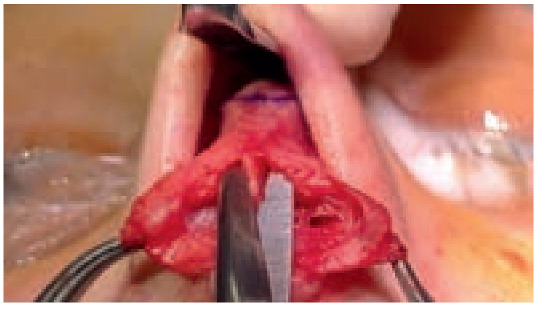
APPROACH AND SOFT TISSUE EXPOSURE

The Spare Roof Technique for reduction of the over projected dorsum can be performed using either a closed or open approach depending upon the surgeon's preference. In my own practice, I tend to do an endonasal approach in 70% of cases and reserve the open approach for 30% of patients with a difficult septum, asymmetric tip, post traumatic case, and for teaching purposes. A submucosal exposure of the septum and ULCs is done. Then, a conservative septoplasty is performed to correct any deviations and to harvest requisite cartilage for grafting while preserving an L-strut. Since a longitudinal septal strip excision of 2-5 mm will be done subsequently to lower the dorsum, the dorsal component of the remaining L-strut should initially be 12-15 mm in height rather than the customary 8-10 mm. Next, the dorsum is exposed using a subperichondrial/subperiosteal dissection which provides complete exposure of the osseocartilaginous dorsum.

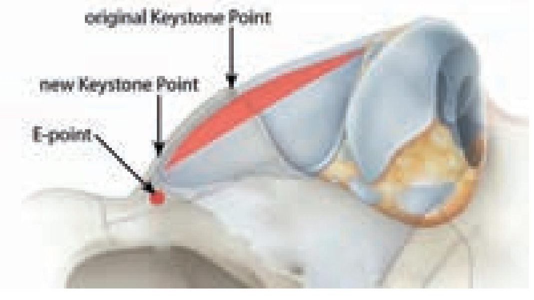
SURGICAL SEQUENCE

Step #1 – The first step consists of a longitudinal cut just below the dorsum from the Anterior Septal Angle up to the perpendicular plate of the ethmoid utilizing angled Fomon scissors. In our technique, we do not respect the W-ASA segment. Thus, the cartilaginous vault is separated completely from the septum as seen below. There is a definite gap between the septum below and the cartilage vault above. After this cut, the dorsal "roof" remains attached to the nasal pyramid at 3 points: 1) cephalically, by the attachment between ULC /nasal bones (dorsal keystone area, DKA), 2) laterally, by the attachments of lateral connections of the ULC / nasal bones (lateral keystone area), and 3) caudally by the attachments of the ULC - LLC at the scroll area. The caudal attachment has no structurally significant impact on middle third support. It is often partially divided in a closed approach with an intercartilaginous incision.

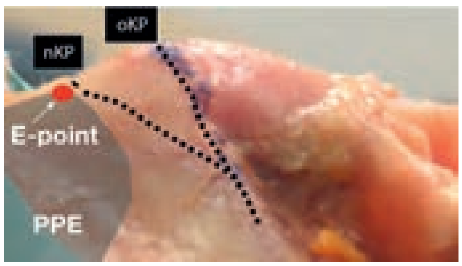


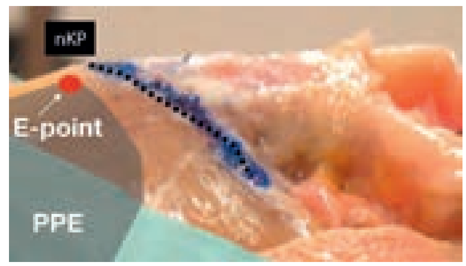


Step #2 – The second step consists of excising excess from the dorsal septum (from 1 to 5 mm, as needed) in order to reduce the hump to the planned height. The excision is done in 1mm increments utilizing a straight scissor until the desired result has been achieved. Slight digital pressure on the dorsum will confirm the amount of reduction achieved. The excised strips of cartilage can be used for columellar or alar rim grafts.

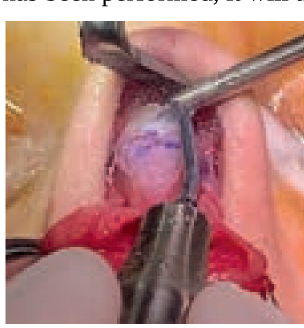


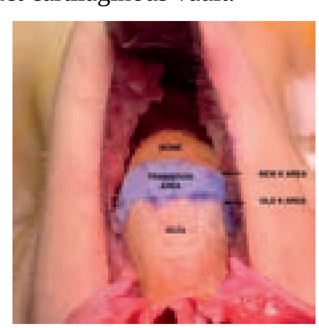
Note: in contrast to most dorsal preservation techniques, there is no need to excise any of the perpendicular plate. The cephalic extension of the quadrangular septal cartilage extends above the cephalic extent of the hump in 97% of our population (Ferreira, 2020). Since only the cartilaginous vault will be lowered, it is not necessary to resect the bony septum to create a space for the bony hump to descend into. As seen on the left below, the cartilage vault is attached to the DKA and LKA and does not sink at this area despite longitudinal septal resection. The E-point refers to the junction between quadrangular cartilage and perpendicular plate of ethmoid. As seen on the right below, following bony cap removal one can see that the Keystone Point (KP) has been moved cephalically to its new location (nKP) almost 10mm from its original location (oKP). The cartilage vault remains supported dorsally and laterally.



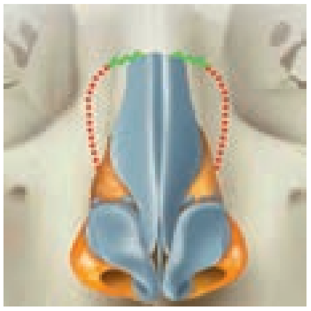


Step #3 – The third step consists of removal of the caudal edge of nasal bones to "decap" the bony part of the dorsal deformity followed by a full release of the cartilaginous vault. Removal of the Bony Cap exposes the underlying cartilaginous hump and preserves its integrity. This is, by far, the most demanding step of the technique**.** The ostectomy can be performed with either a Piezo electric (as seen below), rasp or a diamond bur. Initially, the author (Ferreira, 2016) used a Rubin osteotome to perform the ostectomy of the caudal portion of the nasal bones. However, the Rubin osteotome on occasion led to suboptimal results consisting of a noticeable step due to residual bony excess or noticeable gap in the original Keystone Area. Thus, the author abandoned the osteotome and changed to either a rasp (small humps) or powered instrumentation (medium and large humps). Although Piezoelectric instruments are used, the author finds that the diamond burr is faster and produces more precise results. Following removal of the Bony Cap, one has moved the Keystone Point 7-10mm cephalically, while exposing the cephalic portion of the cartilaginous vault. As discussed elsewhere (Palhazi 2015), the osseocartilaginous dorsum consists of an overlapping relationship between the nasal bones and the underlying cartilaginous vault. These two structures are not rigidly fixed to each other, but are appositionally immersed in fused periosteum and perichondrium. Once the septal strip is excised, the cartilaginous vault is supported only through the DKA and the bilateral LKAs. Typically, the ostectomy in the DKA extends 7-10 mm cephalically and is partial in thickness – i.e., one creates a *transition area* (cartilage vault mixed with some thin bone) which weakens the dorsal support. The ostectomy in the LKA is typically 3-5 mm, depending on the behavior of the "cartilaginous roof". The extent of the LKA release will vary depending upon the initial response of the dorsum to the septal strip excision and the amount of planned height reduction. This step is easier in an open approach. Once the LKA release has been performed, it will allow further descent of the intact cartilaginous vault.

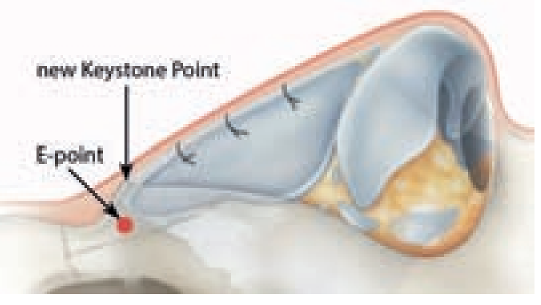


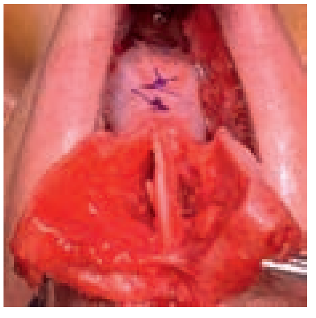


Step #4 – Standard lateral osteotomies are done to control both dorsal and lateral bony width and is done when indicated. We prefer a lateral high-low-high endonasal osteotomy through subperiosteal tunnel dissections using a 5 mm curved guarded chisel. The author rarely does medial oblique osteotomies and generally relies on greenstick osteotomies.

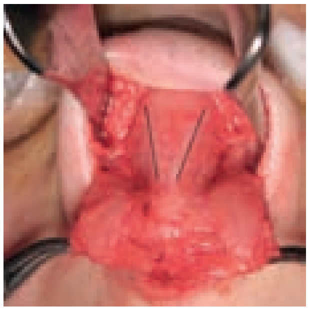


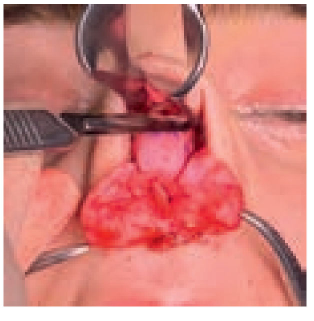
Step #5 – Next step is suturing of the "roof," the preserved cartilaginous vault, to the dorsal aspect of the remaining or reshaped septum. Two sutures of 4-0 absorbable polydioxanone (PDS) suture are used to stabilize the roof and to prevent any spring back effect. Although easier to perform in an open approach, the suture can be done through the closed approach using the following technique. Both in open and closed approach the assistant must hold the Aufrich retractor (puling the skin envelope), while the surgeon holds the Killian forceps thereby opening each side of the nose. The first PDS suture is placed in the old Keystone Area, goes across the septum, then across the ULC (from below to above), then crosses above the ULC to the other side and then into the opposite nostril where it is tied tightly. As previously stated, the septoplasty is performed at the beginning of the surgery and an L- shape strut is preserved whenever possible, with its attachments to the perpendicular plate of the ethmoid and nasal spine. Any part of the dorsal portion part of the L-Strut can be used to "anchor" the sutures to the cartilaginous vault. When deviation is localized in the caudal septum, the caudal septum is mobilized, centralized, and then anchored to the anterior nasal spine fibers with 5-0 PDS.





Step #6 – This step is optional fine tuning. Finally, in patients with noticeable non-aligned aesthetical lines (caudal prolongation of the transition between DKA and LKA), one makes a final tuning, cutting the excess of elevation of the lines (shoulder shave). This step has a significant effect on the surface anatomy, but no impact on structural support. As seen in the clinical case below, one can narrow the wide dorsal lines by sculpting the shoulders of the cartilaginous vault.





VARIATION #1 – Extracorporeal Subtotal Septoplasty

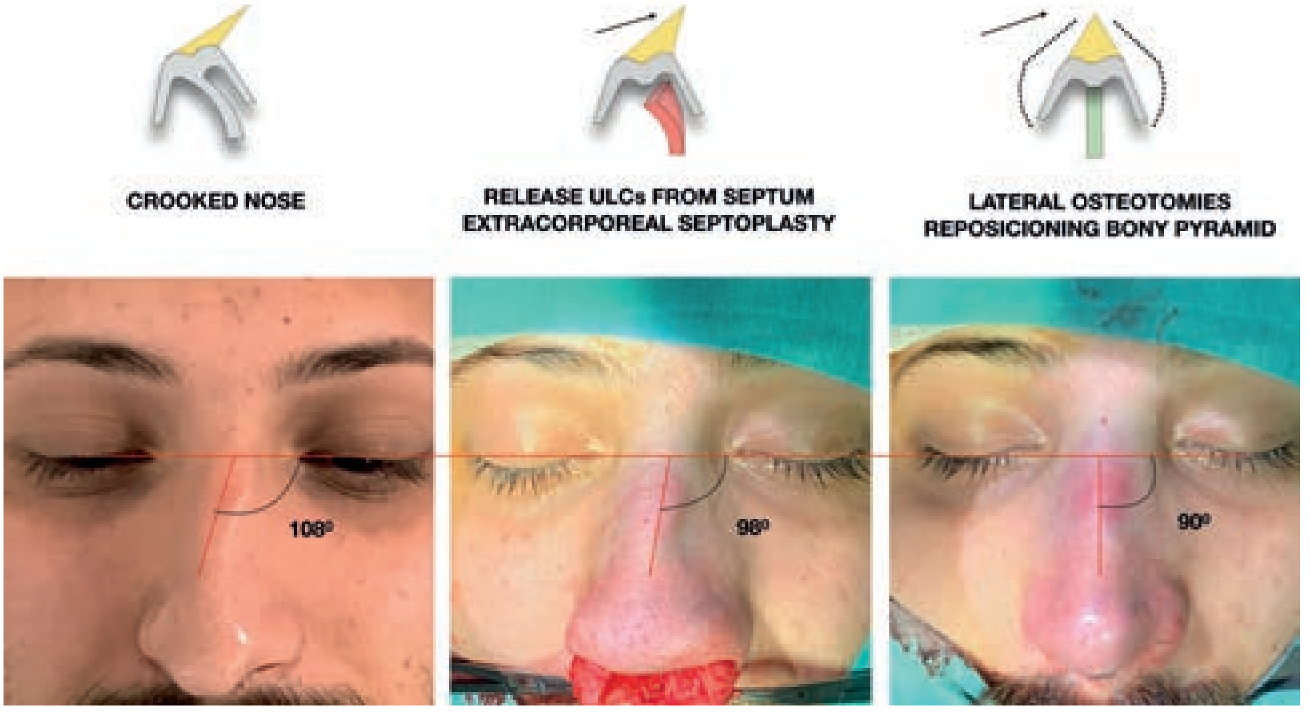
One can complete Maurice Cottle's famous sentence as follows: "As the septum goes, so goes the nose…therefore in crooked noses, if we take out the septum and release the bony pyramid with osteotomies, the nose will go straight…". When dealing with the severely crooked nose, there are 2 distinct groups, those with and those without a significant hump. The entire quadrangular cartilage is removed using a subtotal extracorporeal septoplasty.

Crooked, No Hump

The vast majority of severely crooked noses have no hump. In those without a noticeable hump, the quadrangular septum is removed and is done after Step 1 (creation of the spare roof with a longitudinal cut through the dorsal septum). and then the posterior and basal incisions to make a complete subtotal septectomy. The cartilaginous roof remains firmly attached to bonny vault. In these patients, the DLA and LKA ostectomies are not performed to insure a stable roof. After the corrective lateral osteotomies, the "new" L-shape septal strut will be firmly sutured to the cartilaginous vault. The reinserted "new" septum is fixed at two main points: 1) dorsally, with 2 stitches to the stable cartilage vault, and 2), caudally, a suture placed through a drill hole in the ANS to the base of the new septum. If there is limited support cephalically, the author will suture with 4-0 PDS the new septum to the remaining dorsal septum attached to the PPE.

Crooked, Noticeable Hump

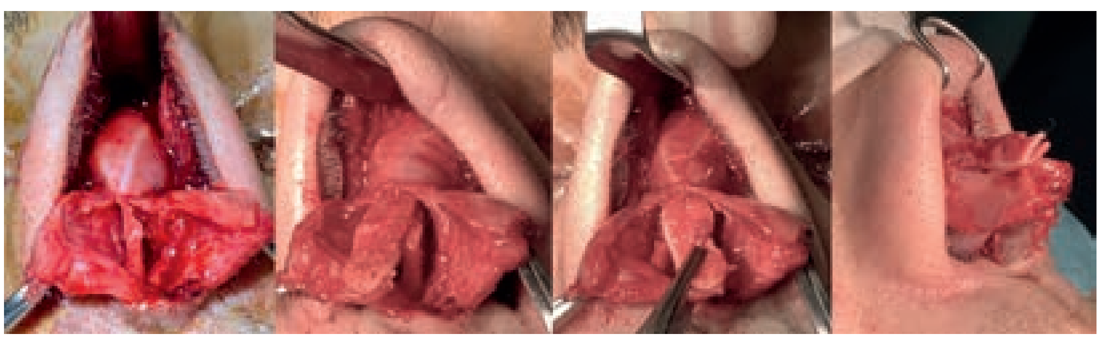
In the crooked nose with a noticeable hump, removal of the quadrangular septum is done only after Step 1 (creation of the spare roof with a longitudinal cut through the dorsal septum) and Step 2 (septal strip excision to determine the final dorsal height) are completed. When performing extracorporeal septoplasty, a 5 mm length of the dorsal cartilaginous septum is retained at its junction with the perpendicular plate of the ethmoid to allow subsequent suture fixation of the "new" septum. A new L-shape septal strut is created on the back table following the standard Gubisch technique. Once reinserted into the nose, suture fixation is done at 2 points. Cephalically, 2 sutures of 4-0 PDS are placed between the new septum and the retained dorsal septum. Caudally, a suture placed through a drill hole in the anterior nasal spine to the base of the new septum.



VARIATION #2 – Correcting the Saddle Nose

All saddle noses with preservation of the cartilaginous vault are suitable for reconstruction through the Spare Roof Technique. These cases include the following etiologies: closed trauma, septoplasty, granulomatous diseases, cocaine abuse and other medical conditions. The author has designated this procedure as the “Reverse Spare Roof Technique”.

The Reverse Spare Roof Technique consists in a cartilage vault “push-up”. Following release of the cartilage vault from the cartilaginous septum, a cartilaginous graft is placed in the “dead space” – above the dorsal septum, and below the ULC. Thus, the cartilage vault is pushed up and the Saddle Deformity corrected, exactly in the opposite way of it’s formation. The “dorsal volumizing graft” is usually ear cartilage due to the fact that these patients usually don’t have septal cartilage. It should be sutured with 4-0 PDS to the dorsal septum and the ULCs very tight. The final dorsum is smooth and natural, with no flap or graft reflected in the surface. The caudal aspect of this graft can be used like an extended spreader graft. Is can be sutured to the LLCs with desired position, there so it is very useful also in short noses. Saddle nose is seen below following excess septoplasty corrected with double auricular graft interposed between septum and cartilage vault.



ADVANTAGES / DISADVANTAGES

Technically, the Spare Roof Technique should be faster than traditional hump resection procedures because it is not necessary to reconstruct the midvault. Aesthetically, the natural dorsum is smoother and much more likely to avoid small bumps and other dorsal defects postoperatively. In cadaver studies it is our impression that our technique provides a higher cross-sectional area of the internal nasal valve. Patients with a straight dorsum and a hump equal or smaller than 5 mm are the best candidates for SRT. It can also be used in patients that have a crooked nose. If the surgeon doesn’t feel comfortable with this technique, then it is easy to convert to a conventional component hump reduction.

Humps bigger than 5 mm are a relative contraindication for this technique. To reduce a potential step at the new nasal dorsum, one must consider two modifications. A more delicate ostectomy can be achieved using a piezo rasp or a diamond burr. The more the cephalic KA is removed the greater the risk of a step. However, if the skin is thicker, then the impact on the surface aesthetics is lower. Even taking these factors into account, we *always* use cartilage powder at the end of the procedure in the dorsum. Cartilage powder or dust is obtained from harvested septal cartilage which is rasped with a #15 blade. The cartilage dust is combined with PRP and the grafts is inserted at the new keystone area. The revision rate, due specifically to dorsal irregularities, has decreased since the adoption of power instrumentation from 10-15% to 1-5%.

CASE #1

Pre- and postoperative 1 year photos. 3mm hump on profile, ptotic tip, short and tension nose with fusiform dorsal aesthetical lines. Slightly open nasal bones. Septal deviation and turbinates hypertrophy. Open nasolabial angle.

Closed approach. Spar Roof Technique. Excision of a 3 mm dorsal septal strip (up to the perpendicular plate). Ostectomy of the bony cap done with a rasp. Lateral endonasal osteotomies to straightening the bony pyramid. Cartilage powder with PRF over the dorsum at the end of the surgery. On the nasal tip domal, interdomal sutures with 5:0 PDS, lateral crural steal (2mm), columellar strut harvested from the bottom of the septum during functional Cottle septoplasty.

CASE #2

Pre- and postoperative 1 year photos. 4 mm hump, ptotic and unsupported tip, tension nose, with typical fusiform dorsal aesthetical lines. Septal deviation and turbinates hypertrophy. Closed nasolabial angle.

Closed approach. Dorsum has been preserved with Spar Roof Technique with the excision of a 4 mm dorsal septal strip. Ostectomy of the bony cap done with diamond burr. Lateral endonasal osteotomies to straightening the bony pyramid. Cartilage powder with PRF on the entire dorsum. Domal, interdomal sutures, lateral crural steal (3mm), columellar strut harvested from the bottom of the septum during functional Cottle septoplasty.

CONCLUSIONS

Why should surgeons master the Spare Roof Technique? There are 7 important reasons. First, it is an excellent method for treating the majority of primary rhinoplasty cases. Second, it preserves the natural dorsum without the need for reconstructing the mid-vault. Third, since it is structurally less aggressive, it should be more predictable then other classical Preservation Techniques. Fourth, playing with the relation/support of the nasal bones/ULCs, it allows one to correct the crooked noses with a different strategy. Fifth, it is technically simpler and easier to master than virtually any other method of Dorsal Preservation. For the less experienced surgeon, one can easily integrate preservation of the cartilaginous vault into their operative sequence without the need to change their preferred method of osteotomies nor their septoplasty technique. Sixth, if the operation is not going well then the fall back option is quite simple - remove the newly created spare roof and do a conventional midvault reconstruction with either spreader grafts or flaps. Seventh is can be used “reversely” in cases of saddle nose when the ULCs are still preserved (even with asymmetries or trauma sequels) – one just have to put a “dorsal volumizing graft” in between the dorsal septum and the ULCs.

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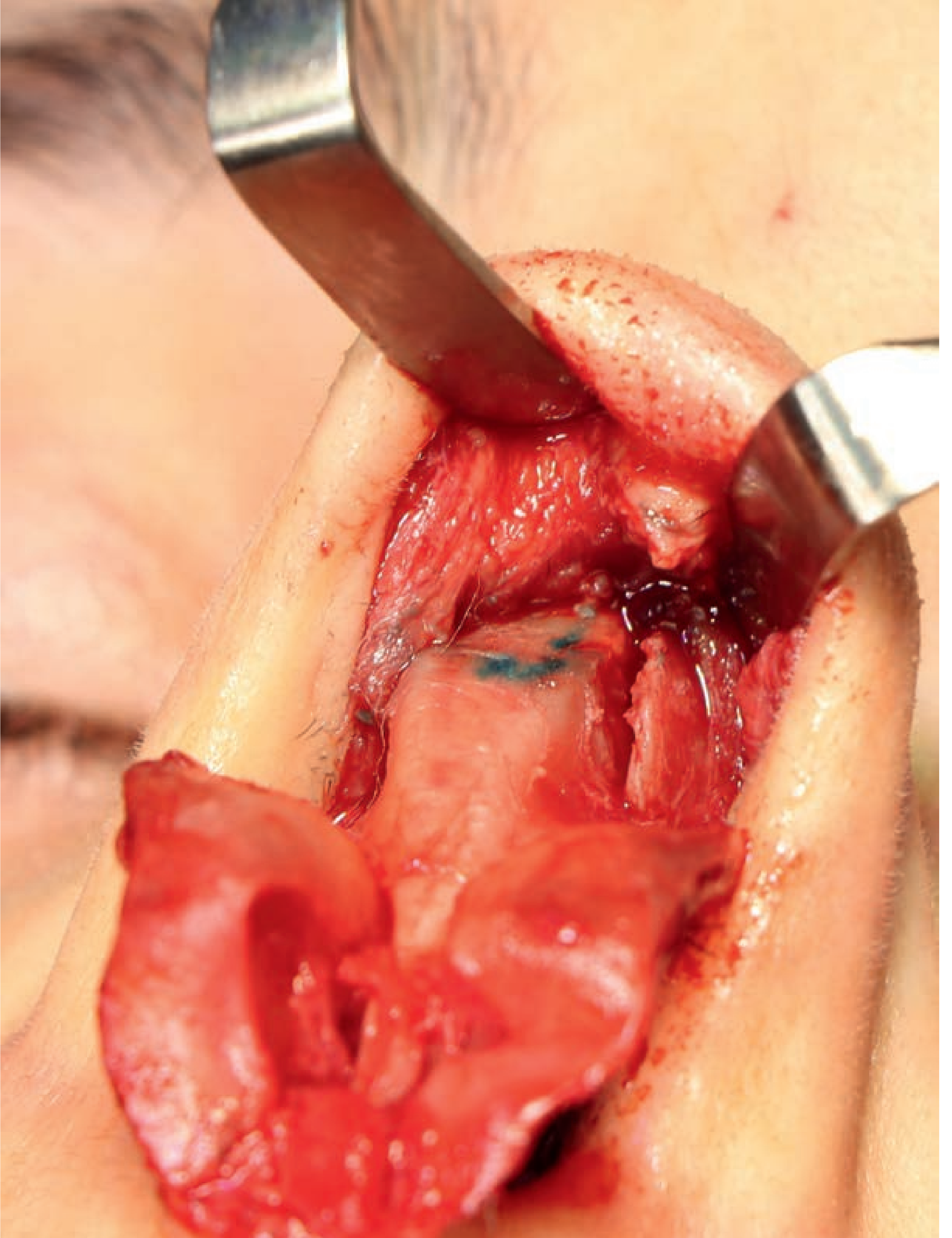
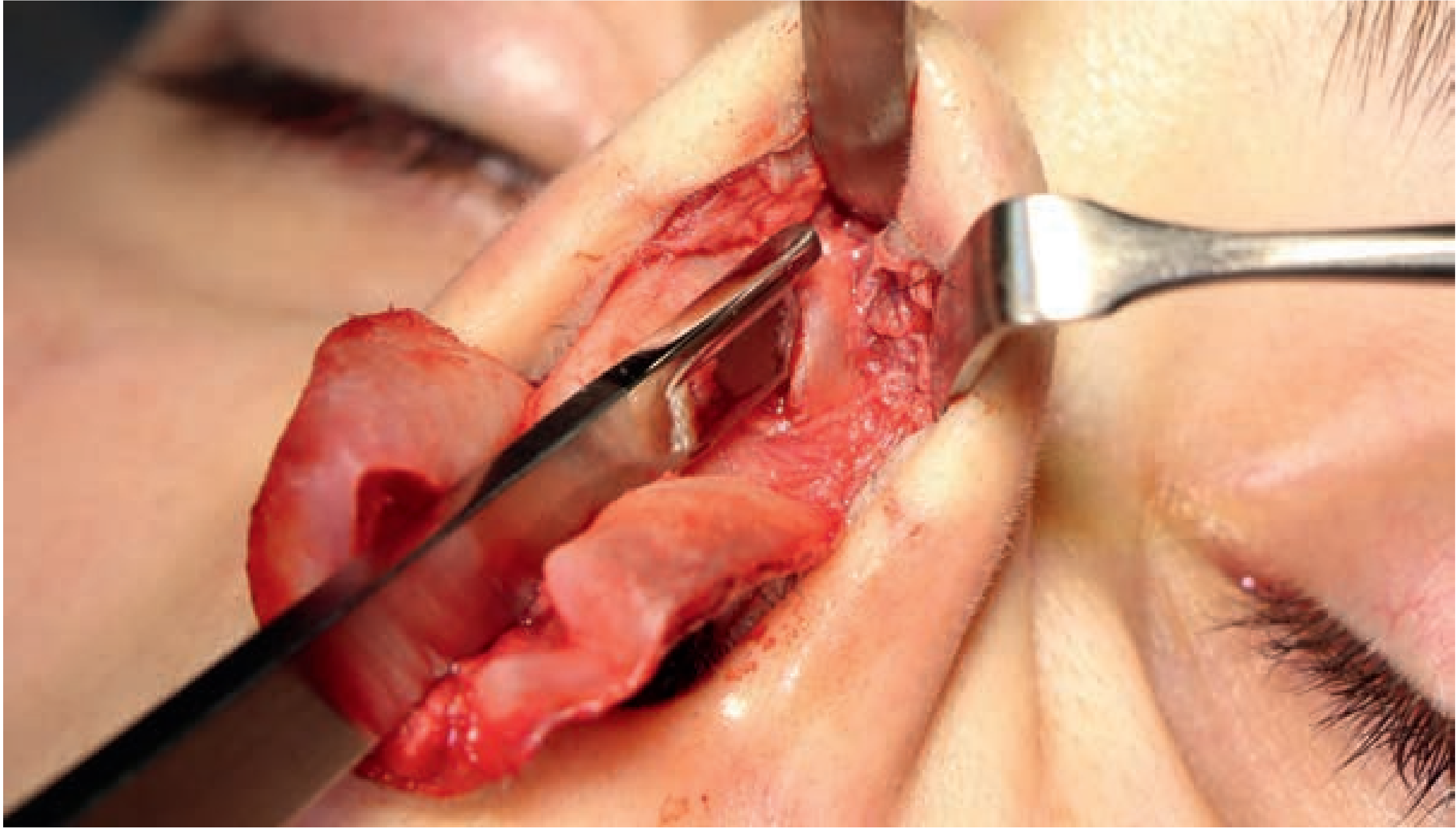




Cartilage Vault Push Down with Optional Bony Cap Preservation

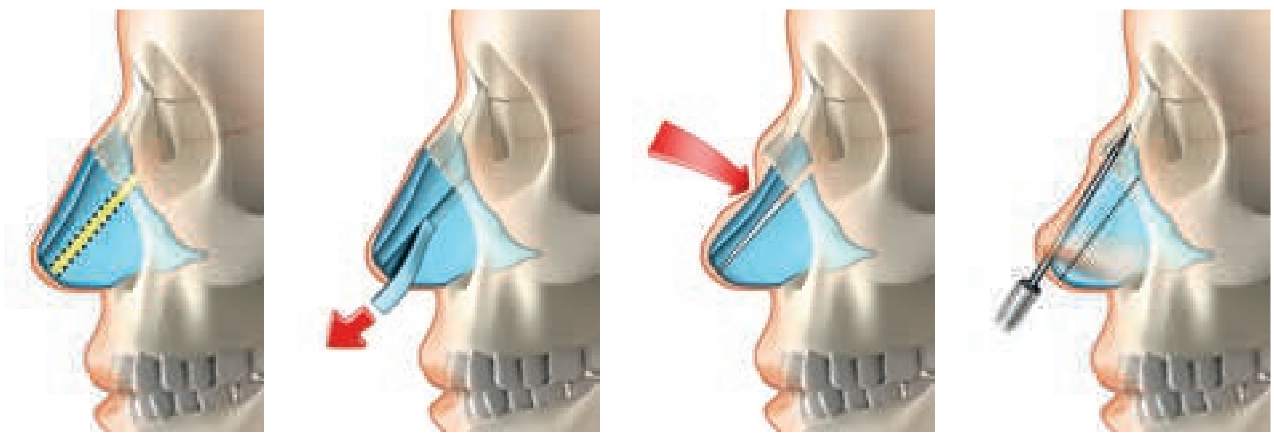
Luiz Carlos Ishida

The author currently does Dorsal Preservation (hereinafter DP) procedure in 100% of his primary rhinoplasties. As will be discussed, 3 different techniques are used: 1) Cartilaginous Push Down with Bony Cap Preservation (80%), 2) Cartilaginous Push Down with Bony Cap Resection (10%), and 3) Saban High Septal Strip Resection with Bony Vault Push Down (10%). Many surgeons are familiar with the “classic Ishida” cartilage vault push down procedure published in 1999. The present chapter will emphasize a completely new approach to the procedure, both as regards the septoplasty and the dorsal modification. Although the name remains the same, the technique differs significantly.

EVOLUTION OF THE ISHIDA TECHNIQUE

In 1999, my father - Jorge Ishida (Ishida et al., 1999) - published a technique for reducing the nasal hump with preservation of the cartilaginous framework. This preservation technique differed significantly from the standard Cottle technique (Cottle, 1954) for 3 reasons: 1) an intermediate septal resection, 2) routine resection of the bony hump, and 3) the use of conventional osteotomies thus avoiding the en-bloc push down maneuver. What were the results and complications? In the initial paper, there was a 15% recurrent hump rate that required simple revision. The isolated treatment of the cartilaginous vault from the bony vault allowed one to correct difficult cases including major nasal deviations, high nasal humps, and very angulated humps. The operation consisted of the following 7 steps:

1) bilateral exposure of the septum through transfixion incision
2) intermediate level longitudinal incision through the cartilaginous septum starting at the perpendicular plate
3) cartilage strip is then excised whose width and shape reflects the amount of hump reduction desired
4) the fibrous connections between the bony and cartilage vault are separated from each other with blunt dissection
5) cartilage vault is pushed down
6) bony hump is removed using osteotome at the level with the newly positioned cartilaginous framework
7) lateral osteotomies are done to stabilize the cartilaginous dorsum and the medial osteotomies are done as necessary



Twenty years later, Jorge Ishida's son - Luiz Carlos Ishida - introduced a new technique (Ishida, 2020) which consists of a Cartilaginous Push Down with Optional Preservation of the Bony Cap. The primary reason for this change is to avoid irregularities or a small open roof in the upper third of the nose which can occur with the original technique. By preserving the bony cap, the integrity and smoothness of the keystone area are maintained, and a greater array of indications occurs for the Cartilaginous Push Down procedure. Since there are no contraindications to lateral and medial osteotomies then the bony pyramid can be narrowed when necessary. To avoid any confusion with using the term "Ishida operation," one can arbitrarily divide the procedures into the *original Ishida* (bony hump resection, intermediate septal resection) and the *modified Ishida* with preservation of the bony cap and variable location of the septal resection (low, high, intermediate). Based on their treatment of the osseocartilaginous hump, both operations involve push down of the cartilaginous hump, but the original one involves resection of the bony hump while the modified one allows preservation of the bony cap.

APPROACH

Using an open or closed approach, the nasal dorsum is undermined in a sub-SMAS plane and the septum is undermined in a subperichondrial plane on both sides. The undermining extends up to the perpendicular plate of the ethmoid.

SURGICAL SEQUENCE

Step #1 – Septal Strip Excision

A strip of septal cartilage is resected parallel to the dorsum. This resection should be done at the most deviated portion of the septal cartilage; most deviations occur at the base of the septal cartilage near the palatal crest. When septal deviation is absent or minimal, the preferred location for resection is approximately 3–4 mm below the dorsum. The High Septal Strip preserves the caudal portion of the septal cartilage (W-ASA segment), which may be used in treating difficult nasal tips. In a series of 48 patients (Ishida, 2020), 29 patients had a cartilaginous Low Septal Strip resection, while the remaining 19 patients had High Septal Strip resection. None of them had Intermediate Septal Strip excision, which confirms the difference between the original and the modified Ishida operation from a septal excision perspective. The High Septal Strip resection should be slightly larger than the reduction on height desired. The height of the Low Septal Strip is in accordance with the lowering desired, plus the deviated portion of the septum. There is no need to be exact with the cartilaginous septal resections, the fine tuning will be done by the incremental release of the lateral portion of the cartilaginous vault. The cartilaginous strip is taken with Metzenbaum scissors and Freer elevator. If bony septum deviation is present, it will be treated separately.

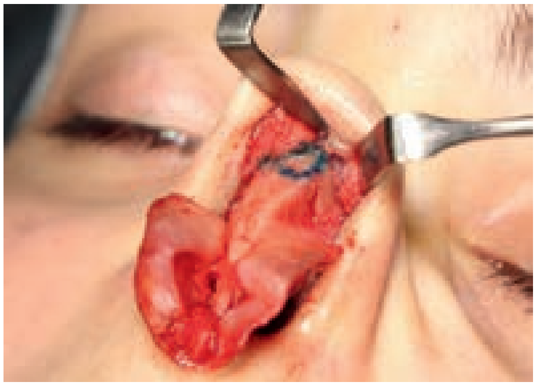
Step #2 – Release of the Cartilaginous Vault

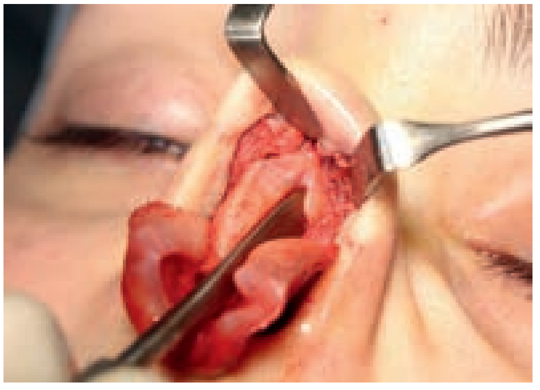
The entire cartilage vault / cartilaginous septum is mobilized in two steps: 1) separating the cartilaginous septum from its attachments to the bony septum in their entirety, and 2) freeing the attachments between the cartilage and bony vaults by dividing the fused perichondrium / periosteum. The septal cartilage is completely detached from the perpendicular plate (PPE) to mobilize the cartilaginous vault. The cartilage should be released as close as possible to the bony septum. It can be done with a Freer dissector from the Keystone Area only in the High Septal Strip resection or all the way along the connection with the bony septum in the Low Septal Strip resection site. This dissection can go either way, up or down the premaxilla depending on the surgeon's preference. It must be emphasized that there is no resection of the perpendicular plate (PPE).

Next, the Cartilaginous Vault is separated from the overlying Nasal Bones using a Freer dissector. Since the cartilage extends in general up to 9 mm under the Nasal Bones and is much softer than these overlying structures, special caution is required. The dissection begins into the Keystone Area and the lateral extent of the dissection correlates with the planned lowering of the dorsum. One critical point - the height of the hump is controlled primarily by incremental undermining of the ULC from the nasal bones (Lateral Keystone Area). As the cartilaginous vault is detached more, the hump is reduced further. The dissection of the ULCs from the nasal bones starts centrally from the Dorsal Keystone Area, sometimes a small incision is needed to proceed with the Freer dissector. The most common problem is the hump recurrence and most often it is due to incomplete detachment of the cartilaginous septum from the bony septum, specially under the keystone area where the septal cartilage extends cephalad.

Step #3 – Bony Cap Preservation or Resection

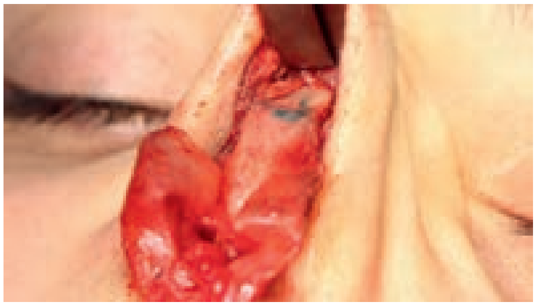
Currently, a Bony Cap Preservation is done in 80% of our primary cases, a Bony Cap Resection in 10%, and a Saban high strip composite push down in 10%. In all of these cases, the septum is approached exactly the same way – low for septal deviations and high for no deviations. The following photos show Bony Cap Preservation. Bony cap preservation begins at the junction of the Dorsal and Lateral Keystone Areas, at the widest point in the middle third of the nose along the Dorsal Aesthetic Lines and converge to the midline cranially at roughly 50–60% of the extent of the nasal bones (below left). The bony cap in the Dorsal Keystone Area will be lowered together with the cartilaginous portion of the hump. The preserved bony cap should not extend beyond the midpoint of the nasal bones for two reasons: to avoid the thicker portion of the nasal bones, and to reduce the need for ethmoid osteotomies. First, a pathway is created between the ULCs and the nasal bones with a Freer dissector (below right).





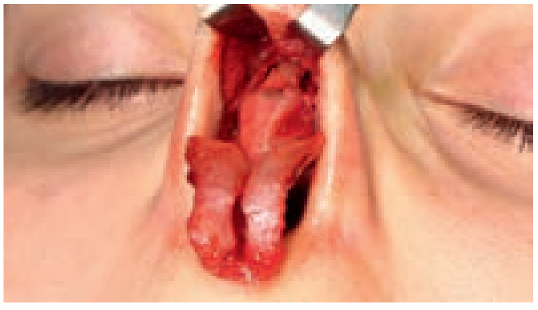
Two angulated paramedian osteotomies are performed along the drawn lines using a straight osteotome.

At this point, the keystone area is pushed down with the finger, and it should be a bit lower down than the desired new level of the dorsum (about 1-2mm). If the dorsum cannot be pushed down, the cartilaginous septum dissection should be checked, specially under the keystone area.



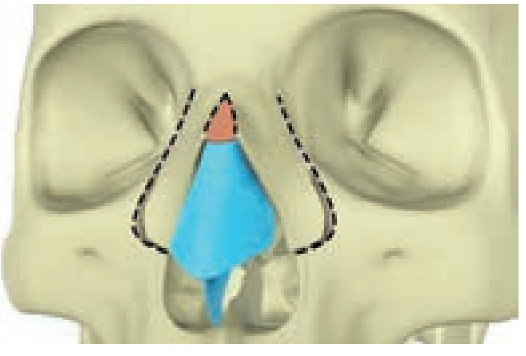
Step #4 – Adjusting the Bony Vault

The residual lateral bony hump is then rasped to the desired level. It is preferable to use fine rasps once the amount of bone rasped is usually small and the nasal bones at this point are very thin and delicate. In female patients we tend to use diamond rasps or even piezo rasping for more control (left). The remaining nasal bones should adapt to the bony cap after the lateral osteotomies (right).



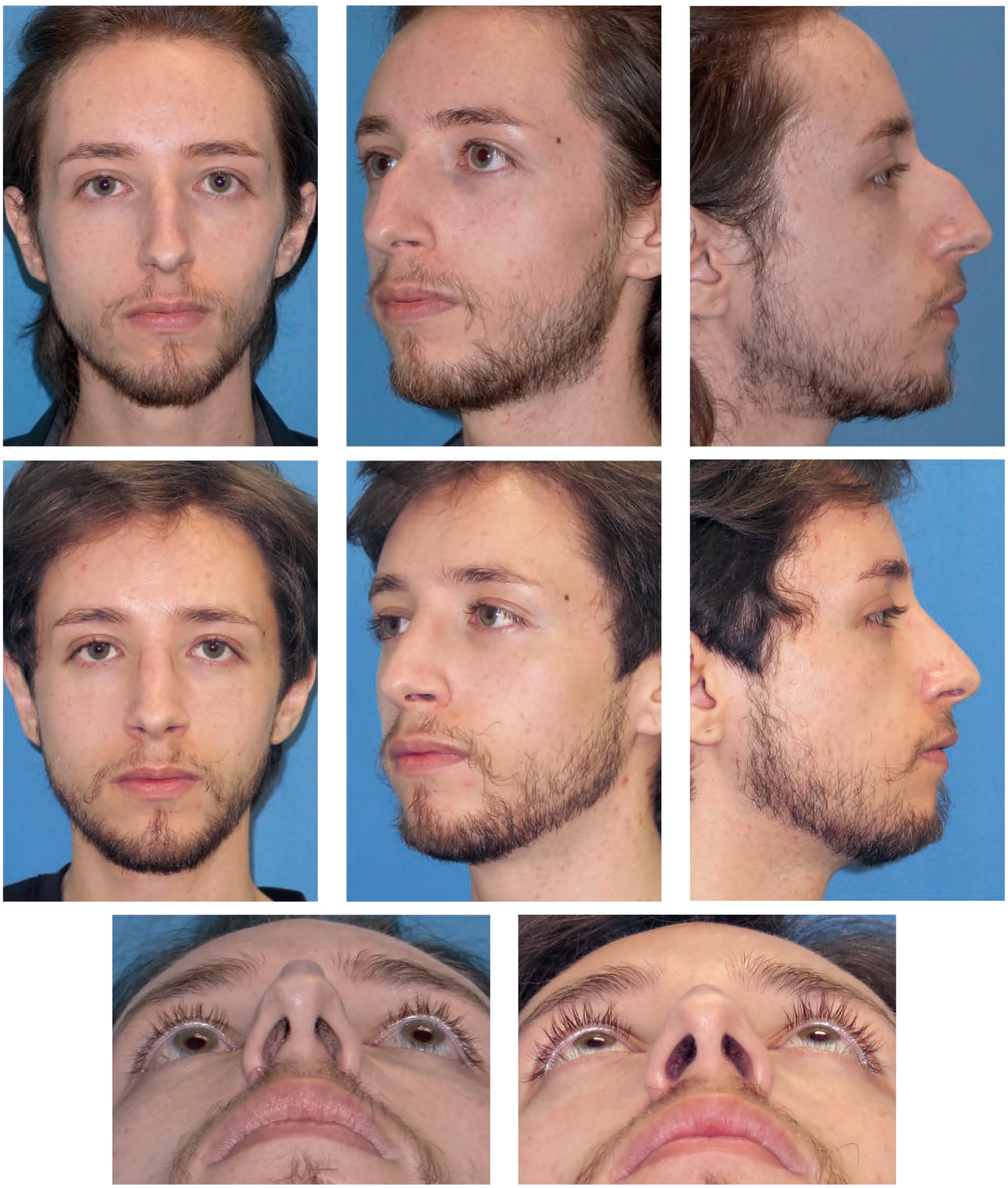
Step #5 Osteotomies and Final Dorsal Contouring

The lateral osteotomies bring the bones closer to the midline and stabilize the dorsum. The lateral osteotomies are done with straight guarded osteotome in a low to low fashion. When the bony dorsum is too wide or there is a bony dorsum deviation, medial osteotomies are performed with curved 5mm chisel. Once the osteotomies are completed then the final dorsal adjustments are made. Any bony irregularities are eliminated with rasp and the bones are brought into position with the retained dorsum. The cartilaginous hump is stabilized in place by the lateral osteotomies, usually no sutures are needed to secure the cartilaginous dorsum in place. The lateral fractures will bring back up those extra 1-2 mm lowered of the step.



CASE #1 – Original Ishida (Bony Cap Excision)

24 years old male patient with thin skin, high and very angled hump, with no functional problems and a mild septal deviation. This patient was treated with a low (base) septal resection followed by a cartilaginous push down with bony cap resection and lateral osteotomies.



CASE #2 – Modified Ishida (Bony Cap Preservation)

23 years old female patient with regular skin, medium hump, small deviation of the keystone area with no functional problems. A low (base) septal resection plus cartilaginous vault push down, bony cap preservation and lateral osteotomies. The tip was treated with a columellar strut and alar cartilage repositioning, no alar cartilage was excised.

CASE #3

A 34 years old female patient with thick skin, small hump, wide nasal dorsum with no functional problems, no septal deviation, poor tip projection and a wide alar base. This patient was treated with a high resection cartilaginous push down, bony cap preservation and lateral osteotomies. The tip was treated with a columellar strut and alar cartilage repositioning, no alar cartilage was resected. The alar base was treated with alar wedge resection combined with sill excision.

ADVANTAGES / DISADVANTAGES

The Cartilaginous Push Down technique with Bony Cap Preservation avoids many of the problems associated with hump resection. By preserving the bony cap, the integrity and smoothness of the keystone area are maintained, along with the broad array of indications for cartilaginous push down. One can treat large, deviated, and/or strongly angled humps. Equally, the bony cap does not impede lateral and medial osteotomies thus allowing the bony pyramid to be narrowed as necessary – wide noses do not represent a contraindication to this type of dorsal preservation. Correction of asymmetric noses and major septal deviations is also possible. Adding the bony cap to the cartilaginous push down preserves the external portion of the keystone area, thus assuring a smooth osseocartilaginous dorsum.

CONCLUSIONS

In a review of 48 patients who had a cartilaginous push down procedure with bony cap preservation, we found the following: 1) 6 were done closed and 42 were done open, 2) the hump size was classified as small (17), medium (24) or large (7) classified by preoperative photographic analysis, 3) 16 patients had significant deviations, 4) the location of the septal resection was low (29) or high (19), and 5) osteotomies consisted of lateral only (22), lateral and medial (18), or none (8). In one patient, the bony cap was lost during the rasping of the nasal bones and the surgery was altered to utilize only the cartilaginous push down. Another patient had a mild hump recurrence during the early weeks following the procedure, which was treated after 8 months by releasing the cartilaginous vault again together with a small rasping of the keystone area.

As previously stated, the author does 100% of his primary rhinoplasties with a DP technique, but uses 3 different techniques. Since my routine technique is the Cartilaginous Push Down with Bony Cap Preservation (80% of cases), the question becomes when don't I use it? I prefer the Cartilaginous Push Down with Bony Cap Resection (10%) for patients with short nasal bones / long cartilaginous vault or dorsums with anatomical irregularities. The Saban (Saban et al., 2018) High Septal Strip resection with complete bony vault Push Down (10%) is reserved for patients with delicate noses and small humps, with no septal or dorsal deviations and little hump angulation.

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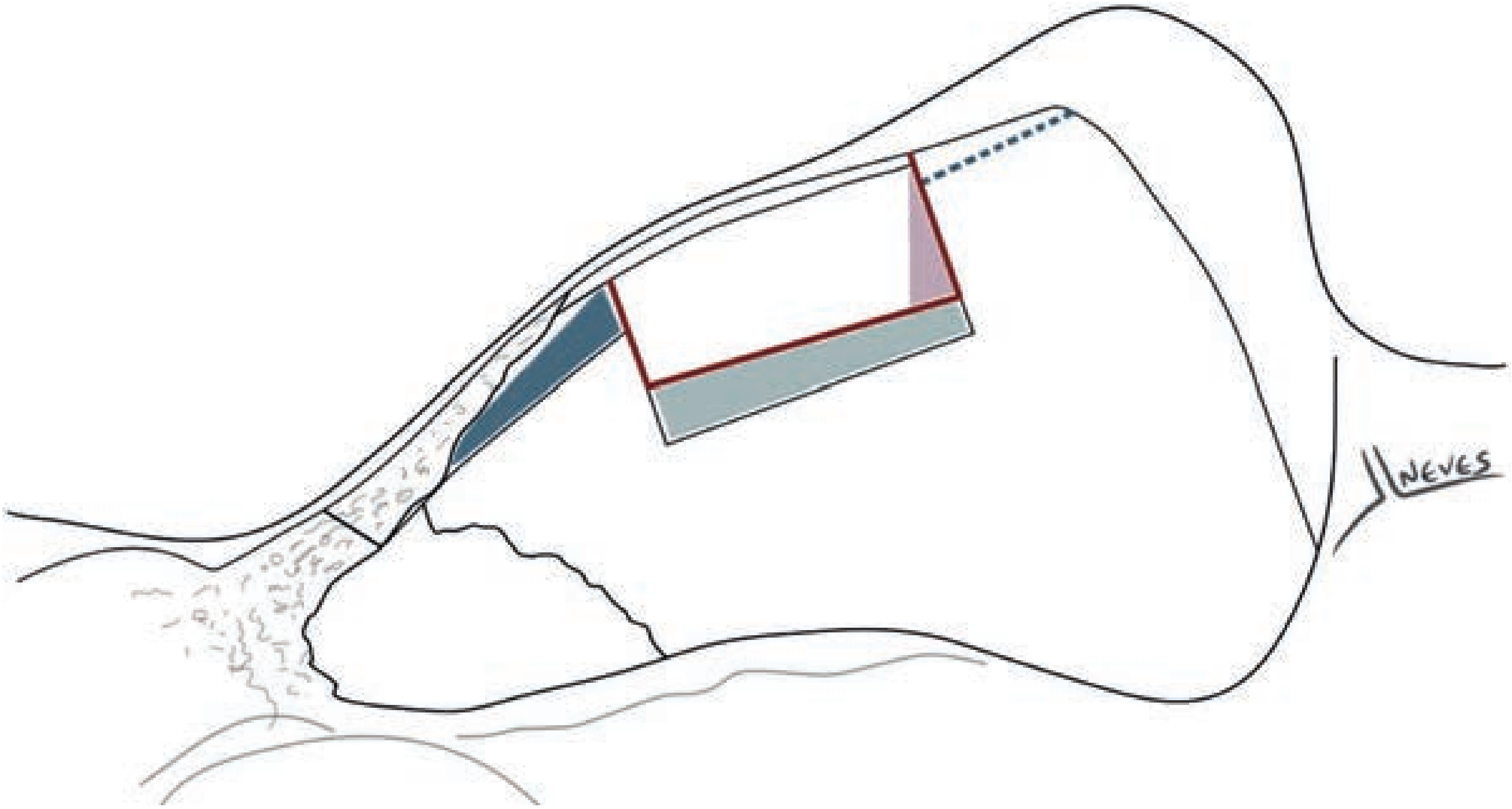


Segmental Preservation Rhinoplasty - The Tetris Concept

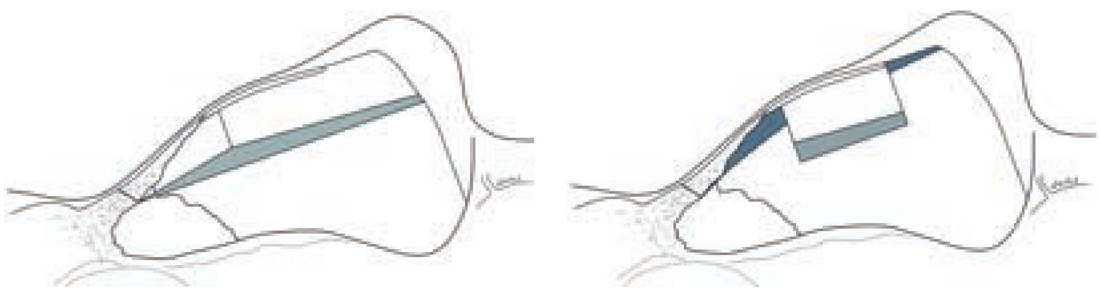
Jose Carlos Neves, Diego Arancibia

In preservation rhinoplasty techniques, the septum can be addressed at one of three levels: low, high subdorsal, or intermediate. When the excision is done lower at its base, the attachment between the cartilaginous vault and the septum is kept intact which allows one to bring the entire structure down as a unit (Cottle, Dewes). Alternatively, it can be addressed higher with a subdorsal longitudinal strip excision thereby separating the two structures with pushing down of the osseocartilaginous vault as an isolated entity (Gola, Saban). The third option is to excises a portion of the septum at an intermediate level which leaves the cartilaginous vault attached to the upper septum which can then be sutured to the remaining lower septum. Although each method has its advantages and disadvantages, we prefer an intermediate level septal excision which preserves a septal strip below the cartilaginous vault thereby giving us control over the final shape of the dorsum. At the outset, the reader should understand the difference in the septal resection between our original “Intermediate Split Preservation Technique” and the evolution to the “Segmental Preservation Technique, the Tetris Concept”.

INTRODUCTION

Our original “Intermediate Split Preservation Technique” (left) consists of the following steps: 1) a tapered intermediate resection (that represents the amount of hump deprojection) beginning at the caudal border of the septum and extending to the perpendicular plate of ethmoid (hereinafter PPE), with its highest point in the most prominent aspect of the hump, at the rhinion level, 2) a vertical chondrotomy just towards this prominent point of the hump, at the K-point or, most often, caudal to it, and 3) suture fixation from the free anterior dorsal septal cartilaginous flap to the basal posterior stable septum.

Although excellent results were achieved, a cut through the caudal border of the septum had the potential to lead to instability and the need to place a cartilaginous strut across the cut. Therefore, a modified intermediate level septal resection was developed which we designate as the Tetris concept (right) and it will be discussed in detail.



SURGICAL TECHNIQUE

Approach and Soft Tissue Exposure

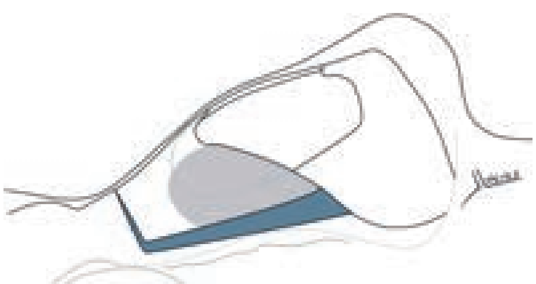
The approach depends on the surgeon’s preferences and it can be an endonasal or an open approach based mainly on the required tip work needed rather than the dorsal deformity. The outer surface of the ULC is dissected generally in a supraperichondrial plane. Exposure is done over the bony pyramid subperiosteally to allow for making the lateral osteotomies under direct vision. When possible, the periosteum is kept intact in the radix area top avoid a potential step that can be created when pushing down the pyramid.

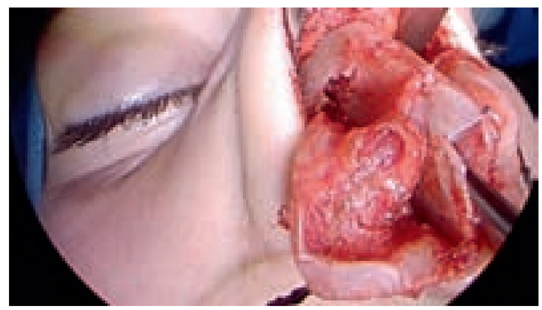
Osteotomies and Pyramid Mobilization

Our preference to approach the lateral nasal wall is the Let Down technique that permits us a better mobilization of the pyramid and avoids bone impaction into the nasal cavity. The transverse and lateral osteotomies are made before the septal resection while the nose is stable and force can be applied without the risk of displacement. In general, the transverse osteotomy is performed under direct vision using a hand saw (e.g. Tastan-Cakir) or an ultrasonic device. Alternatively, a 2mm osteotome can be used percutaneously. The cut is made at the level of the medial canthal ligament up to the level of the lateral dorsum. This way the central dorsum is kept intact with its periosteum allowing for a future greenstick fracture which minimizes the chances of a radix step. The lateral osteotomy consists of two osteotomies followed by removal of the intervening triangular bony wedge from the frontal process of the maxilla. The osteotomies must be done very low laterally, in the nasofacial groove, to avoid any palpable or visible step. It is important to note that next to the medial canthal tendon we create some space where both osteotomies meet to facilitate the Let Down maneuver. The amount of bone removed will not influence the final dorsal profile position which is determined primarily by the septal surgery.

Lateral Keystone Area Release

This maneuver was originally described by Ishida and then part of the “full disarticulation” of Jankowski. Later on, it was termed the “Lateral Wall Split Maneuver” by J. C. Neves and “Ballerina Maneuver” by A. Göksel. In the majority of cases, and specially in larger humps, the lateral articulation between the ULC and the nasal bone (lateral keystone area) can be released which facilitates straightening of the dorsum. The dissection is made in between the medial surface of the nasal bones and the lateral surface of the UCLs and mucosa, after releasing the pyriform ligament. This dissection will allow for an anterior and caudal sliding movement of the middle third of the lateral wall. The more the ULCs are released from the overlying nasal bones, the greater the flattening of the nasal dorsum. The resulting movement of the lateral wall is essential in allowing the septal surgery to control and ultimately define the final nasal profile.

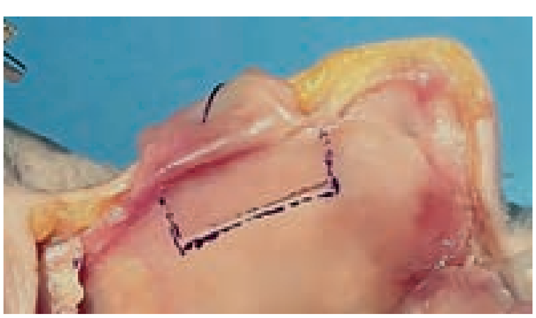


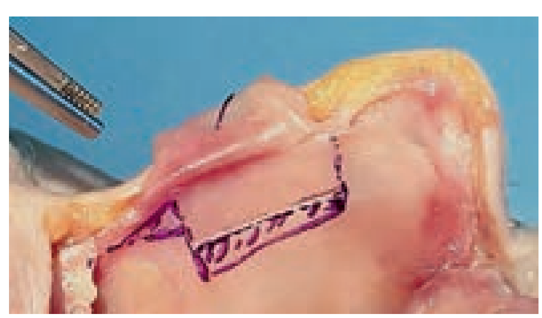


Septal Resection – Tetris concept

Step #1 – Drawing the Cartilaginous block. A rectangular piece of septal cartilage will be designed below the cartilaginous hump in between the most prominent point of the hump (at or slightly caudal to the rhinion) and the caudal border of the ULC (W-point). We start by measuring a 5-8mm line perpendicular to the dorsum at the W-point. This line represents the caudal border of our rectangle. Another perpendicular line is then drawn at the level of the most prominent point of the hump with approximately the same height. It represents the cephalic border of the rectangular piece. This location can be determined by placing a #25 needle through the dorsal skin at the most prominent point on the dorsum and pushing it into the nasal passage. A longitudinal line is drawn uniting the 2 vertical lines which creates the posterior border of the block.

Step #2 – Drawing the Space Slots. Two new shapes will be designed; one below the rectangular block and another below the bony hump. The one below the block must have the height the we intend to reduce the dorsal projection. Since the reduction will be bigger under the most projected point of the hump and less in the more caudal region, the shape of the excised area will usually be trapezoidal. Below the bony hump, we draw a triangular area of excision with its vertex at the level of the transverse osteotomies.



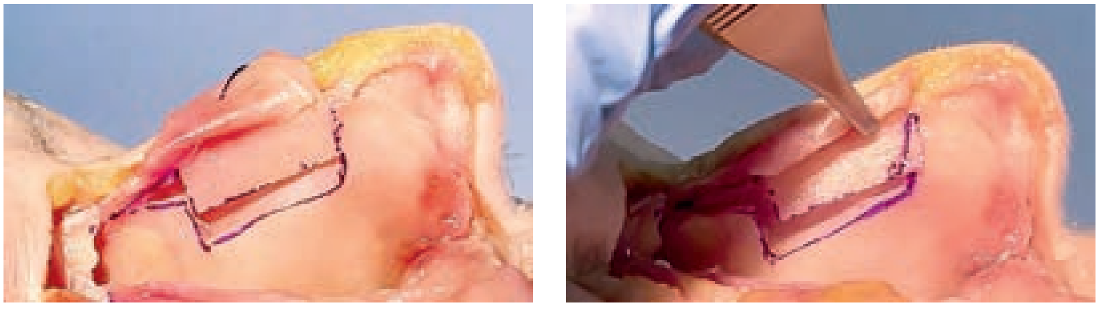


Step #3 – Isolating the Block. Using a #15 blade, the caudal, posterior and cephalic borders of the rectangular block are cut. It is essential to free the cartilaginous hump.

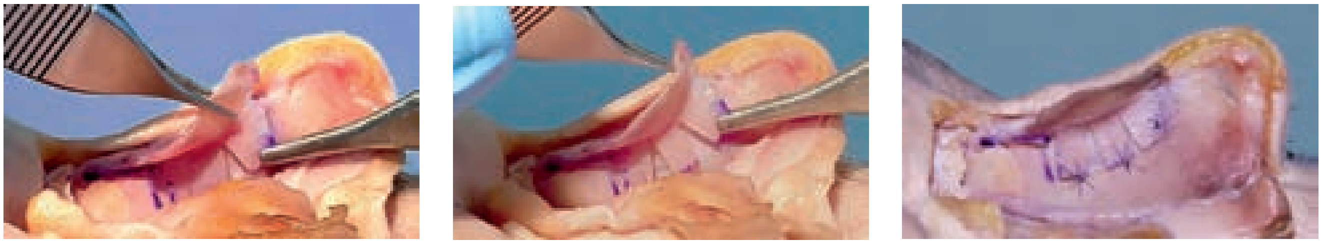
Step #4 – Removing Cephalic Septal Excess. Next, the triangular segment below the bony hump is removed using scissors. The cut always starts tangent to the undersurface of the bony vault to avoid an excess resection that can lead to a radix step. We initially remove a small triangular piece. Then we perform the push down maneuver which is done with a greenstick fracture at the radix and mobilization of the bony vault downward. We then analyze how much we have deprojected the dorsum. If it is not enough, then another slice excision is done until the desired level is reached. In some cases, only cartilage is excised and thus scissors are sufficient. Sometimes a small piece of bone must be removed. If scissors are not enough, then a, rongeur can be used, but we try to avoid creating too big a space and thus a radix step.

Step #5 – Removing Intermediate Septal Excess. At this point in the operation, the dorsal hump has been reduced and the cartilage block is overlapping the septal cartilage. Next, the vertical chondrotomy cut that represents the cephalic border of the block is checked that it extends up to the dorsum which ensures that the block can be rotated downward and caudally thereby eliminating any residual dorsal hump (the Splits effect). At this point, we check if the mark below the block we have previously drawn matches the desired dorsal height we are achieving by moving the dorsal framework. We are ready to remove this piece of the underlying septal cartilage, and thus create the space for our rectangular block. In deviated noses, one can suture the overlapped cartilages side by side without resecting the trapezoid piece. The rectangular block is sutured on the opposite side to the deviation so it can compensate.

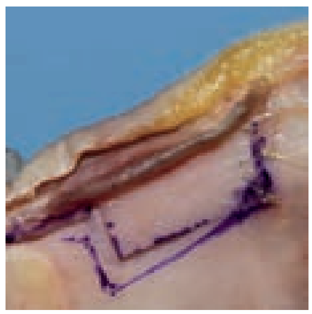
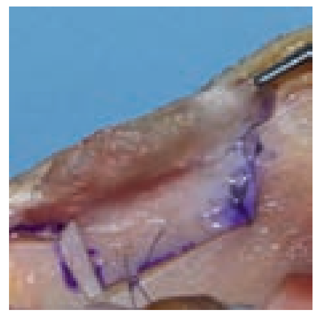
Step #6 – Adjustments to the Block. As already described, the rectangular block is moved downward and caudal in a rotational manner. This movement will create a caudal overlap of a small portion of cartilage of the block with the caudal septum strut we have left intact. Thus, we trim the caudal border of the block so that it fits the slot created perfectly. At this point in the operation, the surgeon decides how satisfied they are with the dorsal profile line. If the dorsum has the desired shape, then a suture closure is done which occurs in 70-80% of cases in the author’s experience. However, if the dorsum is too convex or a more concave shape is desired then a “Tetris split” is done at this time.



Step #7 – Optional Splitting the Tetris Block. In a nasal dorsal hump, the cartilaginous component is always convex. Even after hump reduction, a curved line can persist that creates a small hump in-between the rhinion and supra tip region. In most cases, it is essential to flatten this cartilaginous curve. One or two additional vertical cuts are made in the septal block converting it from a single entity into 2 or 3 new blocks which will be brought caudally into a rotational movement. This movement brings the pieces down into their spaces in a perfect match resembling the Tetris game. The more the block pieces are moved apart the more concave the profile becomes.

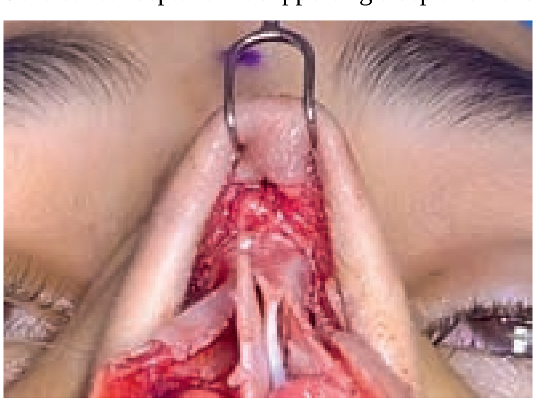


Step #8 – Suturing. The first suture of 5-0 PDS is placed between the caudal border of the *Tetris block* to the *W-ASA segment* which will stretch and help to flatten the dorsum. Occasionally, one will see a small relapse of the hump that will increase slightly with time. This is a significant problem in most DP techniques. In contrast, we use a suture at the rhinion level to prevent a recurrent hump. The cephalic border of the Tetris block is sutured to the underlying stable septal cartilage using 5-0 PDS. This suture can be performed as a simple interrupted one or as a figure of 8 stitch, which is our preference (see photos below). Additional sutures must be added between the caudal and the posterior borders of the Tetris block to the surrounding stable septal cartilage. To increase stability, we include the contralateral perichondrium and mucosa. Note: as the dorsum is flattened, one can produce too much tension on the scroll junction between the ULC and LLC resulting in distortion of the ULC. Therefore, it is sometimes necessary to free the scroll junction.


Step #9 – Adjustments to the W-ASA segment. At this point, the dorsum has been brought down to its ideal position except at the W-ASA segment which was previously preserved. In fact, one can often end up with a slight polly beak appearance. The anterior border of this natural strut must be addressed.


Alternatively, it can be left partially at its maximum height to act like a strut to the tip or to support the stabilization of a septal extension graft. Lower left photo: the caudal septal strut lateral to the Tetris block in a deviated pyramid. Lower right photo: the caudal septal strut supporting a septal extension graft.




CASE #1

Closed Approach. Six months post-op of a tension nose in a class II facial skeletal pattern. A labial incompetence and a lower jaw retrognathia can be seen. The nasal profile was corrected using the Tetris Concept and Let Down technique. The tip was deprojected and a tip plasty was performed. The alar base was reduced. The chin was advanced. Note the *orbicularis oris* muscle relaxation.

CASE #2

Closed Approach. One year postoperative of a straight nose with a high radix and a nasal hump; the tip is ptotic. This case was treated with an intermediate approach to the septum using the Tetris Concept; a controlled step was created at the nasion region so the radix of the nose could be deprojected. The lateral wall was approached with the Let Down Technique. A tip plasty was performed.

NOTES ON THE SEGMENTAL PRESERVATION RHINOPLASTY

The SPRtc is an evolution of the ISRT. Our main goal is trying to control effectively the dorsal profile with accurate maneuvers in each segment. After more than a decade performing conservative dorsal rhinoplasty, the senior author (JCN) felt the need to find some strategies to better control the final position and shape of the dorsum.

*The Bony Pyramid Segment***:** 1) We must have perfect septal support below the Nasion to avoid excessive lowering of the bony dorsum which can create a "radix step." If there is blockage in this region, additional septum is carefully removed using either a scissor or a baby rongeur. If despite one's best effort, a radix step occurs then it can be minimized with a radix graft. 2) Regarding the nasal bone shape, a final sculpture is performed to smooth the profile line (specially in S shape bony dorsum) and the transition in between bone and cartilage. Our preference is a 4 or 5mm barrel burr, but an ultrasonic device or a rasp can be used. The burr can also gently reshape the dorsal cartilage. 3) If the bony upper third is wider than intended, then an osteotomy along both dorsal aesthetic lines is performed using an ultrasonic device which allows gentle medialization of the lateral wall.

The Rhinion and ULC Segment: 1) This segment is where the push down maneuvers show their fragility regarding accuracy and stability. That is why we strongly believe the stabilization of the block of septal cartilage below the UCL that was designed using an intermediate approach (being the ISRT or the SPRtc) really solves this problem. The suture below the Rhinion gives precision and stability to the final dorsal height. 2) In some cases, the goal is to dramatically change the dorsal contour from convex to concave and the Tetris block split is an elegant maneuver that can achieve this goal. 3) By performing the lateral wall split, we reduce the elastic forces of ligaments and attachments, which are responsible for the difficulty to reach dorsal flatness and to prevent relapses of the hump.

The Supratip Segment: 1) The natural caudal strut can be used as part of a strategy to support the tip, but its main goal is to design exactly the supra tip region. In fact, with this preservation we avoid supra tip saddling that is sometimes seen in push down maneuvers, mainly in the Cottle low strip procedure. 2) By keeping intact the caudal septal broad and the septal / anterior nasal spine articulation we avoid any eventual instability of this region.

ADVANTAGES / DISADVANTAGES

The big advantages of this approach are the stability of the rhinion area due to the central suture, the rigidity of the caudal septal border with its attachment to the ANS, and the ability to achieve a flat or even concave profile of the cartilaginous segment by splitting the Tetris block. The suturing of the 2 perpendicular borders of the block promotes a unique stabilization of the nasal pyramid. If the nose has a slight deviation, we can take advantage of the Block overlap with the basal septum and suture it in an overlapping fashion with the block opposite to the deviation. If the septal deviation is mainly basal, we can perform the Split Tetris Preservation Rhinoplasty and then the septoplasty. Eventually, septal cartilage harvesting can be made once the L shape septum is stable. The primary disadvantages of this technique are patient selection and technical challenges. One prerequisite is that there be a sufficiently stable and relatively straight septum without major intrinsic high anterior septal deviations. In severe bigger deviations, we prefer a classical Cottle technique as it permits a more aggressive approach to the septal deviation or an Open Book technique.

CONCLUSIONS

During recent years and for more than a decade, the senior author (JCN) has been dedicated to achieve stable, accurate and predictable results in preservation rhinoplasty. Originally, the inspiration came from Dr Dewes´ modification of the Cottle operation (the SPAR concept, Septal and Pyramid Adjustment and Reposition). The Tetris Concept performed on indicated noses, is a technique that consistently achieves these goals.

Dorsal Direct Resection techniques still are part of our armamentarium of tools in primary rhinoplasties, mainly when Preservation Concepts don't fit the nasal defect. Although, whenever is possible, we prefer to use Preservation Rhinoplasty with the SPRtc our first choice and the Cottle technique reserved for cases with more severe lateralization.

Achieving a natural and no violated dorsum in the proper position with the right shape is definitely the aim of all rhinoplasty surgeon. By performing Dorsal Preservation Techniques, we are definitely closer to this goal.

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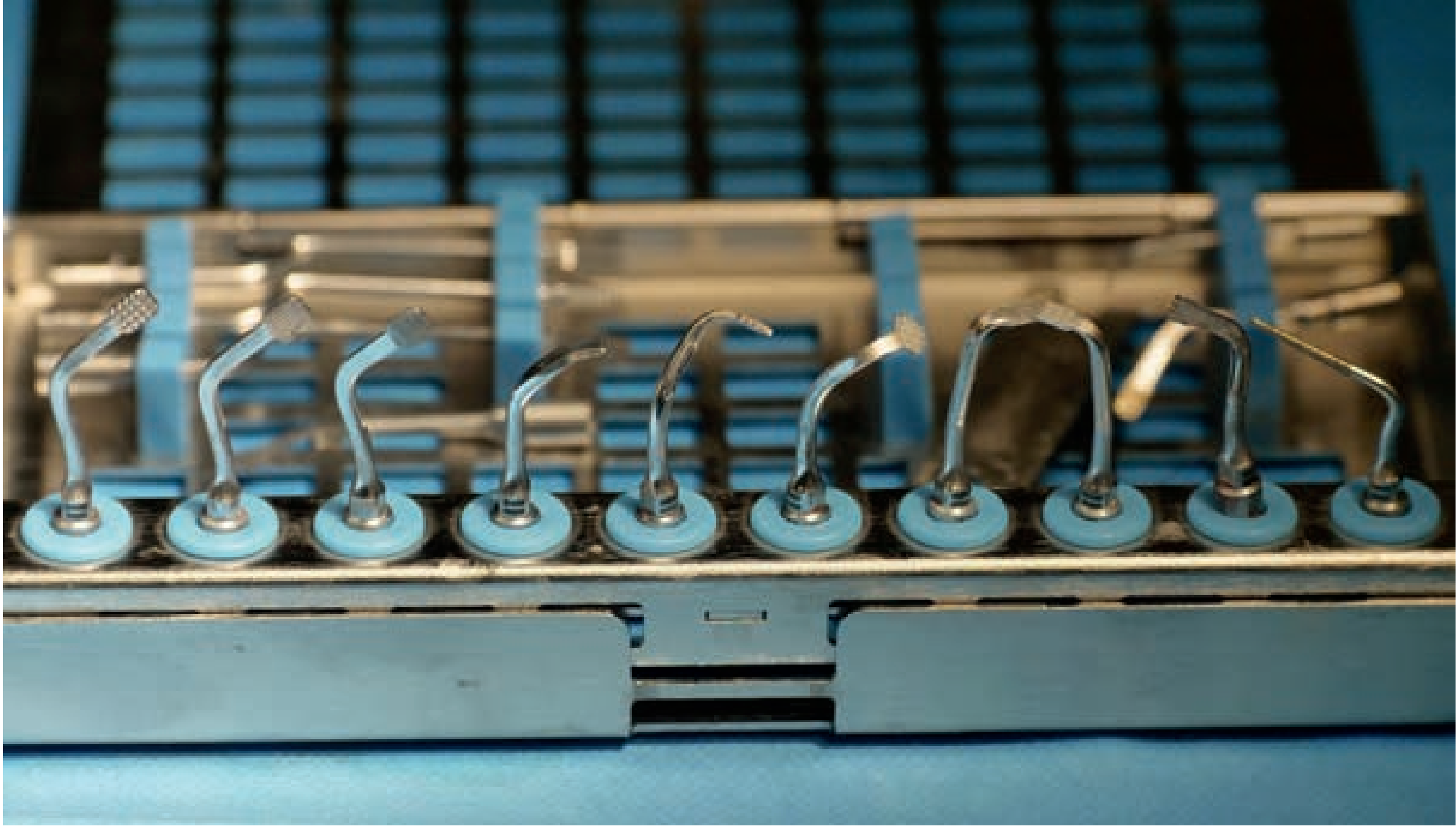


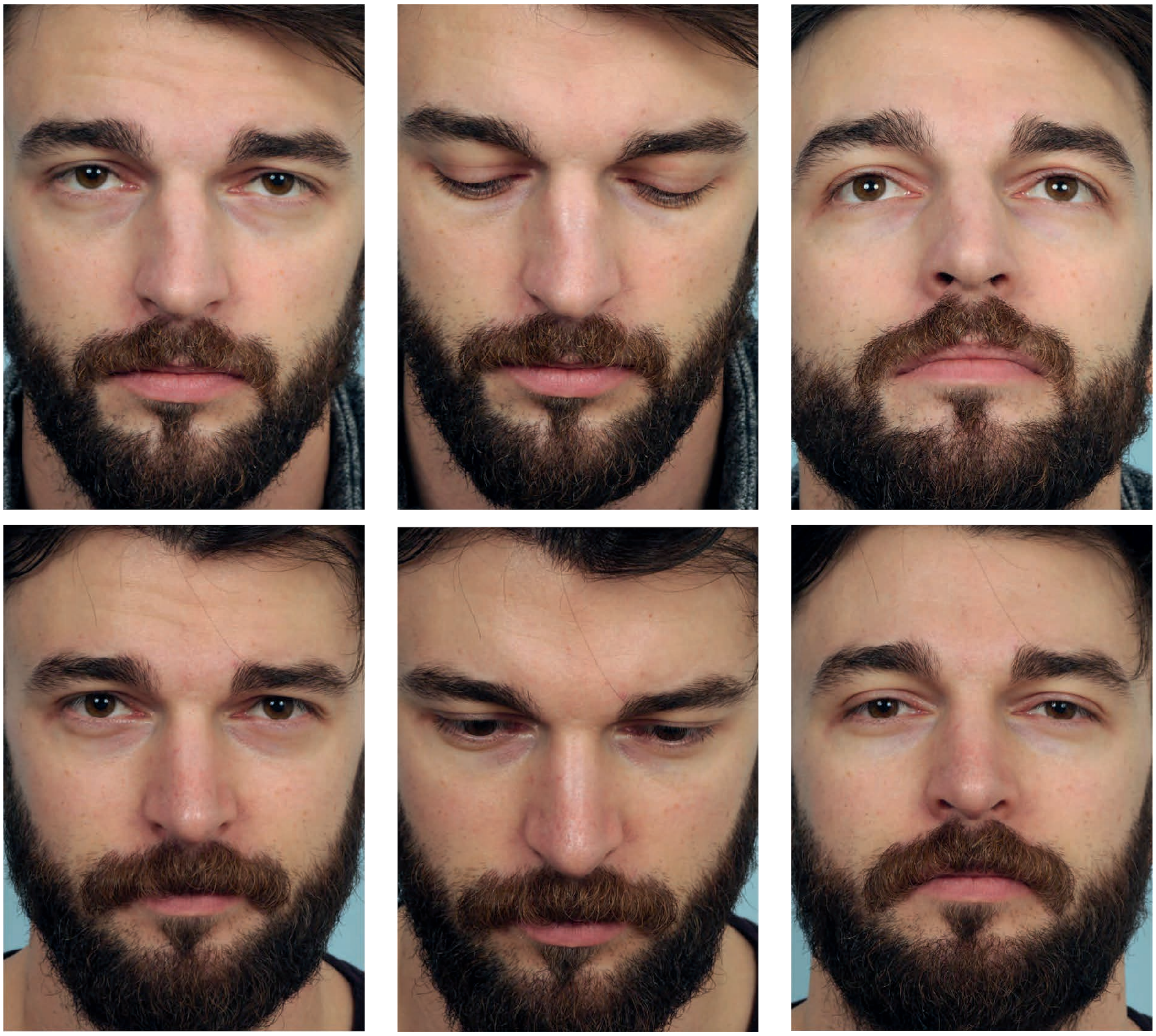
Rhinosculpture with Piezoelectric Instruments for Dorsal Preservation

Olivier Gerbault, Vitaly Zholtikov

Ultrasonic Rhinosculpture (URS) is an important new surgical approach which has dramatic application in both primary and secondary rhinoplasty. URS involves direct shaping of the bony vault with Piezo Electric Instruments (PEI) to achieve the desired aesthetic goals, often without recourse to hump resection or osteotomies. It was developed in 2014 (Gerbault 2016, 2018). The combination of URS and full undermining of the soft tissue envelope allows sculpting of the entire bony pyramid. In primaries, the bony pyramid may be slightly too wide or asymmetric between the two sides. The conventional approach would require osteotomies. In contrast, URS permits removal and thinning of the nasal bones along the dorsum thereby narrowing the dorsal width. In asymmetrical cases, convex lateral bony walls can be directly thinned until the asymmetry is minimized with focal bony convexities removed directly.

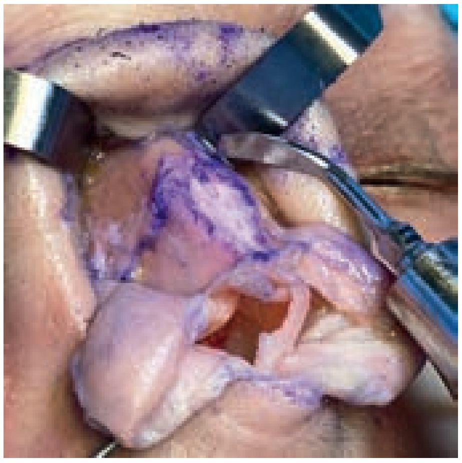
PREOPERATIVE ANALYSIS AND OEPRATIVE PLANNING

Due to the greater number of options available using PEI and Dorsal Preservation (DP) techniques, preoperative analysis of the bony vault has become of critical importance. As regards photographs, the head up hemi- basal and hemi-head down views are the two most valuable for analyzing the bony vault, much more than the frontal view. The frontal view may be misleading as the bone shape and asymmetries can be difficult to assess. Palpation is also of critical importance in planning the surgery as regards bone size (length, width), shape (concave, straight, concave) and asymmetries. Essentially, palpation is used to confirm visual assessment. The dorsal aesthetic lines must be evaluated, both for attractiveness and asymmetries. DP techniques are considered if the dorsal aesthetic lines are attractive and any septal deviation is limited. Radiological assessment of the bone thickness has been useful to plan the USR. Cases with very thin bones on cone beam CT examination are not ideal candidates for USR. As seen in the following case, bony vault asymmetry is associated with a septal deviation. The right lateral bony wall is wider and more convex.



TECHNICAL ASPECTS OF PIEZOELECTRIC INSTRUMENTS

PEI are instruments that vibrate at a very high frequency - about 30,000 vibrations per second. The vibrations of a metallic tip, called an insert, placed on the hand piece are used to selectively cut bone or rigid cartilages while sparing surrounding soft tissues. The technology is based on inverse piezoelectric activity: alternative currents applied to piezoactive ceramic disks generate high-frequency vibratory energy. Bony tissue is emulsified via a cavitation effect and removed by suction irrigation without thermal or mechanical injury to the surrounding tissue. Water irrigation is provided through a distal port on the working tip via a hydraulic circuit inside the hand piece. A peristaltic pump provides differential water flows. A foot pedal allows the surgeon to control all the parameters (power, mode, and irrigation).



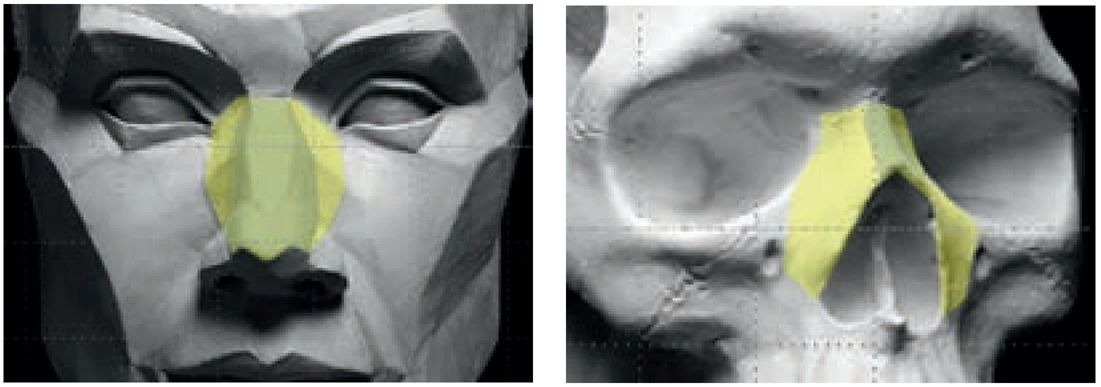
When using a piezoelectric unit, cutting is due to the high frequency vibration of the tip of the instrument. Since vibration is the critical mechanism, excessive pressure must be avoided as pressure decreases efficiency and generates frictional heat. The optimum force required to cut bone depends on its type (cortical or spongious), density (degree of mineralization), width (which differs a lot depending on the area of the nose) and the type of ultrasonic tip used.

In contrast to PEI, electric instruments are non-selective and thus they can harm the surroundings soft tissues as well as the underlying cartilage. Moreover, heat may easily be produced during bone cutting. The degree of thermal injury to the bones depends on many factors and may result in cell death, lack of regeneration, and bone lysis. It has been shown in animal studies that bone healing may be worse with heat than with mechanical or piezoelectric instruments, leading more easily to bone necrosis and callous formation.

SURGICAL TECHNIQUE

Step # 1 – Extended Subperiosteal Bony Vault Exposure

An *extended full open subperiosteal dissection* of the bony vault is a prerequisite for rhinosculpture. After cadaver studies performed in 2014 on bone stability, the full open approach has been developed to facilitate the use of PEI for rhinoplasty. A full subperiosteal dissection of the bony vault is done (yellow shading) – longitudinally from the keystone junction up to the cephalic part of the radix and transversely from one ascending frontal process of the maxilla to the other side. As seen in the accompanying figure, grey indicates a standard undermining and yellow the extended subperiosteal bony vault undermining.



This extended exposure (yellow area) can be performed through an open or closed approach. In the latter case, the marginal incision is extended laterally to facilitate the bony vault undermining and the use of PEI. The wide skin undermining also allows a complete visual assessment of the bony vault shape and characteristics (anatomic variations in shape, length, asymmetries). It also allows placement of interposition grafts inserted in lateral osteotomy fracture lines to stabilize the bony vault once it has been impacted, and to avoid antero-posterior or lateral displacement of the bony vault. In case of inelastic skin, especially mature skin or sun damaged skin, soft tissue envelope redraping is improved. The undermined area is drained by one of two methods. An opening is made in the lowest part of the undermining at the level of the head of the inferior turbinate which allows direct drainage into the nasal fossae. Alternatively, part of the anterior sheath of a 14G needle sleeve is removed with an 11 blade and this drain is inserted from inside the nose at the end of the surgery. The drain is removed on the first post-operative day.

The drawbacks of this extended dissection can be several. First, an increased swelling can occur in the first few weeks or months after the rhinoplasty in about half the cases. However, its occurrence can be lessened by accurate post-op compression, the use of anti-edematous medicines, and postoperative drainage with either a catheter or a stab incision in the nasal fossae. Most swelling usually subsides during the first 1-3 post-operative months. The swelling is noted by the surgeon but is rarely a problem for the patient. Second, numbness of the dorsum or of the sidewalls can occur possibly related to direct stretching of the external sensory nasal nerves. In a few cases, a spontaneous or touch-caused pain can be felt by the patients in the weeks after the rhinoplasty. These painful sensations are always transitory and resolve spontaneously. Third, increased ecchymosis is very uncommon if the perforating vessels arising on the bony vault are cauterized. However, it is more common in mature patients with thin skin.

Step #2 – Sculpting the Bony Dorsum

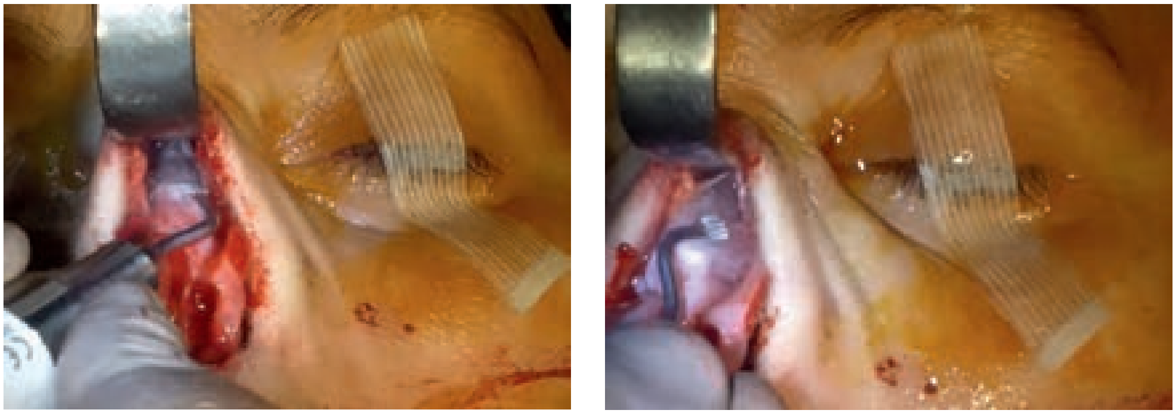
After the exposure is completed, hump removal is the first part of the URS. The *bony cap* is removed to lower the dorsal profile line, to narrow the lateral keystone area (especially when medial oblique osteotomies are not performed), and to remove any bone that may prevent a harmonious cartilaginous dorsal preservation. Bone removal is performed using a rasp if the hump is small (Acteon: RS2H & RS2F). Alternatively, a scraper is used if the hump is larger or if the dorsal skin is thick (Acteon: RHS1). As seen in the intraoperative photos, progressive bone removal of the dorsal and lateral keystone areas (LKA) is followed by a bone thinning in the LKA and on the sidewalls.

The wider the hump, the more lateral the extent of the bone removal. Whichever instrument is used, an open roof never occurs as the underlying cartilage and mucosa are unharmed by the piezo device. When URS is combined with osteotomies, the URS is done first to set the width and shape of the bony segment of the nose before the cartilaginous DP is performed. However, it is usually delayed until the completion of osteotomies when impaction procedures are planned. Whatever the sequence, this first extended removal of the bony cap doesn't burn any bridges and allows one to perform either a cartilaginous DP or an impaction DP later. Several points must be emphasized for URS of the Keystone Area (KA):

- When the bone is thin which is quite frequent, the use of piezo rasps (Acteon: RS2H & RS2F), is essential. Other instruments (piezo scraper, electric burrs, regular rasps) may damage the ULC perichondrium if it hasn't been undermined, produce direct injury to the underlying cartilaginous vault, or may create unwanted bone defects.
- When the bony hump is removed with rasping in a standard reduction rhinoplasty, one often sees a more apparent hump. A comparable greater visibility of the cartilaginous hump often occurs after removal of the bony cap with the protrusion of the cartilaginous vault depending on the shape and stiffness of the ULC at the keystone areas. It should be noted that this prominence of the cartilaginous hump will decrease following a high septal strip excision and/or LKA release.
- Removing the cartilage vault perichondrium helps to flatten a hump after the keystone URS has been performed. The surface of the uncovered cartilaginous vault is wider than when the bone is untouched, allowing an easier straightening of the hump when the perichondrium is removed. The ULC are weaker and more easily reshaped with sutures when their perichondrium has been elevated. The use of the scraper (Acteon: RHS1) makes it very easy to remove the perichondrium on the ULC.

Step #3 – Sculpting the Lateral Bony Wall

This step is performed either before the osteotomies or afterwards on mobilized bones. It' is executed with a rasp (RHS2H) or with a scraper (RHS1). This technique is very efficient and versatile. It is used in the following situations: 1) done alone without any osteotomies in selected cases (URS only,) 2) either combined with osteotomies for preservation and non-preservation techniques of the dorsum,3) when the bony vault has a mild excessive width, and 4) when a minimal dorsal reduction (1-2mm) is indicated. This is *a true URS rhinosculpture where no osteotomy* is performed, but rather a rasping and shaping of the entire bony pyramid. It's very important to rasp down the whole bony vault to avoid any palpable step and to allow a harmonious narrowing of the sidewalls. The advantages are that the bones remain perfectly stable and there is very little bruising after the surgery. The new bony dorsal aesthetic lines can be directly sculpted on the bones by tilting the angle of the rasp or the scraper as seen in the following photos.



Care must be taken not to use URS alone when a significant narrowing of the bones is indicated. At the beginning of his experience with URS (2014-2015), the senior author (OG) “pushed” the indications of isolated rhinosculpture to cases where osteotomies would have been a better option. In these cases, the bony vault remained too wide and needed revision surgery.

The main limitation for URS occurs in patients with thin convex bones under thin skin. In these cases, it is possible to remove all the bone from the keystone areas, creating either visible or palpable defects. In those rare cases of thin bones outside of the keystone area (i.e. when there’s no cartilage vault underneath), the bone convexity can be treated by making crisscross cuts with a thin saw in the latero-medial and cephalo-caudal direction. This crisscross cutting technique flattens localized bone convexity very effectively without removing a significant amount of bone, but a very thin saw is essential (RHS5).

CLINICAL APPLICATIONS

URS can be used in 4 Groups of Dorsal Preservation patients. For all the groups, one can utilize the concept of URS to correct asymmetries of the bony vault directly, by changing the thickness of the nasal bones both dorsally and laterally as well as their intrinsic convexity. To achieve these goals, the surgeon is no longer limited to varying the level or angulation of the osteotomies nor adding multiple osteotomies. *Shaping has replaced breaking.*

Group #1 – Ultrasonic Rhinosculpture *Only* for Dorsal Preservation

The bony vault is lowered and narrowed without doing any osteotomies. Lowering the cartilaginous vault by 1-2mm is frequently the only amount of lowering necessary, especially if a low radix is raised and/or an under projected tip is corrected. The entire aesthetic unit of the bony pyramid is rasped down, with more bone removed usually where it is thicker (i.e.: at the periphery of the bony vault). Care must be taken in the dorsal and lateral keystone areas where both the bone and the skin are the thinnest. In the keystone areas, the use of piezoelectric rasps is considered mandatory to avoid any visible or palpable defect. An exception might be where the bones and skin are very thick. Denuding the cartilaginous vault with a piezo rasp instead of releasing them from the bones prevents the bony edges from being palpable. This method is extremely valuable for cartilaginous dorsal preservation techniques and avoids the need for concealment grafts in the keystone area. Progressive ostectomy of the bony vault changes its biomechanical characteristics. When a complete rhinosculpture has been performed, the bones are more pliable and can be squeezed to narrow the bony pyramid. A real bone remodeling can be performed on some types of bones, but usually not on mature bone nor certain “ethnic” bones. Obviously, all type of septal deviations can be addressed safely when an isolated URS is performed.

Group #2 – Ultrasonic Rhinosculpture for DP using Dorsal Modification & Cartilage Vault Lowering

Preoperatively, the treatment of patients with a 1-4mm hump with good dorsal aesthetic lines will be ideal for a DP procedure with dorsal modification. Equally, there will be patients on whom the surgeon planned a “URS only” procedure, but intraoperatively a persistent hump occurred which required an alternative treatment. A word of caution on septal deviations in this group. If there’s a high septal deviation, techniques with high septal strip may create an axis deviation, especially when the cartilaginous vault is sutured to the septum. That’s why high septal deviations could be contraindicated for any type of high septal strip DP and one could do a modified Cottle procedure instead (see Group 4).

The following progression is recommended:

1) For small cartilaginous humps remaining after URS (1-3mm), removal of the perichondrium over the central cartilaginous vault decreases the volume of the cartilaginous hump while increasing its flexibility. This URS maneuver may lower the profile by 1mm.
2) An additional shaving of the cartilaginous hump in selected anatomic configurations (without disrupting the complete integrity of septopyramidal complex) enables 1mm more of additional lowering. Alternatively, a “shoulder shave” of ULC can be done if the LKA is too convex.
3) A very high septal incision without any trimming just under the cartilaginous roof allows another 2-3mm of hump lowering. Depending on the location of the osseocartilaginous junction of the dorsal septum (in front or behind the highest point of the hump), an incision of the PPE is performed in continuity with the septal cartilaginous incision using a long piezo saw.
4) If this sequence of maneuvers is insufficient, then a high septal strip is done with an incremental trimming of the septum under the cartilaginous roof. Bone trimming of the PPE is usually minimal. This additional trimming enables more lowering of the dorsum. If the ULC are rigid as well as convex or straight, a possible widening of the cartilaginous vault can occur as the dorsum moves downwards. If in contrast the ULC are convex or flimsy, then the deformity may worsen with the cartilaginous impaction. The more the septum is trimmed, the more the cartilaginous vault widens and the more the bony edges become perceptible at the LKA. Sutures are done to narrow the cartilaginous vault and to resist the spreading effect of the unopened lowered cartilaginous vault. However, these sutures may accentuate the gap between the cartilaginous and the bony vault. At this point, one has the option to either rasp the bones more or to do osteotomies to narrow the bony vault. We then enter Group 3, where URS is combined with the appropriate osteotomies.

Groups #3 – Ultrasonic Rhinosculpture with Standard Osteotomies

We’re now at a stage where URS has allowed removal of the bony cap from the DKA and LKA. If there is no high septal deviation, then a high septal strip can be removed. If suturing of the cartilaginous vault to the septum creates a gap between the bony and cartilaginous vaults, then osteotomies are necessary. First, a low lateral osteotomy is performed with a fan shape piezo saw in the nasofacial groove and extended cephalically as high as possible. Second, a mini paramedian osteotomy is done in the area of the desired bony dorsal aesthetic line. It is a short mini osteotomy as part of the bone has already been removed in the LKA. Third, a high transverse osteotomy joins the two previous ones: this allows the bony vault to narrow and to correct the *gap* between the cartilaginous and the bony vault. At this stage, sutures can also be performed between the 2 bony sidewalls to prevent any widening, as the cartilaginous vault may have kept its elastic properties. Bones are drilled with a piezo drill and sutures are passed directly from one hole to the other, or more easily in a crisscross pattern as described by Gubisch-Haack.

Group #4 – Ultrasonic Rhinosculpture with Dorsal Preservation using Bony Impaction Techniques

The type of bony impaction technique will be selected based on the level of septal deviation (high, intermediate, or low) as well as the anticipated need for multiple cartilaginous grafts. A high septal strip technique can be safely done as a continuation of the gradual progressive approach for Group #1. Most surgeons doing high strip DP don't initially remove the bony cap at the keystone area and do bone reshaping only if the hump does not flatten. However, adding URS to these high strip techniques significantly improves correction of the hump and decrease the risk of a recurrent hump. The low septal strip DP are very different and usually planned when a high septal deviation exists, especially in the PPE. However, in those cases URS can be done first to facilitate treatment of the hump, or secondarily if a hump remains after septal reattachment does not flatten the hump.

INDICATIONS / CONTRAINDICATIONS

The indications for URS in Dorsal Preservation cases include those cases where the bony vault is a little too wide and with a mild (2mm or less) bony hump. Several cases of pseudo hump enter this category, in which a low radix will be raised and/or an under projected tip will be repositioned. The surgeon must be prepared to perform a high septal incision and remove the perichondrium if the cartilaginous vault is still too prominent. In other cases, the indications for URS combined with other maneuvers include septal strip excision (high, intermediate, or low), LKA dissection, and osteotomies. In virtually all cases, URS is valuable for minimizing asymmetries and any residual convexities.

Questions are often asked about the fate of bones thinned with URS. It is hard to give a definitive answer. Since 2013, there have been no reports of any long-term adverse effects. Specifically, there have been no reported cases of secondary fractures nor functional issues encountered in thousands of cases performed by surgeons throughout the world. Bony defects can occur anywhere on the bony vault if URS is not performed accurately. Using inserts not adapted for rhinoplasty or certain types of burrs may increase the risk of bone defects. These defects can be a difficult issue to treat when the overlying skin is thin.

CASE #1 – Ultrasonic Rhinosculpture only

On front view, the bony vault is too wide with broad bony dorsal aesthetic lines. On oblique view, the LKA is too convex. The middle third and tip are narrower. On lateral view, the dorsum is too high and too masculine.

The patient had a *true URS without any osteotomies* via a full open approach. The ULC perichondrium was removed but nothing was done to the septum except a small infero-posterior harvesting to do a small septal extension graft. 5 years postoperative results are seen.

CASE #2 – Ultrasonic Rhinosculpture with Cartilage Vault Lowering

Medium skinned patient with a too masculine and long nose. The bony vault is too wide and asymmetric with a wider sidewall on the right side. There's also a septal deviation mad a small hump on profile. The LKA is too convex.

The patient had a URS without any osteotomy via a full open approach. The ULC perichondrium was removed. 1 mm High Septal Strip excision was done to slightly lower the dorsum. A septoplasty and regular septal harvesting was done. The result is shown 9 months postoperatively.

CASE #3 – Ultrasonic Rhinosculpture for Bony Vault Shaping

37 years old woman complained of having a deviated dorsum, hump, bulbous tip.

Open approach, subperiosteal dissection, USR. Thinning bilaterally from the frontal process of maxilla and from the right nasal bone. Bony cap was removed. Low-to-low and partial-length transverse osteotomies resulted in a 2 mm inward medial shift of the base of the pyramid. 2 mm dorsal septum lowering, pedestal spreader grafts. Pre- and postoperative 1 year result.

CASE #4 – Ultrasonic Rhinosculpture for Bony Vault Shaping

This 23 years old woman complained of having a wide dorsum and a bulbous tip.

Open approach, full subperiosteal dissection of the bony vault. URS was performed with bony thickness removed from the lateral parts of the bony pyramid on both sides. There were no osteotomies. Elongated pedestal spreaders. DCF graft (4 cm long, 6 mm wide, 2 mm thick) was placed over the dorsum. Septal extension graft was fixed between the spreaders. Lateral crura transposition, lateral crura strut grafts, tip sutures. Pre- and postop 1.5 year result.

CONCLUSIONS

Based on our own combined personal experience of over 2,000 cases performed in the last 7 years, we can state that USR is a safe procedure with proven efficacy and reliability. It can be used as an isolated rhinosculpture (without any osteotomies) for selected cases of mild humps and slightly too wide bony vaults, especially if the radix and/or the tip must be additionally raised during the procedure. It facilitates dorsal modification in cartilaginous DP techniques where cartilaginous vault de projecting is done. In addition, it is also part of most of the bone work during most DP and non-DP procedures where bone asymmetry can be improved by combining controlled ostectomy and osteotomies.

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Rhinoplasty Anesthesia for Preservation Rhinoplasty

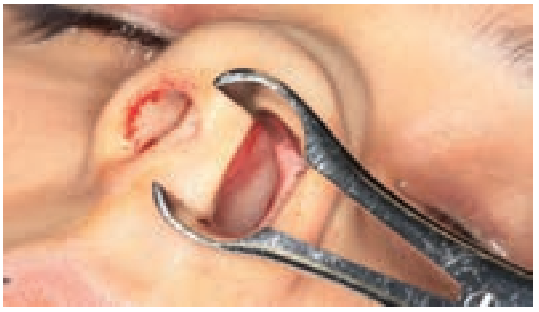
Mustafa Özgön, Barış Çakır

During rhinoplasty surgery, the goals of anesthesia are to ensure a bloodless operative field and patient comfort. The present technique has evolved through a close working relationship between anesthesiologist (MO) and surgeon (BC) which allows each to perform their procedures better and to the benefit of the patient. This technique has been constantly refined and is very sequential beginning with the preoperative medication and nasal spray which are done 15 minutes before the patient enters the OR. Following intubation, the local anesthesia is injected, but not before the systolic pressure is below 90mmHg. A slow and intermittent injection is done in very specific areas. For example, the septum is injected at 3 points (septal floor, posterior septum and radix mucosa). There is no need to inject the entire septum, especially Kiesselbach's triangle, as it only increases the risk of a systemic response. The blood pressure is kept below 90mmHg throughout the surgery to ensure minimal bleeding and excellent visibility. Ultimately, it is the *close coordination between surgeon and anesthesiologist* that results in an ideal perioperative experience for all three – patient, anesthesiologist, and surgeon.

PREMEDICATION

The patient is seen by the anesthesiologist at least one day prior to surgery, and the pre-operative tests are performed. The patient is taken to the pre-op assessment room on the day of surgery and monitored (ECG, SpO2, NIBP), their tympanic temperature is measured, and the baseline values are recorded. An intravenous line is started, and 250 ml %0.9 isotonic NaCl with 1g Metamizole + 45,5 mg Pheniramine maleate + 50 mg Ranitidine is administered (medication dosages are adapted to a patient of weight 60 kg and height 160 cm).

Pseudoephedrine nasal spray is used for septal mucosal vasoconstriction. The spray is given to the patient who is asked to take a deep breath while squirting one spray into each nostril and clean the nose afterwards. In this way the spray acts homogenously on the mucosa. Using the spray 30 minutes prior to surgery ensures a bloodless septoplasty and decreases the systemic absorption of septal injections. It also eliminates the need for intra-operative use of nasal packings with adrenaline.



An IV bolus of 1mg Midazolam + 10 mg Metoclopramide + 40 mg Methylprednisolone is administered as premedication. Dexmedetomidine is administered with an infusion pump at a rate of 40 mcg/h. The patient rests for 15 minutes in the pre-op room.

Once the preparations are completed, the patient is taken into the operating room and monitored again. Room around the patient's head is preferable. The surgeon may need to check for symmetry with a cranial view.

POSITION

The patient is positioned on their back, with a pillow under their head, the arms by their side and supported by a silicone cushion placed under the legs so that the heels do not touch the operating table. The arms are secured with a sheet.

The patient is positioned in reverse Trendelenburg position, with the head extended 20-30 degree so that it is parallel to the floor. This position allows the hip to be in the lowest position and decreases blood pressure in the head. Keeping the head parallel to the floor decreases the likelihood of making rotation errors.

GENERAL ANAESTHESIA

The patient is informed, and anesthesia induction begins. Infusions of Propofol 50 mg/h and remifentanil 250 mcg/h are administered. After an infusion of 50mg 2% Lidocaine + 50 mcg Fentanyl, 5 mg Rocuronium are given for the purpose of priming, and the timer is started. Following 150 mg of Propofol, another 25 mg of Rocuronium is administered.

Once the eyelash reflex disappears, the eyes are covered with a line of Viscotears eye cream and taped crosswise with 0.5 cm transparent tape. After three minutes, the patient is endotracheally intubated with a 7.0 spiral tube. The cuff is inflated with a cuff pressure of 25 cm H_2O. The cuff is connected to a manometer with an extension, and the cuff pressure is continuously monitored during the operation and adjusted to be at 25 +- 5cm H_2O pressure.

After it is ensured that both lungs are equally aerated, the endotracheal tube is fixed to the lower teeth at approximately 21-23 cm with 0 silk suture. In the presence of dental braces, the tube is fixed with 2 cm wide Hypafix tapes at 1 cm distance to the right side of the mouth in the shape of omega, taking care not to pull on the upper lip. The endotracheal tube is connected to the anesthesia device with a semi-closed circuit via an extension tube. Breathing support is secured with 44 % oxygen + 50% Nitrous Oxide and 6% Desfluran at ET CO_2: 30 mmHg (tidal volume 8-10ml/kg, f: 10-12/min, rate of fresh gas flow 2 l/min) in the volume control mode.

IV infusion of 1g Paracetamol is administered over 30 minutes.

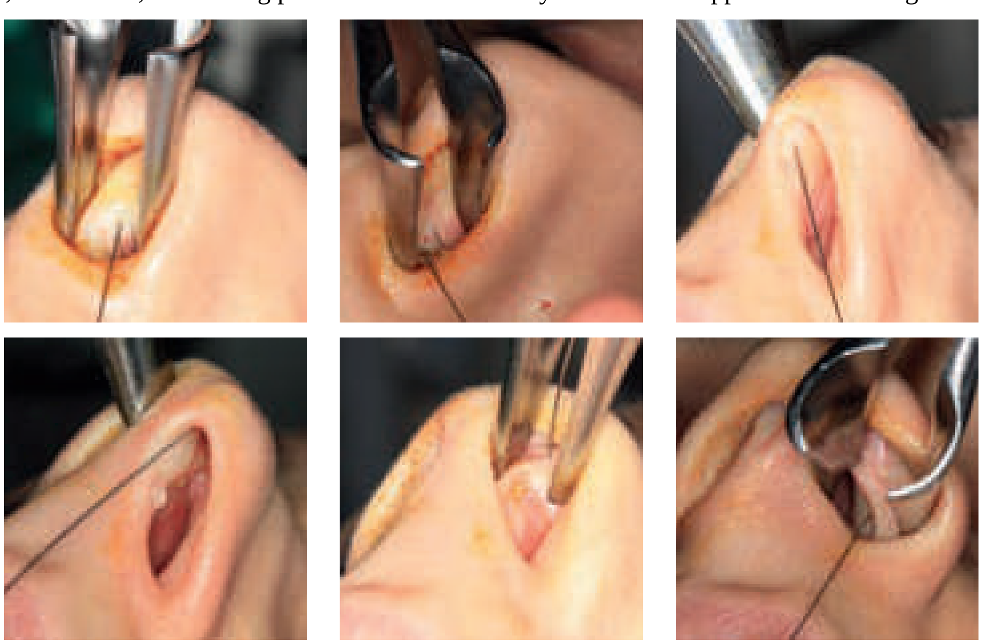
The mouth and stomach are checked with a 16G orange aspirator cannula. Heating systems are stopped, and the patient is handed over to the surgical team.

LOCAL ANESTHESIA

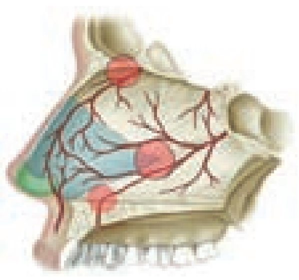
Local anesthetic solution is prepared with 10 cc Mepivacaine + 9 cc 0.9% NaCl + 1 cc 0.25 mg Adrenaline.

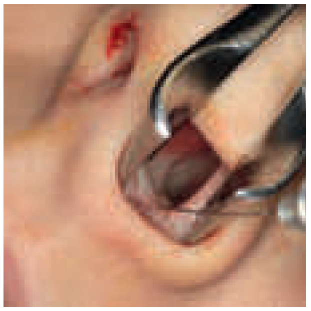
Wait until systolic blood pressure drops below 90 mmHg. Bleeding during surgery is usually encountered if systolic blood pressure goes above 110-120 mmHg when injecting the local anesthetic solution. The half-life of adrenaline is 1-2 minutes. Injection of small doses can prevent the cumulative adverse side effects of adrenaline. Therefore, the injections are administered slowly and intermittently over 10 minutes. Injecting the nose with 4 cc of 1/80,000 adrenaline and the septum with 1.5 cc of 1/240,000 adrenaline solution is sufficient for a bloodless surgery.

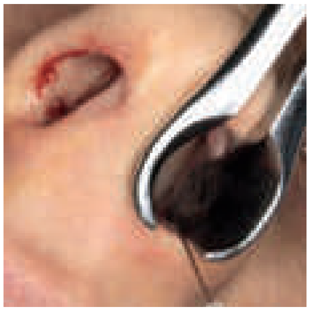
The solution is injected to the caudal septum, anterior to the maxillary spine, the medial and lateral crura, the caudal part of the dome, the dorsum, the starting point of lateral osteotomy and over the upper lateral cartilages.

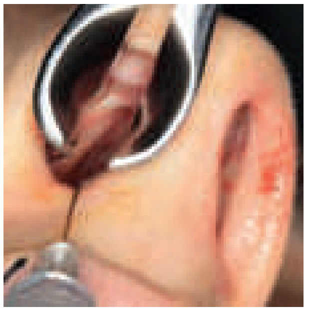


We believe that injecting the septum with adrenaline containing local anesthetic solutions increases bleeding instead of decreasing it. As absorption is high from the septum, pulse rate and blood pressure may increase. Injecting a total of 1-1.5 cc of 1/240,000 adrenaline containing solution to key points in the septum (septal floor, posterior septum and radix mucosa) is sufficient for bloodless septoplasty (see 3 circles in figure below left).









Avoid injecting in the Kiesselbach area, as the circulation is extensive there. Two cc of adrenaline containing Mepivakain solution is diluted with 2 cc of isotonic solution for septal injection.

A slow and intermittent injection will not lead to a significant QT lengthening or arrhythmia in the ECG and increase in ETCO2 will not pass 10%. Increase in ETCO2 or QT lengthening in ECG due to the adrenaline in the local anesthetic solution is accepted to be an early warning sign to pause injecting solution, and the minute volume in the ventilation device is increased to obtain normocapnia.

After dissection, washing the surgical field with 3% Tranexamic Acid may decrease intra-operative bleeding and postoperative bruising (Nayak, Linkov).

Throughout the surgery, balanced salt solutions: Isolyte-S and Lactate Ringer in 5% Dextrose are administered intravenously at a rate of 8-10 ml/kg/hour.

Additional intervention is usually not necessary during the surgery.

The same constant numeric values of haemodynamic parameters are not applicable to every single patient. Patient-specific regular pulse and blood pressure values that ensure a bloodless surgical field are provided. This protocol usually maintains surgical comfort with little use of the aspirator and little swelling.

Dexmedetomidine and Propofol infusions are discontinued at the end of the first hour of surgery. Towards the end of the surgery, while the silicone splints are being placed, Nitrous Oxide and Desflurane are turned off. After a wash-out with 100% oxygen, 44% oxygen and 56% air is administered. Dexamethasone 8mg + Ondansetron 4 mg are administered intravenously.

Upon completion of the surgery, the mouth and stomach are aspirated with an 18 G green aspirator cannula before applying the bandages. Infusion of remifentanil is discontinued, and the body heating system is turned on.

Note: Under deep general anesthesia, right or left sided rotation of the head may assist with the placement of the orogastric catheter (Özgön Maneuver).

The patient may sometimes open the eyes upon contact with cold wet gauzes; if the patient can follow verbal directions, he or she can be extubated and given oxygen with a simple mask at 5-6 l/min. If the patient has not woken up at this stage, the team waits until the patient wakes up, which is usually in less than 15-20 minutes. A conscious patient with sufficient spontaneous breathing is kept on the operating table for 5 more minutes and then transferred to the post-operative recovery room.

CONCLUSIONS

Harmony between the anesthesia and surgery teams affects the surgical outcome. Multimodal analgesia and prophylaxis of nausea and vomiting with combined H1 + H2 receptor blockage, nitrous oxide supported desflurane anesthesia and TIVA at minimal doses are applied. Premedication is supported with an alpha 2 agonist. Sufficient analgesia and anesthesia are provided. Local anesthetic containing adrenaline is administered over more than 10 minutes in controlled doses. The cuff pressure of the intubation tube is monitored continuously with a manometer and kept at a certain level to prevent tracheal mucosal damage. The most important factors for a bloodless surgery are stable blood pressure, pulse and CO_2 parameters.

The patient rests in bed for the first post-operative hour. After an hour, the patient starts drinking water. If the patient does not have nausea, the patient starts an oral diet. The patient rests for another hour. If the patient has no complaints, the patient is made to sit and mobilize. If the patient feels comfortable, the IV line is removed. The patient is advised not to take alcohol or drive for 24 hours and taken to the transfer vehicle in a wheelchair.

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Postoperative Care in Preservation Rhinoplasty

Hüseyin Güner, Ç Meriç Erenoğlu, Erhan Coşkun

Care of the rhinoplasty patient starts with the first consultation and continues for many years. Establishing a good doctor-patient relationship must be based on clear communication and trust. Each aspect of the doctor-patient interaction is important from the consultation to the preoperative planning and throughout the perioperative period. Each step in the perioperative period from the operative day and night, the first week, the first month and throughout the first year are important and have different aspects. In this chapter, we will blend the general rhinoplasty literature with our own experience and practice in performing Preservation Rhinoplasty.

PREOPERATIVE PERIOD

Evaluation of the patient and nose

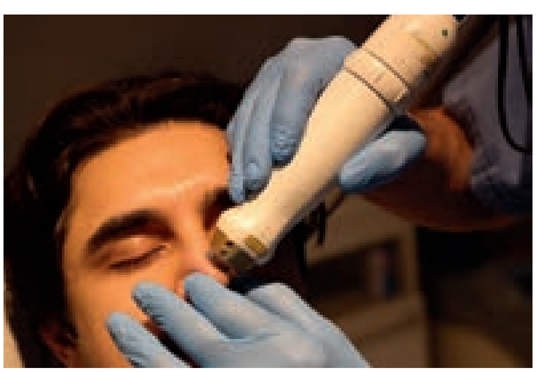
Every patient reacts different to rhinoplasty. Some swell and bruise a lot and some not at all despite a standard postoperative regime. Genetic factors contribute as well as environmental factors in determining how each patient responds. For example, bleeding tendency will render the patient vulnerable to postoperative edema and bruising. So, a good postoperative period starts with a good preoperative evaluation and management. Also, a nose with advanced deviation and with a long-expected operation time will have more swelling and bruising. Thick-skinned patients will have a prolonged time of edema, especially on the tip and supratip area. It is helpful to tell patients what is realistic to minimize subsequent distress. The process of surgery, postoperative period and details of postoperative care must be given to the patient a part of s a written content.

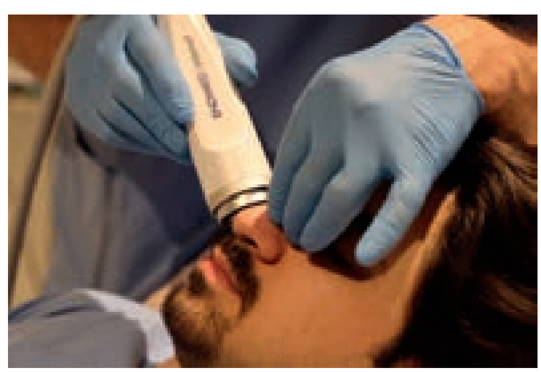
Despite little knowledge as to the actual effects of herbals on postoperative bleeding and bruising, we advise patients to stop all kinds of herbal teas, ginseng, gingko biloba, garlic tablets, fish oil and omega-3 one week before surgery. Avoidance of these herbal agents will reduce risk of intraoperative bleeding. We also advise patients to have a low-salt diet to reduce postoperative swelling.

According to our own experience, patients who were operated on during their menstrual period may experience more bleeding, bruising and swelling. When setting the surgery date, it may make sense to set a calendar according to the patient's period. However, it should be noted that this precaution is not taken for most breast surgeries as stress may alter the normal cycle. We recommend discontinuing preoperatively, all hormone medications such as oral contraceptives which can also increase edema and bruising. Again, many breast surgeons do not consider this a major risk factor

Skin Care

A simple skin care and herbal ointment massages will help to decrease the bacterial load of the nasal skin for one week before rhinoplasty. Especially in patients with thick and sebaceous skin, daily use of the ointment and cleansing the sebaceous pores helps with a comfortable healing period. Fractional 1540 nm Er:Glass, 1440 nm Nd:YAG lasers and needle radiofrequency applications are also useful for preconditioning the skin for operation, twice or three times (depending on the skin) with two week intervals.





In acneic type of skin, it might be useful to start isotretinoin treatment with the supervision of a dermatologist. Besides other factors, isotretinoin is not directly related to impaired wound healing (Heppt et al. 2018). It is necessary to discontinue the drug 2 weeks before surgery. In one case, the authors had to operate while the patient was on isotretinoin and there was no problem with wound healing, but the skin was extremely sensitive.

OPERATION

Indisputably the pre-operative condition of the nose (deviation, old fractures, necessity of grafts) will affect both the technique and the duration of the surgery. In our experience, subperichondrial and subperiosteal dissection and avoiding unnecessary dissections results in less swelling, bleeding and bruising.

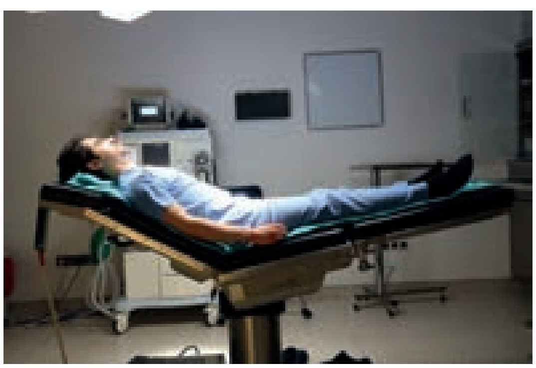
Importance of anesthesia

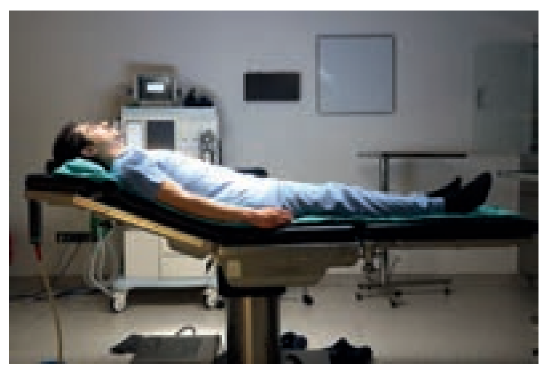
During surgery, we expect the anesthesiologist anesthesia to provide a mean arterial pressure of no more than 60-mm Hg. Remifentanil is known to provide a hypotensive anesthesia, a bloodless field and reduce postoperative swelling (Koşucu et al. 2014). Slow anesthesia induction and slow awakening is important for patient comfort. Aspiration of the gastric content with an orogastric catheter at the end of the operation is also helpful to prevent postoperative nausea and vomiting, especially in patients who have simultaneous extensive septal surgery. Dexamethasone administration, with or without tranexamic acid, is also shown to reduce postoperative edema (Mehdizadeh et al. 2018).

Position (Head elevated)

Patient positioning in rhinoplasty varies as some surgeons prefer operating while standing and some prefer sitting. In any setting, it is advised to provide head elevation.

Position in rhinoplasty can be in 15 degrees reverse Trendelenburg with head and legs elevated and blood accumulated in trunk or only head elevation. Both positions are acceptable while reverse Trendelenburg ("V" position) also protects from deep venous thrombosis (Agutter et al. 2012). Head elevation is helpful to reduce bleeding and swelling while providing a good position for the surgeon's (Nooraei et al. 2013; Ozkose et al. 2016).





Composition of the local anesthesia

We apply xylometazoline spray for vasoconstriction before the patient goes to sleep. Generally local anesthesia solution includes lidocaine, adrenaline and sodium bicarbonate. Our solution is a 10 cc mepivakain, 1 cc adrenaline 0.4 mg, and 10 cc serum physiologic. It is important to wait until the systemic blood pressure gets below 90 mmHg before we start injection in order to reduce induction of local anesthesia solution into the systemic circulation.

When the operation is finished, 1 cc local anesthesia is injected around the infraorbital nerve to provide painless awakening of the patient. It increases comfort in the immediate postoperative period.

Intranasal pads

Panthocaine and otrivin immersed pads are inserted into the nose both for vasoconstriction and pain control. They also help to prevent the surgical site blood to reach the stomach and induce postoperative nausea and vomiting. Using Pads with strings is important to avoid leaving them in the nose.

Ice-saline

Sterile saline “ice” can be kept on the table to apply cold compress intermittently during rhinoplasty. Washing may be done as well with cold water to provide mucosal vasoconstriction. This helps to reduce swelling and bleeding (Taskin et al. 2011).

Taping and Casting

Taping and Casting is done at the end of the surgery while the patient is still under general anesthesia and in a hypotensive state.

After all the dissections, there is a potential space between the tissues that will later cause inflammation, pain and edema. To minimize this, taping is important to apply a gentle pressure to compress the third space. Taping, before casting, is the first step to protect the final nose shape while reducing swelling, bruising and postoperative bleeding. Tapes extending under the eyes and malar fat pads will also reduce the periorbital bruising (Ozucer et al. 2016).

Casting in Preservation Rhinoplasty is different from the classical technique. While the aim of a cast in classical hump resection is to bring the bilateral bony walls closer, the cast in PR helps to hold the hump in its reduced position and to help reduce edema and bleeding. The cast should mainly be applied on the nasal bones, but we also place the cast gently over the nasal tip cartilages in order to prevent excessive tissue swelling.

Dorsal Preservation techniques sometimes require extensive dissection. A broad dissection may require maintaining the external splint for up to 10 days. Wide dissection of the mucosa of PPE may be required in the low septal strip technique. Dolyle silicone splints may not exert enough pressure on this area or it might be undesirable to put the silicone splint in this area as it can push the Rhinion point. The septal mucosa flaps are sutured together with loose approximation using 4/0 or 5/0 rapid Vicryl.

Drains placed in the lateral osteotomy lines are useful in reducing swelling. On the 4th day, they are taken out with the Doyle silicone splints.

POSTOPERATIVE PERIOD

Postoperative 2 Hours

After half an hour resting period in postoperative unit, the patient is transferred to his/her room. The room must be silent, dim and at normal temperature (22 C). There must be one companion and no more people in the room. The patient can eat and drink 2 hours after arriving in the room. An early mobilization is important, and the patient is mobilized when they feel good and have the energy to get up. Head position is elevated. The patient is asked to keep their head straight while resting and sleeping.

Control of Pain, Nausea and Vomiting

Intravenous paracetamol (up to 4 x 500 mg per day) and tramadol are given during this period for pain control. Tramadol is the second choice in pain control after paracetamol, which is used twice a day over a one-hour infusion. It is important to be careful with tramadol as it may cause hypotension. Many surgeons do not prefer NSAIDs especially after cases that bleed during surgery. The authors use NSAIDs if the pain is refractory to paracetamol or tramadol and in cases where bleeding is not expected. Among NSAIDs, dexketoprofen can be given twice a day (25 mg) with a proton pump inhibitor, to prevent gastric irritation.

For the rhinoplasty patient, intranasal discomfort, mouth breathing, nausea and vomiting may be as disturbing as pain. Extubation may cause pain and harshness in the throat, which usually ends in three days. Gargling with chlorhexidine and frequently drinking warm water helps to relieve the pain.

For nausea and vomiting, ondansetron (8 mg twice a day) or dimenhydrinate (50 mg twice a day) and dexamethasone (8 mg twice a day) combination is given to prevent nausea and vomiting (Kizilcik et al. 2017).

Antihistamines can reduce edema as they reduce the circulation of the mucosa.

Hospital Stay

It is the doctor and patient's decision to spend the night in the hospital or at home/hotel. The doctor often makes this decision depending on the extent and duration of the surgery as well as other factors. The night stay usually relieves the doctor and the patient, as there will be a professional attendant checking on the patient. Moistening creams are beneficial to prevent abrasion of upper and lower lips caused by mouth breathing and the comfort of the first night can be increased. Spontaneous nasal bleeding that needs one dressing change every hour is expected. The patient is informed that this much bleeding is considered normal.

Food and Drink

Oral intake is allowed two hours after operation. It is better to eat light and simple food in little amounts and frequently, we offer toast and tea,. A low-salt diet is given to reduce edema. Fatty foods and drinks must be avoided.

Ice Mask

An ice mask is applied every hour for ten minutes until the patient sleeps for the night. It is better not to insist on ice masking if the patient does not tolerate it. We continue masking the same way until the end of second postoperative day.

Discharge

In the morning after surgery, the patient is discharged unless a contrary situation is present. Ocean spray is given for 5-10 times a day to clean the inner nose and moistening cream is given to apply to the incisions. With preoperative antibiotic prophylaxis, there is no need to use antibiotics after surgery. It is important to comply with the rules of sterility in surgery, to keep tissue damage to a minimum and to prevent infection.

We prescribe oral antibiotics (penicillin or macrolides depending on allergy) for 5 days for secondary cases because of cartilage grafting. We use paracetamol for pain, decongestant (usually acrivastine and pseudoephedrine combination) and bromelain, which is known to reduce postoperative swelling (Inchingolo et al. 2012).

The First 10 days

Most surgeons want head elevation for the first three days without turning the head to side. C-shaped soft pillows help to fix the head and neck in position and comfort the patient. The senior author of the chapter believes that with a meticulous surgery and proper taping, patients may go back to their normal laying position in 48 hours.

Doyle splints and drains are removed on the 3-4 postoperative day. The removal is easier if the nostrils and inner nose is well cleansed with ocean spray. A moistening cream can be applied to the inner nose and the incisions with Q-tips, causes the crusts to soften and be rinsed away with spray.

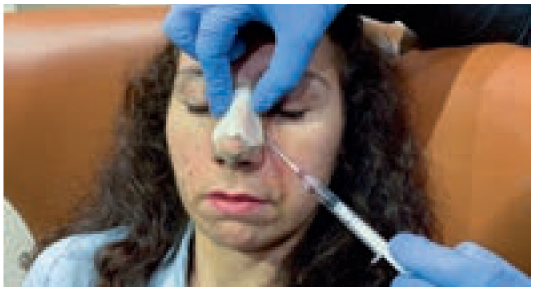
We can also mention that if the surgeon performed wide dissection, then the cast may stay for ten days. It is our general consensus that removing the cast on the seventh day, leads to another swelling period on the nose for 4-5 days. When we keep the cast for ten days in most patients, we do not need to tape again. If there is severe edema, tapes can used for 4-5 days.

The cast is removed on the 7-10 day. It is better to take the time to gently remove the cast rather than pull the skin from the skeleton. Alcohol cleansing is useful to remove the adhesives on the nasal skin. Some patient's nasal mucosa may swell which may push the dorsum back up. Sometimes an external pressure is needed on the key stone after cast removal.

After cast removal, patients may use arnica cream for fast recovery from bruising. 50-factor sun protection is advised to prevent permanent hyperpigmentation in the periorbital skin. A combination of bromelaine (600 mg), vitamin C (200 mg) and quercetin (80 mg) twice a day will help in the early control of prolonged edema.

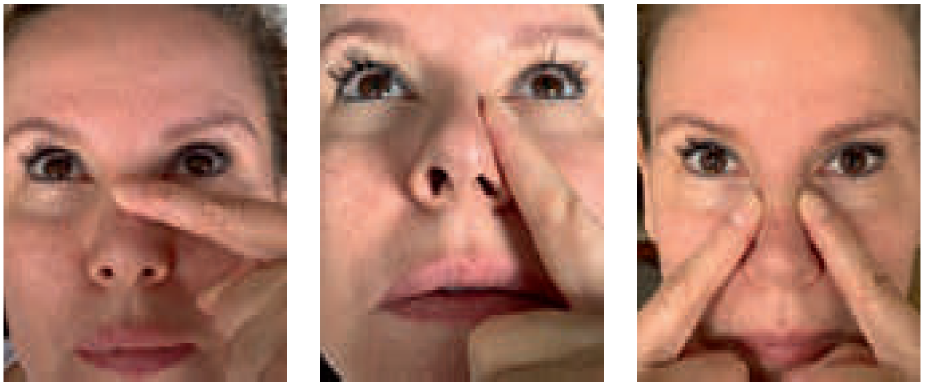
Patient may get back to work by the second week if their job does not necessitate being physically active. We allow sports gradually, first mild walking and then more active exercise after the first month.

Rarely hematoma can be seen on the patients in whom wide dissection was done. Veins arising from nasal bones may cause hematoma formation. When the cast is removed, the nose may appear more swollen than usual. On physical examination, accumulated mobile fluid can be felt easily with finger palpation. This hematoma can be removed with a 21 gouge 2cc syringe. The tip of the needle is held against the bone while the fluid is pushed gently by fingers towards the needle for drainage. Tapes are applied to the nose for at least five days. Although very rare, one should always check the septum for hematoma under the septal mucoperichondrial flaps.



The First Month

If we have corrected a significant deviation, because of the cartilage and soft tissue memory, the nose wants to go back to its prior position. To prevent this, we start massaging against the deviation side at the end of first or second week.

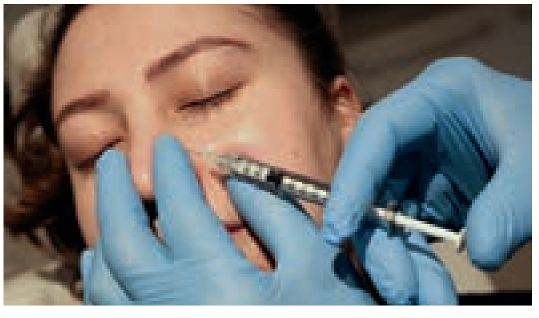


We teach the patient massaging technique to provide straight axis, edema management and prevent nasal bone widening. Massage also helps to prevent hump recurrence, which is the mostly seen complication of dorsal preservation rhinoplasty. The patient is told to continue nasal massaging with herbal ointment three times a day for five minutes in the first month.

Most of the edema resolves in the first month whereas there is still additional time required for nose to settle. This observation is valid for DP even if dorsal edema is less compared to classical hump resection.

1 to 6 Months

This period is when the nasal shape establishes. Any irregularities and errors show themselves during this period. We see the need for revisions at this time, but we do not revise before 6 months and usually only after 12 months. The tip and supratip region are the last to shrink, especially in thick-skinned patients. To enhance this, we use fractional laser and needle radiofrequency. Although we did not see any study regarding this topic, we have been utilizing fractional ablative and non-ablative lasers and needle radiofrequency technologies to manage long-term edema and provide further skin contraction and adaptation. We had the inspiration for this application of energy-based treatment from managing rhinophyma patients (Fink et al. 2018). We prefer needle radiofrequency and ablative fractional carbon dioxide laser combination for thick sebaceous skin type with big pores and needle radiofrequency and non-ablative fractional 1540 laser for middle-thickness skin types. Professional skin care with pore cleansing is also helpful. There is usually no need for additional thinning management for thin-skinned patients. In persistent local irregularities or skin bumps we administer 0.1 cc of triamcinolone acetate mixed with 0.1 cc lidocaine to reduce the subcutaneous thickening and especially in polly-beak deformity caused by persistent supratip edema (Hussein & Foda 2016). This must be done carefully as it might cause excessive collapse of a larger area on the nasal skin. Any additional injections may be done at 3-4 week intervals.



6 to 12 Months

At the end of the sixth month, nasal shape is almost totally clear. The tip may still change a little due to supratip edema and loss of rotation. Any decisions on revision are performed at this time or small corrections with hyaluronic acid fillers may be done. Firstly, 1 cc of adrenaline local anesthetic is applied for the filling. Wait 10-15 minutes. This process makes vasoconstriction and minimal dissection for filling. Cannula application is preferred.

Further Years

Rhinoplasty patient may come after the first year, with some complaints, but hopefully with compliments or a friend requesting a rhinoplasty. If they present with complaints, it is important to listen to their concerns and listen to their expectations. If possible, revisions are done to make the patient happy and they also serve as a learning opportunity for the astute surgeon. One must always take the time to learn from our patients as it will always take us a step further in our rhinoplasty career and help our reputation as a caring physician.

CONCLUSION

Postoperative management of rhinoplasty patients is of critical importance in achieving the desired outcome for both patient and surgeon. Postoperative management for the Preservation Rhinoplasty patient really begins with the initial consultation setting realistic expectations followed by in-depth question and answers during the preoperative visit. The patient must be provided with detail instructions that cover the entire perioperative period. Most surgeons, and their office staff, can usually tell which patients had a Dorsal Preservation procedure versus a resection rhinoplasty as they have less bruising and edema in the immediate postoperative period. However, certain procedures do require special attention with treatment of a crooked nose using a DP technique may necessitate special postoperative care to prevent reoccurrence of the deviation. Rather than a dramatic difference from the standard of care for a reduction rhinoplasty procedure, preservation rhinoplasty requires a greater attention to detail and finesse. Most patients will look better sooner and be happier in the early postoperative period following a dorsal preservation procedure.

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Revisions Following Dorsal Preservation Rhinoplasties

Yves Saban, Sylvie De Salvador, Roberto Polselli

It has been 3 years since our publication reassessing dorsal preservation (Saban, 2018) and Daniel's call for a "Rhinoplasty Revolution" (Daniel, 2018). The time has now come to assess the indications and potential complications of these procedures. Our first article was designed to remind the rhinoplasty world that there were other options in lowering and fine tuning the dorsal profile besides dorsal resection and structure rhinoplasty. It was equally important to summarize our 20 year experience with dorsal preservation and to help in better understanding the philosophy of preserving the nasal structures. The main objective of this chapter is to present and analyze the author's experience and revisions in 352 consecutive primary rhinoplasties operated in a 3 year-period from June 2016 to June 2019. Based on our analysis of 35 revisions we will suggest a classification of dorsal profiles and discuss the decision-making process for selecting the optimal surgical procedure.

INTRODUCTION

Due to the fast-growing interest in preservation rhinoplasty, it is necessary that the present chapter focus on risks and revisions. Therefore, a retrospective analysis has been done which has allowed the senior author (YS) to understand the reasons for his own personal failures as well as for the good results. At the present time, a few excellent papers have been published relating to revisions in dorsal preservation surgery (Tuncel 2019, 2020), functional results (Ferreira, 2016), and complications (see East chapter).

CONCERNS & REVISIONS AFTER DORSAL PRESERVATION RHINOPLASTY

The objective for this chapter is to focus on specific concerns after DP leading to surgical revisions in the author's daily practice and not to make an exhaustive analysis of all the problems that can occur following a rhinoplasty. The fundamental question regarding these revisions, including both "high strip" and classic Cottle procedure, is to understand the underlying mechanisms causing these failures and to suggest ways to prevent them.

To get an element of comparison with the "traditional rhinoplasty techniques", one should review Yu's study of 104 patients who underwent classic reduction rhinoplasty and then sought secondary surgery (Yu, 2013) They stated that 62% of patients experienced nasal obstruction and its functional consequences with 71% having objective intranasal findings conducive to nasal obstruction. The most common reason for seeking a secondary procedure was tip deformity (57%) with functional issues in second place. Interestingly, the crooked middle third was the second most common morphologic deformity (44%), while upper third irregularities (36%) were the third most common. However, these authors did not give precise data as regards inverted-V deformity and a polly-beak appearance which can be due to dorsal saddling interpreted as an illusion of an over projected. NOTE: this chapter deals with one surgeon's *revisions* of his own primaries rather than *secondary* cases which are cases whose primary was done by another surgeon.

CLINICAL CLASSIFICATION OF DORSAL NASAL ANATOMY

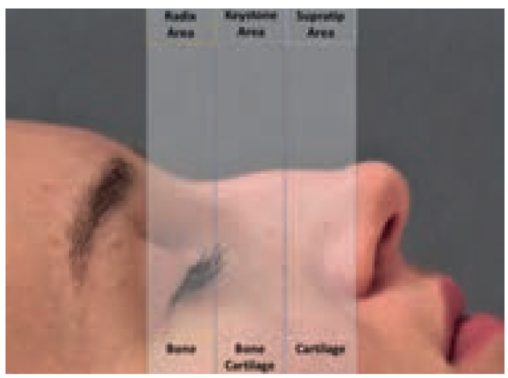
Anatomical knowledge is a basic requirement for performing surgical procedures. Regarding rhinoplasty procedures, anatomy can be divided into 3 parts: nasal morphology, surgical anatomy, and biomechanical factors. Morphological assessment of the nose is an important part of the clinical examination and differs from surgical anatomy. In contrast to resection rhinoplasty, the primary question in dorsal preservation is: how can I lower the dorsum while preserving the external framework? The question is more than "hump" removal" – how do we keep the dorsum intact! Consequently, the classic surgical anatomy classification is not that helpful preoperatively in preservation rhinoplasty as it corresponds to the techniques used for dorsal resection. An example of a classic resection is a *"hump removal"* which is simply measured preoperatively, then resected intraoperatively followed by midvault reconstruction. In contrast, the critical question in DP is how to deal with the entire dorsum. For example, a "Greek" nasal profile is high and straight, without any hump, but how do we lower the dorsum and radix? Another example, is an isolated hump at the keystone area associated with a low radix and a pseudo-saddle middle third deformity which is a challenge for the "preservers."

Recently, many papers and books have been published explaining the surgical anatomy of the nose (Saban 2008, Daniel & Palhazi, 2018) as well as the dynamics of the anatomical-surgical interplay. Expanded knowledge of the nasal SMAS and ligament as well as concepts of nasal compartments are leading to a segmental analysis of the nose which corresponds to surgical steps focused on specific areas. Recent anatomical dissections and ultrasound studies have emphasized the role of the soft tissue envelope in rhinoplasty and how it can influence the shape, volume, and orientation of the underlying bony-cartilaginous framework (Kosins, 2017).

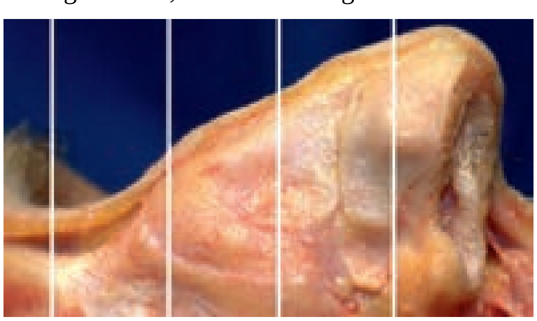
SEGMENTAL ANALYSIS OF NASAL DORSUM

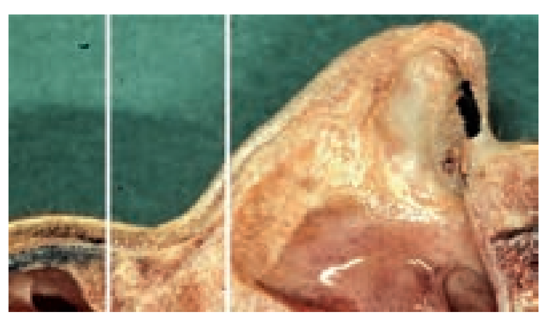
Dorsal analysis is based on the relationships between 3 nasal dorsal segments: radix, keystone area (hereafter KA), and supratip. Variations of the *nasal bones* and pyriform aperture were described more than a century ago by anatomists and anthropologists. Recently, the shape of the nasal bones has been classified and used to explain some surgical procedures of the nasal hump (Lazovic, 2015). V or S shape nasal bones can influence the appearance of the radix and the dorsum. The pyriform aperture width preoperative assessment has been stressed (Saban,2002) mostly in leptorrhine or even stenorrhine patients. The junction between nasal bones and upper lateral cartilages (hereafter ULC) was termed the *keystone area* (KA) by Cottle (Cottle, 1954). It is composed of a bony-cartilaginous overlap in the form of a chondro-osseous joint. The dorsal part is called the “bony cap” where the nasal bones overlap the cartilaginous septum. The KA can be subdivided into a Dorsal Keystone Area (hereafter DKA) and a Lateral Keystone Area (hereafter LKA) (Pallhazi, 2015). (3) The *supratip area* of the cartilaginous dorsum can be designated as the “W-ASA” segment and is the free dorsal portion of the septum caudal to the ULC attachments. The “W-point” corresponds to the division of ULC’s from the septum while the ASA is the anterior septal angle. Finally, tip projection is of great importance in the nasal profile.

The 3 dorsal segments of the profile line are clearly seen in this female patient requesting a rhinoplasty.



On the left below, an anatomic dissection demonstrates the nasal components: the frontal processes of the maxillae, the nasal bones joining in the midline and forming the radix; the DKA and LKA connection of the nasal bones and wide ULCs. On the right below, an anatomic sagittal section through the midline revealing the bony block at the radix.





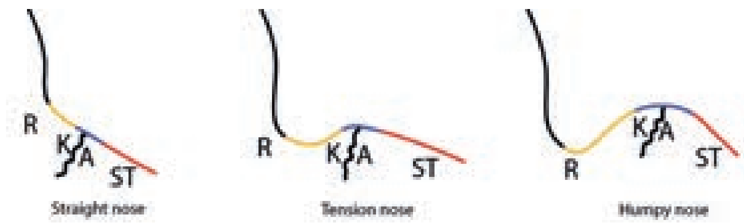
Radix height can be normal, high or deep. The radix is in reality a complex bony structure involving 4 different bones covered by thick superficial soft tissue envelope consisting of 2 fat compartments sandwiching the procerus muscle.

The keystone area may be straight or convex; It corresponds to the bony-cartilaginous overlap related to the bony cap (Palhazi, 2015) and the cephalic part of ULCs. The DKA is a cranial extension of the ULC and is covered by a thin mainly aponeurotic STE. The height of the K-A deserves a special analysis as it is a key decision-making entity. Depending on the "ideal profile line," this height may vary greatly and helps to determine the surgical options. Preserving a dorsum with a 3 mm hump does not generate the same concerns as a 13 mm height hump. The hump is not the more the visible part of the iceberg, it is THE iceberg!

The supratip segment may be straight or convex. The septal W-ASA cartilaginous framework is covered by thick STE corresponding to SMAS extensions and deep Pitanguy ligament (Saban 2008).

CLASSIFICATION OF THE DORSUM FOLLOWING SEGMENTAL ANALYSIS OF THE PROFILE LINE

The relationship between these 3 areas directly influence the appearance of the nasal dorsal profile line. Radix/KA/Supratip segment shapes will form the general shape of the dorsum by following these various combinations:



Straight dorsum	Straight/ Straight/Straight
Tension noses	Convex/ Straight/Straight
Humpy dorsum (or Kyphotic Nose)	Convex/ Convex /Straight
"W-Profiles"	Straight/Convex/Convex

However, the soft tissue envelope thickness can make the nose look straight, even when the underlying bony-cartilaginous framework is convex. This STE thickness is encountered in the supratip scroll area and radix while the STE covering of the KA is extremely thin.

Tip position is critical in analyzing the shape of the dorsal profile line. In most patients, the radix and subnasale lie in approximately the same vertical facial plane. A prominent premaxilla or anterior nasal spine gives the visual appearance of tip over projection. Dorsal preservation in these patients can create an over projected nose or a pseudo-saddling of the middle third/supratip area. Patients with deep radix may benefit from grafting and/or reducing the dorsum more caudally than cephalically (Kosins, 2019). Conversely, retrusion of the maxilla and absence of anterior nasal spine as occurs in Binder's syndrome creates loss of tip support with columella retrusion. Surgical procedures must address the anterior septum and anterior nasal spine/premaxilla. Adapting the dorsum to this kind of tip would inevitably lead to an excessive dorsal reduction. Thus, the surgeon must be aware of this risk and plan to improve tip support and projection using structural techniques. This deformity is quite common in Mestizo and Mediterranean noses.

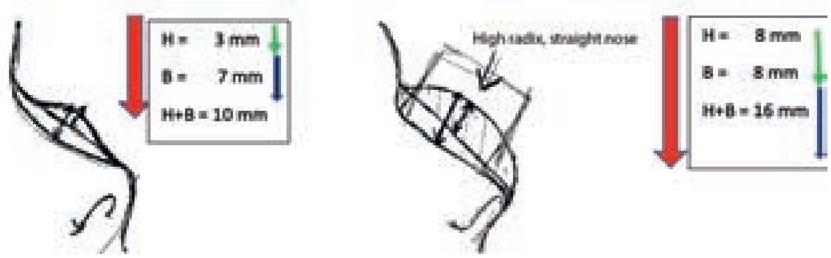
"ICEBERG HUMP" IN DORSAL PRESERVATION

When looking at a dorsal profile, the hump often appears as a bump on the dorsal profile line. So, it seems obvious that the surgeon should just remove the bump ("bumpectomy") to obtain a straight dorsum. In resection rhinoplasty, nasal humps are often considered easy to remove. Conversely, in DP the problem is more complex as the work will be done on the underlying structures. The convex hump may be difficult to straighten and in some cases of severe convexity alternative surgical options must be considered.

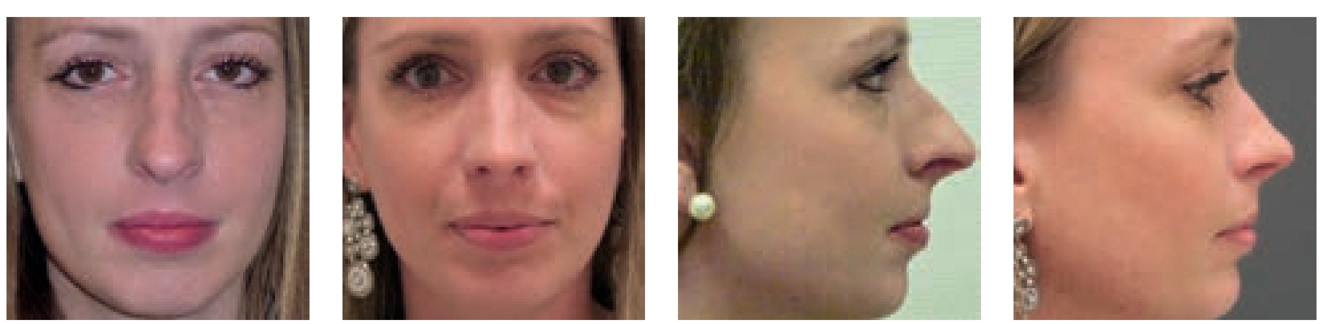
To make it even more challenging, flattening a hump and lowering a dorsum consists of a double action which leads us to the concept of the *iceberg hump*. Sometimes, the hump is just a small fragment ("growler") that can be rasped, or a big one "largeberg" creating greater surgical challenges and in some cases a "Titanicberg" requiring more than one procedure

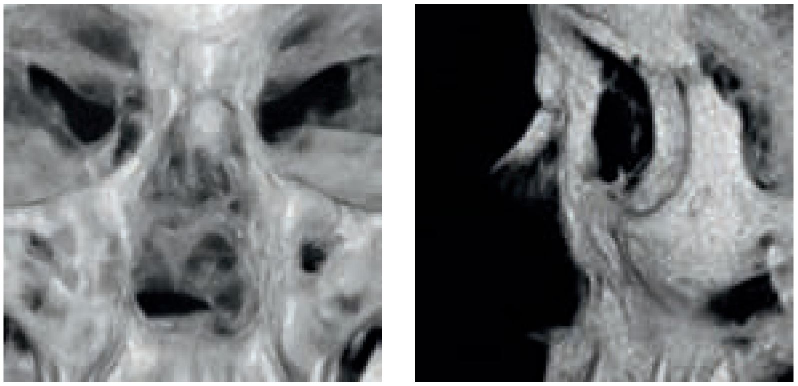
Computer simulations are very helpful in tracking down these "nosebergs" and to allow precise measurements of the dorsal height reduction to be surgically achieved.

Concept of "Iceberg hump": examples of 2 opposite clinical situations (H= hump height; B= base height).



In case of "W-Nose", the "growler" small bump can be reshaped. However, to fit the patient's expectations, a complementary reduction will be mandatory, and the DP procedure will need to lower the dorsum in a conservative way. The case below shows a dissatisfied patient seeking revision, not for a small residual hump, but for body dysmorphia concerns (17m.PO). This 30 year old female presented with an over projected nose, very thin skin, large nostrils and underwent a primary endonasal DP procedure, tip surgery, alar base reduction. No revision surgery was performed despite the patient's relentless pressure. Rather, a strict and frequent follow-up eventually convinced her that the result was satisfactory. It is important to maintain the patient's confidence. It is interesting to point out that the hump appearance is related to the supratip segment that was already convex preoperatively, and underestimated intraoperatively, which led to this pseudo-saddle deformity with an associated small residual hump. Although it could be easily overcome by a revision rhinoplasty, the psychological concern represented a contra-indication.





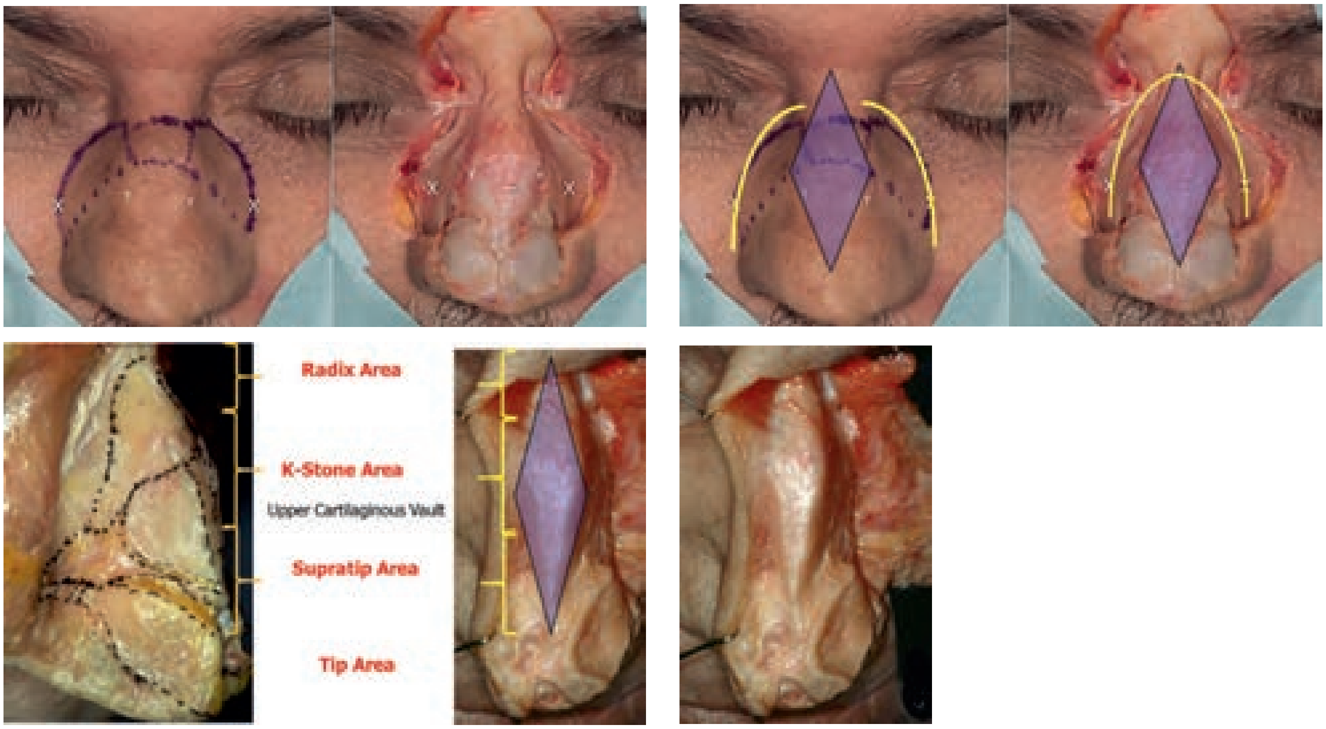
In the case of a “Titanicberg,” the goal will be not only to reduce the hump but also to lower the entire nose. Thus, the surgeon must not only reduce the height of the hump, but also the dorsum itself. The whole iceberg is too high and thus the combine deformity must be corrected thus adding the deep structure to the visible part. The new height requires reduction of the *“hump + base”* which can double the size of the reduction. This concept must be taken into account in planning the final reduction. This patient underwent a primary endonasal hybrid reduction technique with bony cap resection followed by disarticulation and lowering of the intact cartilaginous vault. The patient is quite satisfied with the final result and feels that any residual small bump gives the nose a natural appearance.

FRONT VIEW ANALYSIS

In front view, the width of the nose must be analyzed not only as to the dorsal aesthetic lines but also at the bony base as well. The narrow bony-cartilaginous dorsum and the mainly cartilaginous nose are at high risk of collapse in classic resection techniques. Narrow bony bases that are seen in case of leptorrhine patients with Stenorhinia must be assessed before the surgery to avoid postoperative nasal obstruction related to an extremely narrow pyriform aperture (Saban, 2002).

Conversely, dorsal aesthetic lines can be too wide in broad convex noses, post-traumatic noses, and ethnic noses. Many times, these broad noses may have normal profile lines as if the nose had grown in width rather than in height.

Anatomic dissection can be seen below (upper ones courtesy of Dr Palhazi). Wide basal lines are called “nasal parenthesis” by Jankowski (Jankowski, 2016). Anatomic dissection of the nose shows that dorsal lines are determined by the bony-cartilaginous framework and are not parallel but fusiform. The overlying soft tissues, thicker at the radix and supratip, are responsible for the appearance of brow-tip parallel lines. This fusiform natural shape should logically be the appearance of the nasal framework at the end of the rhinoplasty procedure and lead to a natural dorsum in the postoperative period. However, sometimes these lines may be distorted and appear too broad, leading to surgical reshaping. Generally, a 10 mm dorsal width is the maximum.



MORPHOLOGICAL CLASSIFICATION OF DORSAL PROFILE LINES IN A 352 PATIENT SERIES

Following this classification of 4 main morphotypes, an evaluation has been performed to check its clinical value. Out of 352 patients who underwent a primary septorhinoplasty, an evaluation of the nasal dorsal profile has been performed separately by the main author and another PHD non-MD. Then, the results have been compared between the 2 assessments and a few differences have been noticed.

Regarding the straight noses there was no significant difference which means that this type of profile is easy to identify, even by nonprofessionals (36.65 % vs 38.20%). However, some differences have been found in the other nasal morphotypes, showing the difficulty to differentiate between tension nose and humpy kyphotic nose for non-professionals.

APPLIED SURGICAL BIOMECHANICAL ANATOMY: AVOIDING REVISIONS

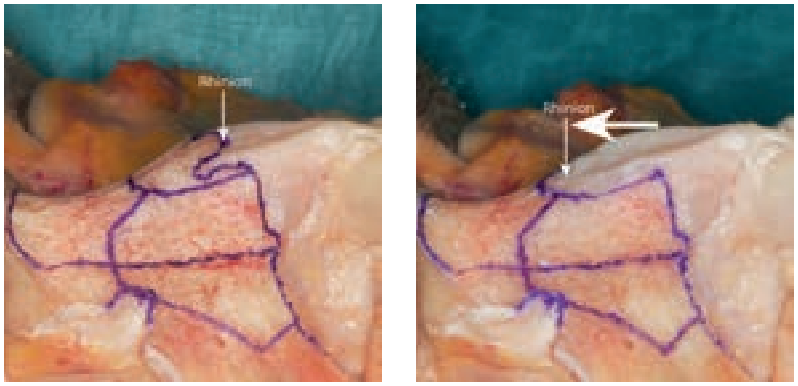
The study of biomechanical surgical anatomy allows for better understanding of how surgical procedures can affect the profile line and how surgical structural modifications can influence the global framework.

Preservation per se is not able to modify the shape of the bones (weak point), particularly those that are strong and rigid. Thus, it is unable to straighten nasal bones and strong or wide cartilages which leads to bony reshaping or partial resection. Conversely, it allows for cartilage remodeling or plication and make revisions simple (strong points). Therefore, preservation is a perfect procedure for straight noses, cartilaginous noses, nice dorsal lines, and internal nasal valve protection. On the contrary, resection techniques with or without reconstruction allow for removing the deformities (strong point) but weaken the dorsal lines and nasal valve (weak points), thus requiring specific procedures to restructure those areas. This is the rationale for procedures mixing preservation and structure.

BIOMECHANICS OF DORSAL REDUCTION: VECTORS/PIVOT-POINT/HINGE/ RHINION-SHIFT

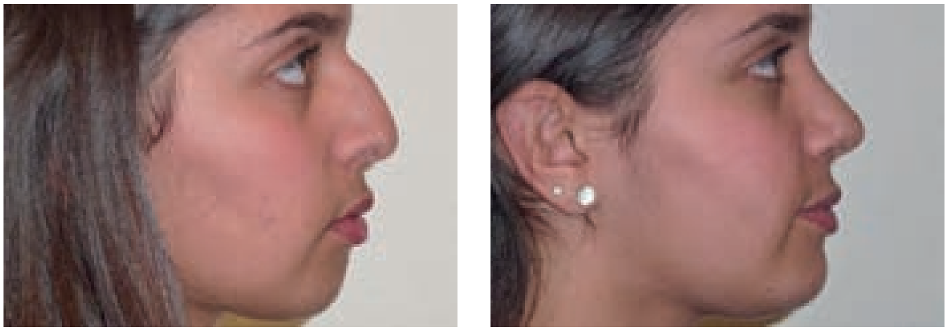
In patients with a straight dorsum, the classic resection procedures may lead to the destruction of a natural dorsum - anatomically, aesthetically, and functionally. In contrast, a preservation procedure leads to conservation of these lines and function. Let us think in term of vectors and pivot point leading to the concept of hinge and rhinion-shift. The diagram below explains the form of subdorsal strip resection, pivot points, and vectors. Depending on the radix height, the shape of dorsal mobilization will be oriented following 3 options. 1) radix lowering, hinge on ASA that will be a pivot point (below, left), 2) uniform global lowering (below, center), or 3) ASA lowering, hinge on the radix that will be a pivot point (below, right). Conversely, in patients presenting with a "W-profile" or challenging dorsum, preservation procedures are often unable to achieve e nice dorsum with attractive aesthetic lines. In these patients, resection with or without reconstruction is essential and offers the best possible outcome.

Concept of "*rhinion-shift*". When nasal bones are S-shape, they need to be reshaped and made straight. Considering the height of this convexity and the shape of the cartilage vault underneath the KA, the need for reshaping may require either a cartilaginous lowering or a partial resection of the ULC. In case of tension nose with a "gentle" convexity (less than 2-3 mm), simple reshaping allows for alignment of the bony dorsum onto the straight cartilaginous dorsum leading to a straight appearance of the profile line. This change can be achieved through simple rasping (classification 2-A ; humps < 2 mm) or bony cap resection (classification 2-B; humps 2-4 mm). Moreover, rasping or removing the bony cap allows the rhinion, ie pivot point of the DKA junction to shift cephalically and to allow flattening or even curving of the dorsal profile line. This process is termed "rhinion-shift" (see figure below, courtesy of Dr. Palhazi)



Male patient with tension nose. Before and after DP rhinoplasty including bony cap resection and “rhinion-shift”.

Female patient with humpy kyphotic nose who underwent bony resection, lateral, medial oblique and transverse osteotomies, and cartilaginous push-down following DKA-LKA disarticulation.



In case of “big convex” kyphotic noses, a nice dorsal profile is often not possible simply by bony reshaping as the underlying ULC has a strong convexity as well. In these cases, resection of the convex bony dorsum may be necessary. Subsequently, the decision to preserve or resect the cartilaginous DKA becomes critical. Resection of the nasal bones may lead to an open-roof deformity that requires classic osteotomies.

At this point, the surgeon faces 2 options: either the DKA-ULCs can be adapted to the desired nasal profile by preserving the cartilaginous vault, or the need for further cartilaginous resection becomes necessary. I start by trying to keep the cartilaginous vault intact and determine if it can if it can be lowered. If that is not possible then the following two options must be considered.

1) Lowering the cartilaginous profile requires a significant strip height resection which creates a true widening of the cartilaginous vault and lateral resistance in the LKA area which in turn requires full LKA disarticulation. Why is the high strip procedure challenging in this specific deformity? The cartilaginous vault segment becomes less controllable thus resulting in intraoperative challenges and postoperative issues related to displacement/ distortions with a high revision rate. In our experience, sufficient correction can be achieved, but requires additional fixation-stabilization by sutures.

2) In these cases, the Cottle procedure (“low strip”) should be considered as it more reliable than the high strip procedure for dorsal stabilization. Advocates of the procedure include Ishida, Jankowski and more recently by Finocchi (see Chapt SPQR). Keeping intact the attachments between the septum and the cartilaginous vault creates a “septal quadrangular cartilage flap” which gives stability to the cartilaginous framework.

3) The last option would be to resect the DKA together with the bony cap, keeping intact the caudal half of the cartilaginous vault and subsequently, the internal nasal valve area and the W-ASA segment. This option of removing the cephalic hump works very well and corresponds to many classic procedures. It may be considered as part of dorsal preservation procedure because it preserves the lower third of ULCs and subsequently the internal nasal valve, as well as the cephalic part of the nasal bones. It requires adjunctive procedures to close the roof: cartilage paste, bony dust, osteotomies, lateral bony rasping or cartilage shaving to smooth the edges depending on the size of the open bony roof.

FUNCTIONAL CONCERNS

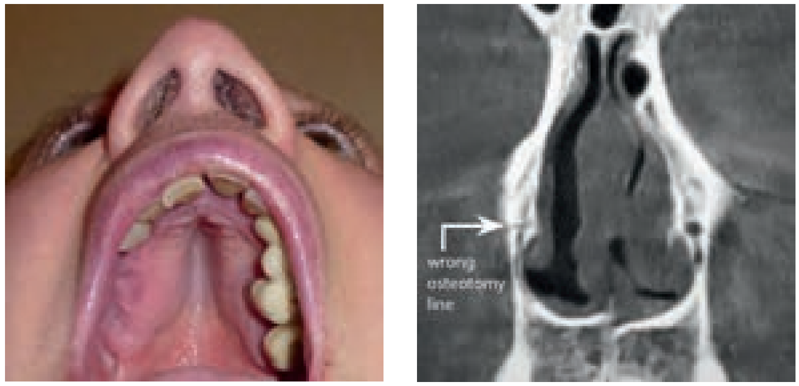
Following rhinoplasty surgery, there is a certain morbidity the does not lead to revision surgery (see chapter on Complications by East). Early postoperative nasal obstruction is most often due to postoperative swelling of the inner lining and inferior turbinates. However, it usually disappears within 3 months after appropriate therapy. In a very few patients (4 patients), postoperative anosmia was reported, but most of them recovered within 3 months. In 2 cases, anosmia improved to a form of hyposmia that lasted for more than 1 year. The pathophysiology of this concern deserves to be analyzed. A portion of the anosmia can be related to persistent nasal obstruction.

Mechanisms including the extent of perpendicular plate of ethmoid mobilization during the rhinoplasty procedure. Also, middle turbinate enlargement that is not easy to identify in the postop period with subsequent blockage of the superior nasal olfactory compartment? Subdorsal subperiosteal septal undermining going too cephalic into the cribriform plate? Aggressive maneuvers during the bony pyramid push down which pulls the perpendicular plate downward? However, no patient reported a CSF leak following DP surgery. In the 4 cases complaining of anosmia, CBCT was performed and there were no issue in the olfactory tract or skull base.

Stenorhinia

Stenorhinia is excessive pyriform aperture narrowing. It has been found preoperatively in 2.8% of our patients. Stenorhinia must be assessed before any septorhinoplasty procedure, even in patients who are not complaining of nasal obstruction (Saban, 2009).

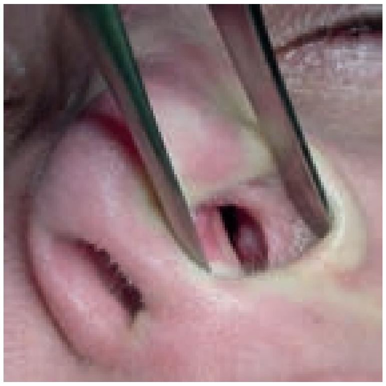
As seen below left, a leptorrhine patient with stenorhinia, a high hard palate (“cathedral palate”), and endomaxillary dysmorphia. Intranasal findings showed a narrow airway passage and cone beam analysis on horizontal cross sections showed attachment of the inferior conchal bone on the frontal process of the maxilla. The photo below right shows a too high osteotomy line in a secondary patient with postoperative stenorhinia.

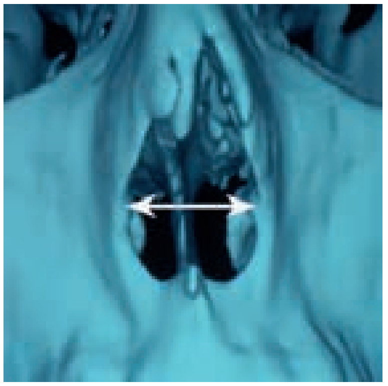


Stenorhinia in patient seeking rhinoplasty.

Intraoperative prevention or postoperative surgical revision of stenorhinia is easy to perform. Through a limited endonasal approach in the pyriform aperture, similar to the lateral osteotomy incision, a subperiosteal elevation of the outer and inner periosteum is performed up to the bony insertion of the head of the inferior turbinate. Then, bony resection of the head of the conchal bone together with a wedge resection of the frontal process of the maxilla is done, in the same way that it is performed in the let-down procedure. Then, after out-fracture of the inferior turbinate, nasal silicone splints are inserted for a 3 to 8 days period to keep the passage open. Pieyre (Pieyre, 1972) was the first to emphasize this clinical problem. Pyriform Aperture enlargement is seen below via an endobuccal approach. The bony head of the inferior turbinate must be resected together with a wedge of the frontal process of the maxilla.

The Push Down procedure has been accused of causing pyriform aperture narrowing. In practice, DP does not cause more pyriform narrowing than the classic in-fracture. Moreover, precise preop evaluation should take into account the pyriform aperture width together with the dorsal height lowering. In those cases requiring more than 5-6 mm of dorsal height reduction, then a Let Down procedure with lateral bony wedge resection is preferred. In cases of leptorrhinia, the bony head of the inferior turbinate is resected. The cases seen below has stenorhinia in which the patient sought functional revision after a traditional primary rhinoplasty.





Inferior turbinate enlargement

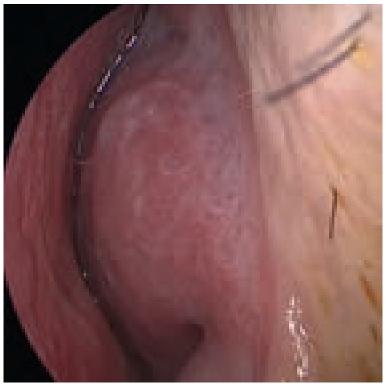
Patients may require systematic intraoperative reduction of the inferior turbinate following various procedures depending upon their anatomy. In our series, 4 patients complained of nasal obstruction persisting longer that 3 months and revision turbinoplasty was done. Based on an experience of over 20,000 endonasal procedures, surgical anatomy of the inferior turbinates is best described as 3 segments: head/body/tail.

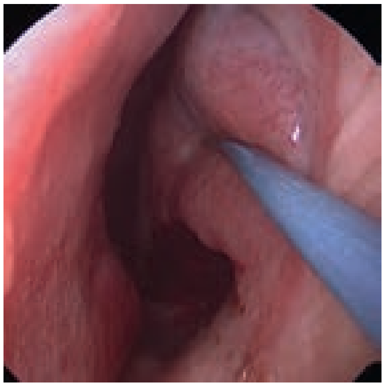
Anatomical structures relevant structures to the inferior turbinates include the following: *head* (mucosa, frontal process of the maxilla, compact bone); *body* (mucosa, conchal bone, inferior meatus, maxillary sinus medial wall, lamellar bones); and *tail* (mucosa, vertical palatine process, compact bone).

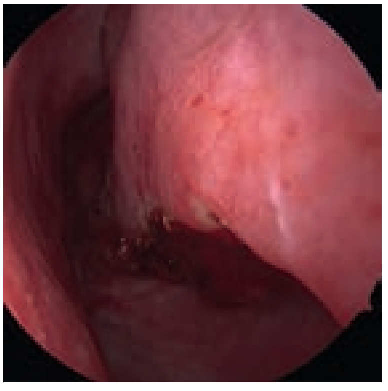
Surgical Turbinoplasties of the Inferior Turbinates – Segmental Classification of the Procedures:

- Head – Cautery of the Mucosa, Pyriform Aperture Wedge Resection
- Body – Surgical Bony and/or Mucosal Resection, Out-fracture, Mucosal Cautery
- Tail – Mucosal Excess Resection and/or Cautery

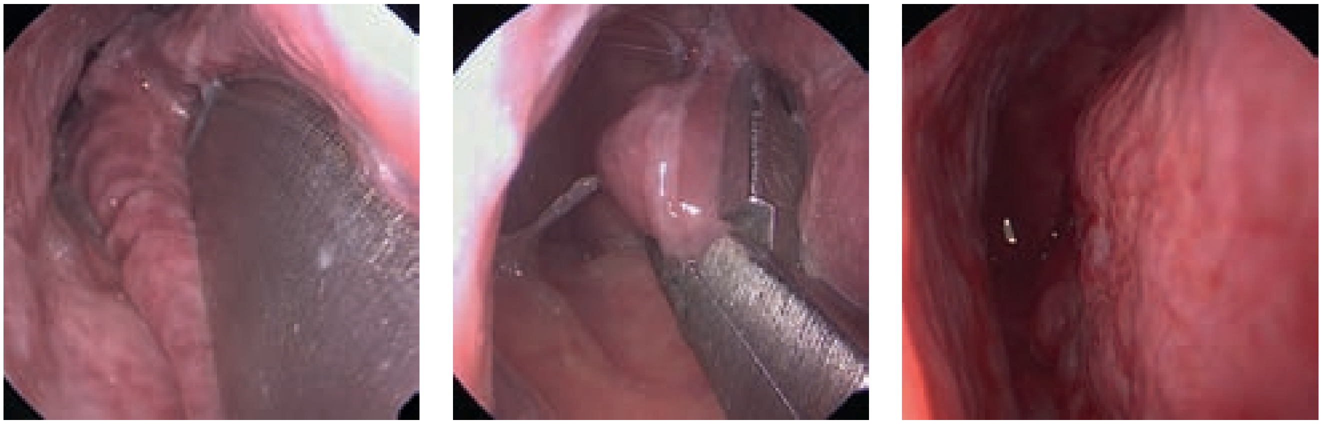
Reduction of an obstructive head of the left inferior turbinate:



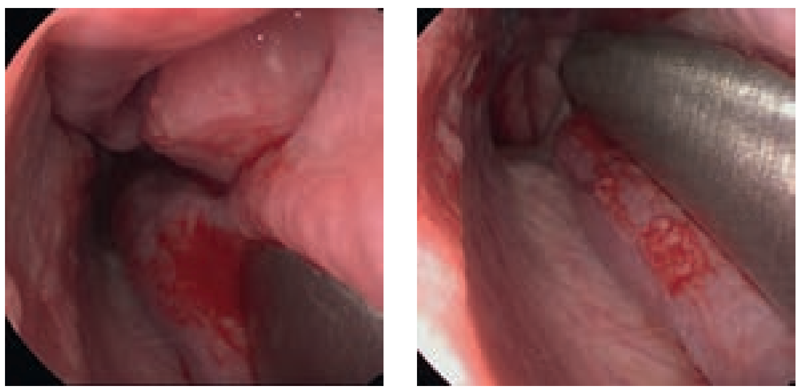




Reduction of the tail of an obstructive left inferior turbinate:



Outfracture of the body of an obstructive left inferior turbinate:



Resection of the lateral part of a left concha bullosa of the middle turbinate in a deviated nose:

Residual septal deviation

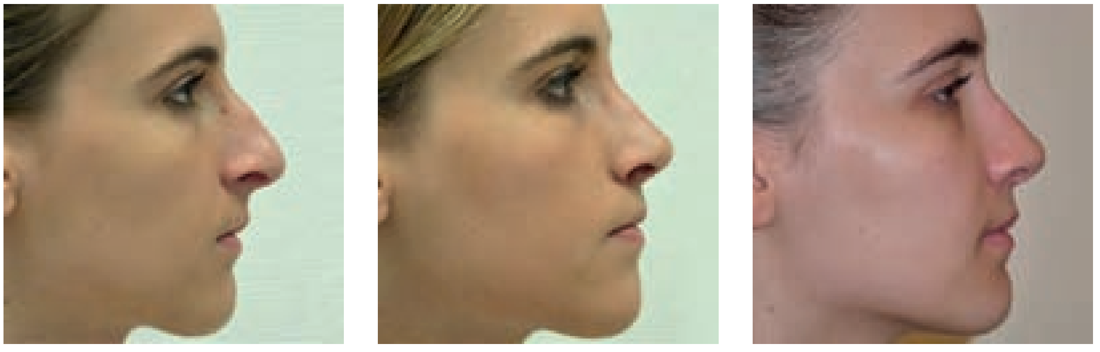
Residual septal deformities should be treated if they are responsible for clinical nasal obstruction or nasal axis deviation. In our series, only 2 revisions septoplasties out of 142 cases were necessary to correct functional obstruction.

AESTHETIC CONCERNS – Outpatient procedures

In the early postoperative period, most of the aesthetic concerns are overcome by office procedures. In the later period, anatomic abnormalities may lead to formal surgical revisions.

Hump or pseudo-hump appearance

Generally, in early postoperative period (within 3 months): periosteal or perichondrial fibrotic reaction may lead to a pseudo- hump appearance that is different than the usual swelling. As compared to routine postoperative swelling, these fibrotic pseudo-humps are harder on palpation and do not compress with digital pressure. They can appear after skin and soft tissue envelope (STE) undermining, perichondrial damage, and dorsal modification procedures like bone rasping. Consequently, one should decide if dorsal STE undermining should be performed in the subperichondrial or subperiosteal plane. In traditional rhinoplasties, it was advised in big hump reductions to remove the periosteum with the hump followed by careful cleaning of the area using a curette or irrigation. Another option is to create a perichondrial-periosteal flap that will be repositioned over the new dorsum and sutured at the end of the surgery. Both methods often require careful triamcinolone injections done after 1 month and repeated if necessary at 3 months. A perichondrial callus - pseudo hump in early postop period is seen below and was treated with one triamcinolone injection.



Swelling in the supratip or scroll area

Swelling in the tip and lobular region causes fullness. This deformity should disappear following standard triamcinolone injections.

Subcutaneous depression

Some subcutaneous depressions may be treated with targeted “safe” absorbable filler injections. The most frequent sites are the radix and the lateral wall. Prior injection of local anesthesia may confirm the patient’s area of concern, followed by deep injection of hyaluronic acid with bony or cartilaginous contact. An aspiration test is done before injecting the filler to avoid intravascular injections. The surgeon should have hyaluronidase at their immediate disposal in case of any blanching or unusual pain and should immediately stop the injection of filler.

Later irregularities

Visible and palpable irregularities can appear after 3 months and up to 2 years in the postoperative period and are caused by cartilaginous or bony spicules. Massage may be effective at the beginning. In 2 patients of our series, we were able to do a subcutaneous correction using a needle (21 G or 16 G) after skin marking and local anesthesia. The goal is to provoke fragmentation and dispersion of these spicules. Post injection inflammation is reduced by injecting a small amount of cortisone. If unsuccessful, then rasping can be done under local anesthesia as an office procedure.

AESTHETIC CONCERNS – Surgical revisions

Out of 352 patients, 35 (9.9%) required a surgical revision mainly related to hump recurrence (9%), axis deviation (3%), middle third widening or thickness (1%). However, some patients had multiple procedures done during the revision (3%).

Humps

The biggest challenge with DP procedures are the persistent, recurrent, or even worse apparition of a hump. Generally, 2 different procedures are done on the dorsum: 1) direct *lowering* of the dorsum, and 2) *flattening* of a convex hump which is more difficult and requires specific maneuvers. Therefore, it is necessary to think in terms of vectors, pivot points, shifting, and blocking points. These biomechanical concepts allow for morphological analysis, esthetic simulation, surgical planning, and intraoperative maneuvers.

*Failure in surgical technique selection***.** The first possibility is that the hump existed prior to the surgery and is still present due to incorrect selection of the operative procedures. If the prior surgical procedure has been properly done, the persistence of a hump may occur if the surgical technique has not been chosen properly. If this abnormality had been detected intraoperatively, a sequential rhinoplasty can be performed, switching to a disarticulation technique or to a classic hump resection. Revisions are not that difficult. However, a complete revision rhinoplasty must be performed.

The coat-hanger effect corresponds to the true hump that has not been completely flatten due to an intraoperative failure in surgical execution. In case of revision, the mechanism of this hump persistence must be analyzed either by a thorough analysis of the previous surgical report or solved intraoperatively by checking each step of the procedure. Why does it occur? The usual sequence is that the hump is still present at the end of the surgery and the surgeon presses on the residual hump to force it downward. At this point, an immediate intraoperative reevaluation of the hump deformity and blocking points should be done. Instead, most surgeons will ignore the problem and close the nose only to have the hump be immediately visible once the dressing is removed and the patient will complain at once. The hump is hard on palpation and has no tendency to flatten with perpendicular pressure. Alas, this is one time where there is no need to wait 6 months to seek revision - it is a waste of time and can be a difficult psychological period to spend with an unhappy patient. As with my own personal experience, it only had to happen once for me to learn that intraoperative wishes do not come true.

A *spring-effect or "popup" deformity* can occur intraoperatively or postoperatively. The spring-effect is more difficult to differentiate from simple swelling. It may be soft on digital pressure, but more resistant than the overlying soft tissues swelling. Generally, this is due to a lack of lateral keystone are (LKA) release. At the end of surgery when the profile is judged excellent, it is highly recommended to wait an additional 5 minutes while performing other tasks and to check again the nasal profile line *without* touching the nose. If the hump has reappeared, then a spring-effect has occurred and further immediate LKA release is mandatory. This short period of time is called "*hump time*". Once the deformity is corrected, then an appropriate fixation/stabilization of the dorsum is done with 2 or 3 sutures. There is no chance that this small hump will disappear later, even with postoperative taping and massages. A revision will be mandatory if the patient complains. It is best to wait a few months for the swelling to dissipate before performing the revision.

A *new hump* can appear on the nose following surgery. Patients showing high straight noses do not like to end up with a bump. This new hump may be due to a cartilaginous middle third saddling or to an unbalanced lowering of bony dorsum and cartilaginous vault. To prevent this deformity, it is critical to delay resection of the W-ASA segment until the very end of surgery. There are two options for treatment: to lower the bony dorsum or to augment the middle third depending upon esthetic analysis and the patient's expectations.

Axis Deviation

This frequent clinical preoperative situation represents the second most common cause of revision following DP procedure with hump recurrence being the first. The mechanisms for its occurrence after DP are different than after a classic resection rhinoplasty. In a DP procedure, mobilization of the entire osseocartilaginous vault as a single unit doubles the risk of asymmetry, while in component rhinoplasty one single side usually appears asymmetric.

The first step is to check if there are cartilaginous deformities that may cause a C-shape deviation thereby creating a shadow on the concave side. In the early postoperative period, taping, massages and pressure may solve the problem in 50% of cases. However, pressing with strength on a bony deviation in the office is truly painful. Consequently, the patients do not want to do it again and prefer the softer solution of doing it themselves at home. If the concern persists after 1 to 3 months, a "manual revision" by external-manipulation-only under sedation can be suggested which is generally accepted by the patient. For those with a persistent deformity and concern, then one can discuss a filler injection.

If a true axis deviation is confirmed, then the mechanisms must be assessed. Two clinical situations and two surgical procedures must be differentiated: either the nose was deviated prior to the primary surgery and the deviation was not corrected completely (8 cases in our series), or it was straight, and then became deviated after the first surgery (1 case in our series). So, the mechanisms and solutions are quite different.

The nose was deviated prior to the first septorhinoplasty and a Cottle's procedure was performed. If the nose was already deviated together with the septum (129 in our series; 36.65%), a Cottle's technique was performed which is our usual procedure for complex deviations. Following surgery, the remaining deviation (8 cases; 2.27%) is assessed both clinically and with a cone beam scan. These recurrences are generally due to inadequate surgery or there are recall forces that brought the nose back to its former position: ULCs abnormalities, unilateral nasal or jugal muscular actions, patient's habit when sleeping on the side. Revision surgery must overcome the axis problem by redoing the whole surgical process and sometimes requires a classic component rhinoplasty.

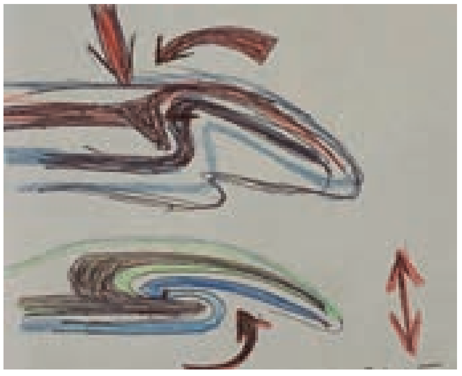
The nose was straight prior to the first rhinoplasty and a high strip resection has been performed. We had one cases that met these criteria (1, 0.3%). A septoplasty was not necessary, and a high septal strip resection was performed. First, one must carefully check the high septum to eliminate the possibility of a neglected septal deviation that must be treated. Once this cause is eliminated, it means that the original stabilization/fixation step was not performed adequately. During the revision, 3 options are available. First, one can simply force the nose straight in the same way that an acute nasal fracture is corrected. This procedure works well as the bones have healed in a *pseudarthrosis* fashion and external maneuvers can reposition the nose into a correct position. This external maneuver works even years after the first procedure in most of the cases of persistent or new deviations. Second, a surgical revision is performed by introducing an elevator through the lateral osteotomy approach, elevating the periosteum, and then going through the fracture line to force the nose to tilt to the ipsilateral side. Third, it may correspond to a congenital or posttraumatic bony asymmetry which was neglected in the preop analysis. Reshaping is mandatory.

Middle Third Fullness: Concept of "scroll-winding-effect"

Clinical findings. Some surgical revisions were needed due to a persistent thickness in the middle third on front view without a polly-beak on profile view nor functional issues. Intraoperatively, a huge fibrocartilaginous tissue mass was found filling the septo-triangular junction and the proximal scroll area corresponding to the W-point where the septal strip had been performed. The visible full resembles a polly-beak deformity, but inside the scroll area.

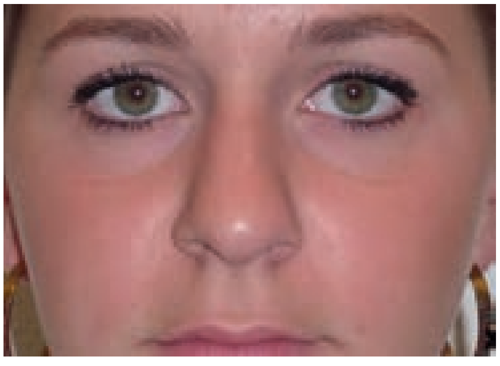
Biomechanics. An excess of cartilaginous scroll may be due to a "scroll-winding-effect" directly related to an excessive overlap of the caudal ULC scroll at the ULC/LLC junction thus adding excess cartilaginous tissue in this area. During surgery done for revising a high strip or rasping a residual hump, we were surprised to discover a large amount of hard white fibrocartilaginous scar tissue in the valve area between the septum and the ULCs scrolls in 5 cases.

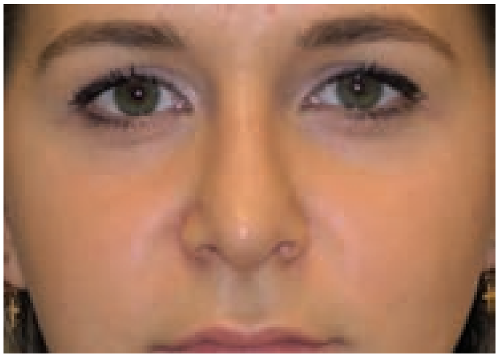
Treatment. Resecting this fibrocartilaginous tissue helped in solving the problem in all cases. This experience led us to add an additional step to our procedure. Through the interseptocolumellar approach, a resection of the proximal scroll area is done after dorsal push-down and sutures. The "scroll-winding-effect" can be seen in the figures below: the push down procedure produces an overlap of the LLC cranial border onto the ULC scroll that is winding cranially as well as enclosing the scroll ligament in a cartilaginous sandwich which causes scroll area thickness and an internal pseudo-polly-beak effect. Routine triamcinolone injections at this site is a consideration. Another elegant solution in primary surgery is the sliding alar cartilage cranial flap (Ozman, 2009, Racy, 2019) which should prevent the "scroll-winding-effect" as well. For details on the incise and slide technique see Tip Surgery chapter by Kosins.



Middle third widening

Widening of the middle third is a side-effect of push-down procedures. We can include an insufficient supratip narrowing in this section as shown on this patient whose profile is satisfactory. Beside the fibrotic scarring process analyzed above which produces middle third thickness, other processes may produce widening of the cartilaginous vault. Lowering the cartilaginous vault biomechanically induces a widening of the arch if its feet stay fixed on the pyriform aperture.



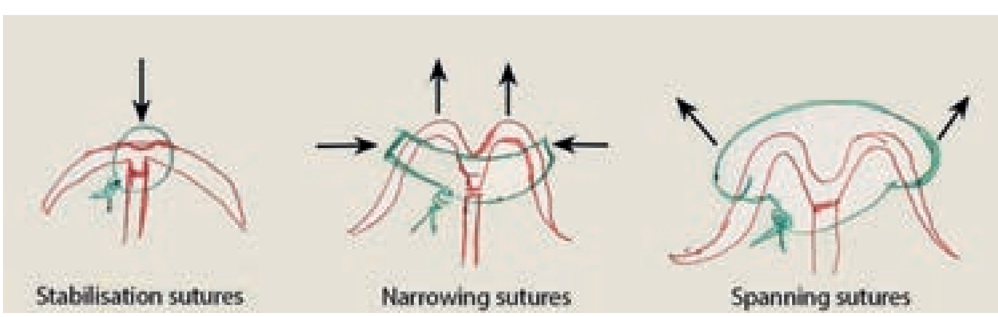


A DP procedure can improve the aesthetics of a narrow vault and open up the internal valve. It is one of the main superiorities of DP versus classic resection techniques. This is critical in cartilaginous noses with short nasal bones. Normal middle vaults generally do not widen significantly. However, this widening effect depends on dorsal height reduction following mathematical laws. Three surgical options are available if there is excess widening.

First is *the "W-point shift" concept.* Cartilaginous vault widening can be prevented in primary DP procedures utilizing a controlled division of caudal part of ULC from the septum. The W-ASA segment should measure 8-10 mm in length. Although not proven by anatomical studies, it is our experience that shorter W-ASA segments are associated with widening. Therefore, it can be elongated by further triangular division until a minimum 8 mm long W-ASA segment length is reached - thus the "W-point shift". It is almost always associated with a partial resection (5mm) of the ULCs scroll, a maneuver that decreases both the volume and the tension on the ULC/septal junction.

Second is the *LKA disarticulation and ULCs lateral shift* as advocated by Göksel (see Chapt. 14). This maneuver not only prevents the spring-effect, but also eliminates the lateral blocking points of the cartilaginous vault. Moreover, the lateral cartilage wall is often an anatomical weak point. Translating laterally, the ULC strengthens this lateral wall as the ULCs lateral edge is added to the fibrous triangle. Following this LKA disarticulation, none of the following have occurred: an inverted V deformity, a lateral valve collapse, nor a lateral step.

The third surgical option is *ULC narrowing sutures***.** Similar to spreader-flap sutures, these septum-ULCs sutures can achieve 3 different goals: 1) fixing the cartilage vault onto the septum for stabilization; 2) narrowing the cartilaginous bridge, and 3) even widening the cartilaginous vault, Narrowing is achieved using U-shaped horizontal sutures as performed in spreader flap fixation. These sutures can be added to ULC chondrotomies done in the paraseptal area that weaken the broad cartilaginous arch.



Bony steps, Radix Steps, and Radix Lowering

These deformities occur following osteotomies, either at the radix or laterally at the naso-jugal junction. They are highly dependent on the surgical procedure and the surgical tools used for performing the osteotomies. The step occurs due to an increased distance between the cephalic cut and the caudal bony displacement.

Radix steps or radix deepening are classic deformities.

Biomechanics. Radix steps may appear when the transverse and radix osteotomies are too caudal on the dorsum which is an anatomical area where the both the STE and nasal bones are thin yet the nasal cavity is wider. The result is that the radix can drop-down into the nasal fossa if the septum or the PPE doesn't block it. Thus, the location of the transverse and radix osteotomies is critical in determining the outcome.

Relevance of Surgical Instruments. One cause of these too caudal osteotomy lines may be surgical instrument selection. The choice of piezo-instruments or manual saws require a wide STE undermining up to the glabella to create the necessary space for introduction of the saws. In contrast, our preference is for percutaneous osteotomies that can be performed without any STE undermining and at the precise chosen level, generally cephalic to the intercanthal line, where the STE is thicker. There is little to no elevation of the radix periosteum.

Importance of percutaneous radix osteotomies. This cephalic placement of the radix osteotomy reduces the risk of radix deepening as well. Performing the radix osteotomy percutaneously allows for immediate intraoperative correction of any unexpected bony step simply by doing another osteotomy more cranially and through the same entry point. Next, the bony fragment is gently pushed into the fracture line without any special maneuvers or skin elevation.

Lateral Bony Wall Steps.

The same process can be used for lateral nasal bony wall steps, mainly observed in very wide bony pyramids with large "nasal parenthesis" (Jankowski, 2016). If these steps require revision, then one must rethink the procedures following the same process or choose a camouflage technique.

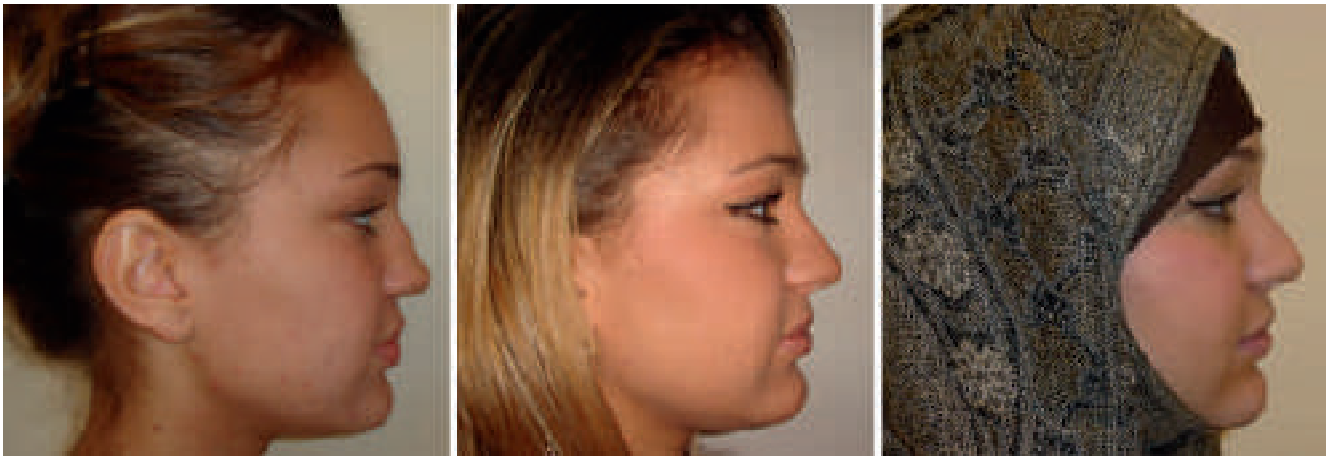
Discussing radix osteotomies leads immediately and causally to the issue with the perpendicular plate of the ethmoid (PPE hereafter) that has many times been raised by rhinoplasty surgeons concerned about the radix lowering and the cribiform plate. The answer requires numerous explanations, causally related to the patient's anatomy and esthetic expectations. East et al have done a cone-beam study that states that the distance between the sellion and the danger zone of the cribriform plate is about 2.5 cm (See CBCT chapter). When no radix lowering is desired, creating a *radix hinge* is critical when performing the transverse and radix osteotomies. Another option recommended by others (Ferreira) is to ignore this area during the procedure! Others, including East and Kovacevic, advocate an oblique caudal direction of the osteotome, to create a true hinge, without any loss of height. In our experience, the cephalic location of the radix osteotomy prevents this side effect, but risks hump recurrence. Therefore, we routinely resect a portion of the PPE.

Middle third saddling

Saddling of the middle third can be a real concern in all DP procedures. In some preservation procedures when the W-ASA segment has not been preserved, then an overlap of the fragments of the cut caudal edges of the septum may occur, creating a descent of the ASA resulting in a loss of support and supratip saddling. These biomechanics led to the concept of *W-ASA segment* which supports the supratip similar to a septal extension graft. We have termed it "an anatomic septal extension strut".

Supratip or middle third saddling has been observed mainly after a Cottle procedure. Biomechanical consequences after mobilization-distraction of the quadrangular flap may lead potentially to this compendium of deformities: saddle nose, tip deprojection, columella retrusion, nasolabial angle deepening (see photo below). Its occurrence can be due to multiple causes: lack of bony pyramid lowering or hump recurrence as well as recoil of the QC due to insufficient mobilization and/or unsatisfactory suture stabilization between septum and ANS. Moreover, these deformities may make a preoperative deformity worse following excessive removal of a low strip or caudal septal edge. A few articles have been published regarding revisions following a Cottle procedure. In a paper reviewing 100 consecutive cases of septorhinoplasty. Barelli described a 12% revision rate as follows: "small revisions were necessary and were usually minor and easy to perform in out-patients. They consisted chiefly in of secondary removal of more septum, usually an inferior strip and relocation of the anterior septum with further "push-down" after osteotomies, out-fracture, or re-modification of the tip with small implants of septal cartilage removed from the patient" (Barelli, 1975).

Importance of "distracting maneuvers". Finally, saddling can happen as well when the shape of the dorsum is very convex, thus predisposing to supratip saddling and requiring specific maneuvers. K-area flattening ("distracting") maneuvers (see below) are critical to prevent this deformity. The patient below presented with a congenital saddle nose and underwent a cartilaginous "*push up distraction*" without any bony procedure. Long postoperative follow-up shows stability of the result.



Camouflage or Structure? If the treatment by Cottle's QC distraction is not possible or ineffective, further correction can be done either by camouflage intraoperatively, or by filler injection in the postoperative period. Another elegant way to treat these difficult deformities are structure procedures which require rebuilding the supportive framework using spreader grafts and cantilever struts.

IMMEDIATE POSTOPERATIVE CONCERNS: < 1 month

Issue	Identification	Treatment
Axis deviation	Frontal view: asymmetry; shadow on one side	Taping 2w, lateral pushing massages
Dorsum hump appearance	Profile view: convexity of the KA	Taping 2w.; cooling, medications
Swelling	Looks like broad dorsum hump	Taping 2w.; cooling, medications
Nasal Obstruction	Endonasal examination: septal deviation or hematoma, swelling of the inferior turbinate	Decongestants, nasal cleaning, follow-up x 2 w.
Anosmia	Patient's complain	Follow-up x 1 m. Nasal cleaning
Skin infection (teenagers, thick skin)	Multiple white purulent spots Sutures site infection	Antibiotics antistaphylococcus Local cleaning. Follow-up 1 w.

EARLY POSTOPERATIVE CONCERNS: 1-3 month

Issue	Treatment
Axis deviation	Carry on night taping and daily massages
Radix deepening	Discuss hyaluronic acid injection
Dorsum hump	Night Taping and Pressions
Persistent Nasal SSTE Swelling	Taping
Nasal Obstruction and Cacosmia	Cleaning-Saline washing- Decongestants
Skin Nodules feelings: entry points for percutaneous osteotomies	Wait 3 months, spontaneous resorption in 3 months
Length of the nose: too short/too long	SSTE massages in opposite direction
Smile: Upper lip stiffness	Wait 3 months; disappears spontaneously

MEDIUM POSTOPERATIVE CONCERNS: 3-6 months (aesthetic medicine touch-up)

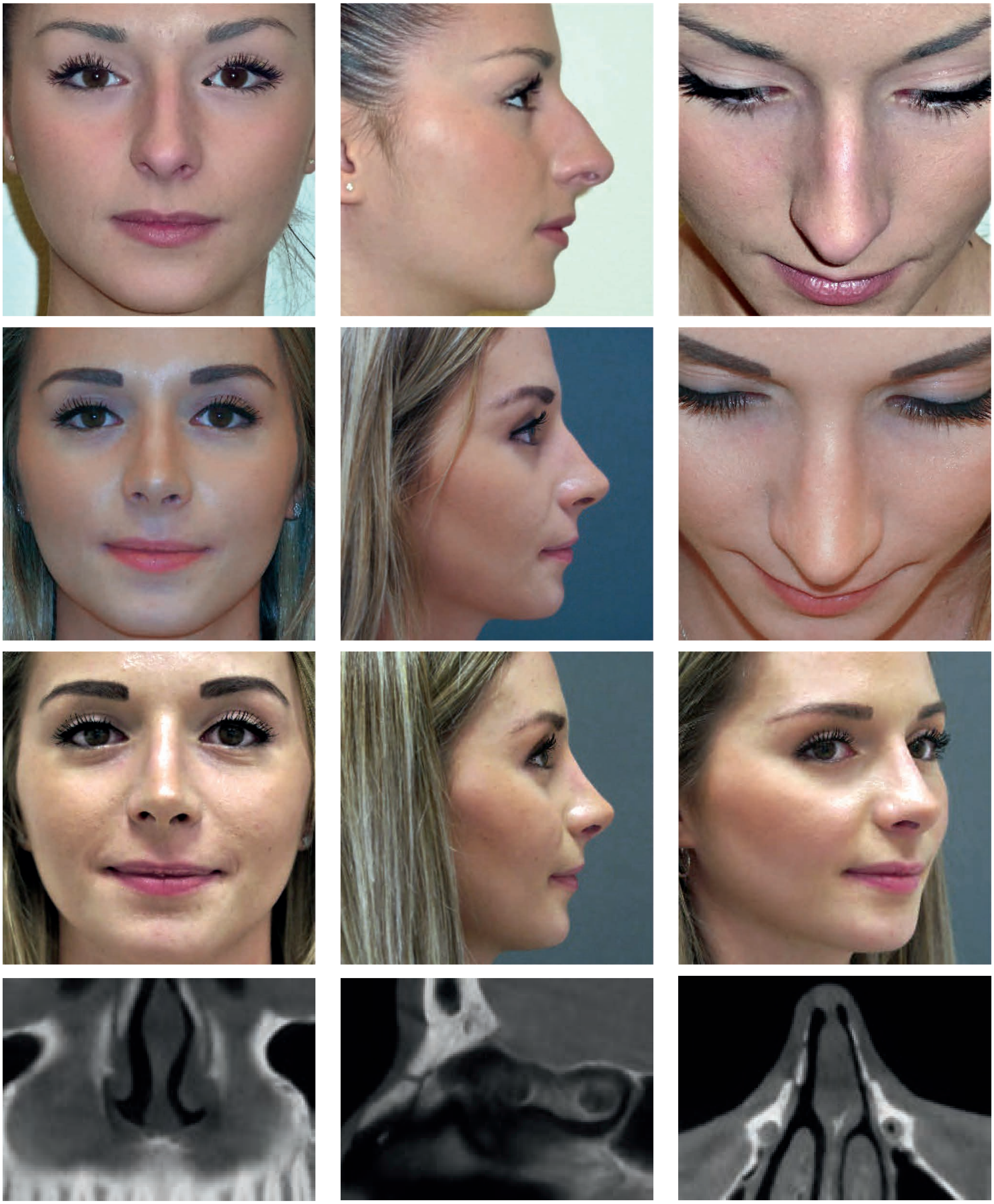
Issue	Treatment
Supratip area: swelling	Cortisone injections (Triamcinolone)
Dorsum K-A: periosteal or perichondrial callus	Cortisone injections (Triamcinolone)
Deep Radix and/or Lateral wall concavity	Fillers (Hyaluronic Acid) Injections

LATE POSTOPERATIVE CONCERNS: > 6 Months (indications for surgery)

Morphological Deformities	Patient's "Emotional" Indications	Functional Issues
dorsal hump recurrence	size of the nose (too high bridge)	nasal obstruction
axis deviation	shape (not curved enough)	septum deviation
middle third thickening or widening	nostril flaring	
supratip saddling	nostril sill asymmetry	
nares flaring		
bony dorsum irregularities		
bony steps		
cartilaginous deformities		

CASE #1

18 years old patient. Tension deviated nose. Thin skin. High expectations. Revision for residual hump, excess of height, over projected tip.

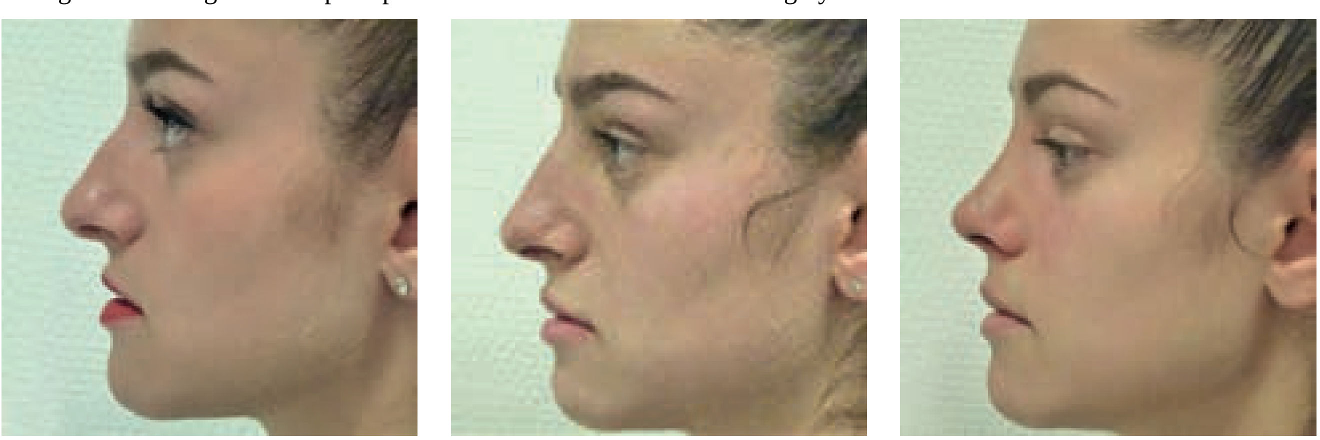


CASE #2

Male 50 years old. Macrorhinia, straight dorsum, large nostrils, strong cartilages. Revision done for high expectations regarding the size of the nose.

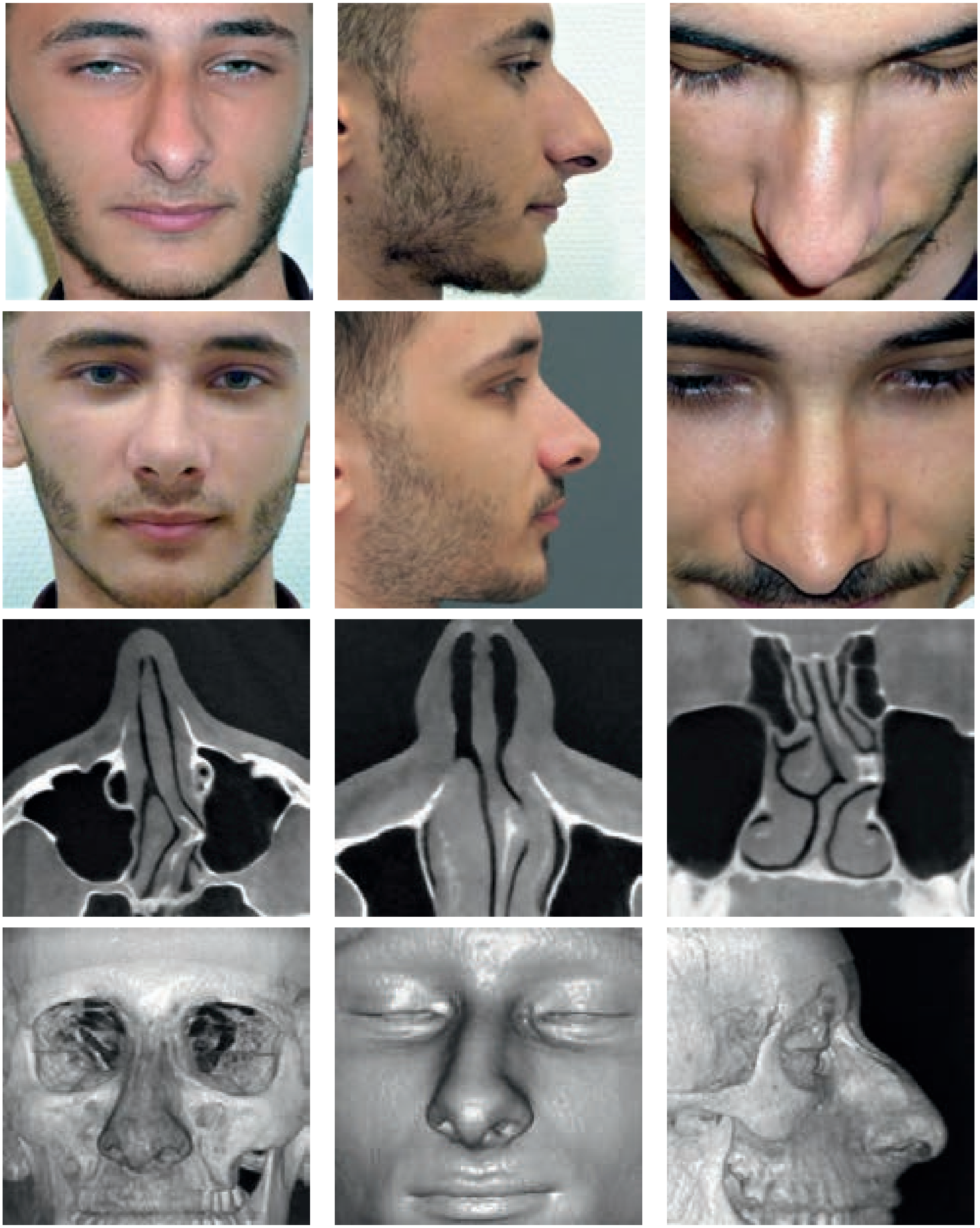
CASE #3

Female 22 years old macrorhinia, straight dorsum, large nostrils, thin skin high strip DP. Primary rhinoplasty with bony cap reshaping by rasping. First surgery did not fill her expectations: seeking revision for a smaller and shorter nose, similar to simulation. “Full high strip DP procedure” redone with septum shortening, alar base reduction. No tip surgery during revision. High level of postoperative satisfaction after revision surgery.



CASE #4

Nasal axis deviation. 18 years old male patient. Macrorhinia. Deviated nose. Thick skin. Septoplasty. Cottle's primary rhinoplasty procedure. Radix deepening, supratip asymmetry. Postop deformity and subsequent revision.



CONCLUSIONS

Biomechanical Surgical Anatomy is paramount to perform dorsal preservation procedures, and to avoid, disappointment and revisions. Careful patient selection, proper execution of the surgical steps, good dialogue and good understanding between patient and surgeon are keys to preventing pitfalls and subsequent revisions.

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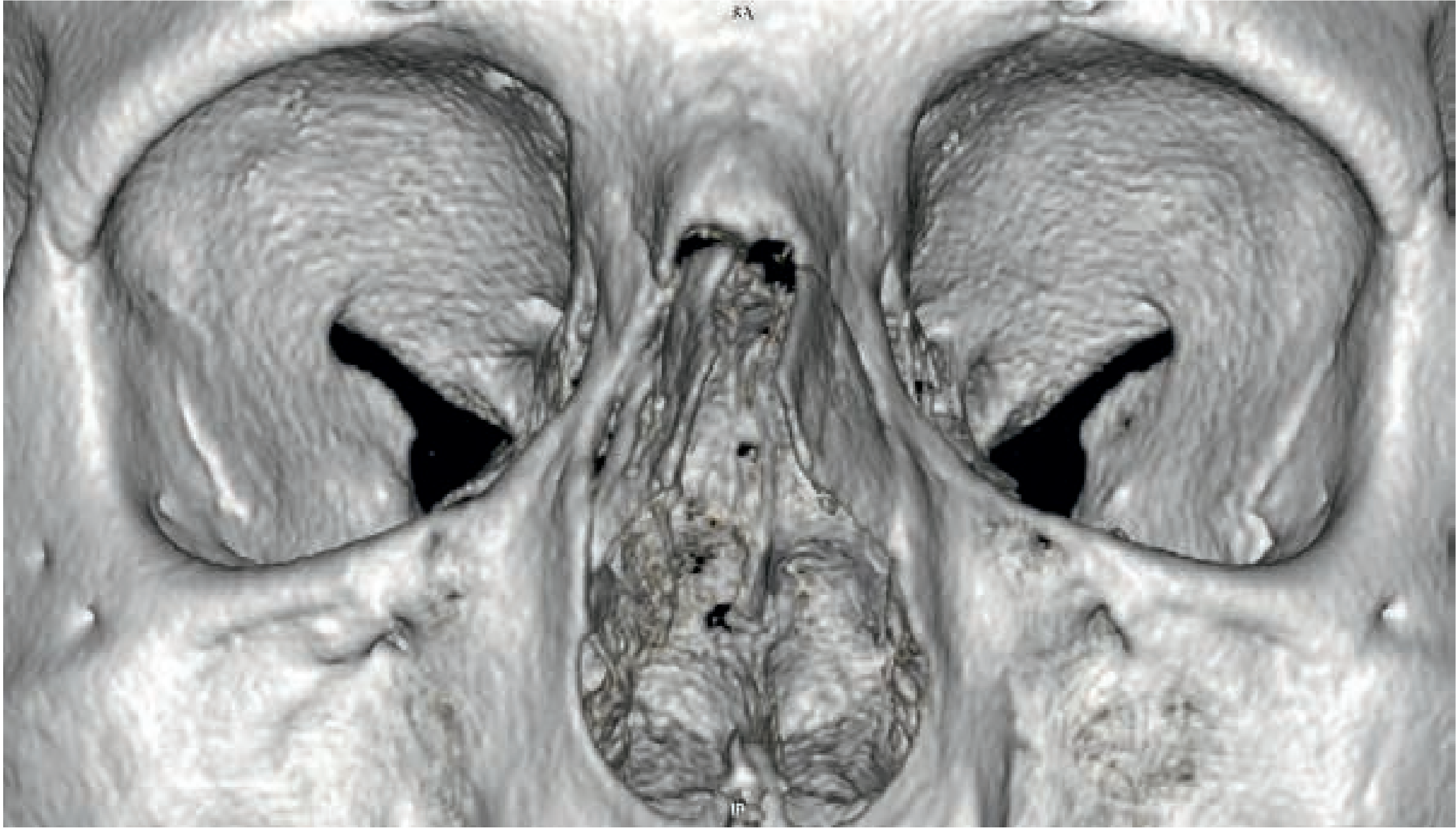


Errors & Complications in Preservation Rhinoplasty

Charles East, Lydia Badia

This chapter is been compiled based on the experience of the authors of this textbook and encompasses their individual complications when starting and in the subsequent development of the techniques in Preservation Rhinoplasty (PR). Naturally some of the complications are common to any technique for rhinoplasty or septorhinoplasty but in collating the collective responses we've tried to categorise the risks of a surgeon starting out adopting this approach to surgery as well as those who have had more experience with longer term follow-up. Many of the technical points are mentioned elsewhere in the textbook, but we felt it would be helpful if these were listed in relation to the dorsum, the tip, the nasal septum and the soft tissue skin envelope. Likely explanations are postulated for these complications and suggested strategies for avoidance or correcting them are included where possible. Of course, it goes without saying that choosing the correct procedure for the individual case is paramount and it's natural with a new approach to surgery and with initial enthusiasm to try and apply novel techniques to every case. This primary error is understandable, invariably leads to a sequence of problems needing revision, resulting hopefully in better judgement which is then reflected in the knowledge to choose the right technique for an individual operation. The rapidly ascending curve of enthusiasm is often followed by a plunge to scepticism and this oscillation continues until the technique finds its place in the individual surgeon's armamentarium.

INTRODUCTION

We have endeavored to classify the commonest deformities which you may come across and experience in PR into: 1) the dorsum, 2) tip, 3) septum and 4) soft tissue envelope. Whether you perform your surgery endonasally or externally, a different range of instruments is needed for PR over a standard surgical set and these are detailed in other chapters. The commonest deformities are the following: residual hump, axis deviation, infantilised nose, asymmetry in the tip/nostrils, loss of tip support, widening of the middle third, supratip saddling, supratip fullness.

DORSUM

Most surgeons will start their journey in PR by choosing dorsal preservation (DP). All of us have had the complication whereby a seemingly satisfactory DP reduction appears to 'spring back' towards its original position. This can happen perioperatively or become evident in the weeks after surgery. There are a variety of reasons why this can occur and in choosing the most appropriate case for preservation, choose an over projected nose with the *V shape* dorsum and preferably one with short nasal bones (see the Anatomy chapter)

The *S-shape* dorsum where there is a kyphotic bony prominence over a cartilaginous hump characterised by a low radix and curved midline nasal bones does not lend itself to a simple preservation approach. For these, modification of the bony cap or possibly radix grafting may be required. It is essential that there are no impacted or tension points when releasing the dorsum for preservation – we've identified various areas where there may be a block to the dorsum dropping or failing to flex at the Dorsal Keystone Area.

Problem #1 – Bony Thickness of the Nasal Sidewall

The bone is thickest in the Nasofacial Groove particularly as you ascend the medial buttress of the face in front of the lacrimal crest into the denser bone of the radix. Incomplete transverse section of the radix (radix osteotomy) by failing to release the Nasal Bone, Nasal Spine of the Frontal Bone and then transverse osteotomies will prevent downward drop or hinge at the radix.

Problem #2 – Junction of the Transverse and Low-to-Low Lateral Osteotomy

The thickness of the bone here makes it difficult to achieve a push down and although it may be possible to squeeze the base of the nasal pyramid medially to allow it to drop inside the Pyriform Aperture, it's not uncommon for it to jump back out away from the face. This can be obvious on the operating table and it's essential to recognise, as any areas of tension with the low-to-low osteotomies can lead to asymmetry or apparent recurrence of the hump. Excessive pressure to try and force the bridge down may result in the complication of nasal sidewall fracture resulting in a concavity or even deviation as seen below.

One can avoid this problem by cutting the bone sagittally at the cranial end of the lateral osteotomies, particularly after an ostectomy to thin the bone (either with a scraper or Piezo tool), which results in a free sliding movement at this junction point. It should be remembered that the internal mucoperiosteum can act as a block and so another important manoeuvre is adequate medial elevation of periosteum to allow a ’bone on bone slide’. The mucoperiosteum can be mobilised from above having made the lateral osteotomy cut using a Freer elevator or may be performed endonasally with an elevator on the inner aspect of the maxilla prior to resection of bone at the Pyriform Aperture and the sagittal osteotomy.

Problem #3 – Webster Triangle / Head of the Inferior Turbinate

Preservation of a small triangle at the pyriform aperture was originally advocated to minimise the impact of middle third collapse in a traditional hump resection without middle third repair. With preservation rhinoplasty, there is no need to retain this bone to preserve the airway. The inferior turbinate head can act as a block point when trying to lower the dorsum via push down. Resection of this pyriform aperture bone either with a 2 mm rongeur or Piezo tool firstly prevents any narrowing of the nasal valve at the turbinate head caused by medialising the bone but secondly combined with the sagittal osteotomy allows for a combination of ‘push down’ and ‘let down’ with no tension or block.

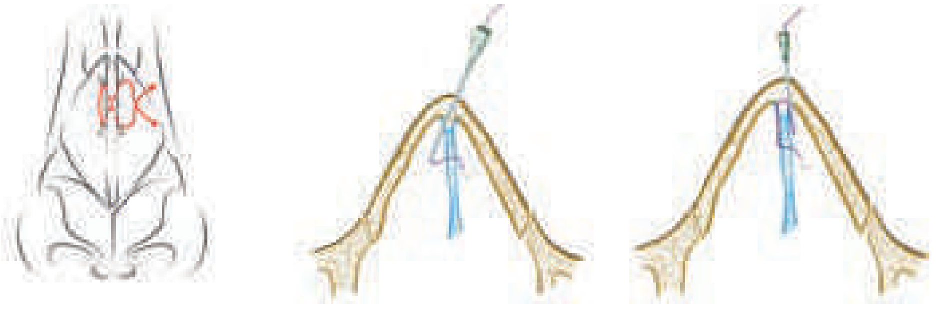
Problem #4 – Failure to Flex at the Keystone

Patients with short nasal bones or predominantly cartilaginous humps are ideal for preservation techniques. Kosins et al. have demonstrated via ultrasound that there is a true flexion possible at the Dorsal Keystone Area (DKA). With increasing age, the cartilaginous skeleton becomes replaced by bone particularly in the perpendicular plate which ossifies caudally. This means with a rigid structure it’s more difficult to produce a flexion at the DKA and so in an older patient an alternative technique of Bony Cap resection may be required.

Leaving a rigid segment of the top of the nasal septum under the detached dorsum can also prevent adequate flexion (coat hanger effect). Scoring the under surface of the DKA will often permit easier flexion. Even with these manoeuvres, flexion may still not occur in which case the block is usually related to the Pyriform Ligament and Lateral Keystone Area (LKA) attachment of the ULC underneath the nasal bone. Release of the LKA by dissection to release the pyriform ligament and separating the ULC/bony junction bluntly with an elevator up to 5 mm from the DKA will invariably allow a convex curved dorsum to flex straight. Care must be taken with this lateral release not to create a concavity of the ULC particularly in the presence of a Paraseptal Cleft which may go unrecognised particularly through a closed approach. The author has experienced this complication which required revision via open approach and insertion of spreader grafts.

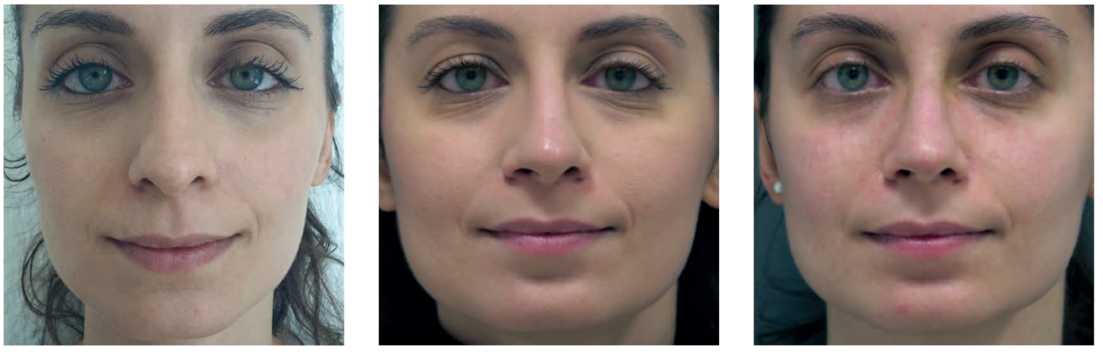
Problem #5 – Inadequate Lowering or Fixation of the Neo-Dorsum to the Septum

In a High Septal Strip DP, it's usual to do a serial reduction to allow the neo-dorsum to sit on top of the reduced septum without overlap. Leaving the septum too high would obviously recreate a convexity. The slight inherent spring that occurs with a push down/let down particularly in the middle cartilaginous third means it's possible for this to spring up naturally. Therefore, it is recommended that fixation between the neo-dorsum and underlying septum be achieved with an intra mucosal stitch that ties the dorsum down or a crisscross suture fixation using a 4-0 or 5-0 PDS attaching the neo-dorsum to the septum behind the valve angle (see figure below left). Also, a U-shaped stitch reattaching the W-segment to the dorsal septum is done. Fixation is easier through an open approach, although there are innovative ways of creating fixation suture using a percutaneous needle to create a passage through the subcutaneous tissue in patients where the dorsal skin has not been raised during the rhinoplasty (after Dogan). Push a green needle through the dorsal skin so that it comes out adjacent to the septum under the ULCs, pass a 4-0 suture intraseptally across the quadrilateral cartilage from the side where your green needle has entered. Push the end of the suture into the needle until it comes out at the top, then withdraw the needle slowly until the tip is in the sub-SMAS plane. Move the tip of the needle over to the other side and push it down through the ULC intraseptally close to the septal cartilage. Pull the end of the thread through and out of the needle, withdraw the needle. You now have a loop that can be tied securely anchoring the dorsum (see figure centre & right).



Problem #6 – Axis Deviation

After residual hump, axis deviation is the next most common dorsal complication and has two main causes. The first is failure to mobilise adequately one side of the nasal pyramid particularly in the push down approach. The nasal pyramid tilts to one side and this may occur from the central point of the radix or indeed the whole radix may displace to one side (see preop, postop complication and repair below). The second relates to the relationship of the neo-dorsum to the underlying septum. In the high septal strip excision, it's not uncommon for an overlap to occur particularly at the W-point. If there is a residual high septal deformity as the dorsum re-approximates to the septum this produces a deviation. Closing the mucosa under the W-point prevents the dorsal segment overlapping (after Cakir). If the septal deviation is complex or can't be addressed by high septal strip resection an alternative should be adopted e.g. the low or intermediate septal strip which allows a finer control of septal deformity under the dorsum but maintaining the advantage of DP (after Ishida, Neves).



Problem #7 – 'Infantilised Nose'

Control of the position of the radix in PR is important. We've already mentioned the V and S shape dorsum, and in planning a new profile. If the radix is high, it's reasonable to move it posteriorly but if the radix is low particularly in patients with a prominent premaxilla, changing the radix position can have a detrimental effect on the overall nasal balance. A recent cone beam CT study has shown that in the majority of young patients a quadrangular cartilage extends a considerable distance cranially often above the planned radix osteotomies point (see CBCT chapter). Thus, there is not always a need to routinely remove perpendicular plate of the ethmoid bone. If a posterior displacement or 'drop-down' is needed, the subdorsal cartilage is resected and then if necessary the PPE is cut. It is recommended that the perpendicular plate is not routinely resected prior to radix osteotomies but can be done nibbling away with a 2 mm Rongeur as required.

None of the authors have produced a CSF leak from the perpendicular plate section. The skull base is nearly 30 mm behind and as long as a twist is not performed on the perpendicular plate, the skull base is not at risk. Remember to release the PPE before performing a high radix osteotomy.

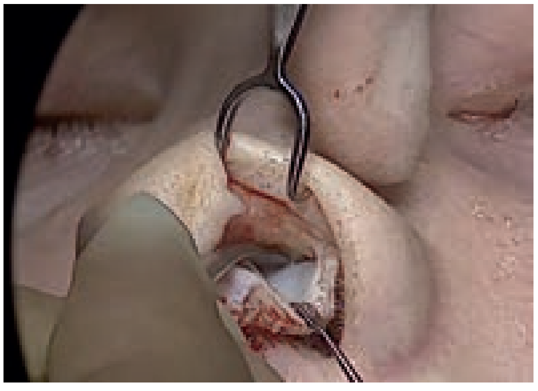
Moreover, if a hinge effect is required compared to a drop-down of the radix then it is recommended that the radix osteotomy is performed approximately 5 mm above the transverse osteotomies and in an oblique fashion. This allows the radix to slide rather than drop. The resulting hinge invariably maintains its anterior projection without dropping down and producing a step deformity. In this fashion, the need for radix grafts or even dorsal skin elevation to the radix is negated.

In a high radix case where the intention is to drop the radix posteriorly, then the radix osteotomy is performed at the same level as the transverse osteotomies and the perpendicular plate is initially cut or nibbled away as necessary to control the amount of drop-down.

SOFT TISSUE & CARTILAGE DAMAGE IN THE APPROACH

The concept of minimum trauma to the soft tissue envelope in PR is done to minimise subcutaneous oedema, prevent secondary thinning of the skin envelope, and to respect the ligaments. It involves a dissection in the subperichondrial-periosteal planes, releasing as necessary the deep attachments of the SMAS which divide the nose into different compartments e.g. Scroll Ligament Complex, Deep Pitanguy ligament and Vertical Pyriform Attachments.

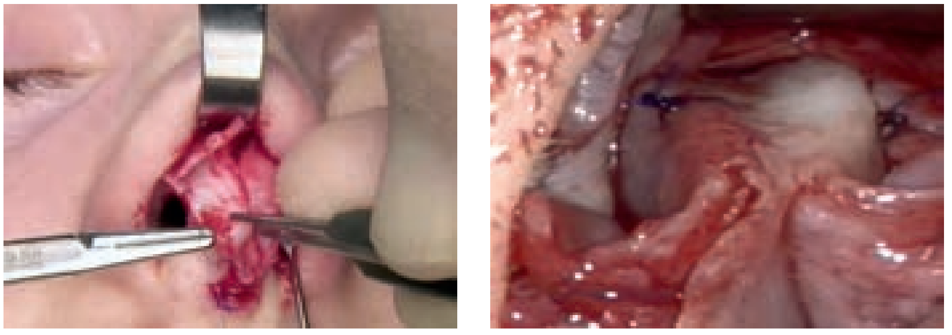
In achieving a subperichondrial dissection, this is easiest in the nasal septum or on the midline of the cartilaginous dorsum which is entirely due to the thickness of the perichondrium and the rigidity of the underlying cartilage. The same is not true for the LLC and ULC which in many cases can be flimsy and easily torn. A subperichondrial dissection of the LLC is facilitated by an auto rim flap and sharp dissection with counter traction using the perichondrium pulled up and by pushing down on the cartilage with the dissector.



It's still not clear whether there is a significant advantage for subperichondrial dissection over a supraperichondrial dissection particularly with weak LLC. The benefit may be outweighed in thin cartilage by the risk of damage. As a compromise, the supraperichondrial dissection can go subperichondrial just before the scroll area allowing release of the Vertical Scroll Ligament. In many instances it's not necessary to completely release the lateral part of the Vertical Scroll Ligament when modifying the nasal tip and clearly this has advantages in reducing trauma to the envelope.

It is essential to have the correct exposure and instrumentation whether elevating the skin envelope for closed or open approaches. Figure below on the left shows the complication of tearing across the LLC using a sharp and bulky dissector initially through a closed approach. Correction involved opening the nose to achieve a suture repair before continuing with the rhinoplasty.

The second area of cartilage damage is at the junction of the ULC and septum particularly if there is a Paraseptal Cleft. Wide retraction with bulky instruments can tear this junction resulting in complete separation or sometimes dissecting the high septum may induce a rupture which should be repaired by direct suturing (see figure on the right).



ASYMMETRY IN THE NASAL TIP

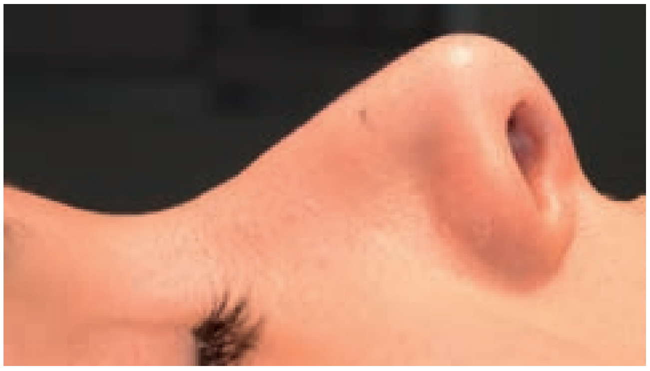
This is a complicated area- bearing in mind that most patients have a degree of asymmetry. It is especially true in those patients with developmentally deviated noses/maxilla where it is extremely difficult to achieve symmetry particularly in closed approach rhinoplasty surgery. Differential lateral crural steal is a common method of equalisation employed with either septal extension graft, tongue-in-groove or columella struts to provide stability to the repair.

Prevention of asymmetry should follow the principles of minimal cartilage resection, dome sutures placed on the cranial aspect of the middle/lateral crus, adequate support of the nostril margin by eversion of the caudal margin of the lateral crus of the LLC and augmenting the rim with free-floating rim grafts if necessary.

One observation has been that with a reduction rhinoplasty, reattachment of the scroll ligament/cartilages has sometimes produced a thickening along the lateral upper border of the tip especially where the ULC was not shortened. This may arise because of the disparity in the skin envelope to the reduced/repositioned cartilage framework underneath and in some instances has required endonasal revision by excising the thickened scroll ligament (see below).

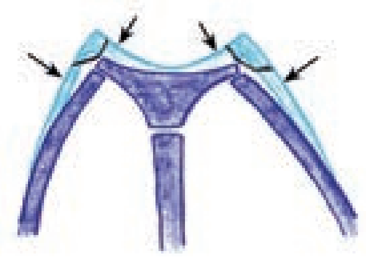
LOSS OF TIP SUPPORT

The variability in the form and shape of the LLCs, the position of the caudal septum and the type of skin envelope may have an influence on nasal tip support. Whilst it may be tempting to rely on the natural ligaments (scroll, Pitanguy, intercrural), section of the tip cartilage by any method invariably results in some weakening and potential retro projection. It's the authors' view that the length and strength of the medial crura, the position of the footplates in relation to the caudal septum, and the inherent resilience of the tip cartilages are major contributing factors to tip projection. Short medial crura and weak cartilages will all predispose to post surgery tip drop especially with dissection within the membranous septum. Reliable methods to maintain tip support would include lateral crural steal, long strut graft, septal extension graft, or a posterior tongue-in-groove. In figure below, reliance on dome suturing alone with ligament preservation/repair did not result in a satisfactory tip condition at one year and required revision with strut graft support.



WIDENING OF THE MIDDLE THIRD

This is an uncommon complication but is more likely when a large cartilaginous hump is reduced by dorsal preservation. Changing the dorsal aesthetic lines from a triangular cross-section to a broader Y shaped cross-section as the middle third drops produces a flaring and widening in the supratip (see figure below). It is difficult to predict this problem as it often appears after several weeks after surgery. However, a caudal release of the ULC from the septum with resection of a small triangle of cartilage paraseptally and resuturing has been effective. Alternatively, resection of the “elbow” of the ULCs with re-suturing removes the bowing effect caused by the downward drop. In the open approach, a criss-cross suture inserted cranial to the internal valve angle is effective not only in anchoring the dorsum, but also counteracting the bowing effect of the upper lateral cartilages therefore maintaining the correct dorsal aesthetic lines.



SUPRATIP SADDLING

It is important to understand that the dynamics of the movement of the dorsum with preservation are different from those of hump excision and in-fracture. An extremely important technical point is that the subdorsal release from the nasal septum needs to start at the W-point, not at the Anterior Septal Angle. Patients with pre-existing low supratips are particularly at risk of an exaggerated deformity which usually requires augmentation by grafting.

Approximately 5 to 7 mm of the dorsal septum should be left intact – sometimes this is difficult if the septum is short and there is very little distance between the W point and the anterior septal angle. In these patients sometimes augmentation of the septal length will be needed to maintain a supratip height.

The same issue happens with the low septal strip as there can be loss of height of the anterior septal angle as the lower border of the septum is pulled forward and fixed to the nasal spine. Careful assessment of the degree of resection of the septum is therefore mandatory to avoid these complications.

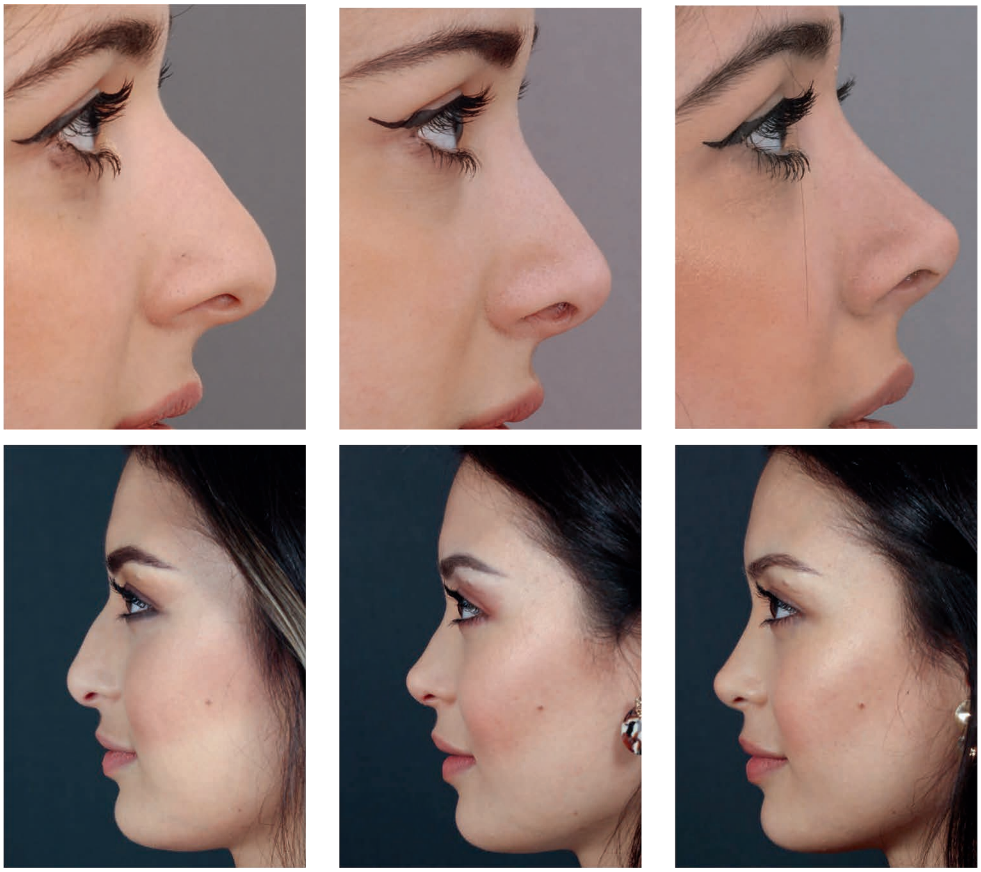
Major supratip saddling can occur with accidental complete mobilisation of the quadrangular cartilage. This is one of the limitations in preservation rhinoplasty as with complex septal deformity is it is often not possible to undertake dorsal preservation. Management the septum involves retaining at least a two-point fixation, the first being a secure attachment to the nasal spine and the second either to the perpendicular plate of the ethmoid in a high septal strip or to the upper lateral cartilages in a low septal strip septorhinoplasty.

Accidental complete mobilisation of the quadrangular cartilage requires immediate on table action to restore septal height and to restore key fixation points. Through the open approach, 1 mm drill holes in the nasal bones allows a criss-cross suture to be employed to anchor the cranial part and a suture fixation with a drill hole through the anterior nasal spine to secure the posterior septal angle is essential.

Transcutaneous osseous wires e.g. an intravenous cannula can be used to stabilise the quadrilateral cartilage when placed across the nose at the level of the stable maxilla. The cannula is removed after 10 days.

Additional dorsal camouflage grafts may be required e.g. fascia or diced cartilage to prevent irregularity.

The following figures show saddling of the supratip treated by reduction of the bony cap by rasping after 6 months.



CONCLUSIONS

We wish to thank all the contributing authors of this book for sharing their experiences, images and thoughts in their individual journeys with PR and hope that some practical tips and advice will be useful for guiding and helping those of you undertaking this exciting modern approach to Rhinoplasty Surgery. For those who are just starting out with Dorsal Preservation procedures, we would suggest that they read Tuncel's recent paper entitled "Reducing Dorsal Hump Recurrence Following Push Down- Let Down Rhinoplasty" (Tuncel, 2020). In their original series, the authors had a 12.1% incidence of hump deformities divided between residual occurrences within a few weeks and recurrent humps which occurred months later. With additional experience and updated surgical techniques, they were able to eliminate residual humps and reduce recurrent humps to 5.3%. Currently, they are approaching the gold standard of <2% recurrent humps by implementing greater use of preop CBCT scans and more selective patient selection. Their experience is typical for many beginning surgeons as they go up the learning curve of preservation rhinoplasty.

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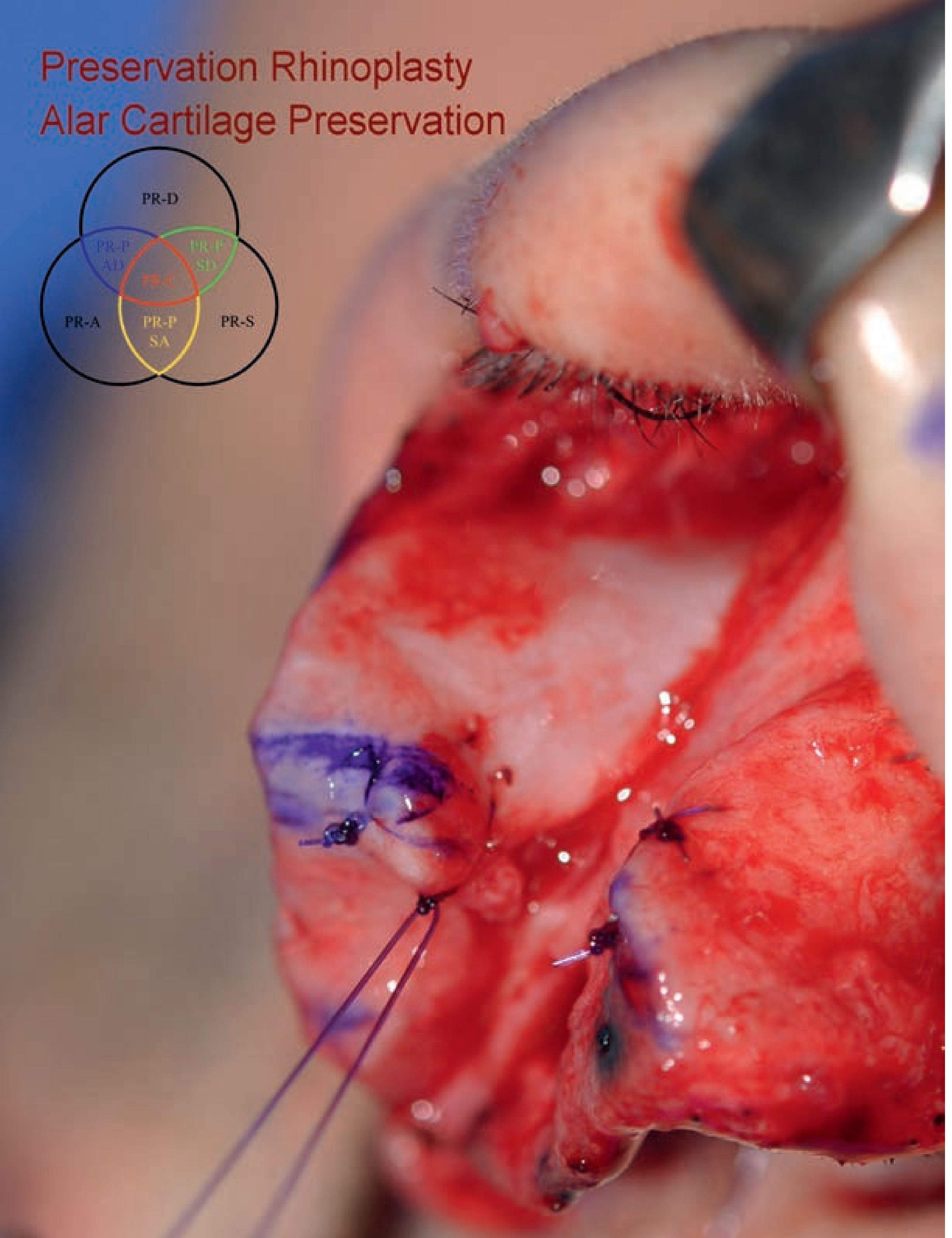
Preservation Rhinoplasty
Alar Cartilage Preservation



Preservation Rhinoplasty
Dorsal Preservation


Preservation Rhinoplasty
Soft Tissue Preservation
PR-D
PR-P
SD
PR-C
PR-A
PR-P
SA
PR-S