Rhinoplasty: Grafts and Sutures

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Abstract: Rhinoplasty is a fascinating and complex surgical procedure aiming at attaining a well-functioning and aesthetically pleasant nose. The use of grafts is of the utmost importance for the nasal surgeon to achieve such results. Also the uses of sutures to control the shape of nose especially tip sutures which will be described.
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Introduction

The nose is a vital part of a person's cosmetic appearance, performing a good rhinoplasty with both a successful cosmetic and functional outcome is challenging. Comprehensive knowledge of facial aesthetics and nasal anatomy is paramount for any surgeon undertaking septoplasty or rhinoplasty procedures. (1)

Surgical anatomy of the nose:

Nasal anatomy can be subdivided into several categories including the skin-soft tissue envelope (S-STE), septum, lateral nasal walls, bony pyramid, cartilaginous vault, and nasal tip.

Skin and Soft-Tissue Envelope:

Evaluation of skin is very important, thin skin does have advantage of fast post operative healing due to less tissue oedema (2), thick skin complicates rhinoplasty by masking refinements even if underlying structures is dramatically changed (3).

SMAS (Superficial Muscle-cauteneous Aponeuretic System)

The nasal SMAS, which is continuous with the facial SMAS, invests and connects the nasal musculature. The SMAS functions as a layer that distributes the tensile forces of the nasal musculature and provides a sling against which the mimetic muscles may counteract**. (4)**

Muscles of the nose

These muscles have two important functions which are regulation of nasal airflow and animation of nose during facial expressions, these muscles classified into Elevators, Depressors, Compressors and Dilators. The procerus, levator labii superiors alaeque nasi, and anomalous nasi are elevator muscles, the alar nasalis and depressor septi nasi are depressor muscles, the transverse nasalis and compressor narium minor are compressor muscles, and the dilator naris anterior is a minor dilator. All muscles supplied by facial nerve (5).

Bony and Cartilaginous vault

The nose may be divided into vertical thirds according to its underlying bony and cartilaginous framework. The upper third of the nose consists of the nasal bones, the middle vault is composed of the ULCs, and the lower lateral (or alar) cartilages span the lower third of the nose. On palpation, the superior nasal bones are rigidly fixed in position, the ULCs are semi-mobile, and the LLCs are more freely mobile (6).

ULCS (Upper Lateral Cartilage):

The lateral configuration of the upper lateral cartilage tends to be more rectangular than triangular and does not, as, is commonly thought, rest on the pyriform process. It is lined by mucosa and covered by the transverse portion of the nasalis muscle; its support comes only from attachments to the nasal bones and septum. There is a common perichondrial lining on the undersurface of the upper lateral cartilages and the septum. The ULCs articulate with the nasal bones above at the rhinion, or keystone area; laterally join with the pyriform aperture via loose ligaments; medially fuse with the septum; and inferiorly interdigitate with the LLCs at the scroll. This ULC–LLC union, or scroll, defines a major tip-support mechanism and may assume various configurations.

Internal nasal valve:

Endonasally, the junction of the upper lateral cartilages with the nasal septum forms the internal nasal valve. This valve angle should be between 10 and 15° for adequate nasal airflow, and must be preserved or recreated during rhinoplasty(7).

LLCS (Lower Lateral cartilage):

it is formed of lateral crus, intermediate crus, medial crus

Medial crus:

The medial crus consists of two components: the footplate segment and the columellar segment. The columellar segment begins at the upper limit of the footplate segment and ends at the columellar lobule

junction ("columellar breakpoint"), where it joins the middle crus.

Intermediate crus:

The middle crus is made up of the lobular segment and the domal segment. The lobular segment of the middle crus tends to be the most variable and have the least correlation between the actual internal structural configuration and the external appearance, The domal segment is usually quite short and also frequently the thinnest, delicate, and narrow portion of the entire alar cartilage arch. The domal segment can vary in configuration.

Lateral crus:

The lateral crus is the largest component of the nasal lobule and plays a major role in defining the shape of the anterior superior portion of the alar side wall. Medially the lateral crus is directly contiguous with the domal segment of the middle crus and laterally with the first of a chain of accessory cartilages that abut the pyriform process. Caudally its free edge may be flat or it can be curved posteriorly to varying degrees. (8)

The junction of the cephalic edge of the lateral crus and the caudal edge of the upper lateral cartilage is known as the scroll area.

GRAFTS in Rhinoplasty

The philosophy and technical use of nasal grafts are different in "closed" and "open" rhinoplasty operation. In 1931, septal and auricular cartilages were described as grafts for the repair and reconstruction of nasal defects. Macroscopically, the ideal graft would not create any donor-site morbidity. It would be readily available, inexpensive, easily carved, fixed to the recipient site without difficulty, and not lose its volume or alter its shape over time. The physical properties of the graft should match those of the recipient site,

with a proportional level of rigidity or flexibility (9).

Classification of grafts:

Essentially, grafts can be obtained from 3 major sources: organisms **(Natural grafts)**, synthetically manufactured products **(Synthetic grafts or alloplasts)**, and tissue biomedical engineering (10).

Natural grafts:

The main type in natural grafts is the cartilaginous type which Nowadays, are widely used in rhinoplasty. Even their fixation is often easier and more precise using an open approach, most of them can also be positioned with a close approach, which is harvested from nasal septum, auricular cartilage and costal cartilage.

A - The Nasal Septum

Septal cartilage is the graft material of choice because of its survival, strength, shaping, and availability. Technically, harvesting cartilage from a "normal" septum is far easier than doing a septoplasty on an "abnormal" deviated septum or reentering the septum during a secondary rhinoplasty (9).

Septal cartilage can be easily harvested during rhinoplasty regardless of the approach and without the need for additional incisions. Septal cartilage is generally straight, providing strong structural support, and has resiliency properties similar to those of the native nasal cartilaginous framework. Furthermore, it offers easy manipulation

Harvesting of nasal septum

After injection of local anesthesia sub perichondrial, mucosa elevated bilaterally and the definitive dorsum and caudal septum established, the following 5 step septal harvest is done:

1) Dorsal incision 10mm below and parallel to the dorsal septum,

2) Caudal incision 10mm back and parallel to the caudal septum,

3) Posterior dissection of the septum out of the vomerine groove,

4) A downward "push" disarticulation of the cartilaginous septum from the bony perpendicular plate of the ethmoid,

5) Careful mobilization of the cartilaginous tail of the septum which can be 10–15mm long.

At this point, the cartilaginous septum is completely disarticulated and easily removed, then we use silastic nasal splints as they provide compression over a greater region and prevent synechiae between the septum and the turbinates (9).

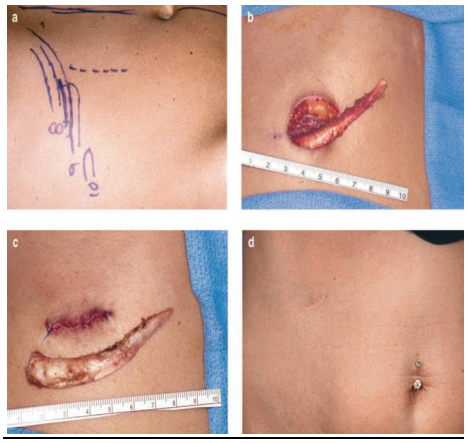
B) Costal cartilage

It is mostly used there may be inadequate septal cartilage available to do the necessary grafting especially secondary rhinoplasty, age of patient is very important as In the younger patient, the cartilage may be more prone to warping. On the other hand, in the case of the older patient, there may be calcification of the cartilage, making carving more difficult (11).

Harvesting of costal cartilage there are two approaches for harvesting the costal cartilage sub-costal approach and inframammary approach.

Sub-costal approach:

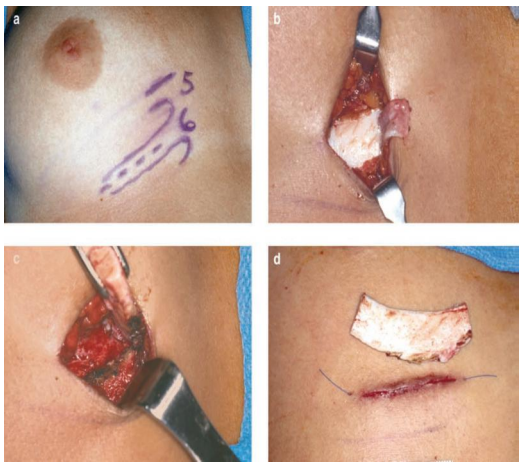
The 9th rib is the first "floating rib" and thus a simple retrograde supra-perichondrial dissection is possible. The patient is placed in the supine position with a small sand bag under the hip. The 9th rib tip is palpated and a 2.5cm incision is marked between the 8th and 9th rib extending laterally from the 9th rib tip, the initial incision is carried down to the fascia. Palpation is repeated to confirm the rib location and dissection continues through the muscle and fascia till the distal 9th rib is fully exposed. Once the rib tip is revealed, it is grasped with forceps and then a retrograde supra-periosteal dissection is done back to the bony junction using the cautery (9).



(a–b) Costal rib: Supra-perichondrial harvest of 9th rib, and (c-d) Costal rib: Sub-perichondrial harvest of 8th rib

Inframammary approach:

It is important to mark the infra-mammary fold, especially its medial extent, preoperatively with the patient sitting, The standard incision is 3.5cm and is placed 1cm above the infra-mammary fold which usually coincides with the 5th costal inter-space, The wound is infiltrated with 6ccs of local anesthesia, The incision is made and then a cautery is used to dissect down to and through the rectus fascia. The muscles are "split," easily retracted and thereby left intact which minimizes post-operative pain. The 5th and 6th ribs are easily exposed. Next, one must decide whether to split or excise the anterior perichondrium as a possible graft for padding of the nasal skin envelope. The lateral perichondrium on either side is elevated using curved elevators, The closure is multi layered, but no drain is required (9).



Infra-mammary rib harvest of full thickness segment and partial thickness piece

c) Conchal cartilage

The convex shape of auricular cartilage can be particularly suitable for some transplants (wing or apical), it will also be a handicap for other (dorsal grafts and structural grafts), Conchal cartilage has proven indispensable as an aid in secondary or reconstructive rhinoplasty, when prior harvest, trauma, genetics, or infectious processes have rendered the nasal framework deficient and the septal cartilage unavailable to the surgeon. Auricular cartilage is of the "elastic hyaline" histologic type (type 4), exhibiting a fixed "genetically sculpted" configuration, which renders it structurally most similar to the lateral nasal cartilages and the external nasal valve. Ear grafts can be classified into two broad categories: cartilage grafts and composite grafts (skin and cartilage) (12).

Harvesting of conchal cartilage:

Grafts can be harvested easily under local anesthesia, and a significant portion of the concha (including both the cymba conchae and the cavum conchae) can be removed without risking donor-site deformity. Complete conchal cartilage excision may cause slight medialization of the pinna; thus, the more protrusive ear should be used as the donor. The ear is infiltrated anterior and posterior with a total of 5 cc of 1% xylocaine with epinephrine 1:100,000. The skin of the anterior conchal bowl should turn white and balloon away from the cartilage under the force of the injection. With the ear retracted forward, a longitudinal incision is made above the planned incision site of the cartilage. The posterior concha is exposed, the cartilage is incised below the anti-helical fold and the anterior skin is elevated. Once the skin is completely elevated, the entire conchal bowl can be removed. Hemostasis is repeated. Any sharp cartilage edges are rounded off. The rolled-up gauze is inserted in the posterior loop and pulled tightly both to cover the suture line and to serve as a support. The mold of gauze is then slipped into the anterior conchal bowl and the two sutures tied (9).

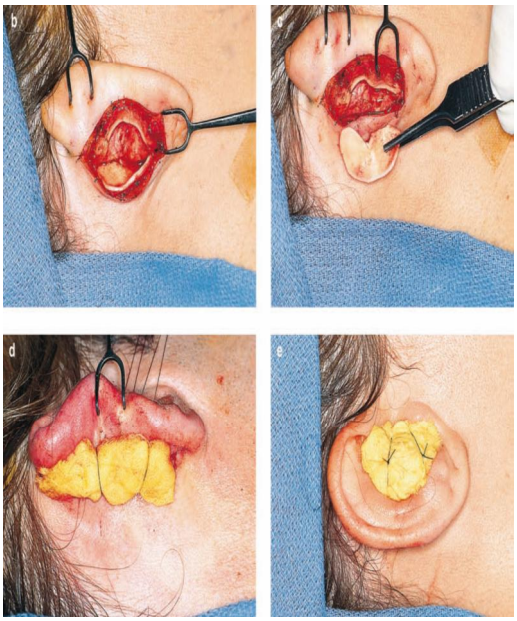
Applications of Grafts in Rhinoplasty

Spreader grafts:

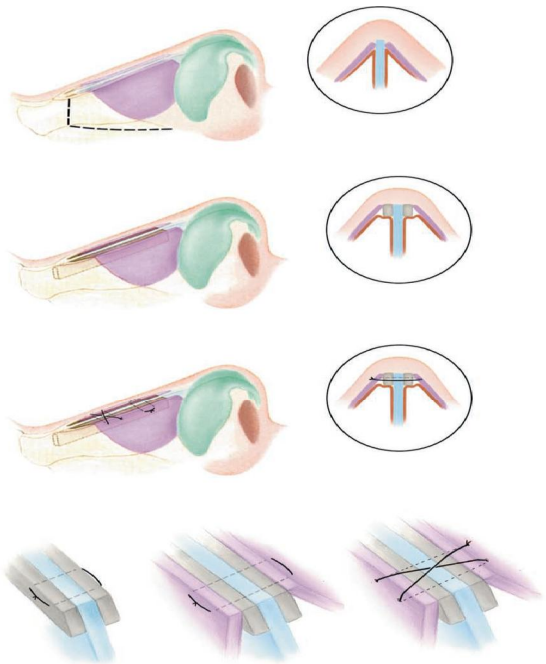
Sheen first described spreader grafts (SPG) to reconstruct the middle vault after dorsal reduction, and this technique proved one of the most valuable grafts in rhinoplasty. The initial Sheen technique was performed endonasally by placement of SPG into submucous tunnels. Variations in the technique have been described, such as endonasal placement with loop sutures, with spreader flap by folding the upper lateral cartilages (ULC), or by various shapes of the grafts. (13)

SPG are used for different and frequent purposes: avoiding inferomedial collapse of the ULC after dorsal reduction, maintaining dorsal aesthetic lines after osteotomies, correcting asymmetries of the middle third and repairing avulsion of the ULC. Their role can

also be functional when opening the nasal valve is needed or structural when used for straightening a deviated dorsal septum or lengthening a short nose. (13)



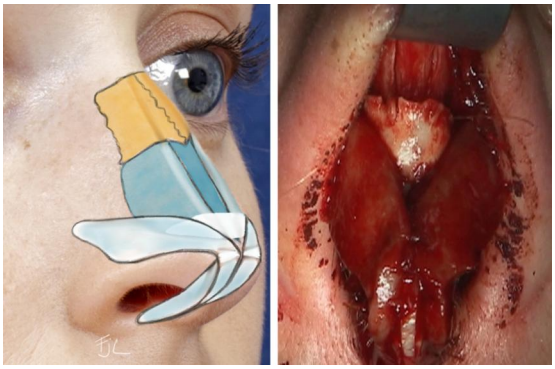
Conchal cartilage harvest



Spreader grafts

The butterfly graft

The butterfly graft is a structurally supportive onlay graft harvested from the conchal cartilage of the ear.it is positioned superficial to the anterior septal angle and caudal edge of the upper lateral cartilage. The caudal aspect of the graft is positioned deep to the cephalic margin of the lower lateral cartilage. The graft provides an outward spring effect both widening and supporting the upper lateral cartilages while also supporting the lower lateral cartilage. (14)

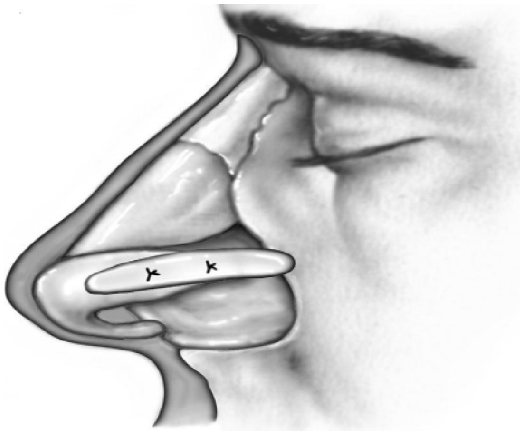


butterfly graft

Alar Batten Grafts

The alar batten graft is the workhorse for functional rhinoplasty and used when there is collapse at the sidewall. This graft is use to support the lateral nasal wall and/or lower lateral cartilage and prevent collapse during inspiration. It is not intended to create a major change in resting anatomy, nor does it address middle vault narrowing. (15)

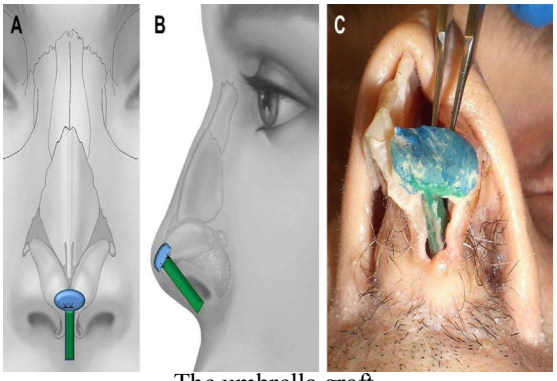
Alar batten grafts can be applied via the endonasal or external rhinoplasty approach. In both cases, the grafts are placed into precise pockets at the point of maximal lateral nasal wall collapse. Typically, curved septal cartilage or auricular cartilage harvested from the cavum or cymba concha of the ear is used. The cartilage graft should lateralize the lateral nasal wall and must be strong enough to resist the negative inspiratory forces that collapse the lateral nasal wall. (16)



Alar Batten Grafts

The umbrella graft

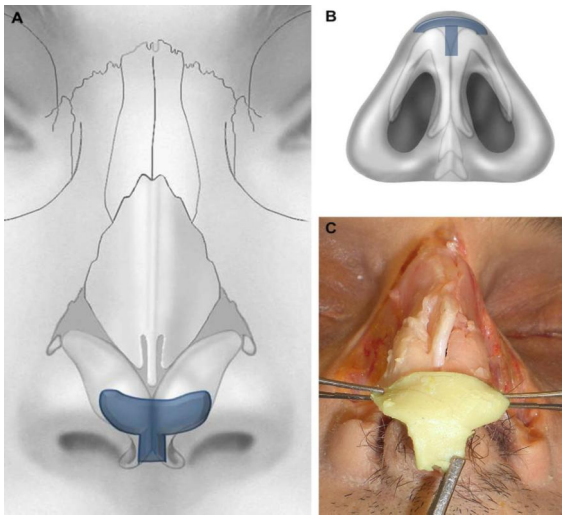
The umbrella graft has two components: a vertical strut and a horizontal onlay graft. The strut lies in a vertical pocket between the medial crura, from anterior to the nasal spine to the nasal tip. The onlay graft lies in a horizontal pocket overlying the alar domes. The configuration of a vertical strut with a horizontal onlay graft resembles an umbrella. (17)



The umbrella graft

The anchor graft

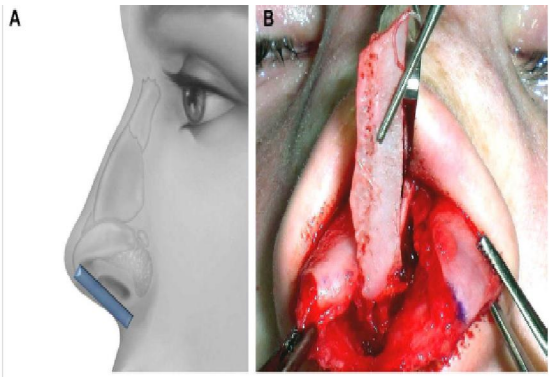
It is named for its shape, has paired transversely oriented curved wing. It is carved from auricular cartilage and is used to replace or reinforce the lateral crura thereby enhaing tip support or projection. (18).



The anchor graft

Columellar strut graft

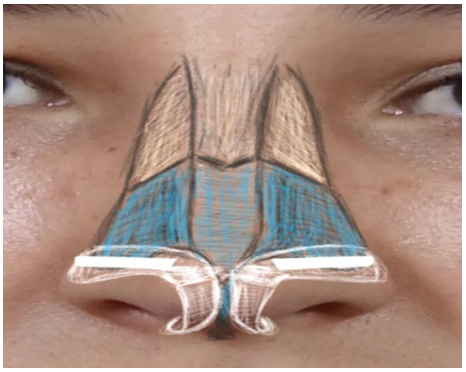
The graft is placed between the paired intermediate and medial crura, using either an endonasal or open rhinoplasty approach. The need for a strong columellar strut is most evident in noses with short, weak, or flared medial and intermediate crura. For endonasal positioning, an incision may be made in the columella, usually caudal to the medial crura. (19)



Columellar strut graft

Lateral crural strut graft

Lateral crural strut grafts have replaced alar batten grafts in the majority of primary cases. Lateral crural strut grafts provide support, but should never be visible. Hiding the graft beneath the lateral crura is essential. A true marginal rim incision is used when the Type III lateral crural strut graft is placed into and sutured along the nostril rim. (9).



Lateral crural strut grafts

Sutures in Rhinoplasty:

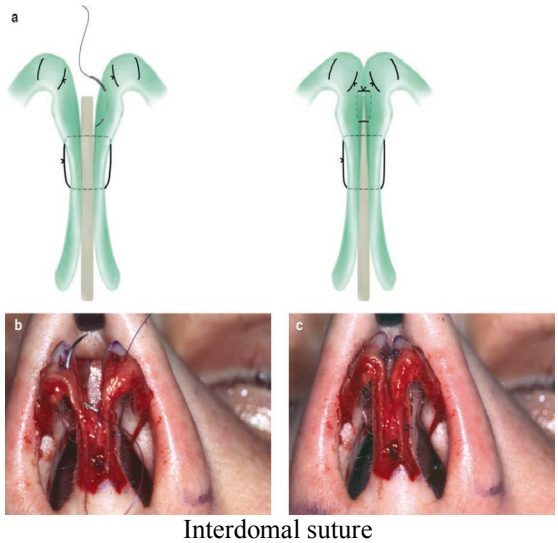
Suture techniques to shape the nose have witnessed a dramatic increase since the early 1980s. For many years, it was believed that permanent sutures would be necessary to achieve a permanent effect on cartilage contour. That has simply not been proven to be true. Polydioxanone (PDS) sutures work just as well as permanent sutures and have the benefit of not causing stitch reactions (by protruding through the skin) or microabscesses that manifest as a bad odor noted by the patient (20).

Before undertaking nasal tip shaping with suture techniques, 3 surgical tenets should be followed to obtain consistent and reproducible results: (1) use a model, (2) preserve a 6-mm strip of lateral curs, and (3) recognize the delayed effects of suture on cartilage (21).

Sutures techniques are an indispensable means to biologically sculpt the cartilage of the nose. Here the authors review their use in tip-plasty and present a 4-suture algorithm that allows for simple, complete control in sculpting the shape of all nasal tips in primary rhinoplasty. The 4 sutures are a medial crural suture, bilateral intradomal sutures, and an interdomal suture along the cephalic edge of the lower lateral cartilage. Correct utilization and placement of these sutures ensures a symmetric tip, good projection, a proper double break to the columella, symmetric tip defining points, and an appropriate angle of divergence to the lateral crura (21).

Inter-Domal Suture:

This suture brings both middle crura together. The suture is placed approximately 3 mm posterior to the dome on the cephalic side of the middle crus (21). It keeps the domes together, enhances symmetry, and also provides strength to the overall tip complex. It is a simple vertical suture that begins on one crura adjacent to the domal creation suture, exits above the crural suture, then enters the opposite crura at the same level, and exits adjacent to the domal creation suture. The knot is gradually tightened until the ideal width is achieved. The simplicity of inserting this stitch is due to its place in the tip suturing sequence (23).

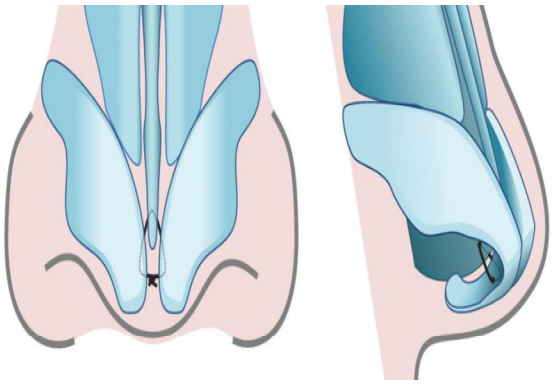


Interdomal suture

Columellar Septal Suture:

This suture (a 4-0 PDS) secures the tip complex to the caudal septum, and provides a slight projection if needed. The suture is not intended to substitute for the columellar strut when there is tip deficiency; it is effective for minor adjustments of the tip complex (21).

With this suture technique, a large needle is passed between the leaves of the middle crura at the point of divergence of the intermediate crura. The needle is then passed through the anterior septal angle, which is usually located more anterior to the columella–septal entry. The needle is then passed back between the leaves of the middle crura. As the knot is slowly tightened, it pulls the tip cartilage up against the caudal septum, which corrects any existing hanging columella and provides a small amount of tip projection (23).

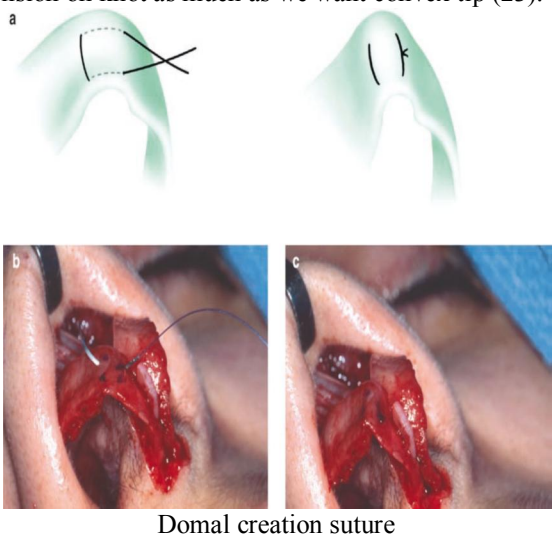


Columellar Septal Suture

Transdomal (dome creation, domal definition) suture.

Most patients undergoing primary rhinoplasty exhibit a convex lateral crura–flat dome. For such patients, transdomal sutures are very effective to flatten the lateral crura and decrease the horizontal contribution to the bulbous nasal tip contour. Therefore, narrows the nasal tip by reducing the angle between the domal and lobular segments of both middle crura, and reduces the interdomal distance (20).

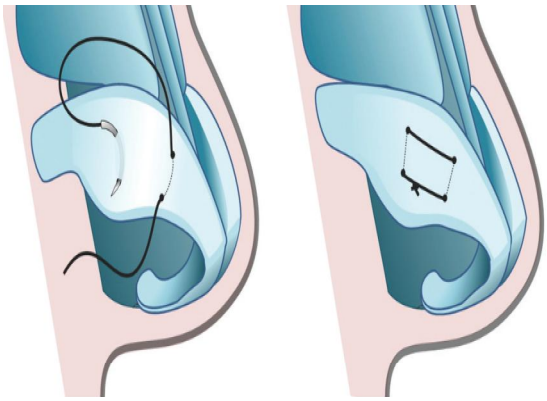
It is a horizontal mattress suture across domal segment and arches it down to create convex dome, tension on knot as much as we want convex tip (23).



Domal creation suture

Lateral crural mattress suture:

It is used to control curvature, If transdomal sutures do not reduce the convexity of the lateral crus, then lateral crural mattress sutures may be used to obtain flat lateral crus (20). the needle is applied perpendicular to the long axis of the lateral crus as a bite is taken on one side of the forceps. The second bite is taken on the other side of the forceps (about 6 mm away from the first bite). The knot is not tied tightly, just tight enough to straighten the lateral crus.. If a bulge develops, one or more lateral crural mattress sutures should be applied. It is often necessary to apply 2 or 3 lateral crural sutures to achieve the desired result. Of note, each suture supplies more strength to the lateral crus, and the effect is additive (21).



Lateral crural mattress suture

Tip positioning suture:

The tip position suture achieves two very much desired tip characteristics – tip rotation and sufficient tip projection to produce a supra-tip break. A 4–0 PDS suture needle is used. The surgeon stands at the top of the table. The suture is transverse beginning with a pass through the mucosa of the infra-lobule with optional inclusion of the columellar strut. The next pass is through the dorsal septum about 3–4 mm back from the anterior septal angle usually avoiding the spreader grafts, then knotting not tightly (23).

Domal stabilization suture:

After all tip modification techniques, it is appropriate to place the domal stabilization suture. A 5.0 polydioxanone suture is placed between the medial third portions of the lateral crura bilaterally just posterior to the junction of the intermediate and lateral crura along their cephalic borders. The knot is placed in a buried interrupted fashion (22).

Tip rotation suture:

Tebbetts introduced the tip rotation suture, which passes from the cephalic edge of the medial crura to the dorsal septum near the septal angle to produce and maintain tip rotation. The nasal tip is then rotated cephalically with an increase in the columellar lobular angle. A rotation suture is designed to increase the angle of tip rotation by advancing the middle crura onto the septum just above the septal angle (20).

The intercrural suture:

The intercrural suture, which is simply a mattress middle crus suture, can be used to reduce the width of the cartilages in this location. PDS (5–0) is used for purchase of the inside of the middle crus (from posterior to anterior) on one side and then on the contralateral side. The knot is located between the middle crura. Care is taken to avoid tying the knot too tightly and thus overly narrowing the normal width of the middle crus (21).

Conclusion

The topic of grafts in rhinoplasty would undoubtedly require a more detailed and extended description, as confirmed by the huge number of textbooks and articles published on this subject. The aim of this article was only to show the different types of grafts used in rhinoplasty either closed or open, either primary or secondary. With more focusing on the natural grafts used.

The nasal tip is one of the most important features of facial aesthetics, and successful rhinoplasty depends on maintaining adequate nasal tip projection and rotation. Securing the position and shape of the nasal tip is one of the most challenging problems in rhinoplasty. Suturing techniques provide a reliable alternative to tip plasties. Nasal tip sutures have long been used as noninvasive techniques. Each suture technique has some benefits, and there are important points to note when using these techniques.

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