Structural Grafts and Suture Techniques in Rhinoplasty

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38.1 Introduction

Structural grafts and suture techniques play an essential role in rhinoplasty. Over the decades, numerous innovations and modifications in graft techniques and sutures have been described. Many long-established techniques have stood the test of time with minor modifications [1]. In this chapter, we intend to discuss the grafts and suture techniques that are most frequently described and employed. A review of all grafts and suture techniques would, of course, be beyond the scope of this chapter.

38.2 Choice of Graft Material

Various graft materials are available for rhinoplasty. Important factors determining the choice of the graft material include adequate integration of the graft at the recipient site, sufficient flexibility, and/or structural stiffness for the intended purpose as well as relatively simple and safe harvest of the graft.

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Autologous transplants unite many favorable features and represent the most frequently utilized graft source in rhinoplasty. Among the autologous grafts, septal cartilage is most frequently utilized because of its ready availability and easy access within the surgical field. The biochemical and biomechanical properties of septal cartilage have been researched in multiple studies and are relatively well understood [2, 3]. In case of inadequate availability of septal cartilage, conchal cartilage represents a good alternative graft source. Relatively large transplants may be obtained from the cavum conchae. The area of the cymba conchae and of the tragus provides smaller but straight pieces of cartilage. Overall the typically more curved structure of auricular cartilage represents a substantial drawback of this grafting material. Scoring and weakening of this cartilage and suture fixation on PDS foil have been discussed more recently as an approach to generate straighter transplants. Calcification of auricular cartilage presents another clinical problem which is typically more pronounced in elderly patients when compared to septal cartilage.

Another alternative graft source is costal cartilage. A larger volume of cartilage or a composite of cartilage and bone is obtained at the expense of an additional remote donor site with its associated morbidity. The propensity of costal cartilage to warp may be recognized early after explantation when the cartilage is split and placed in a sterile liquid. Donor site morbidity and complications may include injury of the pleura and deformities of the chest wall. Techniques to reduce these risks include the preservation of a

M.A. Shiffman, A. Di Giuseppe (eds.), *Advanced Aesthetic Rhinoplasty*,
DOI 10.1007/978-3-642-28053-5_38,

thin sliver of costal cartilage on top of the parietal perichondrium as well as the reconstruction of the rib contour with pieces of residual cartilage wrapped in a Vicryl net [4, 5].

An alternative to the harvest of costal cartilage and bone may be the harvest of calvarial bone. After a trichophytic incision over the parietal bone, a trough is drilled around the intended graft. The graft is then harvested with an angled oscillating saw which separates the external table from the internal table. External table can provide osseous grafts of substantial size a low morbidity [6]. The use of homologous preserved human cartilage is infrequently reported. It seems to be mainly useful for the correction of minor contour deformities while the use of preserved bank cartilage seems not to be suitable for structural and load-bearing purposes [7].

Another allogenic material is acellular dermis. This commercially available material is produced from human cadaveric skin and has been utilized to correct contour irregularities. Reported resorption of this material is up to 50% of the originally placed volume. This freeze-dried material is typically rehydrated prior to insertion. Some authors report insertion in the frozen, stiff state and rehydration in situ [8].

Among the synthetic implant materials, predominantly porous polyethylene and expanded polytetrafluoroethylene have seen a longer-term acceptance. Porous polyethylene allows for tissue ingrowth. This relatively rigid material seems to be associated with a lower rate of extrusion and infection than polytetrafluoroethylene. However the risk of extrusion seems to be considerable with any synthetic material implanted in the nose [9].

38.3 Surgery of the Nasal Tip

Correction of the nasal tip typically requires combination of multiple different techniques. The anatomic structures predominantly responsible for the shape of the nasal tip are the alar cartilage, the caudal septum, and the surrounding soft tissues. Accordingly most corrections of the nasal tip intend to modify these structures. The intradomal suture is a suture technique frequently utilized to narrow the dome of the alar cartilage. This mattress suture may be placed at different heights of the dome. Various effects may be achieved according to the exact placement of the suture, including a modification of the transition to the supratip and the shape and width of the nasal tip itself (Fig. 38.1). The intended effect may be modified by varying the tying force of the suture. The alar spanning suture may be regarded as a variation of the intradomal suture. The alar spanning suture runs between the medial aspects of the lateral alar crura and through the medial crura. The narrowing effect of the alar spanning suture is more pronounced than that of the intradomal sutures. Medial crura sutures have a similar narrowing effect. These are placed as simple interrupted sutures between the medial crura of the alar cartilage. Their effects may include enhanced support of the nasal tip and derotation of the lateral crus of the alar cartilage (Fig. 38.1).

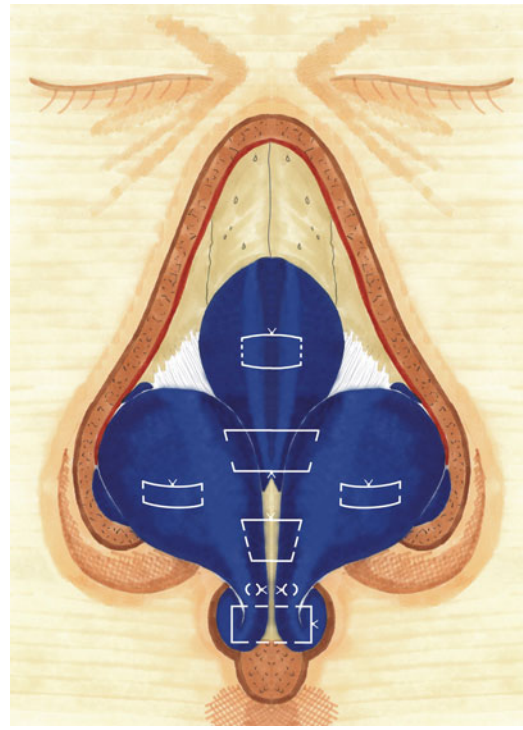

Fig. 38.1 From top to bottom: flaring suture, high interdomal suture, lateral mattress suture, interdomal suture, intradomal suture, medial crural suture

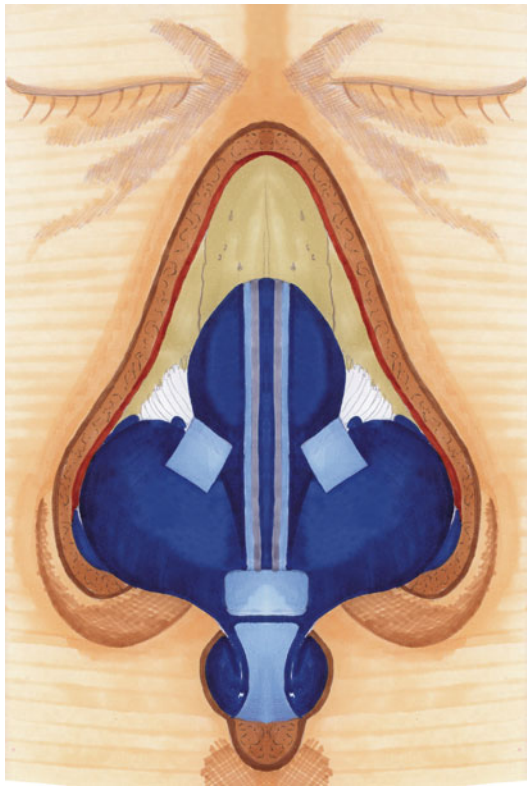

Fig. 38.2 From top to bottom: spreader grafts, intercartilaginous grafts, cap graft, shield-type graft

Conservative resections and suture techniques are often adequate to correct the nasal tip. If these measures are insufficient, cartilaginous transplants may be required. A cap graft is placed on top of the domes in order to correct asymmetries, contour irregularities, or insufficient projection of the nasal tip (Fig. 38.2). Additional crushed cartilage or soft tissue transplants may be placed on top of a cap graft in order to further camouflage the typically finely shaved edges of the transplant. The natural bifidity of the nasal tip is typically abolished with the placement of a cap graft. The nasal tip appears more round. This so-called unitip deformity is rarely noticeable or bothersome to the patient. An important feature determining the shape of the nasal tip is the transition from the tip over the infratip lobule to the columella. Dissection of an intercrural pocket and suture fixation of the columella to the caudal end of the septum is termed the tongue-in-groove technique (Fig. 38.3). This advancement of the

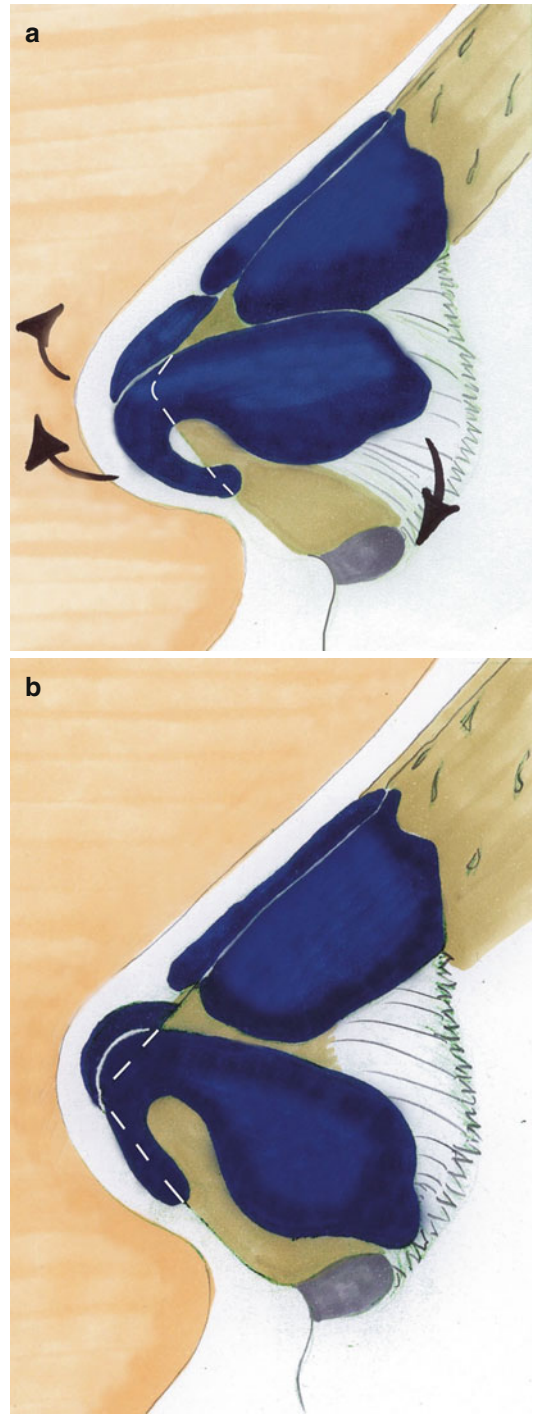

Fig. 38.3 (**a**) Tongue-in-groove technique: rotation of the nasal tip. (**b**) Tongue-in-groove technique: fixation of the columella and nasal tip to the caudal end of the septum

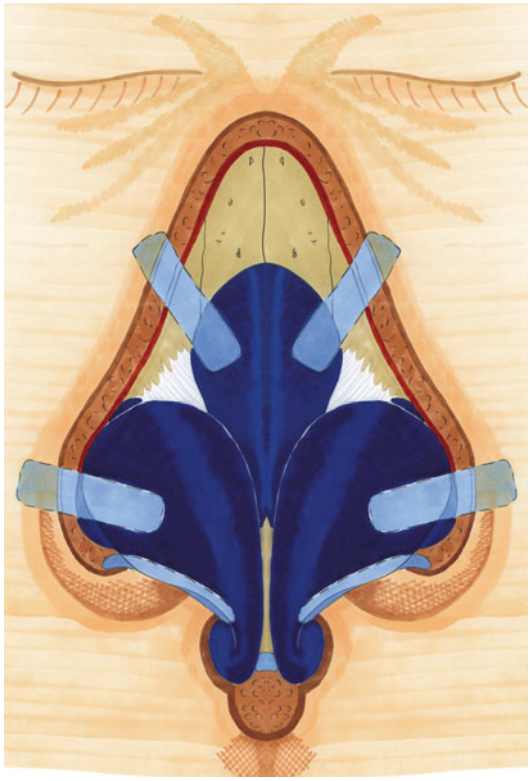

Fig. 38.4 From top to bottom: vertical alar batten grafts, alar strut grafts, alar rim grafts, columellar strut graft

Fig. 38.5 Caudal septal extension graft: side-to-side mattress suture fixation of a caudal septal extension transplant

columella along the caudal end of the septum and subsequent suture fixation allows effective projection and deprojection of the nasal tip as well as modification of columella show [10]. The placement of a columella strut graft may also substantially change the infratip lobule and associated structures. The columella strut may be inserted through a retrograde pocket or from above between the domes. It is suture-fixated between the medial crura of the lower lateral cartilages (Fig. 38.4). The columella strut may enhance tip support and correct a rounded columella. It should not reach all the way to the interior nasal spine as movement of the spine may then result in a bothersome clicking sensation over the spine. A more effective tool to control the position of the columella and the projection of the nasal tip is the caudal septal extension graft. This graft may be fixed to the caudal end of the septum with an end-to-end suture or a side-to-side mattress suture (Figs. 38.5, 38.6, and 38.7). The caudal septal extension graft may be combined with a columella pocket and a tongue-in-groove technique. In addition to good control over the projection of the nasal tip, caudal end deviations and deficiencies of the nasolabial angle may be corrected through this graft as well. Care must be taken to fashion the graft thin in order to prevent thickening of the columellar base [11].

A shield-type tip graft may be placed to change the infratip lobule to tip transition, to derotate the nasal tip, and to increase projection (Fig. 38.2). After it is fashioned with the edges shaved to paper-thin, it is suture-fixated to the medial crus bilaterally. The shield-type tip graft carries the long-term risk of migration and perception of its edges. It seems to be less frequently used because of these deficits. One technique to reduce the risk of visible edges is to connect alar rim grafts with the anterior corners of the shield-type tip (Figs. 38.2 and 38.4). The shield graft is typically placed through the open approach. On the other

Fig. 38.6 (**a**) Preoperative young female patient with ptotic and underprojected nasal tip. (**b**) Postoperative, after placement of a caudal septal extension graft and bilateral spreader grafts

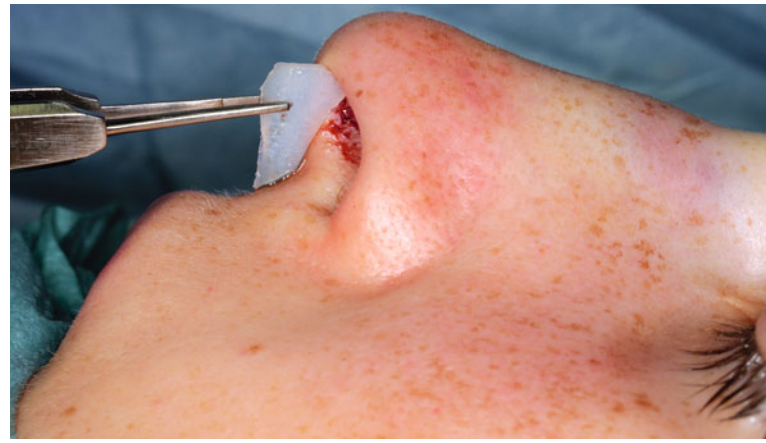

Fig. 38.7 Caudal septal extension graft, intraoperative

hand, the extended columella strut-tip graft is a transplant designed for the endonasal approach [12]. This graft may affect projection, rotation, and definition of the nasal tip favorably. Significant long-term problems have not been described with this graft.

38.4 Techniques to Correct the External Nasal Valve

Alar rim grafts may contribute to improvements in the function of the external nasal valve. Ideally these transplants are curved. Such curved grafts may be obtained from deviated or split and warped septal cartilage. The transplant is inserted into a pocket anterior to the caudal end of the lateral crus. The alar rim graft may also be applied to correct alar retraction and secondary columella show. For this transplant to fulfill any of these functions, it needs to be of adequate size and structural strength. When placed through the open approach, it may be connected to the edges of a shield-type tip graft as delineated above [13].

The lateral crural suture is designed to contribute to the correction of the external nasal valve as well. This mattress suture runs through the lateral crus of the alar cartilage (Fig. 38.1). It may be employed to accentuate the convexity of the lower lateral cartilage or to correct a concave lower lateral cartilage. These effects may be enhanced by scoring incisions of the undersurface of the alar cartilage. A straightening effect of the lower lateral cartilage may be achieved with the lower lateral turnover suture. In this case, a wide cephalic margin of the lower lateral cartilage is incompletely incised and then flipped over and suture-fixated to the caudal aspect of the lower lateral cartilage. When the lateral crus is thin and lacks sufficient height but requires correction of its three-dimensional shape, an alar strut graft may be employed. This graft is suture-fixated to the undersurface of the lateral crus after the vestibular skin has been dissected off the lateral crus. This maneuver allows effective straightening of the lateral crus and may contribute to correcting a boxy tip as well as correcting external nasal valve collapse. The alar strut graft is typically designed to reach laterally past the lateral crus and to fit into a generously dissected pocket lateral to the pyriform aperture (Fig. 38.4). This technique is also well suited to correct overprojection of the tip [14]. In this case, the entire lateral crus is dissected off the undersurface and completely freed. It may then slide freely into the lateral pocket and thus contribute to deprojecting the nasal tip. This maneuver has worked well in the authors' hands to avoid division of the domes or the lateral crus. Nasal valve collapse may be difficult to treat and may at times require the combination of multiple techniques for a best possible result. The lateral suspension suture may be a helpful adjunct to treating this difficult problem. This suture grasps the soft tissue over the pyriform aperture and pulls it into an anterior superior direction. It may be fixated to a transconjunctivally applied bone

anchor or through different suture techniques. In the authors' experience, this technique works only when the soft tissue insertions of the alar base with the pyriform aperture have been mobilized and the alar base has been dissected adequately to move freely and be refixated through scarring in the new position.

38.5 Techniques to Correct the Internal Nasal Valve and the Middle Vault

The intercartilaginous graft is suitable to correct alar retraction and overrotation of the nasal tip. These two deformities are typically a result of previous surgical overcorrection. The intercartilaginous graft is placed between the caudal end of the upper lateral cartilage and the cephalic margin of the alar cartilage (Fig. 38.2). In order to achieve efficient derotation of the alar cartilage, it is typically necessary to widely undermine and release the scar tissue in this area. The intent of this maneuver is to move the alar cartilage down to its previous more physiologic location [15].

The alar batten graft may be placed to correct internal nasal valve collapse and overaccentuation of the horizontal alar fold. Both deformities are frequently a result of prior overresection of the alar cartilage. The graft is suture-fixated over the lateral aspect of the upper lateral cartilage (Fig. 38.4). Determined by the extent of the deformity, the transplant may be extended laterally and placed into a pocket dissected over the lateral aspect of the pyriform aperture [16]. This placement is similar to but more superior to the placement of an alar strut graft. The alar batten graft may also be placed in a more vertical position. This results in a more pronounced outward rotation of this graft (Fig. 38.4). Extra caution must be taken to shave the edges of a more vertically placed alar batten graft very thin to avoid palpable contour deformities over the pyriform aperture.

An outward rotation of the upper lateral cartilages may also be achieved by placement of a flaring suture (Fig. 38.1). This mattress suture grasps the lateral aspect of the upper lateral cartilage and is tied over the anterior septal angle. The widening effect of this suture on the internal nasal valve seems to be more pronounced when the upper lateral cartilage has been released from the septal cartilage and spreader grafts have been inserted [17].

The principle of spreader graft placement is delineated in Figs. 38.2, 38.6, 38.8, 38.9, and 38.10. The spreader graft is a frequently utilized transplant which is placed between the previously released upper lateral cartilage and the septal cartilage. Typically a rectangular transplant of septal cartilage is inserted. A spreader graft with a trapezoidal cross-sectional area is ideally suited to reconstruct the nasal valve angle in a more physiologic manner [18]. When a higher dorsal hump has been resected and the height of the upper lateral cartilages has been preserved, these cartilages may be scored and folded on themselves. The folded segment may act as an auto turn in spreader graft and suture fixated to the septal cartilage like a conventional spreader graft. This elegant method finds frequent use in the authors' routine. Its main advantage is the preservation of precious septal cartilage. In the typical case of a cartilaginous saddle nose deformity, the onlay spreader graft is a useful transplant. This wide rectangular graft is placed on top of the anterior edge of the septum and is suture-fixated to the remnants of the upper lateral cartilages. This graft reconstructs the previously destroyed arc that is physiologically formed by the upper lateral cartilages. Endonasal spreader grafts may be inserted from the undersurface of the upper lateral cartilages [19]. A narrow mucosal tunnel is dissected along the undersurface of the upper lateral cartilage, and an appropriately shaped cartilaginous graft is inserted into this tight pocket. This graft is mainly cosmetic and typically contributes to opening the nasal valve only to a mild degree. The conventional spreader graft may be extended and articulated with a columella strut graft. This complex is then termed a septocolumellar interposition graft and allows effective derotation of an overly rotated and short nose. Asymmetries of the middle vault may be corrected by placement of asymmetrically fashioned spreader grafts. Another graft that has been designed to correct the internal nasal valve is the

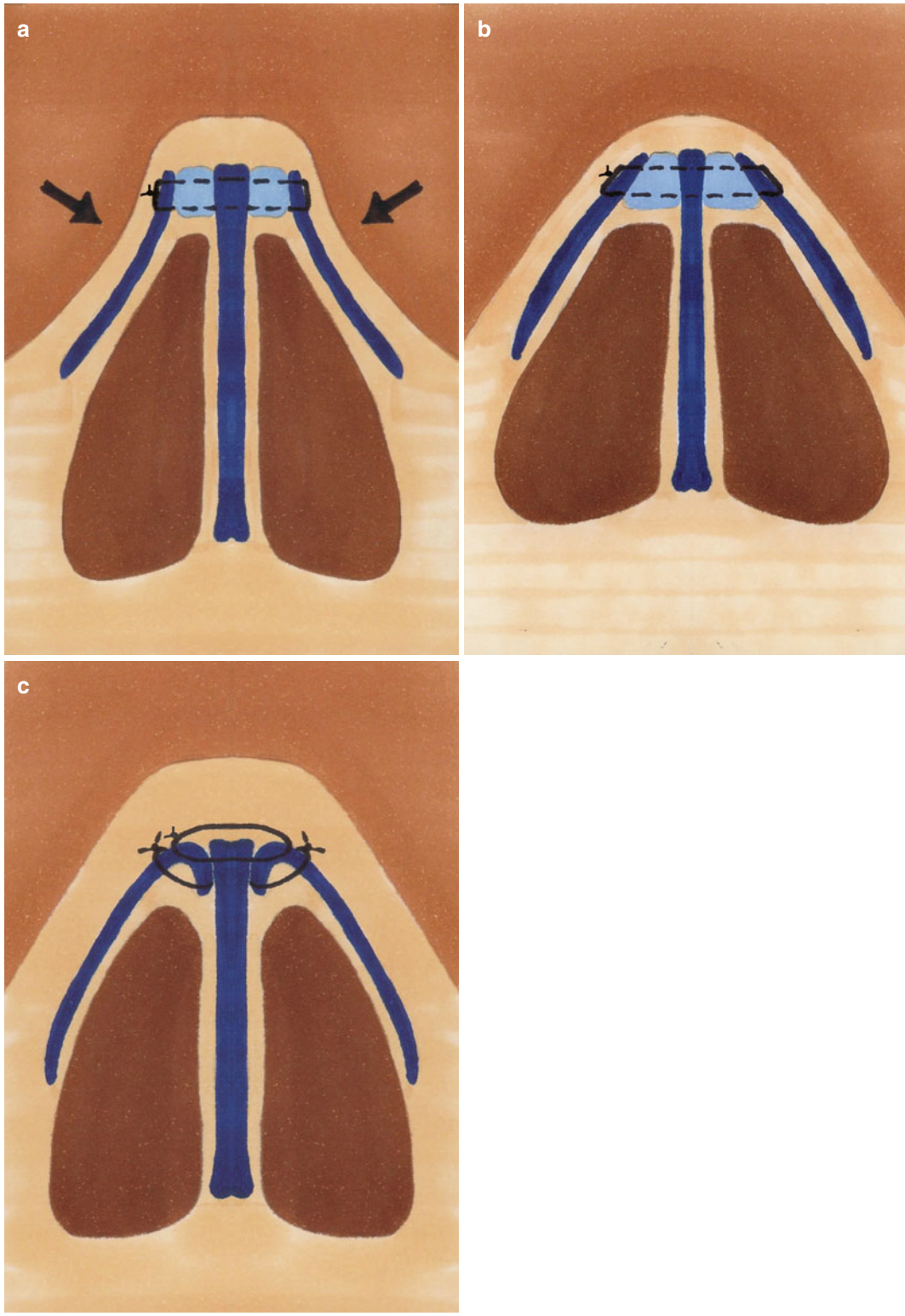

Fig. 38.8 (**a**) Suture fixation of standard spreader grafts may narrow the nasal valve angle, especially when the mattress suture is placed low. (**b**) Insertion of spreader graft with more physiologic, trapezoidal cross section may open the nasal valve angle further. (**c**) Suture fixation of autospreader graft after scoring and folding of the upper lateral cartilage

Fig. 38.9 (**a**) Patient with residual cartilaginous hump and overprojecting tip after previous surgery. (**b**) Surgical result after hump reduction and placement of autospreader grafts

Fig. 38.10 (**a**) Patient with deviated middle vault. (**b**) Surgical result after placement of bilateral spreader grafts

butterfly graft [20]. This rectangular graft is placed on top of the anterior septal angle. It is suture-fixated on either side with the lower edge of the upper lateral cartilage. Through its inherent elasticity, this graft lateralizes the upper lateral cartilages and thus opens the internal nasal valve angle. Important drawbacks of this transplant include the limited flexibility and recoil of the transplanted material and its tendency to fracture when the nose is pinched.

38.6 Techniques to Correct Deficits of the Middle Vault and the Supratip

Augmentation of a saddle nose deformity is challenging. Successful techniques with long-term stability typically require substantial transplantation of a combination of conchal cartilage (Fig. 38.11), costal cartilage (Fig. 38.12), costal bone, or calvarial bone. A composite graft of cartilage and bone may be harvested from the rib. When bone is utilized as a transplant, its solid and stable fixation appears to be an important factor contributing to a good, long-term result. Fixation with wire or screws appears to be more reliable than suture fixation. Transplants containing bone typically result in substantially increased rigidity of the reconstructed nose. More recently, alternative less-rigid methods of reconstruction are favored.

Costal cartilage has an inherent tendency to warp. After explantation of costal cartilage, the transplant may be cut in slices and placed in sterile saline. After 20–30 min, one may observe the early tendency of the cartilage to warp. Typically the more central aspects of the cartilage show a lesser tendency of warping. As described by

Fig. 38.11 Dorsal augmentation with cartilage graft, intraoperative

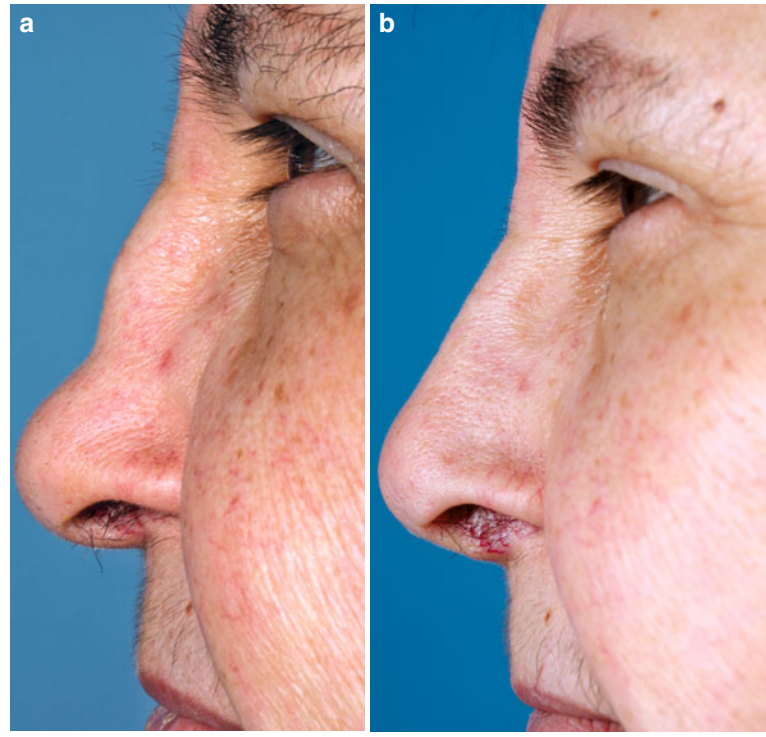

Fig. 38.12 (**a**) Preoperative saddle nose. (**b**) Postoperative, after dorsal augmentation with cartilage graft

Swanepoel [21], segments of costal cartilage may be sutured in reverse order on top of each other. This so-called laminated beam technique allows creation of a straight segment as the inherent forces of warping of each segment counteract each other. Saddle nose reconstruction with a complete costal cartilage dorsal transplant is reliable, but its two shortcomings – rigidity of the nose and tendency to warp – may make alternative methods more attractive.

A newer method of correcting a saddle nose deformity without generating too rigid a nose is diced and wrapped cartilage. Small fragments of cartilage of any origin are wrapped in autologous fascia to form a three-dimensional graft. Early reports describe oxycellulose as a wrapping sheath.

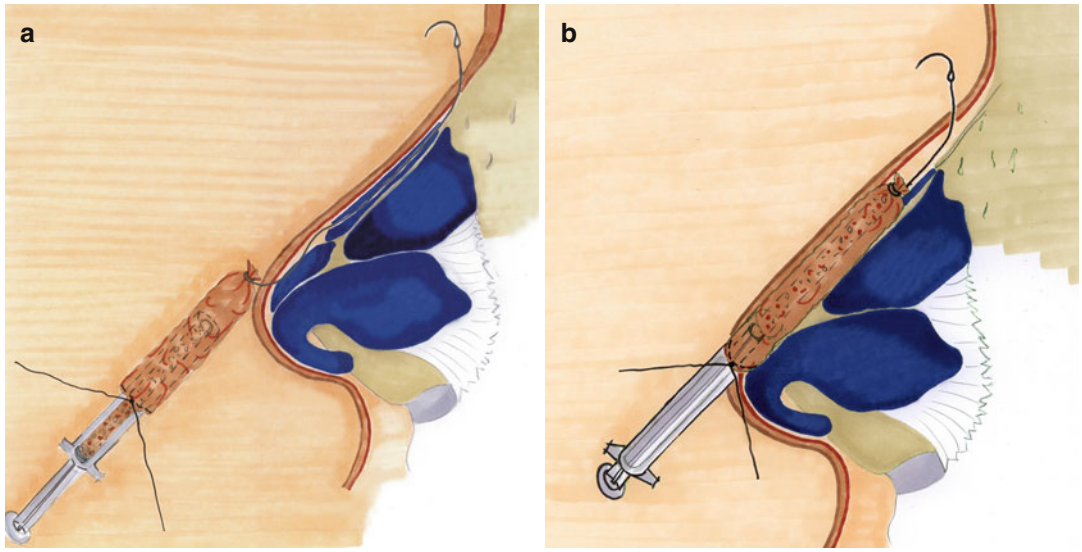

Fig. 38.13 (**a**) Wrapped diced cartilage for saddle nose augmentation: the prefabricated fascial sheath is inserted into the dorsum using a guide suture. (**b**) The fascial sheath is filled through the syringe with diced cartilage fragments. Subsequently the fascial tube is closed with the previously prepared purse string suture

Increased resorption of the graft has been associated with oxycellulose, and the use of autologous material, typically temporalis fascia, is hence favored. Alternative material may include costal or conchal perichondrium. The autologous fascia is sutured to a blind-ending tube and advanced over a 1-mL syringe (Fig. 38.13). The tube is then inserted into the nasal defect and filled with dice of cartilage through the 1-mL syringe. Once an adequate volume of cartilage has been injected, the syringe is removed and the open end of the tube is tied with a suture. The resulting reconstruction is softer than costal cartilage and bone and also has no significant risk of warping [22, 23].

Finer dorsal and supratip contour irregularities may be augmented with crushed or shaved cartilage. We prefer the use of very fine shaved cartilage. Crushed cartilage has a variable resorption rate of approximately 20–60%. Very thinly shaved cartilage is not associated with crush injury to the chondrocytes and thus has likely a less significant rate of resorption.

Alloderm has also been utilized to correct minor contour irregularities. This material is associated with prolonged edema formation and very low rates of resorption. Soft synthetic materials including Gore-Tex and Mersilene mesh are also less frequently utilized because of their risk of infection and extrusion.

Conclusions

Transplants and suture techniques are the key tools when performing septorhinoplasty. Autologous materials have stood the test of time and have proven to be the best graft material in the vast majority of cases. Rigid reconstruction with costal cartilage or calvarium seems to be a secondary alternative if softer methods of reconstruction are available. The use of suture technique may be very helpful, but the basic principle that adequate dissection and mobilization must be achieved before repositioning and refixation of the tissue can be reliably achieved must be respected.

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