Uses of Various Grafting Techniques in External Approach Rhinoplasty: An Overview

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Received: 16 March 2016 / Accepted: 20 June 2016 / Published online: 27 June 2016
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Abstract The surgeons performing rhinoplasty found Graft selection the greatest challenge. To avoid an immune response the preferred choice thus far for nasal reconstruction would be autograft compared to allograft due to its lower rate of rejection. We have evaluated 30 patients who underwent open rhinoplasty and We used conchal and septal cartilaginous grafts in various forms by the open approach to correct various nasal deformities compared our experience regarding the operative technique, graft availability, indications, and limitations. No bony graft material or synthetic materials were used. Preoperative extensive evaluation of the patient was done in order to determine the type of deformity and the type of graft to be used in order to correct the deformity. Preoperative and postoperative photographs were taken in four basic views: frontal, lateral, lateral-oblique and basal in order to assess the results of the surgery. The study was done on 30 patients (20 male and 10 females) using the external rhinoplasty approach using the septal and conchal cartilages in different forms. Autologous septal cartilage was used in most of the patients (25 out of 30) and conchal cartilage was used in 5 patients. Multiple grafting techniques were used in some patients. Three patients had traumatic etiology. Columellar strut graft along with TIG technique was used in 16 patients, spreader graft was used in 8 patients, and septal extension graft was used in 5 patient and shield graft in 1 patient. Septorhinoplasty continues to evolve through various new techniques and modifications with the main goal to improve functional nasal airway and to restore cosmetic

harmony to the face. Optimum result is very much dependent on the surgeon's attention to functional, aesthetic, and reconstructive principles and graft selection.

Keywords Rhinoplasty · Graft · Conchal cartilage · Septal cartilage

Introduction

Rhinoplasty is an operation planned to reshape the anatomic features of the nose into a new more pleasing relationship with the surrounding facial features. Septorhinoplasty consists of septoplasty, tip remodeling, hump removal, narrowing of nose with osteotomies, and final correction of subtle deformities. The results achieved in rhinoplasty are directly related to the surgeon's ability to elucidate how subtle change in the bony and cartilaginous support of the nose will change its appearance [1]. To sculpt the nasal framework in rhinoplasty numerous grafting techniques have been developed on the principal that maintenance of major supporting structures of the nose is fundamental for aesthetic and functional purposes. However, the type of graft, its shape, position, and usage may vary depending on the situation and the objectives of the surgeon.

In a twisted nose, whether posttraumatic or nontraumatic, the nasion and nasal tip are in the same vertical plane with the midvault deviated to one side. On the contrary, in a crooked nose, the nasion, mid-vault, and the nasal tip are in a straight line off the vertical plane. A saddled nose, owing to the loss of the dorsal aspect of the quadrangular cartilage, has a supra tip depression, shortening of nose, and often over rotation of the tip. The nasal tip can also be deformed in many ways—over projected,

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under projected, rotated, and abnormally shaped, amongst others. Nasal deformities and alar asymmetry are most significant in cleft lip/cleft palate patients as compared to traumatic or nontraumatic nasal deformity patients.

New techniques are formulated with greater attention to the nasal anatomic variability in humans. Proponents of the closed or endonasal approach emphasize on its advantages, namely, absence of external incisions and less dissection required, therefore minimizing soft tissue trauma and subsequent scarring. It is less dependent on postoperative steroids to reduce postoperative swelling. However, exposure to the surgical field is very limited, and tip supporting mechanism tends to be compromised with time [2].

On the contrary, the open or external approach offers a much superior exposure of the nasal tip for inspection of the nasal osteocartilaginous framework without anatomic distortion, therefore allowing proper remodeling of the nasal framework. The surgeon can be assured of accuracy while performing detail suturing and resection manipulation. It also offers unparallel accuracy for structural diagnosis and placement or manipulation of graft, if needed, under direct vision.

Being a tertiary referral hospital, the author's preference for open approach also facilitates the teaching and learning of nasal anatomy and surgical techniques [3].

The nasal profile and skin thickness varies among different races. The term crooked nose is commonly used for all of the clinical conditions involving deviation of the nasal pyramid from the median line (Table 1). In these cases, it can appear vaguely C-shaped or S-shaped or wholly displaced to one side or the other i.e. I-shaped [4].

In 1931, in his masterpiece "*Nasenplastik und sonstige Gesichtsplastik*", Joseph first described septal and auricular cartilage grafts for the repair and reconstruction of nasal defects. All grafts were inserted through endonasal incisions until the 1970s (i.e. the shield and spreader grafts proposed by Sheen in 1984, the columellar strut and spreader graft described by Baum in 1977, the columellar batten proposed by Goldman in 1953 and the "onlay graft" placed on the domes described by Peck in 1983) [5].

In "open" rhinoplasty grafts must be an integral part of the analysis and operative planning, and not an intraoperative necessity". In the "transcolumellar" approach, grafts have a "structural" role, thus becoming an essential part of the new, altered, (sometimes) unnatural anatomy of nasal

structures: grafts are used in about 99 % of all "open" rhinoplasties [6, 7]. In "closed" rhinoplasty, grafts have a "defining" role and should be used only when necessary during the surgical procedure: preserving the integrity of nasal skin enables a precise assessment of the result obtained during surgery (and therefore the intraoperative necessity of grafts), thus allowing to determine the need for possible modifications or removal of grafts [5].

Materials and Methods

This is a retrospective review of 30 patients with either developmental or posttraumatic nasal deformities who were treated surgically in the department of otorhinolaryngology SKIMS Medical College, Bemina. Preoperative extensive evaluation of the patient was done in order to determine the type of deformity and the type of graft to be used in order to correct the deformity. The nasal profile and the skin thickness of the individual groups were assessed. Following which, these patients either underwent different surgical procedures, after a proper consent was obtained. The incision used was inverted V-shaped trans-columellar in all the cases. Local infiltration was given using 1:100,000 xylocaine epinephrine solution. All surgeries were done under general anaesthesia. The conchal and septal cartilaginous grafts were used in 30 patients in various forms by the open approach to correct various nasal deformities. Eight patients had only external nasal deviation while the rest had both external nasal deviation and septal deviation. No bony graft material or synthetic materials were used. Preoperative and postoperative photographs were taken in four basic views: frontal, lateral, lateral-oblique and basal in order to assess the results of the surgery (Figs. 1, 2).

The patient was counselled by the surgeon regarding the postoperative outcome whereby the aim was to achieve both an improvement in nasal function and cosmesis. Patients records were then reviewed concerning graft selection, functional as well as cosmetic improvement.

The Different Type of Grafts Used and the Methods Employed

Tongue-in-Groove Technique

This technique was done with a combination of columellar strut graft in all cases except one. After completion of any of the septoplasty techniques the medial crura are separated and a groove is created between them. The medial crura are then advanced cephaloposteriorly, placing the denuded caudal septum into the potential space created between them. If there was excessive width to the columella

Table 1 Type of deformity

Type of dorsal deviation	No. of cases
I-Type	10
C-Type	12
S-Type	08

Fig. 1 Preoperative evaluation in different views

Fig. 2 Post-operative evaluation in different views

Table 2 Use of various graft materials in different sites

Graft material	Site of augmentation			
	Tip	Nasal dorsum (spreader graft)	Columella	Nasal dorsum (augmentation-onlay graft)
ASC	–	03	18	–
ACC	02	03	02	02

ASC autologous septal cartilage, ACC autologous conchal cartilage

preoperatively, soft tissue from the dissected pocket may be removed to help in the narrowing. Once any required cartilage trimming is completed, the caudal septum is again placed into the groove between the medial crura (Table 2).

Columellar Strut Graft

This technique was generally followed along with the combination of TIG technique. Excess of soft tissue on the dome was shaved off and a groove was created in between the medial crura of the lower lateral cartilages (LLCs) in all cases with columellar droop or a poorly defined columella. The septal or conchal cartilage harvested is cut according to the desired height and width of columella. A bi-layered cartilage strut graft is created by suturing two pieces of cartilage with absorbable vicryl suture and the graft is kept in the groove and fixed using a straight hypodermic needle. The medial crura along with the graft are then sutured with absorbable vicryl sutures. The skin flap is repositioned to ensure the adequate repair of the defect. L-shaped strut graft was used in 1 case. The septal cartilage was harvested, producing an L-shaped strut of more than 10 mm.

The harvest was carved into an L-shaped strut. The horizontal portion of the strut was fixed to the caudal septum with more than two sutures. The vertical portion of the strut was then placed between the LLCs. Then, the LLCs were advanced as needed (caudally, cephalically, or anteriorly), and after ensuring proper placement of the graft, it was sutured into place.

Spreader Graft

Most of the deformities of the nasal pyramid were corrected merely by doing medial and lateral osteotomies. But patients with cartilaginous deformities mainly of middle one-third and in those in which saddling of the nasal dorsum was seen, the use of spreader graft came into play. During septorhinoplasty to reconstruct the deviated nose, both lateral and medial nasal osteotomies are carried out so that the deviated nose can be detached from its bony attachments for easy repositioning at the midline. Spreader grafts are then inserted between the upper lateral cartilages and dorsal septum for structural reinforcement and straightening of the cartilaginous crooked nose. We used unilateral spreader graft on the concave side to camouflage the deviation. The graft was placed as described previously and sutured in place with horizontal mattress sutures using vicryl such that the knot of the suture lies on the convex side so that whole of the dorsum is pulled towards the concave side in order to bring whole of the nasal pyramid in straight alignment. In the case of saddle nose deformity and 1 case of revision rhinoplasty, conchal cartilage was used as graft material. The graft was cut into rectangular shape and placed bilaterally extending up to the K-area

(keystone area), and sutured in place with absorbable vicryl sutures.

Septal Extension Graft

This technique was used in 1 patient with columellar retraction along with gross posterior septal deviation and S-shaped external nasal deviation. Using open approach the septorhinoplasty was done columellar retraction was corrected using the excised septal cartilage which was sutured as a direct extension of the caudal end of the remaining septum using figure-of-8 sutures using vicryl sutures.

Shield Graft

The shield graft is usually attained from septal cartilage it is accurately moulded and edge- bevelled to obtain a shield-like shape [3]. The graft is inserted at the tip-columellar junction (anterior to the intermediate crura) to define the “double-break” columellar profile (Table 3).

Results

The study was done on 30 patients (20 male and 10 females) using the external rhinoplasty approach using the septal and conchal cartilages in different forms. Autologous septal cartilage was used in most of the patients (25 out of 30) and conchal cartilage was used in 5 patients. Multiple grafting techniques were used in some patients. Three patients had traumatic etiology. Columellar strut graft along with TIG technique was used in 16 patients, spreader graft was used in 8 patients, and septal extension graft was used in 5 patient and shield graft in 1 patient (Table 4).

Table 3 Types of grafts used

S. No.	Type of graft used	No. of patients
1.	Columellar strut (with TIG technique)	16
2.	Spreader graft	08
3.	Septal extension graft	05
4.	Shield graft	01

Table 4 Results based on patient satisfaction

Result	Type of crooked nose		
	I-shaped	C-shaped	S-shaped
Very satisfied	07	08	04
Moderately satisfied	03	04	03
Unsatisfied	00	00	01

Discussion

An open approach would allow direct visualization of the tip problem and subsequent tip plasty under direct vision. The external or open approach is essentially a more aggressive form of delivery. When the nasal tip is highly asymmetrical, markedly over projected, severely under projected, or anatomically distorted as in secondary revision cases, the open approach is considered. The trans-columellar scar is of negligible significance as it routinely heals inconspicuously when meticulously repaired. The anatomical view is unparalleled through this approach, affording the surgeon diagnostic information unavailable through traditional closed approaches. These technical virtues must be balanced with potential disadvantages of enlarged scar bed, slightly delayed healing with prolongation of tip oedema, and increased operating time. When subtle and conservative tip surgery is indicated by the patient's existent anatomy, the open approach is unnecessary and even counterproductive autogenous grafts are the gold standard for augmentation in open septorhinoplasty [8].

Autogenous materials incite much less inflammatory response with low rates of resorption, extrusion, and infection, though it may be associated with donor site morbidity and longer operating time. More often, autogenous grafts are used for reconstruction. In our study we used only autologous cartilaginous graft materials harvested from the septum and the concha [8].

Quadrangular Cartilage Graft

The gateway to the nose for the otorhinolaryngologist is the septum. The quadrangular cartilage and bone septum is a useful supply of cartilage and bone that is easily harvested during surgery [9]. Using quadrangular septal cartilage is advantageous to the otorhinolaryngologist because it is locally available in the same surgical field and because of the ease of contouring the cartilage [10].

Conchal Cartilage Graft

Another source of harvested graft can be from the pinna, where the conchal cartilage is pliable and easily shaped [11]. An essential consideration in harvesting conchal cartilage is to use portions of the concha that are most similar to the nasal anatomy. The cymba concha due to its curvature is suitable for reconstruction of the lateral crura and correction of saddled nose deformity [12]. The cavum concha which is thicker and stiffer is ideal for projection of the nasal tip [13, 14]. Conchal cartilage is easily available, easy to carve, having low donor site morbidity, and less metabolically demanding; thus it undergoes less resorption [15].

According to Kridel et al. [16] surgeons over the years have tried a variety of techniques to rotate, refine, and project the nose. Most successful surgeons today use a variety of methods to obtain the desired correction. The tongue-in-groove (TIG) technique is designed to be used in combination with other surgical maneuvers. Specifically this technique is useful to obtain nasal tip rotation, to predictably adjust tip position, to correct excess columellar show, and to straighten caudal septal deviation [16]. Aesthetically, maximum columellar show should not exceed 4 mm, which is the width of the typical medial crus [17]. Excess columellar show or a hanging columella may be caused by prominent medial crura, excessive membranous septal flaps, or a projecting caudal cartilaginous septum [18]. To determine the appropriateness of the TIG technique, the nose is analyzed for projection, acuity of the nasolabial angle, degree of columellar show, and amount of deviation of the columella and caudal septum. With the external approach, visualization of the position of the septum between the medial crura is readily appreciated. Buried suture fixation is facilitated, and the vestibular skin lining the cephalic portion of the medial crura is separated during this external rhinoplasty manoeuvre and not as a routine component of the tongue-in-groove technique. The TIG technique is a conservation technique that avoids cartilage excisions and adds support to the nasal tip. The technique can provide a predictable and adjustable degree of rotation and can increase or decrease projection while at the same time reducing the amount of columellar show [16].

Nasal tip support is an important consideration for Asian rhinoplasty. A number of soft tissue components and cartilaginous relationships support the nasal tip. The attachments that connect the upper lateral cartilages and the lower lateral cartilages (LLCs), the lateral crura of the LLCs and the pyriform aperture, the paired domes of the LLCs, the medial crura of the LLCs and the nasal septum, and that of Pitanguy's dermocarilaginous ligament all play important roles [19].

Any dissection of the above structures may damage the support of the nasal tip. Surgical procedures such as transfixation incisions, cephalic trim, intercartilaginous incisions, and medial division of the LLCs disrupt the support and cause changes in the tip position. Therefore, reinforcement of the nasal tip is required in most cases in such procedures [20]. In 1932 Eitner, in his masterpiece "*Kosmetishe operationen*", described a graft inserted between the middle crura to support tip projection in bulbous or fatty skin noses [21]. In 1944, Daley proposed a mattress suture to stabilize this graft in place [22]. Finally, in 1977 Baum confirmed the indications of this graft in fatty skin noses and bulbous tips ("to force ends of lateral crura to project upward simultaneously"), in order to avoid the loss

of tip projection along time [23]. Nowadays, this still remains the main indication of columellar strut in "closed" rhinoplasty. The philosophy and use of columellar strut in "open" rhinoplasty is different from its use in an "endonasal" approach: Tebbetts on the possibility to attain tip projection, in most cases, with the "simple" reshaping-suturing of nasal tip cartilaginous structures [24]. Moreover, we believe that septal caudal edge acts as a pillar and represents a valid support for tip projection in most primary rhinoplasties. However, the loss of tip support secondary to columellar incision makes it necessary to place a columellar strut in almost all "open" rhinoplasties to avoid tip de-projection over time [5]. In cases of well-developed medial crura, the intercrural suture or floating columellar strut using septal cartilage or auricular cartilage should be used, but in cases with an underdeveloped medial crura, septal cartilage should be used as a fixed-type columellar strut. A columellar strut graft or batten graft clarifies the nasal tip definition through an interdomal suture and maintains the position against pulling forces exerted by the depressor septi nasi muscle contraction and skin sutures [25].

In the 1980s, Sheen [12] popularized spreader grafts as a method of reconstructing the internal nasal valve and recontouring the aesthetic appearance of the nasal dorsum in rhinoplasty. Since that time, spreader grafts are commonly indicated in cases of primary and secondary rhinoplasty. Conceptually, the grafts were used to act as volumetric expanders to stabilize and shift the upper lateral cartilage away from the dorsal septum to increase the internal nasal valve angle. The internal nasal valve is the narrowest part of the nasal airway and its cross-sectional area is determined by the angle formed between the caudal part of the upper lateral cartilage and nasal septal cartilage. The average angle of the nasal valve in a normal Caucasian ranged from 9° to 15° [26–28]. Nasal valve collapse occurs when this narrowest part becomes weak and narrower than 9°. Nasal valve collapse is a common anatomical cause for nasal obstruction [12, 29]. The etiology may be congenital, traumatic, or iatrogenic, especially after septorhinoplasty [12, 28, 29]. Factors like septal deviation, aging, facial nerve paralysis or paresis, allergic and non-allergic rhinitis may contribute and worsen nasal valve insufficiency. Spreader grafts play a role in the treatment of nasal valve collapse by widening the nasal valve angle and maintaining the widened angle with variable degrees of success [28, 30–32]. Removal of the hump usually leaves a flat and open roof, causing weakness of tissues at the junction of septal dorsum and upper lateral cartilage, and compromises the nasal valve angle. Following the reduction of the nasal hump to a desired level, spreader grafts are usually positioned to prevent the complication of nasal valve collapse [12].

A crooked nose may be congenital or acquired. The acquired crooked nose is more common and typically caused by trauma [33]. These deformities are usually due to a set of anatomical abnormalities and result in aesthetic and functional problems. The associated anatomical abnormalities include septal cartilage and vomer deviation, or their misalignment on the maxillary bone and deformity of nasal bone and tip [34]. During septorhinoplasty to reconstruct the deviated nose, both lateral and medial nasal osteotomies are carried out so that the deviated nose can be disconnected from its bony attachments for easy repositioning at the midline. Spreader grafts are then inserted between the upper lateral cartilages and the upper part of septal cartilage for structural reinforcement and straightening of the cartilaginous crooked nose [35]. Unilateral spreader grafts or spreader grafts with different thicknesses may be used in these patients, and the grafts help to maintain the nasal pyramid in a straight position at the midline. Septal integrity depends on a strong L-shaped dorsal and caudal cartilaginous strut with attachments to the nasal bones and maxilla. Loss of the septal height and tip support causes saddle deformity of the lower two-thirds of the nasal dorsum. A saddle nose results from a wide range of conditions like septal perforation, facial trauma, septo(rhino)plasty, cocaine abuse and systemic diseases like Wegener's granulomatosis and T cell lymphoma [36, 37]. While minimal deformities can be treated with dorsal onlay grafts, in major saddle nose deformities, reconstruction of the saddled nasal dorsum and tip support with two articulated pieces of rib cartilages are usually required [38]. The saddle nose deformity can also be treated with an L-shaped composite strut graft of columellar strut and two spreader grafts [39].

The spreader graft is limited in its ability to adequately support and lateralize the lateral nasal wall hence reducing its functional outcome [31, 40–42]. Another limitation of spreader grafts is the need for long enough cartilage grafts usually harvested from the septal cartilage. Especially, in cases of secondary rhinoplasty or after septoplasty, it is difficult to obtain adequately long and straight cartilage grafts from the septum [39].

The septal extension graft, first introduced by Byrd et al. [43] in 1997, achieved fixing a graft on the caudal or dorsal septum between both of the lower lateral cartilages while controlling nasal lengthening and tip projection, rotation, and shape. Compared to the columellar strut in patients with weak midvault or lower lateral cartilage, the septal extension graft has been found to be more favorable for maintaining tip projection through stronger support.

Basically, the septal extension graft is formed by fixing the septum through a septal angle, extending to the interdomal space. The distal portion of the graft, forming an appropriate supratip break, is made through a three-point

fixation at a lower lateral cartilage along with tip position as needed. Furthermore, three different procedures for fixing the proximal portion to the septum according to the shape and direction are presented: the paired spreader type, paired batten type, and direct extension type [43].

The paired spreader type is a graft inserted between the upper lateral cartilage and the dorsal septum via a spreader graft, extending over the caudal margin. This correction can reinforce a weak mid-vault and lateralize the upper lateral cartilage, resulting in the widening of the internal valve. Paired battens are fixed diagonally across the dorsal and caudal septum. This procedure does not widen the mid-vault and has an advantage over the spreader type of tip projection from the supporting vectors. The direct extension type of graft is fixed directly to the anterior septal angle by a horizontal figure-of-eight suture. It cannot be fixed firmly and easily shifts from the midline or does not allow a sustained tip projection and is used only in case of limited available cartilage [44].

Determining a lateral view intraoperatively is important to avoid excessive extension, which can cause caudal displacement of the columella, leading to hanging columella. In addition, positioning the graft under the dome and tapering it by a tip-defining suture would prevent the caudal end of the graft from extruding into the interdomal space, which will be seen to broaden eventually [45].

The shield graft is usually attained from septal cartilage; it is accurately moulded and edge-bevelled to obtain a shield-like shape [46]. The graft is inserted at the tip-columellar junction (anterior to the intermediate crura) to define the “double-break” columellar profile. The graft stiffness should be adjusted to prevent it from appearing under the skin [5].

Conclusion

Septorhinoplasty continues to evolve through various new techniques and modifications with the main goal to improve functional nasal airway and to restore cosmetic harmony to the face. Optimum result is very much dependent on the surgeon's attention to functional, aesthetic, and reconstructive principles and graft selection. Performing rhinoplasty in a multi-ethnic community possesses more challenges to the rhinoplastic surgeon. Moreover, the best intentions and efforts for the betterment of the patients must be balanced by the surgeon's initiative to keep improving his clinical acumen and surgical skills.

Compliance with Ethical Standards

Conflict of interest All the authors declare that they have no conflict of interest among each other.

Ethical clearance and informed consent The study was done after taking informed consent from the participants. The study was also cleared by ethical committee of the concerned hospital.

Funding No funding from any source.

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