Aesth Plast Surg
DOI 10.1007/s00266-009-9349-5

ORIGINAL ARTICLE

Alar Batten Cartilage Graft: Treatment of Internal and External Nasal Valve Collapse

Valerio Cervelli · Diana Spallone · J. Davide Bottini · Erminia Silvi · Pietro Gentile · Beniamino Curcio · Michele Pascali

Received: 29 December 2008 / Accepted: 27 March 2009

Abstract
Background The aim of this study was to describe the efficacy of alar batten graft in correcting internal and external nasal valve collapse (i.n.v. and e.n.v.) and evaluate the functional and aesthetic results.
Methods From July 2006 to September 2008, 80 patients (54 females and 26 males) underwent alar batten cartilage grafting. The patients were divided into three groups: (1) 55 patients with iatrogenic nasal valve collapse (80% i.n.v., 20% e.n.v.), (2) 15 patients with posttraumatic nasal valve collapse (45% i.n.v., 55% e.n.v.), and (3) 10 patients with congenital nasal valve collapse (100% e.n.v.). Patients were evaluated at 6, 12, 24, and some at 36 months after surgery. The final follow-up was at least 24 months.
Results The results of this study revealed a significant increase in the size of the aperture at the internal or external nasal valve after the application of alar batten grafts. All the patients noted improvement in their nasal airway breathing and in their cosmetic appearance. No major complication was observed.
Conclusion The alar batten graft is a simple, versatile technique for long-term reshaping, repositioning, and reconstruction of the nasal valve collapse.

Keywords Alar batten graft · Nasal obstruction · Internal and external nasal valve collapse

V. Cervelli · D. Spallone (✉) · J. D. Bottini · E. Silvi · P. Gentile · B. Curcio · M. Pascali
Department of Plastic and Reconstructive Surgery, University of Rome "Tor vergata", Viale Oxford, V. U.Saba n 71, 00100 Rome, Italy
e-mail: dianaspallone@hotmail.it

The nasal valve area has been the subject of numerous studies [1–6] because of its functional and aesthetic importance. The composition of the nasal valve includes the caudal aspect of both the upper lateral cartilages, with connections to the septum and piriform aperture, and the lower lateral cartilages, with attachment to the upper lateral cartilage by the scroll. In particular, the internal nasal valve is the area between the caudal border of the upper lateral cartilages and the dorsal septum [7]. This angle is usually 10°-15° in the Caucasian nose. The external nasal valve is the area bounded by the alar lobule laterally, nasal sill inferiorly, and columella medially [7]. Weakness of these structures and/or excessive negative airway pressure during inhalation can result in collapse of the nasal valve with resultant obstruction.

Internal nasal valve collapse is usually observed after previous reductive rhinoplasty or in older patients who show weakening of the supportive structures of the nose (upper and lower lateral cartilages). Patients with internal nasal valve collapse typically have "pinching" or medial collapse of the supra-alar region [8].

External nasal valve collapse is described as collapse of the nostril margin of the nose (alar collapse) on moderate to deep in inspiration through the nose [3, 6]. In contrast to internal nasal valve collapse which is usually observed in those who have previously undergone surgery, patients with external nasal valve collapse frequently have not undergone previous surgery [8]. The collapse of the external nasal valve is most often seen in patients with narrow nostrils, a projecting tip, and thin weak sidewalls [9]. In this study we focus our attention on an anatomic variant in which the lateral crus does not parallel the alar rim. Sheen [10] was the first to describe this condition as malrotation of the alar cartilages with a weak lateral alar rim leading to the characteristic "parenthesis" deformity of the nasal tip [11].

Published online: 07 May 2009

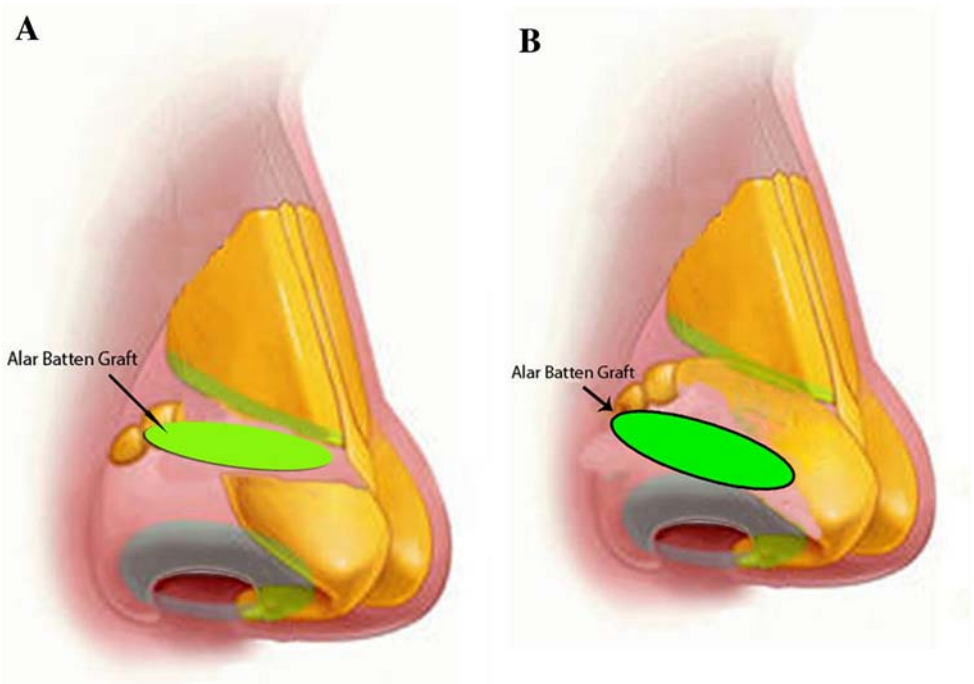

Fig. 1 **a** The alar batten graft for correction of internal nasal valve collapse. The graft is placed at the epicenter of collapse over the site of previously overresected lateral crura. **b** For correction of external nasal valve collapse, the graft is placed caudal to the cephalically positioned lateral crura

The most effective methods to treat collapse of this difficult anatomic area have used cartilage grafts to restore function and enlarge the diameter of the internal nasal valve, to strengthen the lateral crura of the lower lateral cartilage, or to support the connections of this cartilage to the piriform aperture. Of the cartilage grafts, the alar batten graft has proven to be a valid technique for the treatment of external and internal nasal valve collapse (Fig. 1). As described in the literature, alar batten grafts are useful for correcting the boxy nasal tip, malpositioned lateral crura, alar rim retraction, alar rim collapse, and concave lateral crura. We describe our personal experience and show representative results with the use of alar batten grafts in 80 patients.

Materials and Methods

From July 2006 to September 2008, 80 patients (54 females and 26 males), with ages ranging from 18 to 75 years (mean age = 36.6 years), underwent alar batten cartilage grafting at the Department of Plastic and Reconstructive Surgery, University of Tor Vergata, Rome. The patients were divided into three groups: group A, 55 patients with iatrogenic nasal valve collapse, including 30 bilateral and 25 monolateral (80% i.n.v., 20% e.n.v.); group B, 15 patients with posttraumatic nasal valve collapse, including 11 mono and 4 bilateral (46.6% i.n.v., 53.3% e.n.v.); group C, 10 patients with congenital malformation, all bilateral (100% e.n.v.). It was the first rhinoplasty for 22 (31.2%) and the second rhinoplasty for 59 (68.7%) patients (Table 1). Auricular cartilage was the donor site choice in 72 patients with anterior incision for all, and septal cartilage was used in 8 patients.

Table 1 Patients and procedures

Nasal valve collapse	Group A	Group B	Group C
Monolateral	25 (45.45%)	11 (73.3%)	0 (0%)
Bilateral	30 (54.55%)	4 (26.6%)	10 (100%)
Internal nasal valve collapse	44 (80%)	7(46.6%)	0 (0%)
External nasal valve collapse	10 (20%)	8(53.3%)	10(100%)
First rhinoplasty	0 (0%)	11 (73.3%)	10 (100%)
Second rhinoplasty	55 (100%)	4 (26.6%)	0 (0%)
Total	55	15	10

Group A = iatrogenic nasal valve collapse; Group B = posttraumatic n.v.c.; Group C = congenital n.v.c

Patients received preoperative and postoperative photographic documentation while breathing quietly and at maximun nasal inspiration. Significant functional nasal airway obstruction was diagnosed on physical examination. The physical examination included an assessment of the external appearance of the nose; Cottle maneuver in which the patient lateralizes the cheek and lateral wall of the nose, which results in improved nasal breathing; and a rhinomanometry test. Active anterior rhinomanometry (RMM) is the most commonly used technique to measure nasal patency [12]. Mucosal decongestion using imidazoles may help to differentiate mucosal congestion from skeletal abnormalities.

Patients and surgeon rated cosmetic and functional outcomes. Functional results were based on improvements

Table 2 Functional and cosmetic assessments: surgeon and patients

Assessment	Outcome no. of patients (%)	
	Functional	Cosmetic
Surgeon		
Excellent	70 (87.5%)	65 (81.2%)
Good	10 (12.5%)	15 (18.7%)
Poor	0 (0%)	0 (0%)
Patients		
Excellent	72 (90%)	68 (85%)
Good	8 (10%)	12 (15%)
Poor	0 (0%)	0 (0%)

in nasal airway performance at rest and at maximum nasal inspiration. The patients were asked to rate their nasal airway breathing before and after application of alar batten grafts using a scale of 1-5, with 1 being no obstruction and 5 being complete obstruction. Aesthetic results were evaluated using a visual analog scale for the patient's self-estimation (excellent, good, poor) and the plastic surgeon's estimation (excellent, good, poor) (Table 2). At follow-up, patients were evaluated at 6, 12, 24, and 36 months. The final follow-up was at least 24 months.

Surgical Technique

We applied alar batten grafts in all patients via the external rhinoplasty approach. Auricular cartilage was the donor site of choice for alar batten grafts because it is elastic and has a high degree of memory. Conchal cartilage also has varied contours that can be matched to the desired contour of the ala. The anterior auricular incision was made along the lateral edge of the concha where the plane of the auricular cartilage is perpendicular to the temporal skull (Fig. 2). Septal cartilage may be used as an alternative, but it may not be abundant and its shape can be unpredictable. Closure of the donor site was performed with continuous sutures of 6-0 nylon that were removed after 5-6 days (Fig. 3). Once harvested, the graft was carved into a crescent shape with beveled edges and a notched end (Figs. 4 and 5). A fresh No. 15 blade was used to bevel the edges of the graft and to remove any sharp or protuberant pieces of cartilage. In general, all soft tissue down to but not including the perichondrium is removed to improve viability and decrease absorption. Particular care was taken to ensure that the perichondrium remains intact on the side of the cartilage implant to improve its viability and decrease absorption. The notched end will help secure the graft laterally on the bony piriform aperture, resisting slipping and collapse. Usually these grafts are shaped into a bar measuring 4-6 mm in width and 15-25 mm in length.

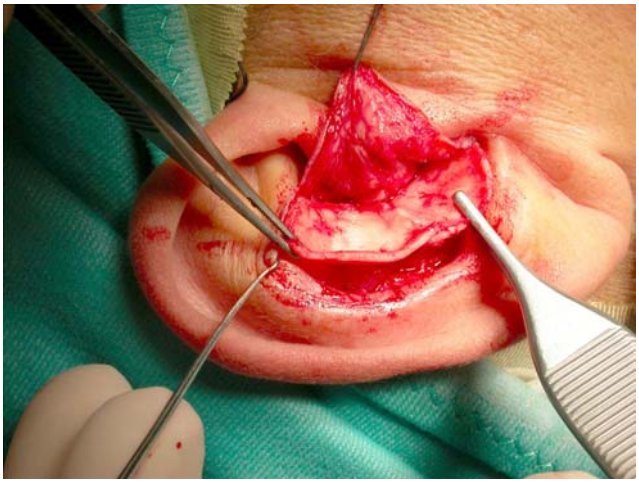

Fig. 2 Graft harvesting via an anterior approach

Fig. 3 Closure of the auricular cartilage with simple continuous sutures of 6–0 nylon

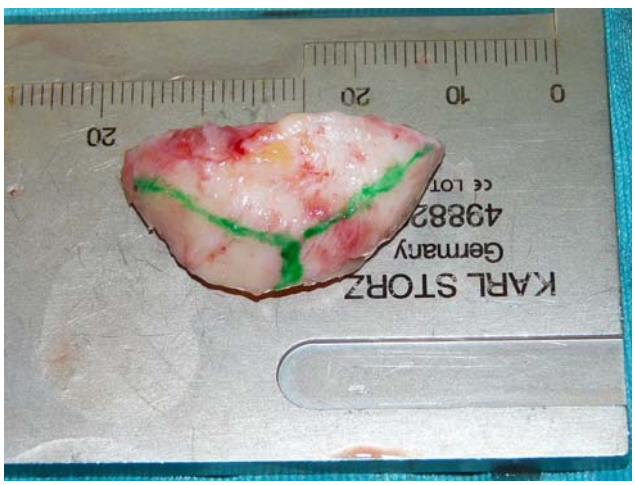

Fig. 4 Auricular cartilage. Two alar batten grafts were obtained from the harvested cartilage and were used for bilateral nasal valve collapse

Fig. 5 Auricular cartilage. *Note*: The bending of the auricular cartilage that is similar to the alar cartilage

Fig. 6 Preoperative drawing on the skin. The pocket is dissected at the precise epicenter of the collapse. *Note*: The subtotal interrupted lateral crus after an aggressive surgery marked in red

Larger grafts are used in patients with severe collapse or thicker skin to provide increased support.

Before the operation the position of the graft was marked on the skin to make sure that a precise pocket is dissected precisely at the epicenter of collapse (Fig. 6). Positioning the graft can vary from case to case depending

Fig. 7 Graft placement. The alar batten graft is held externally on the skin. *Note*: How the graft is positioned at the precise point into the epicenter of the collapse

on whether internal or external nasal valve collapse is being treated. When internal nasal valve collapse was being treated, the graft was placed in a pocket at the site of the supra-alar collapse and near the caudal margin of the upper lateral cartilage or where the lateral crura may have been previously overresected (Fig. 7). The convex side of the graft is oriented laterally to correct the supra-alar pinching. The pocket is subcutaneous, but if the pocket is too superficial and the skin is too thin, particular care must be taken to avoid edges because the graft may be palpable or visible.

When external nasal valve collapse was being treated, the graft was typically placed into a pocket caudal to cephalically positioned lateral crura. To amplify the effect, the graft must be placed into a precise subcutaneous pocket at the point of maximal lateral wall collapse.

It is critical for the alar batten graft, especially in patients with parenthesis deformity, to be long enough to overlap the existing lateral crural cartilage and extend laterally to the bony piriform aperture (Fig. 8). This requires vertical transsection of the lateral crus accessory cartilage junction, with graft placement superficial to the accessory cartilages. To avoid fullness where the strut crosses the rim, the end of the strut should be placed caudal to the alar groove. Before the placement of the graft, it is imperative to put the malformed lateral crura into a more physiologic position. The graft can be modified by placement in an undermined vestibular skin pocket parallel to the alar rim rather than deep to the lateral crus. This modified positioning enables the strut to support the alar rim, straighten and camouflage the convex caudal margin,

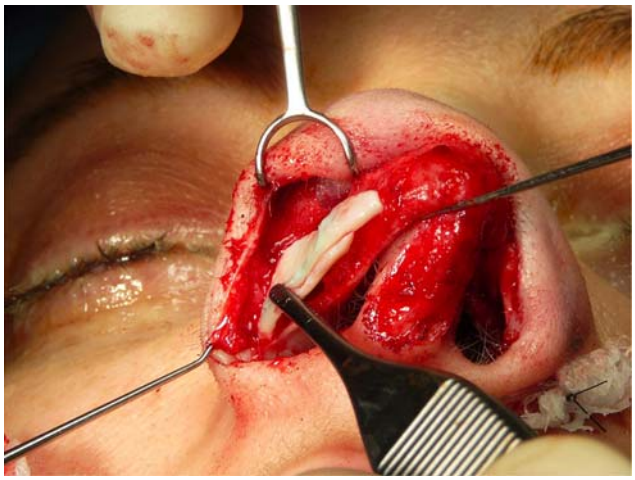

Fig. 8 Graft placement. The graft is positioned caudal to the lateral crura and extended laterally to the bony pyriform aperture via an external approach

and obliterate the parentheses. We have chosen to place the grafts on the vestibular side of the lateral crura to provide strong but invisible support for the lateral crus. Graft placement superficial to the lateral crus is not recommended because of the risk of a visible step-off at the anterior end of the graft. After alar batten grafting, the alar rims have improved support and the parentheses deformity has been eliminated. To maximize the effect there should be slight tension of the cartilage graft; this allows re-expansion of the nasal ala and nasal valve. In fact, if the pocket is too big the graft may shift and will not provide the desired lateralizing effect.

In general, if an external rhinoplasty approach is used, it is important that the dissection not extend lateral to the junction of the middle and lateral third of the lateral crura. If a more extensive dissection is performed, then the possibility for creating a precise lateral pocket is lost. The vestibular skin is undermined off the lateral crus toward the caudal border. Along the anterior two-thirds of the lateral crus, the vestibular skin is left attached to the caudal border. Once the graft is inserted into the pocket, it should be sutured to the lateral crura with two to three sutures of 5-0 Vicryl to prevent its migration (Fig. 9). In our study special care was taken to avoid distorting the position of the lateral crura with the application of the fixation suture.

We treated 7 (46.6%) of 15 patients with posttraumatic nasal valve collapse with multiple skin flaps for soft tissue coverage of a nasal alar defect after placement of an alar batten cartilage graft. Two patients were treated with a two-stage nasolabial interpilation flap, three with a bilobed transposition flap, and two with a forehead flap. Free cutaneous grafts rarely can be placed, although the risk of ischemia is enhanced by the avascular nature of the underlying cartilage graft. In major nasal reconstruction we

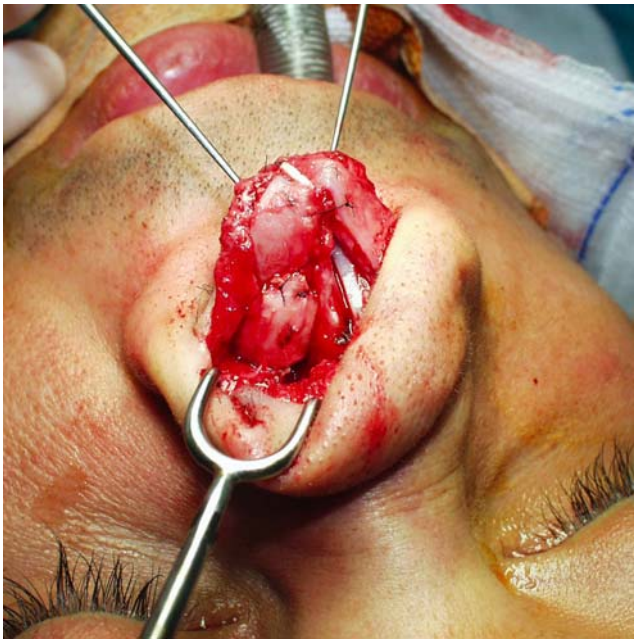

Fig. 9 Graft sutured to the lateral crura to prevent migration

place nasal stents because the silicon conformers limit the effects of wound contracture. We use Koken (®SILIMED, Rio de Janeiro, Brazil) stents and remove them after 2 months.

Results

All patients who underwent rhinoplasty for nasal valve collapse were evaluated with a postoperative follow-up ranging from 12 to 72 months (minimum of 24 months) (Figs. 10, 11, 12). All patients noted improvement in their nasal airway breathing. The preoperative and postoperative measurements obtained with the active anterior rhinomanometry were also reported (Table 3). The mean preoperative nasal breathing score for all patients was 4. The functional result was scored as excellent by 72 patients (90%) and good by 8 patients (10%), with a mean improvement in nasal breathing score of 2.5. The aesthetic result was evaluated by the surgeon as excellent in 65 patients (81.2%) and good in 15 (18.7%). For each score given by the surgeon, the patient's assessment was the same or better (Table 4).

We also evaluated intraoperative and postoperative adverse effects. There were no infections. Tenderness at the donor site with hypertrophic scar occurred in 3 patients, an edematous tip in 12 patients resolved in 6 months, and there was no graft resorption in any patient. Graft migration developed in one patient who had an external nasal valve collapse, surface irregularities occurred in 6 patients but resolved in 6 months, and no contracted intranasal

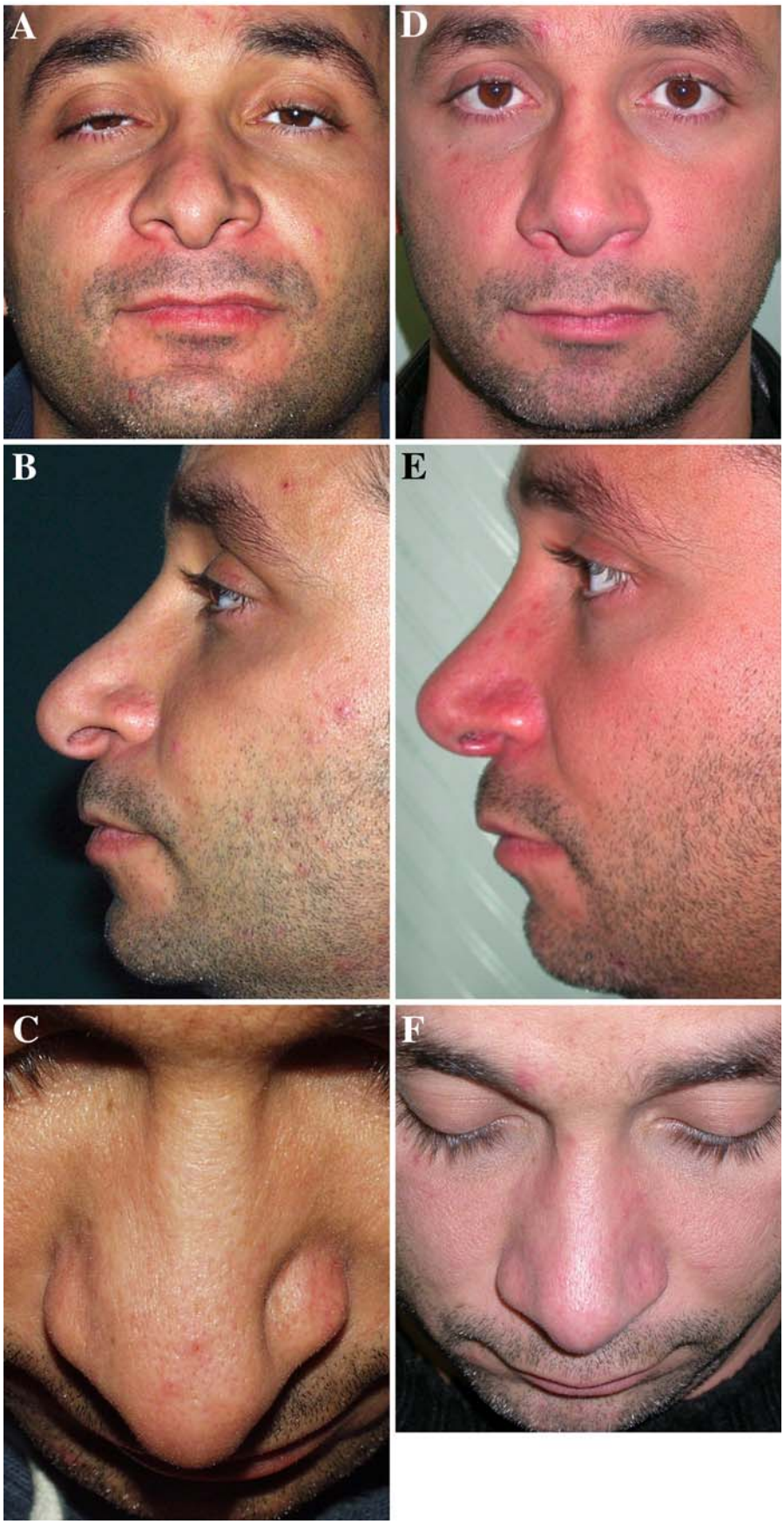

Fig. 10 Patient who underwent previous reductive rhinoplasty and suffered from severe iatrogenic nasal valve collapse of the right rim. **a–c** Preoperative views. **d–f** Twenty-four-month postoperative views. The preoperative basal view reveals collapse of the internal nasal valve monolaterally. The postoperative basal view reveals lateral positioninig of the internal nasal valve and aesthetic improvement

Fig. 11 Patient with congenital nasal valve collapse. **a–c** Preoperative views. **d–f** Thirty-six-month postoperative views. The postoperative views show how the strut supports the alar rim, straightens and camouflages the convex caudal margin, and obliterates the parentheses

Fig. 12 Patient with posttraumatic nasal valve collapse. **a–c** Preoperative views. **d–f** Twelve-month postoperative view. The postoperative basal view shows correction of the right nasal valve

Table 3 Descriptive statistics of active anterior rhinomanometry of the patients before and after nasal surgery

Active anterior rhinomanometry	Patients (n = 80)	
	No decongestant	With decongestant
Before nasal surgery		
Minimum	36	180
Maximum	1144	1705
Mean	515	674
Standard deviation	238	248
After nasal surgery		
Minimum	349	1100
Maximum	1700	2105
Mean	856	980
Standard deviation	259	269

All data are in ml/s

We used the criteria given in the consesus conference of standardisation committee on objective assessment of the nasal airway (2005, Brussels)

Table 4 Functional results: preoperative and postoperative

Nasal airway breathing	Preoperative	Postoperative
No obstruction	0 (0%)	72 (90%)
Light obstruction	0 (0%)	6 (7.5%)
Moderate obstruction	10 (12.5%)	2 (2.5%)
Severe obstruction	50 (62.5%)	0 (0%)
Complete obstruction	20 (25%)	0 (0%)

scars or excessive narrowing at the piriform aperture were observed. Necrosis of a full-thickness skin flap overlying the cartilage graft occurred in one patient. During the early postoperative period, some patients complained of slight fullness in the supra-alar region. In most cases, this fullness resolved with time.

Discussion

The key to a successful surgical correction of nasal obstruction is diagnosing the precise anatomic point of collapse [11]. The search for the anatomic epicenter of obstruction will typically lead to an abnormality related to the internal nasal valve or external nasal valve.

In patients with a history of prior nasal surgery, special consideration must be given to the possibility of nasal valve collapse. Overaggressive resection of the lateral crura during rhinoplasty and the subsequent postoperative soft tissue contraction may lead not only to internal but also to external nasal valve compromise [1]. The incidence of significant postrhinoplasty nasal obstruction has been estimated at 10% [13]. Constantine and Clardy [4] performed nasal air flow measurements on patients with postrhinoplasty nasal obstruction and found septal deviation, internal nasal valve obstruction, and external nasal valve collapse to be the primary culprits. During primary rhinoplasty it is imperative to leave an adequate rim of cartilage during resection, typically 7-9 mm, preserving an intact strip of cartilage from the feet of the medial crura to the most lateral part of the lateral crus [1]. Also, particular attention must be given to avoid resection in patients with vertically oriented lateral crura; in fact, failure to recognize this anatomic situation can lead to "parenthesis" deformity and may result in dysfunction at the intervalve area. The "parentheses" deformity of the nasal tip, which is shown from the frontal view [14], is caused by a malpositioned lateral crus that does not parallel the alar rim. Its cephalad orientation and the fact that it is most perpendicular to the unsupported alar rim lead to the typical deformity.

Numerous techniques have been devised to treat collapse of this difficult anatomic area, but few ensure reliable functional support and some may negatively alter facial aesthetics and function [3, 4, 8, 15–22]. The "ideal" graft should be available in an unlimited supply, have the ability to be formed into infinite contours, be completely biocompatible, and require no morbidity to obtain. Some authors use alloplastic materials for the correction of nasal valve collapse [23–25]. Allograft material is wide ranging, e.g., Medpore, Gore-Tex, silicon, Supramid. Gore-Tex or expanded polytetrafluoroethylene (ePTFE) has not be linked to the most common adverse effects such as extrusion or degradation, but its inability to maintain an exact shape or provide support structure limits its use in nasal reconstruction to only certain cases [25]. However, the nose, with its thin skin cover, has proven at risk for alloplastic implants. Autologous cartilage includes auricular, septal or rib cartilage, and the curved outer table of calvarial bone. The most effective treatment methods use autologous cartilage, placed as a structural support across an alar defect, to enlarge the diameter of the internal nasal valve, to strengthen the lateral crura of the lower lateral cartilage, or to support the connections of this cartilage to the piriform aperture [22]. Sheen [10] described the use of spreader grafts to displace the upper lateral cartilages laterally, effectively widening the nasal valve and increasing the cross-sectional area. In this technique, placement of spreader grafts will lateralize the upper lateral cartilages but they tend not to impact the angle of the valve. Park [21] in addition to the spreader grafts, uses a flaring suture. A permanent suture is placed to lateralize the ventral portion of the upper lateral cartilages, using the nasal dorsum as a fulcrum.

Alar batten grafts are curvilinear cartilage grafts that are placed into a precise pocket at the point of maximal lateral

wall collapse or supra-alar pinching [5]. Alar batten grafts are thought to offer a rational and versatile solution to a wide array of lateral crural deformities and deficiences and they support the precise point of lateral nasal wall collapse without creating a deformity. Gunter and Friedman [16] used the lateral crura strut graft for reshaping, repositioning, and reconstructing the lateral crura in 118 patients. Toriumi [6, 8, 9] reported the use of the alar batten graft for the correction of external and internal nasal valve collapse. Rohrich et al. [11] used the alar contour graft to correct alar rim deformity. Becker and Becker [1] also evaluated the senior author's experience with the use of the alar batten graft for nasal valve collapse in 46 patients. Byrd et al. [2] analyzed the functional and cosmetic outcomes of 25 patients in whom reconstruction involved alar batten grafts. Byrd et al. [2] reported the use of alar batten grafts to restore form and function and also to prevent impending contraction related to nasal alar distortion after removal of deep alar tumors.

According to the senior author's experience, we have found the alar batten graft to be useful in the correction of malpositioned lateral crura and nasal valve collapse. We placed all the grafts via the open rhinoplasty approach. The literature has reported the use of the open approach to treat external nasal valve collapse and the endonasal approach to treat internal nasal valve collapse. However, we have had satisfactory results with the open approach in treating both types of collapse. Although it is technically possible to place these grafts via an endonasal approach, we believe that an open rhinoplasty facilitates accurate graft positioning and suture placement.

Conclusion

Treatment of nasal obstruction requires a diligent search for the epicenter of dysfunction. The alar batten graft is a versatile technique for reshaping, repositioning, and reconstructing the nasal valve. The major advantage to alar batten cartilage grafting is that it is an autologous tissue, has a similar contour to the alar rim, and establishes patency of the nasal valve. Conchal cartilage has been demonstrated to be a safe, effective, and versatile donor material in nasal surgery.

References

1. Becker DG, Becker SS (2003) Treatment of nasal obstruction from nasal valve collapse with alar batten grafts. J Long Term Eff Med Implants 13(3):259–269
2. Byrd DR, Otley CC, Nguyen TH (2000) Alar batten cartilage grafting in nasal reconstruction: functional and cosmetic results. J Am Acad Dermatol 43:833–836
3. Constantine MB (1994) The incompetent external nasal valve: pathophysiology and treatment in primary and secondary rhinoplasty. Plast Reconstr Surg 93:919–931
4. Constantine MB, Clardy RB (1996) The relative importance of septal and nasal valvular surgery in correcting airway obstruction in primary and secondary rhinoplasty. Plast Reconstr Surg 98:38–58
5. Tardy ME, Garner ET (1990) Inspiratory nasal obstruction secondary to alar and nasal valve collapse: technique for repair using autologous cartilage. Operative technique. Otolaryngol Head Neck Surg 1:215–218
6. Toriumi DM (1995) Management of the middle nasal vault in rhinoplasty. Operative technique. Plast Reconstr Surg 2:16–30
7. Ballert JA, Park SS (2008) Functional considerations in revision rhinoplasty. Facial Plast Surg 24:348–357
8. Toriumi DM, Josen J, Weinberger M, Tardy ME Jr (1997) Use of alar batten grafts for correction of nasal valve collapse. Arch Otolaryngol Head Neck Surg 123(8):802–808
9. Toriumi DM (1996) Surgical correction of the aging nose. Facial Plast Surg 12:205–214
10. Sheen JH (1984) Spreader graft: a method of reconstructing the roof of the middle nasal vault following rhinoplasty. Plast Reconstr Surg 73:230–237
11. Rohrich RJ, Raniere J Jr, Ha RY (2002) The alar contour graft: correction and prevention of alar rim deformities in rhinoplasty. Plast Reconstr Surg 109(7):2495–2505
12. Clement PA, Gordts F (2005) Consensus report on acoustic rhinometry and rhinomanometry. Rhinology 43:169–179
13. Beekhuis GJ (1976) Nasal obstruction after rhinoplasty: etiology, and techniques for correction. Laryngoscope 86:540–548
14. Singh DJ, Bartlett SP (2007) Aesthetic management of the ear as a donor site. Plast Reconstr Surg 120(4):899–908
15. Clark JM, Cook TA (2002) The 'butterfly' graft in functional secondary rhinoplasty. Laryngoscope 112:1917–1925
16. Gunter JP, Friedman RM (1997) Lateral crural strut graft: technique and clinical applications in rhinoplasty. Plast Reconstr Surg 99(4):943–952; discussion 953-955
17. Guyuron B (2001) Alar rim deformities. Plast Reconstr Surg 107(3):856–863
18. Kalan A, Kenyon GS, Seemungal TA (2001) Treatment of external nasal valve (alar rim) collapse with an alar strut. J Laryngol Otol 115(10):788–791
19. Khosh MM, Jen A, Honrado C, Pearlman SJ (2004) Nasal valve reconstruction. Arch Facial Plast Surg 6:167–171
20. Murrell GL (2004) Auricular cartilage grafts and nasal surgery. Laryngoscope 114(12):2092–2102
21. Park SS (1998) The flaring suture to augment the repair of the dysfunctional nasal valve. Plast Reconstr Surg 101:1120–1122
22. Troell RJ, Powell NB, Riley RW, Li KK (2009) Evaluation of a new procedure for nasal alar rim and valve collapse: nasal alar rim reconstruction. Otolaryngol Head Neck Surg 122(2):204–211
23. Berghaus A, Stelter K (2006) Alloplastic materials in rhinoplasty. Curr Opin Otolaryngol Head Neck Surg 14(4):270–277
24. Pele ZM, Warren AG, Johnston P, Yaremchuk MJ (2008) The use of alloplastic materials in rhinoplasty surgery: a meta-analysis. Plast Reconstr Surg 121(3):85e–92e
25. Williams JD, Romo T, Sclafani AP, Cho H (1997) Porous high-density polyethylene implants in auricular reconstruction. Arch Otolaryngol Head Neck Surg 123:578–583