Abstract

**Background:** Alar cartilage malposition is a common anatomic variation in which the axis of the lateral crus lies cephalically and may be parallel to the cephalic septum. Malposition of the lateral crus may produce inward collapse of the ala that is observable on deep inspiration.

**Objectives:** The authors performed the alar rim flap technique to treat patients with alar malposition and assessed functional and aesthetic outcomes.

**Methods:** Twelve patients who underwent primary open rhinoplasty with the alar rim flap technique were evaluated in a prospective study. A 2- or 3-mm caudal portion of the lateral crus was elevated from the underlying mucosa, pulled caudally, and extended with a cartilage graft. This extension of the alar rim flap was placed through the pyriform aperture for additional support. Patients completed pre- and postoperative questionnaires addressing nasal obstruction and underwent paranasal computed tomography. Patients received follow-up for an average of 16 months (range, 8–27 months).

**Results:** Patients with alar cartilage malposition and external valve insufficiency experienced aesthetic and functional improvements after rhinoplasty with the alar rim flap technique. No patients developed alar rim collapse or flap displacement.

**Conclusions:** The alar rim flap technique is effective for the correction of malpositioned lateral crura and external valve insufficiency. Because this technique does not damage the scroll area, disruption of the internal valve area is avoided.

Level of Evidence: 4

The nasal valve is located in the anterior segment of the nasal cavity and is the region of maximum nasal airflow resistance.1 The external nasal valve is bounded by the pyriform aperture, the lower lateral cartilage (LLC) and its attachments, and the caudal septum. The medial cephalic border of the LLC occurs at the domal junction with the domal segment of the middle crura and has a scroll junction with the upper lateral cartilage. The caudal borders usually run parallel to the nostril rim and turn cephalically. The lateral border occurs at the junction of the lateral crura and the accessory cartilage. Congenital weakness or malposition of the LLC is associated with contour deformities and collapse of the alar rim. The contour and resilience of the alar rim affect the aesthetic and function of the nasal tip. Therefore, careful management of the LLC during rhinoplasty is essential to successful outcomes.

In a discussion of alar malposition, Sheen2 emphasized the link between the anatomy of the lateral crura and external valve function. Greater cephalic rotation of the lateral crus reduces rigid support for the ala. Overzealous resection of the cephalic margin of the LLC diminishes its support and creates a dead space that may contract and contribute to malposition of the alar rim.3-5 Reduced support by the LLC may cause alar collapse, especially during deep inspiration (Figure 1).

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Several surgical methods have been proposed for correcting weak or deformed lateral crura. Traditionally, structural and contour deformities of the alar rim have been addressed with batten grafts, strut grafts, composite grafts, and suture techniques.5,6 The alar rim graft involves a less conventional surgical maneuver in which the graft is placed in a nonanatomic fashion along the alar margin.7 An effective technique for stabilizing the lateral crus is the strut graft.8-10 This procedure involves dissection of the underside of the lateral crus from the underlying mucosa and placement of a cartilage graft into a prepared pocket. Malpositioned lateral crura may be managed by repositioning the lateral crura and placing strut grafts; this approach also is applicable to the correction of alar rim retraction and the prevention of alar rim collapse.8 Correction of alar malposition by alar transposition may destroy the scroll area and lead to impaired function of the internal valve.11 In this study, we describe the alar rim flap technique for correction of alar malposition without complete alar transposition.

**METHODS**

Twelve patients (8 women, 4 men) who underwent primary open rhinoplasty performed by the senior author (C.A.K.) at Erciyes University (Kayseri, Turkey) from March 2012 to June 2014 were evaluated in a prospective study. Patients included in this study presented with malpositioned lateral crura and collapse of the external valves during forced inspiration. Patients who previously underwent rhinoplasty were excluded from this study to avoid instances of insufficient length of the vertical axis. Nasal airway obstruction was diagnosed on physical examination by an assessment of the external appearance of the nose and the Cottle maneuver. Ethics approval was obtained from the Erciyes University Ethics Committee, and all patients gave written informed consent.

Preoperative and postoperative digital photographs were obtained for analysis of changes in the external valve area and aesthetic outcomes. In addition, patients were physically examined at postoperative visits by the author (C.A.K.) or his assistant. Because we consider dynamic alar wall stability to be more important than static stability, every patient was assessed for alar wall stability during deep inspiration.

Patients were assessed subjectively and objectively. All patients completed the Nasal Obstruction Symptom Evaluation (NOSE) questionnaire before and 6 months after surgery.12 The NOSE questionnaire addressed the severity of nasal congestion and nasal obstruction, difficulties with breathing through the nose and sleeping, and the inability to draw sufficient air through the nose during exercise or exertion (a blank copy of the NOSE questionnaire is available as Supplementary Material at www.aestheticsurgeryjournal.com). Patients scored the severity of their symptoms from 0 to 4, with 0 corresponding to the absence of symptoms and 4 indicating severe problems. The results of this subjective questionnaire then were scaled to a total score of 0 to 100 by multiplying the raw score by 5. The minimum and the maximum improvement of the NOSE score (iNOSE) were determined by comparing the NOSE scores pre- and post-operatively. In addition, all patients underwent paranasal
computed tomography (CT) preoperatively and 6 months postoperatively. The angle between the columella and alar sidewalls at the most anterior part of the nose was calculated from CT results and was compared pre- and postoperatively (Figure 2).

**Surgical Technique**

All patients in this study underwent primary open rhinoplasty under general anesthesia. Local anesthesia (lidocaine [2%] and adrenaline [1:80,000]) also was infiltrated into the incision and dissection planes. An inverted V columellar incision and bilateral marginal incisions were made, and the nasal flap was elevated in the subsuperficial muscularaponeurotic system (SMAS) plane. The malpositioned LLC was dissected bilaterally, a \( \geq 6 \)-mm-wide cephalic portion of the LLC was left intact, and the remaining caudal region of 2 to 3 mm was marked (Figure 3). To avoid distorting the tip anatomy, the markings were not extended to the tip-defining or estimated points. The caudal region of the LLC was dissected from the underlying mucosa, and the distal end was cut (Figure 3, dotted lines). The caudal region of the LLC then was elevated and pulled caudally. This area corresponds to the alar rim flap. Autogenous cartilage grafts were harvested and cut to pieces 3 mm wide and 15 to 25 mm long. All patients in this study received septal cartilage grafts, but conchal or rib cartilage may be harvested if septal cartilage is unavailable. The cartilage grafts were placed on the deep surface of the alar rim flap and secured with 5-0 polydioxanone sutures (Figure 4). The distal end of the alar rim flap was inserted into a pocket prepared from the lateral end of the marginal incision to the pyriform aperture. Open rhinoplasty then proceeded with standard techniques, and the alar rim flap was sutured to the mucosa during mucosal closure to prevent displacement of the flap. The surgical procedure is described in stepwise fashion in Figure 5. Patients received follow-up for an average of 16 months (range, 8-27 months).

**Statistical Analysis**

Statistical analyses were performed with SPSS software (version 20.0, IBM Corp, Armonk, NY). Descriptive statistics of continuous variables were represented with the mean, standard deviation, median, minimum, and maximum values. Normality of continuous variables was ascertained with the Shapiro-Wilk test. Variables that were not normally distributed were compared by means of the Wilcoxon test. Statistical significance was defined as \( P < .05 \).

**RESULTS**

The mean age of the 12 patients included in this study (8 women, 4 men) was 27 years (range, 22-35 years). After rhinoplasty with the alar rim flap technique, all patients indicated that their overall surgical results were satisfactory when asked by the operating surgeon. All patients had significant improvement in nasal obstruction symptoms. The
The mean preoperative NOSE score was 70.42 (standard deviation [SD], 8.11), and the mean postoperative score was 13.75 (SD, 3.77; \( P < .05 \)). The minimum iNOSE score was 45 and the maximum iNOSE score was 75.

The angles between the columella and lateral side walls before and after the operation are summarized in Table 1. Marked improvement was observed postoperatively. The mean preoperative and postoperative angles of the nose were 7.21 (preoperative) vs 9.06 (postoperative) for the right side and 7.23 vs 9.19 for the left side (\( P < .05 \)).

Clinical results are depicted in Figure 6 and Supplemental Figure 1. External valve collapse during deep breathing was treated successfully in all patients. Representative treatment of a 28-year-old man who presented with a bulbous tip and external valve incompetency due to cephalically malpositioned lateral crura is shown in Video 1, which can be viewed at www.aestheticsurgeryjournal.com.

DISCUSSION

Malposition of the alar cartilages resulting in a cephalad position of the alar crura is a common anatomic variation that has been described by Sheen.\(^2\) Characteristic findings of malposition of the alar cartilages include a broad and
bulbous nasal tip, parenthesis deformity, abnormal axes of the lateral crura, long alar creases that extend to the nostril rims, alar wall hollows, nostril deformities, and associated incompetence of the external valve. Patients who present with this deformity frequently flare their nostrils to stabilize their external valves. Care must be taken to recognize these anatomic variations preoperatively to avoid unacceptable aesthetic results, incompetence of the external valve, and a need for secondary rhinoplasty.13,14

The lateral crus is normally located 2 to 3 mm from the alar edge and runs parallel to the alar rim for half of its length. The perpendicular distance from the midnostril point to the caudal borders of the lateral crura ranges from 3 to 7 mm; any distance exceeding 7 mm is considered alar malposition.15,16 Pseudomalposition occurs when the cephalic margin of the LLC is more superior than the caudal edge; this condition negatively affects the appearance of the nasal tip.17,18 Because treatments for pseudomalposition and alar malposition differ, preoperative assessment of the type of malposition is essential for satisfactory outcomes.

Many surgical techniques have been proposed for correcting alar malposition and external valve insufficiency. These include resection of the lateral crural tail to rotate the cartilage arch, reduction or relocation of the lateral crura, splinting the alar rim with autologous grafts, and various suture techniques.2,16,19-25 The aim of these surgical procedures is to reinforce the external valve, but each has unique benefits and drawbacks that should be considered during the preoperative assessment. Sheen26 advocates treating alar malposition by excising the entire lateral crura and the domal segment of the middle crura, placing a centrally located multilayer tip graft, and reinserting the modified lateral crura laterally to support the alar rim. Hamra20 has emphasized the importance of reorienting the lateral crura downward to the alar rim. However, repositioning the lateral crura may damage the junction of the scroll with the upper lateral cartilage and affect the function of the internal valve.

Alar rim grafting techniques are common treatments for alar collapse and alar contour irregularities.17,28 Although the outcomes of alar rim grafting usually are satisfactory,
visibly noticeable grafts are an occasional result. Gruber et al. advocated applying a graft to the alar rim that is anatomically shaped to avoid this undesirable outcome. Alar batten grafts effectively strengthen the lateral crus regardless of placement location or suturing technique, but these grafts have a high risk of postoperative displacement.

The primary aim of the alar rim flap technique is to correct functional problems by reinforcing the external valve, but this procedure also yields a favorable aesthetic shape of the alar rim. The alar rim flap technique can readily be combined with other tip refinement procedures. For patients in this study with distinct supratip fullness or a bulbous tip deformity, we combined the alar rim flap technique with minimal (eg, 1 mm) cephalic excision of the LLC and applied tip-defining sutures with tip grafts if necessary. To avoid damaging the scroll area, complete alar transposition was not performed. Instead, the caudal portion of the LLC was pulled caudally and extended with cartilage grafts, and the resulting alar rim flap was placed under the vestibular skin and lateral wall mucosa where it could be supported by the pyriform aperture. Because we sutured the mucosa to the alar rim flap during closure, we did not observe any instances of postoperative displacement. The alar rim flap technique resulted in decreased operating times and increased external valve durability. Postoperatively, all patients had improved NOSE scores and increased angles between the columella and alar sidewalls. Aesthetic results were considered satisfactory by the patients and surgeons involved in this study.

The alar rim flap technique may not be suitable for secondary rhinoplasty patients who lack sufficient caudal excess of the lateral crura or who have severe LLC deformities because this technique requires adequate cartilage strength. In addition, the alar rim flap technique may produce internal valve deficiencies in patients with a vertical axis of the LLC that is less than 6 mm. This procedure should be reserved for primary rhinoplasty patients with malpositioned lateral crura and a sufficiently long vertical axis.

CONCLUSIONS

For patients with alar malposition who undergo rhinoplasty, preoperative recognition of this anatomic variation is a prerequisite for successful functional and aesthetic results. The alar rim flap technique can effectively correct alar cartilage malposition and external valve insufficiency. With this surgical maneuver, the scroll area and internal valve are not damaged, the external valve is sufficiently supported, and favorable outcomes can be achieved.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

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REFERENCES