Reconstructive Rhinoplasty

The 3-Dimensional Nasal Tip

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Objectives: To review nasal alar support mechanisms, introduce the concept of tractional forces on the nasal ala, and describe a reconstructive technique to correct nasal tip deformities associated with weakened tractional force on the nasal ala.

Design: Photographic study and retrospective medical chart review.

Results: We noted that patients with weakened support at the dome of the lower lateral cartilage had lateral alar deformities. Strengthening the cartilaginous deficiency improved the nasal appearance and function in 90% of patients.

Conclusions: Deformities of the nasal tip are among the most difficult to correct. Tractional forces provided by dome strength help to maintain the ala in its normal anatomical position. Structural tip grafts restore the tractional force and, thereby, help to correct the alar deformity.

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To avoid nasal tip complications in primary rhinoplasty and to repair them properly in revision or reconstructive rhinoplasty, we have found that it is essential to consider the lower lateral cartilage as a 3-dimensional structure. Traditional teaching has emphasized a 2-dimensional approach to the structural support of the lower lateral cartilage and tip position: ventral to dorsal, as quantified by tip projection, and medial cephalic to caudal, as quantified by tip rotation and width. The third dimension that we include in our preoperative analysis and surgical approach is the lateral alar cephalocaudal dimension, which is quantified by alar rim position. The position of the lateral alar rim is related to the cephalocaudal traction forces that are determined largely by the shape and strength of the lower lateral cartilage, in particular, at the dome region. Weakened dome support alone, even in the presence of a very strong and prominent lateral crus, often results in a narrowed domal angle with associated alar retraction or collapse. Despite the integrity of the lateral crural elements, domal weakness with its loss of caudally directed traction will likely result in alar deformities. We review herein the concept of the 3-dimensional nasal tip and discuss its reconstruction in revision rhinoplasty.

Common goals of nasal tip surgery are to create a stable, symmetric, and properly projected and rotated nasal tip that is triangular on base view and harmonious with the rest of the nose. Nasal tip surgery is generally recognized as the most complex portion of rhinoplasty, and tip irregularities are a common cause of revision rhinoplasty. At primary rhinoplasty, failure to recognize and respect the structural integrity of the nose may result in tip deformities. Overaggressive resection of the lower lateral cartilage has been a common cause of nasal tip deformities. Alar retraction, alar collapse, alar notching, pinched tip, and bossae formation may all result from surgical attempts to enhance the appearance of the lower third of the nose. These deformities may persist after secondary rhinoplasty if the weakened tip support mechanisms are not strengthened adequately.

METHODS

ANATOMY

The surface anatomy of the nasal tip consists of 3 segments: the columella, lobule, and ala. Underlying these surface landmarks are the skeletal support structures of the lower third of the nose. The major support mechanisms of the tip include the size, shape, and strength of the lower lateral cartilages, the attachment of the feet of the medial crura to the caudal border of the septum, and the attachments of the upper lateral cartilages to the lower lateral cartilages at the scroll region (Figure 1). There also are several minor support mechanisms, including the interdomal ligaments, quadrangular cartilage, nasal spine, membranous sep-
To better understand our 3-dimensional approach to the reconstruction of the nasal tip, we must first consider the lower lateral cartilages as a single and complete entity, independent of other support mechanisms of the tip. The lower lateral cartilages form the foundation of nasal tip support, and their intrinsic strength determines the shape of the nasal tip (Figure 1). The relative position of the lateral crus is determined by the forces within the cartilage itself, especially at the dome region, but also at the medial and lateral crus. The strength of the curvature of the lower lateral cartilage at the dome (middle crus) determines the position of the lateral alar rim relative to the lobule, columella, and septum. On frontal and basal views, this determines the amount of nostril flare and shape (convexity vs concavity), and on lateral view, it determines the degree of alar retraction and columellar show (Figure 2). The alar cartilage lies approximately 6 mm from the nasal rim at the dome and 13 mm from the rim at the lateral aspect of the lateral crus. These measurements may vary depending on the patient and previous surgical changes.

**THE TRIPOD CONCEPT OF THE NASAL TIP AS A 2-DIMENSIONAL MODEL**

Most descriptions of nasal tip surgery focus on modifications of the lower lateral cartilages with cartilage resection, cartilage grafts, or suture techniques. Much of our understanding of the aesthetic changes associated with these modifications emanates from Anderson's description of the nasal tip as a tripod (Figure 3). Anderson's model helps us to conceptualize the aesthetic changes produced in the tip with shortening or lengthening of the legs of the tripod. Thus, to alter the projection of the nose, we may shorten or lengthen the medial crura within the columella. Similarly, to alter nasal width and rotation in the lobule, we may resect elements of the lower lateral cartilage. However, the tripod analogy focuses on the tip in only 2 dimensions. The ventral-to-dorsal dimension is measured as tip projection, and the medial-to-lateral dimension is measured as tip width and rotation. The third dimension on which we have focused is the lateral alar cephalocaudal dimension. We define this dimension in terms of traction on the lateral aspect of the lower lateral cartilage and the resultant lateral alar position (Figure 4). Weakening of the downward traction exerted by the intrinsic tensile strength of the lower lateral cartilage, particularly in the dome region, often results in alar retraction and other stigmata associated with overly aggressive rhinoplasty techniques.

**RECONSTRUCTION PRINCIPLES**

In recent years, rhinoplasty surgeons have come to appreciate that excisional rhinoplasty techniques, especially when excessive, may cause unpredictable results as wound contracture alters the surgically manipulated skeletal structures. These concerns have been addressed with the increased use of suture techniques in primary rhinoplasty and less reliance on pure cartilage excision techniques (Figure 5). Often, patients present for revision of tip irregularities after primary rhinoplasty in which aggressive cartilage resections were performed. Patients with retracted alae, collapsed alae, pinched tips, or tip asymmetries often have weaknesses in the lateral alar cephalocaudal traction forces as a result of cartilage resection at primary rhinoplasty. Our approach to these rhinoplasty complications is described in the following section.
TECHNIQUE

We retrospectively reviewed all 3-dimensional tip reconstructions performed with the described technique during the past 13 years. We identified 130 patients (71 women and 59 men) who underwent lower lateral cartilage replacement with conchal cartilage grafts or repositioning of the native alar cartilage remnant, in combination with a “gusset plate” tip graft, for the overresected nasal tip.

At the preoperative office visit, the strength of the remnant alar cartilages, the quality of the skin overlying the cartilage, and tip position, strength, and symmetry are determined. Visual inspection and palpation allow us to accurately predict in most cases the amount of cartilaginous remnants. We evaluate the position of the ala relative to the columella on lateral view and the width of the nasal aperture and degree of alar collapse on nasal view. The key to properly correcting alar deformities, particularly those caused by changes in the cephalo-caudal tractional forces, lies in the external rhinoplasty approach that allows us to visualize directly and precisely the remnant cartilaginous structures (Figure 6A).

After the skin and soft tissue envelope is elevated off the nasal tip cartilages, tip support and projection are evaluated by inspection and palpation of the medial crura. Next, the tractional strength of the lateral crura relative to the medial crura is evaluated. This is achieved by palpating the lateral crus of the lower lateral cartilage and appreciating its resistance to movement in a cephalo-caudal direction. After all dorsal and septal work is finished, we completely remove the lateral crus of the lower lateral cartilage after transecting it from the medial crus at the dome (Figure 6). The medial crural remnants on either side are sutured together at the dome, and a columellar strut graft is placed to maintain and strengthen tip support. We next return the resected lateral crus to the alar rim, or, if the native lateral crus is weak and inadequate, we replace it with a conchal cartilage graft (Figure 7). The medial aspect of the lateral crus replacement is secured to the medial crural stub. The lateral aspect of the lateral crural replacement is suture-secured to the pyriform aperture and positioned in a far caudal, nonanatomic position to reverse existing alar retraction and to prevent future alar irregularities. Care should be taken to ensure as far a caudal position of the repositioned cartilage as possible to secure long-term results in the face of contractile forces that may otherwise cause recurrent lateral alar deformities. Finally, and importantly, a structural tip graft is used to return strength to the third dimension of the nasal tip (Figure 4).
The primary role of this tip graft is to add a cephalocaudal traction force to prevent alar retraction in the newly reconstructed nasal tip. It acts in a fashion analogous to a gusset plate in a steel bridge structure (Figure 9). That is, once secured with sutures to the medial and lateral crura, it produces downward and outward tractional forces on the lateral crura to prevent alar retraction and alar collapse. The strength afforded by the gusset plate tip graft maintains the caudal position of the ala against medically and cephalically directed contractile forces that act on the lateral crus during wound healing.
RESULTS

We have been using the techniques described in the “Methods” section in both reconstructive rhinoplasty after excision of a neoplasm and in revision cosmetic rhinoplasty. When revising a nose with alar retraction, alar collapse, alar notching, pinched tip, or bossae, we focus on realigning the lateral crus of the lower lateral cartilage far caudally in a nonanatomic caudal position. We then strengthen the nonanatomic position of this cartilage with the placement of a structure-enforcing gusset plate tip graft. These techniques have been used on 130 patients during the past 13 years, with excellent long-term results. In 70% of the patients, the native lower lateral cartilages were used, but the other 30% required conchal cartilage grafts as replacements for the insufficient native lower lateral cartilage. All the noses have maintained normal function and appearance of the tip. With an average follow-up of 7 years, we have not had any case of alar malpositioning after the gusset plate repair. Patient and surgeon satisfaction with the aesthetic and functional results of the procedure was 90%, based on retrospective questionnaire and medical chart review. The primary area of dissatisfaction was related to asymmetries at the nasal tip. Three cases are described herein.

CASE 1

A 72-year-old man who underwent rhinoplasty 51 years earlier was referred to our clinic because of nasal obstruction related to a nasal fracture he sustained 2 years after his first rhinoplasty. The nasal obstruction had worsened in recent years, and he began snoring about 5 years before we evaluated him. Nasal examination revealed total collapse of the alar cartilages, with notching of the rims (Figure 10A-C). The patient underwent revision septorhinoplasty with conchal cartilage graft replacement of the native lower lateral cartilage, strut graft, and tip graft. Medially, these alar replacement grafts were secured to the cut ends of the medial crura just above the columellar strut. A gusset plate tip graft secured the alar replacement grafts and improved tip definition (Figure 10D-F).

CASE 2

A 28-year-old woman was seen for a long-standing nasal airway obstruction. She reported that she had fractured her nose at age 14 years and again at age 15 years. She had septorhinoplasty at age 16 years. Over the 4 years before presenting to us, she became aware of marked twisting of the nose, increased nasal obstruction, and alar retraction. We noted collapse of her nasal alae, with bossae formation (Figure 11A-C). We performed revision septorhinoplasty with dorsal hump resection, repositioning of the remnant native lower lateral cartilages, securing of the medial stubs of cartilage, columellar strut graft, and gusset plate tip graft. At 4-year follow-up, the patient had excellent breathing and satisfactory cosmesis (Figure 11D-F).
CASE 3

A 60-year-old woman with a history of previous cosmetic rhinoplasty performed through a delivery approach presented with a short nose, wide nasal tip, and dissatisfaction with her nasal breathing and aesthetics. Revision septorhinoplasty disclosed that the lower lateral cartilages were significantly asymmetric and weak. Also, amorphous cartilaginous and fibrous tissue in the supratip region completely obliterated the cephalic margin of the lower lateral cartilage (Figure 12A-C). Intraoperatively, it was apparent that a dome division had been performed previously. We reapproximated the medial stubs in the midline with 4-0 polydioxanone sutures after placing a columellar strut. The remnant native lower lateral cartilages were then approximated to the medial crura and secured in their new position with a gusset plate tip graft. This was followed by a dorsal onlay graft of septal cartilage and medial and lateral osteotomies. At 5-year follow-up, the patient had excellent cosmetic and functional results (Figure 12D-F).

COMMENT

The nasal tip is divided into 3 subunits: the columella, lobule, and ala. In the past, we focused on altering the nasal lobule to refine the tip. We often did not consider the third subunit, the ala, in our approach to primary rhinoplasty. However, alar position is inevitably changed by the same rhinoplasty maneuvers that affect rotation, projection, and tip width. Modifications to the columella and lobule are invariably associated with secondary changes to the alar position because these modifications weaken the lateral alar cephalocaudal traction force. This force is provided by the intrinsic strength of the lower lateral cartilage, and it determines the shape and position of the lateral ala. A weakened tractional force results in alterations in the position of the alar rim. The new position of the alar rim is determined by the areas of strength of the lower lateral cartilage remnant as well as by the forces of wound contracture over time. Frequently, weakening the dome results in cephalic alar retraction because of loss of the cephalocaudal traction forces provided by dome strength that push the lateral crus downward and outward. This mechanism of alar retraction should be distinguished from alar retraction caused by the overaggressive resection of the lateral aspect of the lower lateral cartilage. The cause of alar retraction in the case of lateral crural resection follows the surgical principle that in the presence of a tissue void (area of resection of lateral alar cartilage), contracture occurs from a region of poor support (the newly resected lateral crus) to the area of greater support (the middle third of the nose). Regardless of how conservative the ap-
proach is, changes to the columella and lobule in the dome region (i.e., changes to the first 2 dimensions) will affect the third dimension, that is, lateral alar position. It is essential to recognize that adding structural support to the dome helps provide the caudally directed tractional forces to the lateral alar segments, thereby reversing and preventing alar retraction, alar collapse, and alar asymmetries.

CONCLUSIONS

The lower lateral cartilage and the nasal tip generally have been thought of in 2 dimensions: medial to lateral and ventral to dorsal. We have been looking at the nasal tip and lower lateral cartilage in 3 dimensions, taking into account the additional cephalocaudal dimension of the lateral ala. We believe that this third dimension of the tip, which has been underemphasized in the past, is related directly to the tractional forces provided by the lower lateral cartilage strength at the dome. To reconstruct a nasal tip and lateral ala that will withstand the forces of wound contracture after cartilage weakening techniques, a gusset plate tip graft is required to strengthen the cephalocaudal tractional forces and reestablish the strength of the third dimension. This tip graft provides solid structural support of the nasal tip by reinforcing the intrinsic strength of the lower lateral cartilage and forcing the lateral crura downward and outward.

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REFERENCES


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