Defining the Infratip Lobule in Rhinoplasty: Anatomy, Pathogenesis of Abnormalities, and Correction Using an Algorithmic Approach

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Background: Excess infratip lobule projection is often the result of deformities of the middle crus and lower lateral cartilage. The causes and correction of excess projection have not been well described. The classification of the deformities causing excess infratip lobule projection is defined and a surgical algorithm for addressing the infratip lobule is presented.

Methods: A retrospective review of primary rhinoplasties was combined with the use of a cadaver model to identify the causes of excess infratip lobule projection and develop an algorithm for its correction. Specific cases are presented to demonstrate the consistency and predictability of these techniques.

Results: The classification of excess infratip lobule projection is divided into intrinsic (i.e., long middle crus, wide middle crus, lower lateral malposition, and combination) and extrinsic causes (i.e., prominent septum). After correcting extrinsic causes, the algorithm progresses from medial to lateral, working from the medial crus to the lateral crus. Final refinement using transdomal sutures establishes the endpoint for infratip lobule projection and alar rim position when the cephalic and caudal edges (rotational orientation) of the lower lateral cartilage lie in the same plane.

Conclusions: A simple classification and logical algorithm are established to help rhinoplasty surgeons achieve aesthetic and consistent infratip lobule projection in cosmetic rhinoplasty. Establishing appropriate infratip lobule projection is essential for an aesthetic result in the lower third of the nose. The appearance of this complex area with the tip, columella, ala, and lobule has great importance in the final outcome in rhinoplasty. (Plast. Reconstr. Surg. 130: 1148, 2012.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, V.

Outcome in rhinoplasty are based on comprehensive nasal analysis, mastery of nasal anatomy, and understanding the consequences of each surgical maneuver. Complex relationships exist throughout the nose, and manipulation of one part often has an effect on its neighbor. This is especially true in the lower third of the nose, a complex area encompassing the nasal tip, columella, ala, and lobule. Numerous recent articles have addressed nasal tip contouring and have described the aesthetic evaluation and treatment for the tip. This is not surprising given the importance of the nasal tip in the final outcome of rhinoplasty. The infratip lobule, however, has not previously been addressed.

The infratip lobule is a challenging area because the forces involved in its shape are multifactorial and dynamic. It is influenced by alar-columellar relationships, tip rotation, the anterior septal angle, and underlying lower lateral crural malformation or malposition. The key to successfully controlling the infratip lobule lies not only in the analysis but also in the sequential algorithm for its correction.

In this article, we describe the preoperative analysis, anatomy, classification system, and operative techniques to manage the infratip lobule.
Anatomical dissections with suture manipulation are used to demonstrate the operative techniques and to show the immediate effects. We also provide cases showing the different types of infratip lobule projection and its management. This research was performed in conformation with the Declaration of Helsinki.

ANATOMY AND NASAL ANALYSIS

Surface Anatomy

The lower third of the nose is evaluated on the anteroposterior, lateral, and basal views. The infratip lobule is the area of the nose bounded by the tip-defining points superiorly, and the columella caudally (Fig. 1). The infratip lobule occupies a central location on the tip, subjacent, and counterbalancing the supratip break and tip-defining points. Its lateral boundary is the soft triangle and the apex of the nostril. On the anteroposterior view, a line drawn through the tip-defining points and the inferior extent of the lobule defines the infratip lobule projection (Fig. 2). In the ideal nose, the nostril apices coincide with the midpoint of the infratip lobule. On the lateral view, the infratip lobule projection is delineated by the tip and the columellar-lobular angle. Visually, the projection is influenced by the alar-columellar relationship.

Cartilaginous Anatomy

The lower lateral cartilage is divided into three crura as defined by Sheen and Sheen: medial, middle, and lateral (Fig. 3). The medial crus becomes the middle crus at the columella junction, and the middle crus becomes the lateral crus at the domal junction. The medial crus determines tip projection and tip support and serves as the central leg of the nasal tripod. At the junction of the medial and middle crura, the lower lateral cartilage changes its trajectory in multiple planes, taking a more cranial trajectory and rotating along its long axis. It is this change in angulation that defines the columellar-lobular angle and marks the beginning of the infratip lobule. The middle crus diverges from the midline to form the dome of the lower lateral cartilage. The dome of the lower lateral cartilage marks the transition of the middle crus to the lateral crus and corresponds to the tip-defining points, which delineate the superior aspect of the infratip lobule. Thus, the trajectory, length, and strength of the middle crus of the lower lateral cartilage defines the shape, contour,
and projection of the infratip lobule. The lateral crus determines the amount of alar support and tip rotation as the other two legs of the nasal tripod. Because the middle crus is between the medial and lateral crura, there are significant interactions between the components of the lower lateral cartilage.

Nasal Analysis and Planning

A standard nasal analysis is performed, the components of which have been well described. The evaluation and planning of the lower third on the nose combines the assessment of the infratip lobule with tip projection, tip definition, alar position, and the alar-columellar relationship. Modification of the lower lateral cartilages will correct asymmetries and bulbous or boxy tips. Determination of tip projection and definition will guide the use of a columellar strut and domal suture techniques.

Evaluation of the infratip lobule begins with the alar-columellar relationship and the shape of the lower third of the nose. The surgeon can anticipate the shape and strength of the lower lateral cartilage by examining the alar-columellar relationship. The alar-columellar relationship is the cutaneous manifestation of the underlying interactions between the medial, middle, and lateral crura. Establishing a normal alar-columellar relationship will ensure proper positioning of the medial, middle, and lateral crura. Excess infratip lobule projection in the setting of a normal alar-columellar relationship signifies a problem with the length or width of the middle crus.

Anatomically, the infratip lobule overlies the middle crus of the lower lateral cartilage. As a result, the shape and projection of the infratip lobule is based on the subjacent middle crus. The specific deformities of the middle crus are often revealed intraoperatively. However, evaluation of the basal view can give an indication of the length of the middle crus. In the ideal nose, the ratio of the lobule to the columella should be 1:2. When the lobular portion exceeds this ratio, it is likely that the middle crus is elongated.

Equally important is the angle of departure between the lateral crus and the alar rim and the rotational orientation of the lateral crus with respect to its cranial and caudal edges. A lateral crus with a large angle of departure will have a recessed and weak facet. This will give the appearance of a pinched tip and overprojected infratip lobule. This is often superimposed onto an abnormal rotational orientation with the caudal edge of the lateral crus below the cranial edge, which compounds this deformity. Alar support procedures such as a lateral crural strut graft or alar contour graft can often compensate for weaknesses in alar support. This configuration is often seen in patients undergoing primary rhinoplasty with very weak lower lateral cartilages. A rotational orientation with the caudal edge above the cranial edge will produce alar notching and nostril flaring, also leading to excess infratip lobule projection. This deformity is often compounded in the secondary rhinoplasty where a weak or diminutive lower lateral cartilage exists from prior overzealous weakening or excision causing alar retraction or discrepancies in the alar-columellar relationships.

Evaluation of causes outside of the lower lateral cartilage is important as well. The anterior septal angle and caudal septum are subjacent to the infratip lobule. Therefore, prominence of either can lead to excess infratip lobule projection. Plunging tips and tension tips should be noted before surgery, because these can contribute to excess infratip lobule projection (Fig. 4). Maneuvers that correct these issues include caudal septal resection, dorsal reduction with appropriate medial crural support, and columellar support.

CLASSIFICATION

The classification and management of excess infratip lobule projection has not been described previously and is the rationale for writing this article (Table 1). Causes of excess infratip lobule projection are divided into intrinsic and extrinsic causes. For simplicity, intrinsic causes are deformities or abnormalities in the lower lateral cartilage and extrinsic causes are everything outside of the lower lateral cartilage. Correct classification is
dependent on a thorough preoperative nasal analysis and intraoperative confirmation of the anatomy. After identification and classification of the underlying abnormalities, they are easily corrected with standard surgical techniques.

**Type I: Intrinsic (Middle Crus Too Long)**

In type I deformities, the middle crus is too long. Because the vertical height of the middle crus is limited by its surroundings, the middle crus buckles or bows out inferiorly, causing excess infratip lobule projection. Depending on the relative lengths of the middle crus, this can be symmetric or asymmetric between the left and right sides. In addition to an overprojecting lobule, the deforming forces of a buckled middle crus may cause asymmetries of the lateral crus or the tip-defining point, leading to associated tip asymmetries.

**Type II: Intrinsic (Middle Crus Too Wide)**

In type II deformities, the middle crus is too bulky or wide. This may or may not be associated with discrepancies in vertical height. A wide middle crus will push on the infratip lobule causing overprojection. Although the trajectory of the middle crus is within normal limits, the mere bulk and width pushes on the soft-tissue envelope and causes prominence of the infratip lobule. This deformity is often seen in conjunction with a boxy or bulbous tip.

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**Table 1. Classification of Different Types of Intrinsic (Types I to IV) and Extrinsic (Type V) Abnormalities and the Effects on the Middle Crus (shaded red) and the Infratip Lobule***

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Depiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Middle crus too long</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>II</td>
<td>Middle crus too wide</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>III</td>
<td>Lower lateral malposition or asymmetry</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>IV</td>
<td>Combination of intrinsic (types I–III) abnormalities</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>V</td>
<td>Extrinsic: prominent caudal septum or septal angle</td>
<td><img src="image5.png" alt="Image" /></td>
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*The medial, middle, and lateral crura are labeled.
Fig. 5. Arrow indicates the rotational orientation necessary to elevate the caudal edge of the lower lateral cartilage to the same plane as the cranial edge.

Fig. 6. Illustration showing lower lateral cartilage after placement of medial crural suture, interdomal suture, and transdomal sutures.

Table 2. Correction of Intrinsic Deformities*

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Maneuvers</th>
<th>Cadaver</th>
<th>Effect</th>
<th>Deformities Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verticalize the medial crus and set junction of medial and middle crura</td>
<td>Medial crural shortening suture</td>
<td>Tip support, Sets junction of medial and middle crus, Control/reduce the length of the middle crus</td>
<td>Type I</td>
<td></td>
</tr>
<tr>
<td>Shape middle crus</td>
<td>Cephalic trim of middle crus, Caudal trim if needed</td>
<td>Controls width of middle crus, Improves tip definition</td>
<td>Type II</td>
<td></td>
</tr>
<tr>
<td>Set junction of middle and lateral crura</td>
<td>Interdomal suture, Shaped columellar strut with intercrural suture</td>
<td>Sets tip-defining points, Improves symmetry of LLC, Sets/reduces final length of middle crus and infratip lobule projection</td>
<td>Type III and type I</td>
<td></td>
</tr>
<tr>
<td>Evaluate intrinsic asymmetries of LLC Adjust rotational orientation of lateral crus</td>
<td>Transdomal sutures</td>
<td>Improves symmetry of tip, Adjusts and finalizes infratip lobule projection, Achieves the endpoint of lower lateral cartilage position by setting caudal and cranial edge at same level</td>
<td>Type III and type IV</td>
<td></td>
</tr>
</tbody>
</table>

*Stepwise algorithm of surgical maneuvers for correction of intrinsic deformities, correlation to cadaver dissection photographs, the effect on the lower third of the nose, and the deformities addressed.
Fig. 7. Case 1. Preoperative (left) and postoperative (right) views (anteroposterior, lateral, and basal).
Type III: Intrinsic (Lower Lateral Malposition or Asymmetry)

Type III deformities have a malpositioned or asymmetric lower lateral cartilage. This is most often related to the angle of departure between the lateral crus and the alar rim or to the rotational orientation of the lateral crus with respect to its cranial and caudal edges (Fig. 5). The rotational orientation that produces the ideal infratip lobule projection is one where the cranial and caudal edges lie in the same plane. Malposition of the lower lateral cartilage is often superimposed on intrinsic asymmetries or deformities that will need suture correction.

Type IV: Intrinsic (Combination of Intrinsic Deformities)

Type IV deformities involve a combination of types I to III. They often have multiple asymmetries and deforming forces, with the middle crus being too long and too wide (types I and II). The left and right middle crura may be similar but are often asymmetric. Deformities of the middle crus are often superimposed on abnormalities of lower lateral cartilage (type III).

Type V: Extrinsic

Type V deformities are extrinsic to the lower lateral crus. A prominent caudal septum or anterior septal angle can displace the infratip lobule, causing prominence. Septal abnormalities can also cause abnormalities in nasal length (long nose), nasal height (tall nose), the columellar-labial angle, or the columellar-lobular angle, all of which may give the perception of excess infratip lobule projection. Furthermore, septal prominence can also contribute to a tension tip or a plunging/drooping tip, leading to overprojection of the infratip lobule.

OPERATIVE TECHNIQUE

The operative correction of excess infratip lobule projection addresses each of the specific types of deformity in a stepwise fashion (Table 2). If there is a prominent caudal septum causing overprojection of the middle crus and infratip lobule, the caudal septum is trimmed. The first maneuver to address intrinsic deformities is to verticalize the medial crus by placing a medial crural suture. This is the initial step toward resolution of a type I deformity by defining the junction of the medial and middle crus. By incorporating portions on the middle crus, a high intercrural suture can shorten the middle crus by absorbing its length and, by definition, control the projection of the infratip lobule. This suture also begins to define the amount of tip projection and provides for a stable middle base for the “nasal tripod.” In patients with weak tip support, a columellar strut is incorporated.

Next, the middle crus is trimmed to control its width. Any excess width or bulk of the middle crus can lead to excess infratip lobule projection (type II) and paradomal fullness and bulbosity. Cephalic trim is performed to create symmetrical crura and improve tip definition and lower lateral symmetry. The caudal aspect of the middle crus can also be trimmed if necessary. In patients where tip support is a concern, resection of the anterocaudal septal angle can achieve the same effect as caudal trim of the middle crus without weakening the lower lateral cartilage.

Placement of the initial interdomal suture narrows the angle of divergence and begins the process of defining the junction of the middle crus with the lateral crus and the tip-defining points. Transdomal sutures will define the junction of the
Fig. 9. Case 2. Preoperative (left) and postoperative (right) views (anteroposterior, lateral, and basal).
middle and lateral crura, establish the length and shape of the middle crus, and determine infratip lobule projection. The transdomal sutures are usually placed toward the leading edge of the lower lateral cartilage. The slightly more caudal placement derotates the tip and controls the infratip lobule projection. Differential placement of transdomal sutures in the cranial-caudal dimension allows for shaping to improve symmetry of the domes and also changes the rotational orientation of the lateral crus. These sutures will finalize the shape of the tip-defining points and the infratip lobule.

The endpoint of the transdomal sutures should be to straighten and flatten the lateral crus and establish proper rotational orientation. The more convex the lateral crus, the larger the bite and the more lateral the placement. A lateral crus that is less convex requires a more medial, smaller bite. The final result following transdomal suture placement is a symmetric, aesthetic nasal tip with well-proportioned crura (Fig. 6). One cannot overemphasize the importance of precise placement of the transdomal sutures. The position and orientation of the transdomal sutures will sculpt the tip and rotate the lateral crus. The rotation of the lateral crus will determine the rim elevation and, ultimately, the appearance of the infratip lobule. We have found that the alar rim position corresponding to a rotational level where the cephalic and caudal edges are on the same plane will give the ideal infratip lobule projection.

In situations where there is slight overrotation of the lateral crus because of suture placement for tip projection or tip sculpting, an alar contour graft or lateral crural strut grafts may be used to correct the rim position.12,13 The need for alar rim support is based on the trajectory of the lateral crus. Adequate rim support and preservation of the normal alar-columellar relationship ensures that the perceived lobule projection equals the actual projection.

**CASE REPORTS**

**Case 1**

This patient underwent open rhinoplasty (Figs. 7 and 8). On clinical examination, the patient had a mild prominent caudal septum (type V extrinsic deformity). On the anteroposterior view, her nostril apex is cranial to the midpoint of the lobule and she has mild alar retraction. These findings signify a type III deformity with lower lateral malposition and abnormal rotational orientation of the lower lateral cartilage. Intraoperatively, she was noted to have a long (type I) and wide (type II) middle crus with very convex lower lateral cartilages. She had a 3-mm component dorsal reduction and infracture. She had a lower lateral cartilage turnover flap to decrease the width of the middle crus and improve asymmetry and deformity of the lower lateral cartilage. A very slight caudal septal trim was performed. Intercrural and interdomal sutures were used to shorten the middle crus, and transdomal sutures were used for final rotational adjustment of the lower lateral cartilage. Alar contour grafts were used to support the rim.

**Case 2**

This patient underwent open rhinoplasty with 18-month followup (Figs. 9 and 10). She has a tension tip and prominent caudal septum, indicative of an extrinsic type V deformity. On the anteroposterior and lateral views, she has a mild retracted ala and an abnormal alar-columellar relationship, suggesting lower lateral cartilage malposition and abnormal rotational orientation, a type III deformity. Intraoperatively, her middle crus was both long (type I) and wide (type II). She had a large 7-mm component dorsal reduction with spreader grafts and infracture. Her caudal septum and septal angle were trimmed and centered. A columellar strut was used to set tip projection after a lower lateral release deprojected the tip. A cephalic trim was performed to reduce the width of the middle crus. Intercrural and interdomal sutures were used to shorten the middle crus to prevent overprojection of the infratip lobule. Transdomal sutures were used to adjust the rotational orientation of the lower lateral cartilage by bringing the caudal and cranial edges of the lower lateral cartilage into the same plane. The transdomal sutures in conjunction with the alar contour graft preserve the alar-columellar relationship.
DISCUSSION

The appearance of the nasal tip and the lower third of the nose has great importance in the final outcome of rhinoplasty. Although many articles have addressed nasal tip contouring, few have addressed infratip lobule projection and the complex relationships between the infratip lobule and the lower lateral cartilage. We prefer a systematic approach working from medial to lateral followed by final contouring and shaping. The classification and algorithm for addressing the infratip lobule projection form the basis of this article.

The contour and projection of the infratip lobule are defined by the middle crus of the lower lateral cartilage. The deformities affecting infratip lobule projection have been categorized into five types: four intrinsic and one extrinsic. Intrinsic issues are addressed through a variety of suture, sculpting, and grafting techniques. Extrinsic causes require preoperative recognition so that an appropriate plan can be devised.

Although prior articles have addressed elements of contouring the lower third of the nose, a stepwise algorithmic approach with a specific endpoint for addressing infratip lobule projection has not been clearly delineated in the literature. Toriumi discusses tip contouring and the effects of the rotational orientation of the lower lateral cartilage on tip shape and alar rim support. In that article, it is stressed that the caudal edge of the lateral crus should not be cephalic to its cephalic edge. As previously noted, when the caudal edge of the lateral crus rotates higher than the cephalic edge, alar notching and alar weakness occur. However, the article does not specifically address the effect of the rotational orientation of the lower lateral cartilage on infratip lobule projection or the endpoint for lower lateral cartilage rotation. Ghavami et al. discuss shaping the nasal tip and establish an algorithm for tip shape and projection. Although many of the rhinoplasty techniques are similar to those presented in this article, the authors do not discuss the effect of different suture techniques on the infratip lobule.

The algorithm for correction of intrinsic deformities progresses from medial to lateral. First, medial crural sutures are used to set tip projection and define the beginning of the middle crus. Next, the middle crus is trimmed or debulked as necessary to improve definition and symmetry. An interdomal suture is used to define the domes, narrow the angle of divergence, and begin to set the junction of the middle and lateral crura. The intercrural and interdomal sutures together control the length of the middle crus. Transdomal sutures are then used to refine the tip, define the rotational orientation of the lower lateral cartilage, and control the infratip lobule projection. The endpoint of suture placement and final infratip lobule projection occurs when the cranial and caudal edges of the lower lateral cartilage are of equal height and in the same plane. This represents the fundamental and crucial concept in determining the infratip lobule projection. If the angle of departure of the lower lateral cartilage from the alar rim is excessive, alar contour grafts or lower lateral strut grafts are placed. This stepwise correction of the middle crus and the geometry of the lower third of the nose results in optimal infratip lobule projection.

The infratip lobule is central to the lower third of the nose. Establishing an algorithm and endpoints for the variety of surgical maneuvers is essential for consistent and predictable results. It is important to recognize that aggressive overcorrection can worsen the deformity. Furthermore, the aesthetic analysis and surgical planning need to address not only the individual elements of the nose but also the effects of one region on the overall outcome. Our method of medial to lateral stepwise correction provides aesthetic results when used in conjunction with our overall surgical philosophy in rhinoplasty.

ACKNOWLEDGMENT

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REFERENCES


Plastic Surgery Level of Evidence Rating Scale—Diagnostic Studies

<table>
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<tr>
<th>Level of Evidence</th>
<th>Qualifying Studies</th>
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<tr>
<td>I</td>
<td>Highest-quality, multicentered or single-centered, cohort study validating a diagnostic test (with “gold” standard as reference) in a series of consecutive patients; or a systematic review of these studies</td>
</tr>
<tr>
<td>II</td>
<td>Exploratory cohort study developing diagnostic criteria (with “gold” standard as reference) in a series of consecutive patient; or a systematic review of these studies</td>
</tr>
<tr>
<td>III</td>
<td>Diagnostic study in nonconsecutive patients (without consistently applied “gold” standard as reference); or a systematic review of these studies</td>
</tr>
<tr>
<td>IV</td>
<td>Case-control study; or any of the above diagnostic studies in the absence of a universally accepted “gold” standard</td>
</tr>
<tr>
<td>V</td>
<td>Expert opinion developed via consensus process; case report or clinical example; or evidence based on physiology, bench research, or “first principles”</td>
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