Rhinoplasty continues to be one of the most commonly performed aesthetic surgical procedures, with over 217,000 performed in 2014.1 Over the past 25 years, the open approach has increased in popularity and is the focus of this article.2–4 The principles for successful rhinoplasty include comprehensive clinical analysis and defining rhinoplasty goals, preoperative consultation and planning, precise operative execution, postoperative management, and critical analysis of one’s results. Systematic nasal analysis is critical to establish the goals of surgery. Techniques to address the nasal dorsum, nasal airway, tip complex, alar rims, and bony vault that provide consistent results are discussed. (Plast. Reconstr. Surg. 137: 725e, 2016.)

Learning Objectives: After studying this article, the participant should be able to: 1. Understand both preoperative aesthetic and functional assessment of the rhinoplasty patient. 2. Develop an operative plan to address aesthetic goals while preserving/improving nasal airway function.

Summary: Rhinoplasty continues to be one of the most commonly performed aesthetic surgical procedures. Over the past 25 years, the open approach has increased in popularity and is the focus of this article. The principles for successful rhinoplasty include comprehensive clinical analysis and defining rhinoplasty goals, preoperative consultation and planning, precise operative execution, postoperative management, and critical analysis of one’s results. Systematic nasal analysis is critical to establish the goals of surgery. Techniques to address the nasal dorsum, nasal airway, tip complex, alar rims, and bony vault that provide consistent results are discussed. (Plast. Reconstr. Surg. 137: 725e, 2016.)

CLINICAL ANALYSIS AND DEFINITION OF GOALS

Nasofacial Proportions and Systematic Nasal Analysis

Comprehensive preoperative clinical analysis including evaluation of nasofacial proportions and systematic nasal analysis will help establish goals for rhinoplasty surgery (Table 2).3,6,7 In addition to evaluating the patient’s primary areas of concern, a systematic approach to evaluating nasal structures and their relationship to one another will help to achieve facial balance and harmony after rhinoplasty. Nasal skin thickness and quality will also influence the results of surgery; the effects of osteocartilaginous manipulation in patients with thick nasal skin will have a less dramatic effect on surface contour, whereas subtle changes will be visible in patients with thin skin.3,8 Thick, sebaceous nasal skin will tend to have prolonged postoperative edema requiring a longer period to resolve compared with thin nasal skin.3,8

A myriad of descriptions of aesthetic ideals and relationships have been described in detail,7,9–23 including sex-specific24–28 and age-specific29–36 characteristics. In addition, features and aesthetic ideals common to specific ethnic groups have been described extensively.37–59

Evaluation of the patient should include not only static views but also dynamic views. Smiling may reveal descent of the nasal tip, shortening of the upper lip,
or a transverse crease in the midphiltral area.60–63 Careful observation of these subtleties will ensure thorough evaluation and appropriate discussion with the patient to define all of the goals of surgery.

### Defining Rhinoplasty Goals

The aesthetic goals following rhinoplasty are dependent largely on the patient’s concerns and expectations. In attempting to satisfy the patient, it is still important to restore naso-facial balance and harmony, and to preserve sex-specific characteristics and ethnic congruence. In patients with nasal airway obstruction, it is important to restore the nasal airway. For patients that present without nasal airway problems, respecting and preserving the key structures are requisite.

The goals should be defined and discussed with the patient in detail before surgery. The changes that will be done to address the patient’s primary concerns should be discussed, along with other potential changes that will be required to create the most balanced and proportionate result. A frank discussion of what is and is not achievable in surgery will help to set realistic expectations for the patient and help to reduce the risk of postoperative patient dissatisfaction.

### PREOPERATIVE CONSULTATION AND PLANNING

The preoperative consultation serves as an opportunity to evaluate the patient, discuss the patient’s concerns, and educate the patient on what may be possible to achieve.5,6 For the surgeon, it is an opportunity for screening the patient for his or her suitability for rhinoplasty surgery. Patients with unrealistic expectations or underlying psychiatric problems should not be operated on. In addition, the surgeon should exercise caution in operating on a patient with different aesthetic goals from what the surgeon recommends. During the consultation, the patient’s nasal history and medical history should be reviewed. Physical examination should involve both clinical analysis and examination of the nasal airway.

### Focused Nasal History

In addition to reviewing the patient’s medical history, the patient should be asked about a history of allergic disorders such as hay fever and asthma, and other problems, including vaso-motor rhinitis and sinusitis.64 Nasal obstruction secondary to inferior turbinate hypertrophy is usually found in patients with a long history of allergic rhinitis.65,66 Prior nasal trauma and operations including rhinoplasty, septal reconstruction/septoplasty, and sinus surgery should be noted. Smoking, alcohol consumption, and use of illicit drugs (in particular, cocaine)67 can compromise outcomes. A review of current medications and dietary supplements may reveal those

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**Table 1. Advantages and Disadvantages of Open Rhinoplasty**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binocular visualization</td>
<td>External nasal incision (transcolumellar scar)</td>
</tr>
<tr>
<td>Evaluation of complete deformity without distortion</td>
<td>Prolonged operative time</td>
</tr>
<tr>
<td>Precise diagnosis and correction of deformities</td>
<td>Protracted nasal tip edema</td>
</tr>
<tr>
<td>Allows use of both hands</td>
<td>Columellar incision separation and delayed wound healing</td>
</tr>
<tr>
<td>More options with original tissues and cartilage grafts</td>
<td>Suture stabilization of grafts often required</td>
</tr>
</tbody>
</table>

**Table 2. Systematic Nasal Analysis**

<table>
<thead>
<tr>
<th>Frontal view</th>
<th>Lateral view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial proportions</td>
<td>Nasofrontal angle: acute or obtuse, high or low radix</td>
</tr>
<tr>
<td>Skin type/quality: Fitzpatrick type, thin or thick, sebaceous</td>
<td>Nasal length: long or short</td>
</tr>
<tr>
<td>Symmetry and nasal deviation: midline, G-, reverse G-, or S-shaped deviation</td>
<td>Dorsum: smooth, hump, scooped out</td>
</tr>
<tr>
<td>Bony vault: narrow or wide, asymmetrical, short or long nasal bones</td>
<td>Supratip: break, fullness, pollybeak</td>
</tr>
<tr>
<td>Midvault: narrow or wide, collapse, inverted-V deformity</td>
<td>Tip projection: overprojected or underprojected</td>
</tr>
<tr>
<td>Dorsal aesthetic lines: straight, symmetrical or asymmetrical, well or ill defined, narrow or wide</td>
<td>Tip rotation: overrotated or underrotated</td>
</tr>
<tr>
<td>Nasal tip: ideal/bulbous/boxy/pinned, supratip, tip-defining points, infratip lobule</td>
<td>Alar-columellar relationship: hanging or retracted alae, hanging or retracted columella</td>
</tr>
<tr>
<td>Alar rims: gull shaped, facets, notching, retraction</td>
<td>Periapical hypoplasia: maxillary or soft-tissue deficiency</td>
</tr>
<tr>
<td>Alar base: width</td>
<td>Lip-chin relationship: normal, deficient</td>
</tr>
<tr>
<td>Upper lip: long or short, dynamic depressor septi muscles, upper lip crease</td>
<td>Basal view</td>
</tr>
</tbody>
</table>

Fig. 1. The external nasal valve exists at the level of the inner nostril. It is formed by the caudal edge of the lateral crus of the lower lateral cartilage, the soft-tissue alae, the membranous septum, and the sill of the nostril. The internal nasal valve accounts for approximately half of the total airway resistance and is bordered medially by the septum, inferiorly by the nasal floor, laterally by the inferior turbinate, and superiorly by the caudal border of the upper lateral cartilage. The junction between the septum and upper lateral cartilage is normally 10 to 15 degrees. (From Howard BK, Rohrich RJ. Understanding the nasal airway: Principles and practice. Plast Reconstr Surg. 2002;109:1128–1146. Reprinted with permission.)

Fig. 2. “Danger signs” that may indicate the patient has underlying psychological issues. (From Rohrich RJ, Janis JE, Kenkel JM. Male rhinoplasty. Plast Reconstr Surg. 2003;112:1071–1085. Reprinted with permission.)

1. Minimum disfigurement.
2. Delusional distortion of the body image.
3. An identity problem or sexual ambivalence.
4. Confused or vague motives for wanting the surgery.
5. Unrealistic expectations of change in life situations as a result of the surgery.
6. A history of poorly established social and emotional relationships.
7. Unresolved grief or a crisis situation.
8. Present misfortunes blamed on physical appearance.
9. Older neurotic man overly concerned about aging.
10. A sudden anatomic dislike, especially in older men.
11. A hostile, blaming attitude toward authority.
12. A history of seeing physicians and being dissatisfied with them.
13. The indication of paranoid thoughts.
that can cause increased risk of bleeding and postoperative ecchymosis, including acetylsalicylic acid, nonsteroidal antiinflammatory drugs, fish oil, and certain herbal supplements. The key structures that affect nasal airflow (Fig. 1) include the external and internal nasal valves, the inferior turbinates, and the nasal septum. The patient should be examined for collapse of the external nasal valves on deep inspiration, and a Cottle test should be performed to evaluate patency of the internal nasal valves. Internal nasal examination is aided with the use of a nasal speculum. Oxymetazoline nasal spray facilitates mucosal constriction if mucosal edema is present. Narrowing or collapse of the internal valves with inspiration should be noted, along with inferior turbinate hypertrophy, which typically occurs on the side opposite septal deviation. Septal deformities, including deviation, tilt, spurs, and perforations, should be identified. The availability of septal cartilage is assessed, as this is the primary source of autogenous graft material.

Standardized Photography and Digital Imaging
Standardized photographs including frontal, lateral, oblique, and basal views should be obtained for every patient. In addition, dynamic views including a smiling view and inspiratory views may reveal deformities that are not readily apparent on static views. These are a critical component of the medical record, and can be used for preoperative planning and evaluation of postoperative results. The use of digital imaging is becoming more common. It is a good tool for communicating with the patient and can be used as an opportunity to evaluate the patient’s expectations. The patient should be informed that the images created with digital imaging do not guarantee a result.

Managing Patient Expectations and Suitability for Rhinoplasty
Evaluation and management of patient expectations is a key component of the preoperative consultation. The patient should list the top three specific concerns about his or her nasal appearance and/or function and should attempt to rank these in order of importance. Most patients have realistic expectations for surgery and can understand the limitations of rhinoplasty with adequate discussion. Reviewing photographs with the patient allows the patient to appreciate different views of his or her face and nose that can help identify specific areas of

<table>
<thead>
<tr>
<th>Table 3. Approach to Open Rhinoplasty*</th>
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<tbody>
<tr>
<td><strong>Anesthesia</strong></td>
</tr>
<tr>
<td>Incisions (transcolumellar and infracartilaginous)</td>
</tr>
<tr>
<td>Skin elevation/dissection of lower lateral cartilage/upper lateral cartilage</td>
</tr>
<tr>
<td>Transnasal release of depressor septi muscle (if indicated)</td>
</tr>
<tr>
<td>Intraoperative diagnosis</td>
</tr>
<tr>
<td>Assessment of tip projection</td>
</tr>
<tr>
<td>Component dorsal hump reduction/dorsal augmentation</td>
</tr>
<tr>
<td>Septal reconstruction/inferior turbinoplasty (if indicated)</td>
</tr>
<tr>
<td>Correction of caudal septal deviation (if indicated)</td>
</tr>
<tr>
<td>Reconstitution of dorsum with upper lateral tension</td>
</tr>
<tr>
<td>spanning sutures, autospreader flaps, or spreader grafts</td>
</tr>
<tr>
<td>Cephalic trim of lower lateral cartilage or lower lateral crural turnover flaps (if indicated)</td>
</tr>
<tr>
<td>Establish final tip projection (columellar strut graft and tip suture technique)</td>
</tr>
<tr>
<td>Invisible or visible tip grafts (if indicated)</td>
</tr>
<tr>
<td>Osteotomies</td>
</tr>
<tr>
<td>Final inspection/irrigation</td>
</tr>
<tr>
<td>Wound closure</td>
</tr>
<tr>
<td>Five-step medial crural footplate approximation (if indicated)</td>
</tr>
<tr>
<td>Alar base surgery (if indicated)</td>
</tr>
<tr>
<td>Transoral dissection and transposition of depressor septi muscle (if indicated)</td>
</tr>
<tr>
<td>Splints and dressings</td>
</tr>
</tbody>
</table>


Video 1. Supplemental Digital Content 1 demonstrates primary open rhinoplasty and the correction of a boxy tip. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B668.
concern. Certain deformities that may not have been apparent to the patient before consultation can be discussed using photographs. A patient that focuses on minor or uncorrectable problems or with unrealistic expectations despite extensive discussion will likely be disappointed after surgery regardless of the aesthetic improvement; it is better to avoid operating on these patients.\textsuperscript{3,6,83} One of the key elements is to make sure that you delineate what you can and, also, what you cannot do to improve the appearance of their nose.

Assessment of the emotional stability of the patient is critical when evaluating the patient seeking rhinoplasty.\textsuperscript{3,6,83,91-101} Motivating factors should be identified, and the surgeon must differentiate between healthy and unhealthy reasons for seeking rhinoplasty. Feelings of inadequacy, immaturity, family conflicts, divorce, and other major life changes may be unhealthy motivating factors behind the patient seeking aesthetic surgery.\textsuperscript{100,101} Poor postoperative patient satisfaction is often based on emotional dissatisfaction as opposed to technical failure, and this can be avoided by preoperative identification of these unhealthy motivating factors (Fig. 2).\textsuperscript{3,6,85,100,101}
PERIOPERATIVE PREPARATION

In addition to preoperative consultation and defining the goals of treatment, it is helpful to prepare the patient for what to expect on the day of surgery and during the recovery. Providing the patient with written preoperative and postoperative instructions is helpful. Informing patients before surgery about when results will be evident, how much time off work and away from daily routines will be required, and when follow-up visits will be will lay the foundation for a smooth recovery.6

KEY OPERATIVE ELEMENTS

Intraoperatively, adequate anatomical exposure of the nasal deformity through the open approach, preservation and restoration of the normal anatomy, correction of the deformity using incremental control, maintenance or restoration of the nasal airway, and recognition of the dynamic interplays between the composite of maneuvers are required.3,5,83,102-112 The maneuvers required for successful rhinoplasty and their sequence are dependent largely on the patient’s concerns and expectations, preoperative naso-facial analysis, and intraoperative diagnosis (Table 3).3,5,6,83,112 Several details are key to achieving optimal results following rhinoplasty. (See Video, Supplemental Digital Content 1, which demonstrates primary open rhinoplasty and the correction of a boxy tip. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B668.)

Fig. 4. Component dorsal hump reduction. (Left) Creation of submucoperichondrial tunnels and separation of the upper lateral cartilages from the septum. (Center and right) Incremental reduction of the septum proper with reduction and preservation of the upper lateral cartilages, which results in a rounding of the dorsum. (Reprinted with permission from Rohrich RJ, Muzaffar AR, Janis JE. Component dorsal hump reduction: The importance of maintaining dorsal aesthetic lines in rhinoplasty. Plast Reconstr Surg. 2004;114:1298-1308.)

Video 2. Supplemental Digital Content 2 displays a component dorsal hump reduction. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or available at http://links.lww.com/PRS/B669.

Video 3. Supplemental Digital Content 3 displays a dorsal reconstitution. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B670.
Component Dorsal Hump Reduction and Reconstitution of the Dorsum

A prominent dorsal hump is a frequent complaint of patients seeking rhinoplasty. Much of the emphasis is placed on the nasal profile when dorsal hump reduction is required. However, of equal importance is creating a frontal view with smooth and straight dorsal aesthetic lines after dorsal hump reduction (Fig. 3). Reduction of the dorsum can lead to problems, including the inverted-V deformity, internal valve collapse, and irregular dorsal aesthetic lines. Composite reduction offers little control and potentially contributes to these problems. Component dorsal hump reduction is a cartilage preservation technique that has the advantage of incremental control and greater precision (Fig. 4) (Reference 113 Level of Evidence: Therapeutic, V). It involves the following:
1. Release of the upper lateral cartilages from the dorsal septum.
2. Resection of the dorsal septum incrementally.
3. Rasping of the bony dorsum.
4. Restoration of the dorsal aesthetic lines.

Using a component approach, cartilage of the dorsal septum and upper lateral cartilages that are routinely excised en bloc with a composite approach are preserved instead. With this technique, each structure can be manipulated independently. (See Video, Supplemental Digital Content 2, which displays a component dorsal hump reduction. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B669.)

The upper lateral cartilages may or may not require reduction before reconstitution of the dorsum. (See Video, Supplemental Digital Content 3, which displays a dorsal reconstitution, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B670.) The upper lateral cartilages and dorsal septum can be reconstituted using several different methods including upper lateral cartilage tension spanning sutures (Fig. 5), or autospreader flaps (Fig. 6), or may require placement of spreader grafts (Fig. 7). Incremental reduction of each structure preserves cartilage and, in many cases, this obviates the need for routine use of spreader grafts to reconstruct the midvault. In some cases, spreader grafts have the disadvantage of excessively widening the dorsal aesthetic lines. In addition, significantly more cartilage graft material is required to perform these grafts. However, spreader grafts may be necessary for correction of the deviated nose, the narrow midvault, or collapsed internal valves, and in secondary cases.

Table 4. Classification of the Deviated Nose*

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Caudal septal deviation</td>
<td></td>
</tr>
<tr>
<td>a. Straight septal tilt</td>
<td></td>
</tr>
<tr>
<td>b. Concave deformity (C-shaped)</td>
<td></td>
</tr>
<tr>
<td>c. S-shaped deformity</td>
<td></td>
</tr>
<tr>
<td>II Concave dorsal deformity</td>
<td></td>
</tr>
<tr>
<td>a. C-shaped dorsal deformity</td>
<td></td>
</tr>
<tr>
<td>b. Reverse C-shaped dorsal deformity</td>
<td></td>
</tr>
<tr>
<td>III Concave/convex dorsal deformity (S-shaped)</td>
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</tr>
</tbody>
</table>

Management the Nasal Airway

The key structures that affect nasal airflow include the nasal septum, the inferior turbinates, and the internal and external nasal valves, and these need to be preserved or reconstructed during rhinoplasty.3,6,64,69,70,126,127

Septal Reconstruction

Septal deviation may occur with or without external nasal deviation.5,77,81,128–134 External nasal deviations can be classified into three basic types: caudal septal deviations, concave dorsal deformities, and concave/convex dorsal deformities (Table 4).128,134 Septal deviation occurs most commonly as a septal tilt but can also occur in anteroposterior dimensions, craniocaudal dimensions, or as septal spurs.76 Correction of septal deviation is a key element in improving nasal airflow and correcting the external deformity (See Video, Supplemental Digital Content 4, which displays a septal reconstruction and cartilage harvest. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B671.) Although anterior and inferior deviation tends to be poorly tolerated because of the smaller cross-section of the anterior nasal airway, posterior deviation may

Fig. 8. In many instances, the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can help add strength. (Reprinted with permission from Constantine FC, Ahmad J, Geissler P, Rohrich RJ. Simplifying the management of caudal septal deviation in rhinoplasty. Plast Reconstr Surg. 2014;134:379e–388e.)

Fig. 9. Outfracture (above) and submucous resection (below) of the inferior turbinate. (Reprinted with permission from Rohrich RJ, Krueger JK, Adams WP Jr, Marple BF. Rationale for submucous resection of hypertrophied inferior turbinates in rhinoplasty: An evolution. Plast Reconstr Surg. 2001;108:536–544.)
Fig. 10. Algorithm for achieving adequate tip projection and refinement. (Reprinted with permission from Ghavami A, Janis JE, Ackel C, Rohrich RJ. Tip shaping in primary rhinoplasty: An algorithmic approach. Plast Reconstr Surg. 2008;122:1229–1241.)
also contribute to nasal airway obstruction.64,69 During septal reconstruction, cartilage preservation is essential. If possible, the deviated septum should be repositioned to the midline, and/or significantly deformed portions should be removed. The anterior septum should be preserved for support, and an L-strut of 15 mm or greater may be necessary to maintain long-term support of the nose (Fig. 8).81

Inferior Turbinate Outfracture/Submucous Resection

The turbinates exist as three or four bilateral extensions from the lateral nasal cavity. The inferior turbinate consists of highly vascular mucoperiosteum covering a thin semicircular conchal bone.3,64–66,69,135,136 In combination with the internal nasal valve, the anterior extent of the inferior turbinate can be responsible for up to two-thirds of the upper airway resistance.66,3,64,69 In patients with nasal airway obstruction secondary to inferior turbinate mucosal hypertrophy, inferior turbinate outfracture is performed, whereas in patients with bony hypertrophy, submucous resection is required (Fig. 9).3,64–66,69,135,136 Overly aggressive surgical management may be complicated by bleeding, mucosal crusting and desiccation, ciliary dysfunction, chronic infection, malodorous nasal drainage, or atrophic rhinitis.3,64–66,69

The Internal Nasal Valve

The internal nasal valve is formed at the junction of the septum with the caudal edge of the upper lateral cartilage. The anterior head of the inferior turbinate may project into its posterolateral aspect. The import role of the internal nasal valve in nasal airflow has been discussed in great detail, and this area typically accounts for half of the total nasal airway resistance.3,65,69,70,72–76 Internal nasal valve collapse can be associated with nasal deviation or iatrogenic internal nasal valve obstruction and can occur secondary to midvault collapse. Component dorsal hump reduction and dorsal reconstitution allow incremental control and greater precision to prevent iatrogenic midvault collapse.112–118
The External Nasal Valve

The external nasal valve is composed of the caudal septum and medial and middle crura medially, fibrofatty alar rim laterally, and nostril sill posteriorly. Common deformities including caudal septal deviation or alar rim collapse can cause external valve obstruction. During forced inspiration, dynamic external valve collapse may be observed. The strength of the alar rims is dependent on both the quality of its fibrofatty composition and the lateral crus superiorly.

Correction of caudal septal deviation or medial crural deformities may be required. Alar rim collapse may be corrected by nonanatomical alar contour or extended alar contour grafts, alar batten grafts, lateral crural strut grafts, or lateral crural turnover flaps.

Altering Tip Position and Shape

The length, strength, shape, and position of the lower lateral cartilages and the fibrous/ligamentous attachments between these paired structures play a central role in supporting the nasal tip (Reference 150 Level of Evidence: Therapeutic, V). The upper lateral cartilages, nasal septum, nasal base, and piriform aperture provide additional stability and support to the nasal tip through their soft-tissue attachments. A graduated approach to nasal tip surgery requires a combination of techniques including narrowing of the alar rim strip, the use of a columellar strut graft, nasal tip suturing, and nasal tip grafting. Application of these techniques will help to correct tip deformities, improve tip shape, and minimize deformities secondary to loss of support. The open approach is advantageous, as release of soft-tissue supporting structures allows greater manipulation of tip position and shape. Both tip projection and rotation can be changed using an incremental approach with manipulating soft tissues and the cartilaginous framework. However, the open approach will also cause mild loss of tip projection because of disruption of the soft-tissue supporting structures; thus, it is important to restore or increase support using a combination of grafting and suturing techniques. Both columellar strut grafts and septal extension grafts can help to maintain or increase tip projection, and a variety of suture techniques will help maintain nasal tip support following open rhinoplasty. (See Video, Supplemental Digital Content 5, which
displays a columellar strut graft, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B673.

**Tip-Suturing Techniques**

The prudent use of three key tip-suturing techniques can alter tip position and shape (Fig. 11).150–158 (See Video, Supplemental Digital Content 6, which demonstrates tip suturing, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B673.) Medial crural sutures can be used in isolation to correct medial crural asymmetries, to reduce flaring, and to control the overall width of the columella. Medial crural–columellar strut sutures are

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**Video 7.** Supplemental Digital Content 7 displays alar contour grafts. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B674.

**Video 8.** Supplemental Digital Content 8 displays lateral crural turnover flaps. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B675.

**Video 9.** Supplemental Digital Content 9 displays percutaneous lateral nasal osteotomies. This video is available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B676.
placed in the middle third of the medial crura to secure it to the columellar strut graft. Fixation to a columellar strut can increase both tip projection and tip strength simultaneously, as the medial crura are elevated toward the anterior septal angle. These maneuvers are often required before other tip sutures are placed because the medial crural–columellar strut complex acts as a point of stability in the nasal tripod, and can limit the dynamic effects suture techniques have on the cartilaginous framework. Transdomal sutures can alter both tip shape and contour of the lateral crura. Differential placement of this suture can be used to correct domal asymmetries of position and shape. The transdomal suture is a powerful suturing technique, and care should be taken to avoid creating unnecessary tension on the lateral crura, excess concavity adjacent to the domes, and more tip projection than required. Excess tension, in addition to placement of the transdomal sutures in a cephalic position, can cause or accentuate excess infratip fullness. The interdomal suture is a horizontal mattress suture placed between the domal segments of the middle crura of the lower lateral cartilages. The interdomal suture technique decreases the angle of domal divergence, narrows the tip-defining points, can further camouflage a columellar strut graft or septal extension graft, enhance the infratip lobule, and increase projection.

**Invisible and Visible Tip-Grafting Techniques**

Cartilage grafting is commonly required during rhinoplasty. Traditionally, visible grafts including onlay tip and dorsal grafts have been used. However, these do have long-term consequences, including displacement, absorption, and increased visibility with changes to the overlying skin envelope with aging. The use of the open approach combined with tip-suturing techniques has decreased the necessity for visible tip grafts. In some cases, invisible grafts can be used to increase structural support and improve contour and avoid some of the untoward long-term consequences of visible grafts. Invisible grafts used to support and shape the tip complex include columellar strut grafts, alar contour grafts, anatomical cap grafts, and morselized onlay grafts. The columellar strut graft is used to maintain or increase tip projection. In combination with medial crural-columellar strut graft sutures, it can be used to unify the tip complex, and treat the hanging tip, the dynamic tip, the tension tip, alar-columellar discrepancies with columellar retraction, irregularities of the medial crura, and the aging nose.

An anatomical cap graft can be used in instances where a small amount of volume augmentation or tip contouring is required. The cephalic trim of the lower lateral crus is ideal, given its smooth and soft consistency. A morselized onlay graft can be used if more volume augmentation or correction of irregularities is required. The cartilage can range from slightly bruised to crushed into a thin sheet (Fig. 12). If the use of tip-suturing techniques and invisible grafts cannot create adequate tip projection and shape, visible tip grafts including tip onlay, infratip lobular, and combination grafts should be used.

**Fig. 15.** Patterns of osteotomies. (Reprinted with permission from Rohrich RJ, Krueger JK, Adams WP Jr, Hollier LH Jr. Achieving consistency in the lateral nasal osteotomy during rhinoplasty: An external perforated technique. *Plast Reconstr Surg*. 2001;108:2122–2130.)
Correction and Prevention of Alar Rim Deformities

The alar rims contribute to the alar-columnellar relationship, nasal tip support, and the patency of the external nasal valve. In addition, the alar rims are intricately related to the tip complex. A well-defined and smooth light reflex starting at the tip complex and continuing along the alar rim is ideal. To achieve this, the lateral crus should be straight in an anteroposterior direction, and the caudal edges of the lateral crus should be in approximately the same horizontal plane as the cranial edge. A weak lateral crus may buckle, causing a concave alar rim and a pinched tip appearance (Fig. 13) (Reference 142 Level of Evidence: Therapeutic, V).

The presence of deformities of the alar rims such as alar notching or retraction, facets of the soft-tissue triangles, malposition of the lateral crura, or functional problems including external valve collapse should be addressed during rhinoplasty. Various techniques to alter the length and strength of the lateral crura and the alar rims including lateral crural horizontal mattress sutures, lower lateral crural turnover flaps, alar and extended alar contour grafts, alar batten grafts, and lateral crural strut grafts have been described (Fig. 14). (See Video, Supplemental Digital Content 7, which displays alar contour grafts, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B674.) Following rhinoplasty, the failure to provide adequate

Fig. 16. (Above) Preoperative frontal, lateral, and basal views of a 19-year-old woman with nasal airway obstruction, a dorsal hump, mild alar retraction, and a severely boxy tip. (Below) The 1-year postoperative result demonstrates a straight dorsum with restoration of balanced dorsal aesthetic lines and improvement in tip definition.
support to the alar rims may predispose to alar rim notching, retraction, or collapse. The use of grafts to strengthen the lateral crura and alar rims can help to prevent these problems. Maneuvers such as cephalic trim may have the untoward effect of weakening the lateral crura, leading to these problems. Instead, where narrowing of the alar rim strip is required to achieve tip definition, techniques such as lateral crural turnover flaps or the addition of lateral crural strut grafts will improve support. (See Video, Supplemental Digital Content 8, which displays lateral crural turnover flaps, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B675.)

Nasal Osteotomies

Nasal osteotomies may be required to narrow a wide bony vault, close an open roof deformity, or straighten deviated nasal bones.3,112,113,128,193–207 (See Video, Supplemental Digital Content 9, which displays percutaneous lateral nasal osteotomies, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B676.) The goals of nasal osteotomies are maintenance or creation of smooth

Fig. 17. Gunter diagrams demonstrating operative plan. The dorsum was addressed using component dorsal hump reduction and bilateral autosizer flaps. Septal reconstruction was performed to correct the nasal airway obstruction. Tip shaping was achieved with a columnellar strut graft and tip-suturing techniques. Bilateral lower lateral crural turnover flaps and alar contour grafts were used to strengthen the alar rims.
dorsal aesthetic lines and obtaining a desirable width of the bony vault.\textsuperscript{3,112,113,193} Osteotomies can be classified by approach (external or internal), type (lateral, medial, transverse, or a combination), and level (low-to-high, low-to-low, or double-level) (Fig. 15).\textsuperscript{3,193} Relative contraindications to the use of osteotomies during rhinoplasty include patients with short nasal bones, elderly patients with excessively thin nasal bones, those with relatively thick nasal skin, and some non-Caucasian patients with extremely low and broad noses.\textsuperscript{3,112,113,128,193–207} Multiple osteotomy techniques including intranasal, intraoral, and percutaneous have been described.\textsuperscript{193–207} Percutaneous lateral discontinuous osteotomies have the advantage of producing a more controlled fracture with less intranasal trauma and minimizing morbidity, including bleeding, ecchymosis, and edema.\textsuperscript{3,195}

**POSTOPERATIVE MANAGEMENT**

Postoperative management of rhinoplasty patients is an important component of rhinoplasty and an extension of what was performed in the operating room.\textsuperscript{208} Patients should be informed of activity restrictions, because these restrictions will often influence when they can return to their normal daily activities and to work. It is particularly important to recognize patients’ concerns and anxiety in the early postoperative period. Many patients requesting rhinoplasty have expectations of how they will appear after their surgery, but because of swelling and bruising, it may be several weeks after surgery before patients can really begin to appreciate the changes to their appearance (Figs. 16 and 17). It is essential to provide support during this interval and reassure patients that what they are seeing is a normal part of the recovery process. Ultimately, the final results after open rhinoplasty can take over 1 year to appreciate (Figs. 16 and 17). In patients with thick skin, edema may take even longer to fully resolve. (See Video, Supplemental Digital Content 10, which displays various closures and splints, available in the “Related Videos” section of the full-text article on www.PRSJournal.com or at http://links.lww.com/PRS/B677.)

**Complications**

The incidence of significant complications following rhinoplasty is low.\textsuperscript{209–215} Common complications following rhinoplasty include bleeding, infection, nasal airway obstruction, and deformities (Table 5).\textsuperscript{208,215} Recognizing these complications and timely treatment will help to prevent any untoward long-term problems.

**CONCLUSIONS**

Accurate preoperative systematic nasal analysis and evaluation of the nasal airway, along with identification of both the patient’s expectations and the surgeon’s goals, form the foundation for

<table>
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<tr>
<th>Table 5. Complications of Rhinoplasty*</th>
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<tbody>
<tr>
<td><strong>Hemorrhagic</strong></td>
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<td>Epistaxis</td>
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<td>Septal hematoma</td>
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<tr>
<td><strong>Infectious</strong></td>
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<td>Cellulitis</td>
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<td>Septal abscess</td>
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<td>Toxic shock syndrome</td>
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<td><strong>Traumatic</strong></td>
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<tr>
<td>L-strut fractures</td>
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<td>Lacrimal sac/nasolacrimal duct injury and epiphora</td>
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<tr>
<td>Intracranial injury and cerebrospinal fluid leak</td>
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<td><strong>Functional</strong></td>
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<td>Septal perforation</td>
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<tr>
<td>Infranasal synechiae</td>
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<td>Vestibular stenosis</td>
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<td>Internal/external valve collapse</td>
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<td>Septal deviation</td>
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<td>Rhinitis</td>
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<tr>
<td>Gustatory rhinorrhea</td>
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<tr>
<td><strong>Aesthetic</strong></td>
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<tr>
<td>Deformities of dorsum or nasal tip</td>
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<tr>
<td>Deviation</td>
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<tr>
<td>Asymmetry</td>
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<td>Alar notching/retraction</td>
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<td>Supratip (&quot;pollybeak&quot;) deformity</td>
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<td>“Inverted-V” deformity</td>
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<td>“Rocker” deformity</td>
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<td><strong>Soft tissue</strong></td>
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<td>Prolonged edema</td>
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<td>Visible/depressed transcolumnellar scar</td>
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<td>Contact dermatitis</td>
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<td>Skin necrosis</td>
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<td>Nasal cyst</td>
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success. Intraoperatively, key elements of success include adequate anatomical exposure of the nasal deformity, preservation and restoration of the normal anatomy, correction of deformities using techniques that provide consistent results, and maintenance and restoration of the nasal airway. During postoperative recovery, care and reassurance combined with an ability to recognize and manage complications leads to successful outcomes following rhinoplasty.

**PATIENT CONSENT**

Patients provided written consent for the use of their images.

**REFERENCES**


