Evidence-Based Medicine: Rhinoplasty

Daniel O. Beck, M.D.
Jeffrey M. Kenkel, M.D.
Dallas, Texas

Learning Objectives: After studying this article, the participant should be able to: 1. Discuss the key components in the aesthetic, functional, and emotional evaluation of a patient presenting for rhinoplasty. 2. Describe the various surgical options to achieve the goals identified during consultation. 3. Recognize appropriate nonsurgical options and their limitations for treating nasal deformities. 4. Assess the benefits and risks of using perioperative antibiotics in rhinoplasty. 5. Identify common postoperative sequelae of rhinoplasty and formulate a plan of care based on best evidence data.

Summary: This article was prepared to accompany practice-based assessment with ongoing surgical education for the Maintenance of Certification for the American Board of Plastic Surgery. It outlines the evaluation of the rhinoplasty patient and highlights both surgical and nonsurgical options to address nasal defects. In addition, data from the current literature are included to supplement physician knowledge for enhanced perioperative care and improved outcomes. (*Plast. Reconstr. Surg.* 134: 1356, 2014.)

Rhinoplasty is one of the most challenging operations in all of plastic surgery. With little margin for error, guided and precise movements are essential to successful functional and aesthetic outcomes. Despite its complexity, rhinoplasty remains the second most common aesthetic surgical procedure performed by plastic surgeons, with 242,684 cases in 2012.[1] The purpose of this article is to briefly review key anatomy and concepts and provide a summary of recent evidence-based studies on rhinoplasty to guide the surgeon's practice. An excellent comprehensive review of rhinoplasty techniques was published in this *Journal* as a CME article in 2011 by Rohrich and Ahmad.[2]

PREOPERATIVE ASSESSMENT

The preoperative assessment is the opportunity for the surgeon to learn what specifically the patient is dissatisfied with regarding his or her nose. In addition, it allows the surgeon to perform a complete nasal examination and analysis. Based on these assessments, an appropriate surgical plan can be made. Just as important, it provides the opportunity for the surgeon to assess patient expectations, evaluate whether these expectations are realistic, and ascertain the patient's psychological fit for rhinoplasty.

A comprehensive nasal history to elicit factors affecting surgical planning and perioperative care is documented. The duration, frequency, and laterality of all symptoms should be noted. A record of allergies, recurrent epistaxis, rhinitis, or sinusitis must be well characterized and controlled before surgery.[3] Prior nasal trauma, surgical interventions, cocaine use, or a history of obstruction may present with altered anatomy and may be missed on cursory examination. Current prescription and over-the-counter medications are reviewed to identify those with a known increased risk of bleeding. Finally, any factors contributing to compromised wound healing including smoking and metabolic disorders are documented.

The external and internal nasal valves, the inferior turbinates, and the nasal septum all influence flow through the nasal airway and should be evaluated thoroughly in patients presenting for rhinoplasty. On examination, external indicators of nasal abnormality include inspiratory collapse of the external nasal valves and subjective inspiratory improvement with

From the Department of Plastic Surgery, University of Texas Southwestern Medical Center.
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application of the Cottle maneuver. Anterior rhinoscopy with a lighted nasal speculum facilitates internal examination, including dynamic collapse of the internal nasal valve and evaluation of the inferior turbinates for hypertrophy. The septum is examined for any deformities or perforations, and the availability of cartilage as a source of graft material is assessed. The presence of uncharacteristic masses or obstruction from an unidentified source warrants further workup and investigation by rhinomanometry or sinus computed tomography.[4–6]

Idyllic proportions attempting to define aesthetic beauty are well detailed in the literature and have evolved to recognize the impact of age, sex, and ethnic variances.[7–24] A complete systematic nasofacial analysis, guided by these norms, identifies existing anatomical relationships and irregularities (Table 1).

At this point, pertinent findings and the surgical goals should be discussed and any discrepancies between patient expectations and the surgical plan addressed. Recent advances in computer imaging and three-dimensional modeling can assist in creating this unified vision (Figs. 1 and 2).[25,26] It may be helpful to see the patient more than once to review the surgical goal and how it fits with the patient's expectations.

Patient Selection

Proper patient selection is the single most important determinant of procedural success. With minimal assistance, most patients are able to define and prioritize specific concerns of nasal appearance and function. Any inability to meet initial expectations is tempered by an understanding of the limitations of rhinoplasty. For patients who remain focused on minor defects or maintain unrealistic expectations after consultation, the chance of poor postoperative satisfaction, regardless of aesthetic result, is high. Before any intervention, the emotional stability and motivating factors for seeking rhinoplasty should be evaluated thoroughly (Fig. 3). Picavet et al. assessed the psychiatric state of 226 patients seeking rhinoplasty by evaluating the prevalence and severity of body dysmorphic disorder (**Level of Evidence: Risk, III**).[27] In the overall rhinoplasty population, 33 percent demonstrated moderate or severe symptoms of body dysmorphic disorder, increasing to 43 percent in patients seeking aesthetic rhinoplasty. There was a significant correlation between the prevalence of body dysmorphic disorder and aesthetic consultation, previous rhinoplasty, and an existing psychiatric history. However, no significant correlation was found between patient age, sex, marital status,

Table 1. Systematic Nasal Analysis*

View	Characteristics for Evaluation
Frontal	
Facial proportions	With focus on symmetry of middle and lower thirds
Skin type/quality	Fitzpatrick type; thin or thick; sebaceous
Symmetry and nasal deviation	Midline; C-, reverse C- or S-shaped deviation
Bony vault	Narrow or wide; short or long nasal bones; asymmetries
Midvault	Narrow or wide; lateral or dorsal collapse; inverted-V deformity
Dorsal aesthetic lines	Well- or ill-defined; symmetry; continuity; straight or divergent; narrow or wide
Nasal tip	Symmetry of tip-defining points; bulbous, boxy or pinched tip; supratip break; columellar-lobular angle; symmetry of infratip lobule
Alar rims	Gull-wing appearance with columella; notching; retraction; flare
Alar base	Width, alone and in relation to nasal tip
Upper lip	Long or short; dynamic effect of depressor septi muscles; creasing
Lateral	
Nasofrontal angle	Acute or obtuse; high or low position of radix
Nasal length	Long or short
Dorsum	Smooth vs. dorsal hump; overprojection or scooping
Supratip	Presence or absence of break; fullness; polybeak deformity
Tip projection	Overprojected or underprojected
Tip rotation	Overrotated or underrotated; evaluation of nasolabial angle; fullness at columellar-lobular angle
Alar-columellar relationship	Hanging or retracted ala and/or columella
Periapical hypoplasia	Deficiency of maxilla, soft tissue, or both
Lip-chin relationship	Normal; vertical deficiency or excess; horizontal deficiency or excess
Basal	
Nasal projection	Columellar-to-lobular ratio
Nostril	Shape, symmetry, axial orientation
Columella	Septal tilt, flaring of the medial crura
Alar base	Base width and width-to-height ratio

*Adapted from Rohrich RJ, Ahmad J. Rhinoplasty. *Plast Reconstr Surg.* 2011;128:49–73.

other previous aesthetic procedures, and the severity of body dysmorphic disorder symptoms.

Antibiotics

The intranasal area is a clean contaminated field, with *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Streptococcus viridans* the most commonly identified organisms of the nasal flora. The drive to prevent surgical-site infection by these potential infectious organisms has fostered an increased use of perioperative antibiotics in rhinoplasty despite no definitive consensus on site contamination, efficacy, or dosing.[28–34]

Rajan et al.[35] performed a prospective study of 200 patients undergoing septorhinoplasty. Patients received prophylactic antibiotics as a single intravenous dose or a single intravenous dose with an oral course for 7 days. No significant difference in postoperative wound infection was seen between the two groups. However, the incidence of antibiotic-related side effects was significantly greater (29 percent versus 2 percent) in the combined regimen group, suggesting that prolonged antibiotic use is not warranted. Andrews et al.[36] performed a prospective trial of 164 patients undergoing septorhinoplasty who were randomized to receive either three prophylactic intravenous doses of antibiotic over 12 hours or three intravenous doses with an oral course for 7 days. No significant difference in infection rate was noted between patients receiving perioperative versus postoperative antibiotics.

Ricci and D'Ascanio [37] performed a prospective trial of 630 patients undergoing septoplasty to assess the necessity of antibiotic prophylaxis. Subjects were randomized to receive no antibiotic prophylaxis, a single intravenous dose at induction, or a single intravenous dose with an oral course for 7 days. Postoperative complication and infection rates were nearly identical between all groups and in line with previous studies, leading to the conclusion that prophylactic antibiotic use is not required. Toia et al.[38] performed a prospective study of 1100 plastic surgery patients, with 287 that underwent a clean procedure including rhinoplasty. In this group, antibiotic prophylaxis was administered only when the operation lasted more than 3 hours and/or the American Society of Anesthesiologists score was 3 or higher. This resulted in a 1.1 percent overall surgical-site infection rate, which was lower than previously reported studies, leading to the conclusion that antibiotic prophylaxis in rhinoplasty is required only when the above criteria are met.

S. aureus*/Methicillin-Resistant *S. aureus

The anterior nares and vestibule of approximately 60 percent of the general population are intermittently colonized by methicillin-sensitive *S. aureus*, in line with colonization rates exhibited by patients presenting for septorhinoplasty (**Reference 33 Level of Evidence: Therapeutic, III**).[33,39] Routine preoperative screening followed by nasal and extranasal decolonization of carriers has demonstrated a significant reduction in hospital-acquired surgical-site infection by endogenous methicillin-sensitive *S. aureus* during prolonged hospital admissions (>4 days).[40] However, local infection by *S. aureus* following septorhinoplasty is less common than with other local flora, and a paucity of literature exists demonstrating a direct correlation between nasal colonization and subsequent infection. Currently, no high-level, evidence-based data exist to suggest a benefit to identification and treatment of nasal colonization by methicillin-sensitive *S. aureus* in the typical healthy, day-surgery rhinoplasty patient. Furthermore, the presence of methicillin-sensitive *S. aureus* in healthy carriers is protective against nasal colonization by any of the more virulent strains of methicillin-resistant *S. aureus*. Preoperative eradication of methicillin-sensitive *S. aureus* with the use of broad-spectrum antibiotics permits colonization by methicillin-resistant *S. aureus* and is of particular concern in cohorts with greater risk of exposure to methicillin-resistant *S. aureus*, including health care workers, patients with hospital admissions in the past year, those caring for children or the elderly, and the immunocompromised.[41,42] To further delineate risk factors for nasal colonization by methicillin-resistant *S. aureus*, Nicholas et al.[43] reviewed 157 patients presenting for outpatient rhinologic surgery. The prevalence of methicillin-resistant *S. aureus* colonization was noted to be 1.3 percent and found to have a significant correlation with a previous history of methicillin-resistant *S. aureus* infection. Conversely, recent antibiotic use, recent hospitalization, previous intranasal surgery, or occupations in health care were not significant lone risk factors for preoperative methicillin-resistant *S. aureus* colonization.

Although the reported incidence of localized methicillin-resistant *S. aureus* infection after septorhinoplasty is extremely low, difficulties in treating resistant bacteria and potential compromise of functional or cosmetic results warrant consideration of preoperative identification and eradication in nasal carriers. In addition, best practice

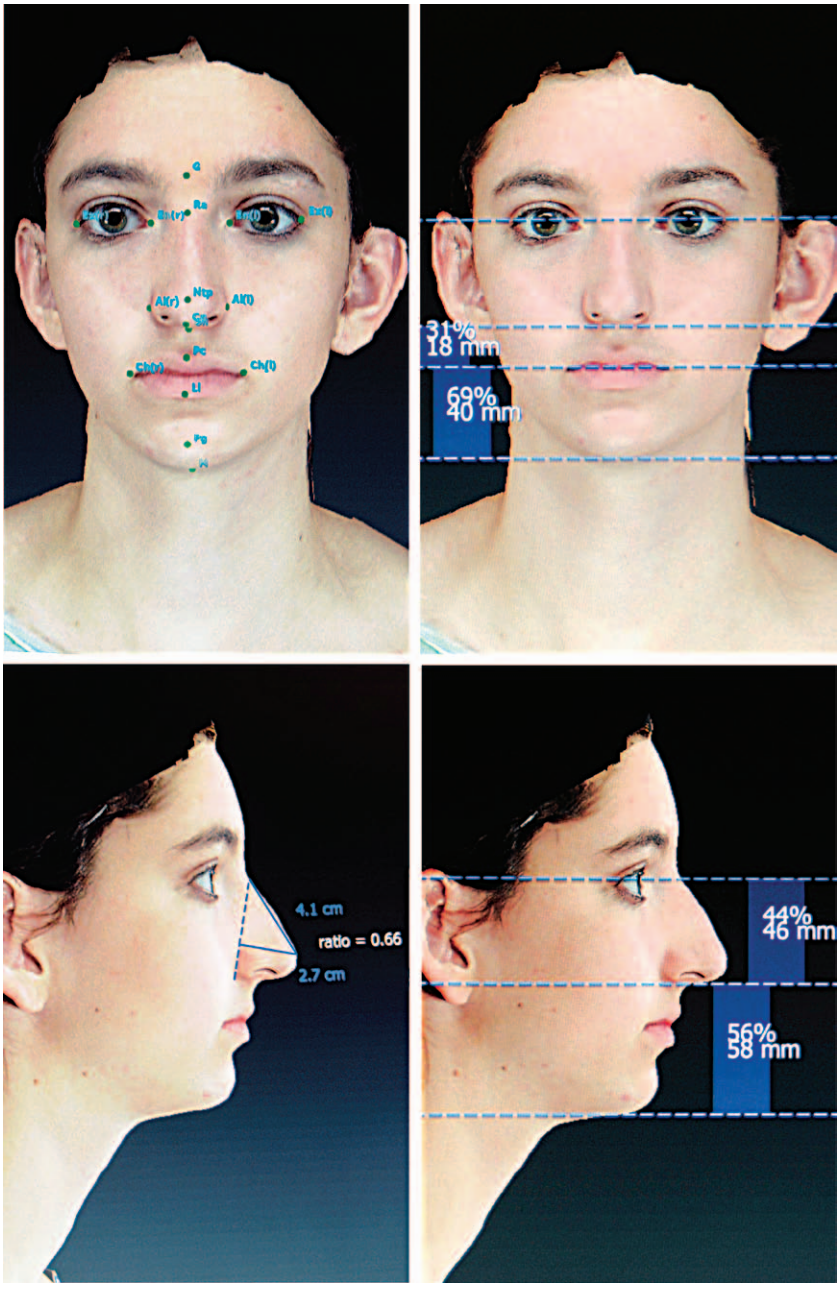

Fig. 1. Three-dimensional modeling and analysis by stereophotogrammetry. (*Above*) Multiple synchronous digital photographs are captured at various angles to the patient and merged to create a three-dimensional image. Key landmarks are selected either manually or automatically on the three-dimensional model (*above*, *left*) and analyzed with special software. Image morphing and manipulation of the facial proportions (*above*, *right*, and *below*, *right*) and nasal parameters (*below*, *left*) can be performed immediately with the patient or saved for later use. All generated images can be rotated and visualized in multiple planes. Images shown here were captured and analyzed using the Vectra 3D system (Canfield Scientific, Inc., Fairfield, N.J.).

management includes identification of at-risk patients presenting with suspected surgical-site infection after rhinoplasty along with thorough clinical assessment and delineation of simple soft-tissue infections from those requiring surgical intervention.[44] Routine postoperative surgical-site testing in nonsymptomatic patients is not recommended. Common agents for empiric therapy of

Fig. 2. Unlike standard two-dimensional photography, three-dimensional imaging software allows point-to-point measurements along the contour of the nose (*above*, *left*) and analysis of volume differences by means of changes in a color gradient (*below*, *left*) to further operative planning. After digital manipulation of the targeted areas, the preoperative and postoperative images can be superimposed to conceptualize the planned operative changes (*right*). The overlay photograph can be saved and used for review of the surgical goals at subsequent preoperative visits with the patient. (Reprinted with permission from Afrooz PN, Amirlak BA. Digital imaging and standardized photography in rhinoplasty. In: Rohrich RJ, Adams WP Jr, Ahmad J, Gunter JP, eds. *Dallas Rhinoplasty: Nasal Surgery by the Masters*. 3rd ed. Boca Raton, Fla: CRC Press; 2014:111–132.)

a suspected methicillin-resistant *S. aureus* infection include trimethoprim/sulfamethoxazole, rifampin, and clindamycin; however, methicillin-resistant *S. aureus* strains display complex susceptibility patterns, and choice of antibiotic therapy should be based on local prevalence and susceptibility data.[45]

Surgical Intervention

Addressing patient concerns and achieving a balance of nasofacial relationships in line with age, sex, and ethnic considerations are the primary goals of aesthetic rhinoplasty. Successful execution depends on anatomical identification and adequate exposure of all deformities, followed by directed incremental correction with preservation of normal anatomy. Access for evaluation and repair can be gained through an open or endonasal approach. Both tactics have their merits and disadvantages (Table 2). Currently, no study with a high level of evidence comparing the open versus closed approach exists. Proper selection of technique is dependent on the anatomical deformities to be addressed and surgeon preference.[46–49] A sequential process for open rhinoplasty is presented (Table 3).

After initial exposure and evaluation, modification of the nasal dorsum is addressed. A prominent dorsal hump composed of bony and/or cartilaginous elements is a frequent presenting complaint in rhinoplasty patients. Reduction with preservation of the middle nasal vault and internal nasal valve can be achieved through a composite or component reduction technique. The component technique (Fig. 4) allows greater precision by following five essential steps: (1) separation of the upper lateral cartilages from the septum; (2) incremental reduction of the septum; (3) incremental dorsal bony reduction by rasping; (4) verification by palpation; and (5) any indicated final modifications (e.g., grafts, suturing techniques, osteotomies).[50,51] Mojallal et al.[52] performed a retrospective analysis of 100 patients undergoing primary rhinoplasty using the component technique for dorsal hump reduction (**Level of Evidence: Therapeutic, IV**). Preoperative and postoperative software imaging analysis demonstrated marked improvement in dorsal aesthetic

Fig. 3. Warning signs that may indicate a patient is not psychologically fit to be considered a candidate for elective aesthetic surgery. (Reprinted from Rohrich RJ, Janis JE, Kenkel JM. Male rhinoplasty. *Plast Reconstr Surg*. 2003;112:1071–1085.)

line symmetry and facial balance, validating component dorsal reduction as a reliable and reproducible technique.

The component dorsal reduction technique can be used as a means of isolating the bony and midvault components in preparation for augmentation as well. Dorsal augmentation with cartilage, bone, soft tissue, and various synthetic components has been described. A comprehensive literature review by Lee et al.[53] examines the level of evidence, outcomes, and complications of studies using various techniques and materials for augmenting the nasal dorsum. They found that most studies reported favorable outcomes regardless of method used, although these results were composed largely of low-level (IV/V) evidence.

Thereafter, structures composing the internal nasal airway are addressed. Maintaining the anatomy and support of the midvault is vital to preventing collapse and compromise of the internal nasal valve. The need for graft support of this region should be assessed.[54–59] Septal deviation can involve the quadrangular septal cartilage or bony elements from the perpendicular plate of the ethmoid and vomer. Configuration and degree of deviation can dictate treatment options and potential autologous graft availability.[60–63] Adequate correction depends on complete release of all mucoperichondrial attachments along with appropriate restorative techniques (e.g., cartilage scoring, resection, buttress grafts). Bony spurs are identified and resected as necessary. Inferior turbinate hypertrophy refractory to medical management is treated primarily with a turbinoplasty procedure.[64] Analysis of the common surgical techniques demonstrated an optimal level of nasal patency and mucociliary clearance at 6-year follow-up using submucosal resection with or without outfracture (**Reference 65 Level of Evidence: Therapeutic, II**).[65,66]

Next, the intricate relationships among the lower lateral cartilage, caudal septum, ligamentous support structures, and the overlying soft tissue are addressed. Collectively, these structures comprise the nasal tip, infratip lobule, columella, and ala and define the lower third of the nose.[67,68] Maneuvers for nasal tip contouring include cephalic trim of the lower lateral cartilages, tip-suturing techniques, tip grafting, and use of a columellar strut graft.[69–87] Shortening and suturing of the middle and medial crura supplement correction of the infratip lobule and columella base not addressed using the above techniques.[88] Notching of the alar rims is effectively addressed with cartilage-based rim grafts, whereas more severe collapse requires maneuvers that reposition or revise

Table 2. Open versus Endonasal Rhinoplasty

Open
Advantages
Full exposure of nasal anatomy for diagnosis, evaluation, and correction of deformities
More options for graft refinement of nasal defects
Precise graft placement and suture stabilization
Ease of suture refinement techniques
Ability to control bleeding under direct visualization
Disadvantages
Transcolumellar incision with potential for wound healing and scarring
Extended operative time
Prolonged nasal tip edema
Closed
Advantages
Dissection limited to area(s) of deformity
No external scar
Ability to create a precise graft pocket, limiting the need for suture stabilization
Reduced operative time
Maintains full vascularity to the nasal tip, promoting wound healing
Reduced postsurgical edema
Disadvantages
Requires accurate preoperative diagnosis and surgical planning
Limits visualization of nasal anatomy
Limited ability to manipulate anatomy, making complex modifications difficult
Potential for overdissection of graft pocket and malposition of grafts

Table 3. Surgical Approach to Open Rhinoplasty

Local anesthetic injection, nasal packing for vasoconstriction
Transcolumellar and infracartilaginous incision
Skin elevation for exposure of lower and upper lateral cartilages
Intraoperative evaluation
Assessment of tip projection
Component dorsal hump reduction (bony, cartilaginous)
Septal reconstruction/graft harvest
Augmentation of dorsum/internal nasal valves
Cephalic trim of lower lateral cartilage (if indicated)
Establishment of final tip projection (suture techniques, columellar strut, tip grafts)
Alar rim grafts (if indicated)
Inspection/revision as necessary
Inferior turbinoplasty (if indicated)
Osteotomies
Final inspection and closure of incisions
Approximation of medial crural footplates (if indicated)
Alar base resection (if indicated)
Depressor septi muscle transection (if indicated)
Splints and dressing

the length and strength of the lateral crura.[89–99] Respecting the dynamic associations between structures in the lower third of the nose is the key to successfully creating balanced nasal contour, projection, and rotation.[100] Final shaping can be achieved with nasal osteotomies,[101–109] depressor septi muscle translocation,[110,111] and alar base resections[112,113] as indicated.

Nonsurgical Intervention: Soft-Tissue Fillers

Synthetic Fillers

The use of soft-tissue fillers on minor irregularities after rhinoplasty provides a minimally invasive means of correction without subjecting the patient to the costs and risks of revision surgery. Furthermore, fillers are increasingly being used to correct discrete congenital and age-related asymmetries in patients looking for alternatives to primary surgical intervention.[114–118] Proper use of fillers as an adjunct to rhinoplasty requires a full understanding of filler properties, injection techniques, and local anatomy for optimal outcome and avoidance of complications.

Of the available fillers, the most frequently reported materials used to improve the nasal silhouette include hyaluronic acid, calcium hydroxylapatite, and silicone. Hyaluronic acid, a component of human connective tissue, and calcium hydroxyapatite, a nonimmunogenic mineral constituent of bone, both provide a temporary, pliable, and predictable filler material. In addition, both display an excellent safety profile, and although not specific for nasal augmentation, both have been approved by the U.S. Food and Drug Administration for augmentation of facial soft-tissue rhytides. The use of liquid silicone, a permanent highly viscous synthetic compound for augmentation, remains controversial.[119–123] Reports of contour irregularities and granuloma formation have impacted its use as a soft-tissue filler. Currently, no U.S. Food and Drug Administration–approved injectable silicone for facial soft-tissue augmentation is available. The recommended layers for injection of soft-tissue fillers in rhinoplasty are typically within the mid to deep dermis, the immediate subdermal layer, and the supraperiosteal/supraperichondrial region to maximize the volumizing effect and avoid visual and palpable contour irregularities.[124,125] Injection techniques vary and should be chosen based on the area being treated (Fig. 5).

Bioengineered hyaluronic acid products are chemically cross-linked to improve stability and maintain a specific viscosity and hydrophilicity (Table 4). A highly cross-linked, low-hydrophilic hyaluronic acid such as Restylane (Galderma Laboratories, L.P., Fort Worth, Tex.) will maintain the contour and fill seen at the time of injection and is preferred for augmentation of the thinner skin of the nasal dorsum and sidewalls (Fig. 6). In contrast, the various forms of Juvéderm (Allergan, Inc., Irvine, Calif.) have lower viscosity and greater hydrophilicity, imparting a pliability and potential bulk from

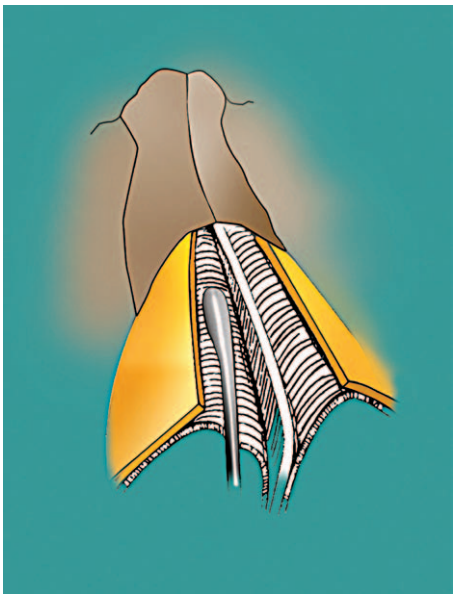

Fig. 4. Component dorsal reduction. Creation of submucoperichondrial tunnels and separation of the upper lateral cartilages from the septum allow preservation of the upper lateral cartilages and incremental reduction of the bony dorsum and cartilaginous septum as distinct units. Complete reduction is verified through three-point external palpation of the midline and bilateral dorsal aesthetic lines. Final modifications (e.g., grafts, suturing techniques, osteotomies) are performed as indicated. Addressing the dorsal components individually minimizes the common sequelae of composite reduction including overresection or underresection of the osseocartilaginous septum, inverted-V deformity, excessive midvault narrowing, irregularities of the dorsal aesthetic lines, cicatricial narrowing of the internal nasal valve, and webbing of the nasal vestibule. (Reprinted 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.)

fluid absorption beneficial when augmenting the thicker tissue of the tip and ala[126] (Table 5). Overcorrection of targeted areas by 10 percent is safe and will help offset the 20 to 30 percent reduction of fill volume typically seen over the first 3 months after augmentation.[127] Duration of enhancement with hyaluronic acid fillers is influenced by injection site and filler properties but, overall, improvement can predictably range between 6 and 12 months, although correction lasting up to 18 months has been reported.[128] In addition, hyaluronic acid fillers have the luxury of being able to be reversed with hyaluronidase (10 units of hyaluronidase per 0.1 ml of hyaluronic acid injected).

Lack of hydrophilic properties, postinjection sculptability, and longevity of calcium hydroxylapatite may give a perceived advantage over hyaluronic acid fillers. Treatment of smaller soft-tissue irregularities and larger bony and cartilaginous deformities of the nose have been treated with good patient satisfaction, few serious complications, and results persisting over 1 year.[129–131] Rivkin and Soliemanzadeh[132] retrospectively reviewed 295 patients selected from a 4-year sequential series of patients undergoing nonsurgical rhinoplasty with calcium hydroxylapatite (Radiesse; Merz Aesthetics, Greensboro, N.C.) and reported a revision rate of 44 percent within 2 months and 46 percent between 2 and 12 months of the initial procedure. Adverse events included prolonged (>2 weeks) swelling and erythema (17.6 percent), severe bruising (2.4 percent), cellulitis (2 percent), and skin necrosis (0.7 percent) and were more prevalent in patients undergoing previous rhinoplasty.

Thorough nasal analysis, an understanding of the surrounding vascular anatomy, and adherence to principals of safe injection technique are all vitally important in avoiding complications while augmenting the nose. Most complications such as infection, contour irregularity, and overfill are minor and easily corrected. However, vascular compromise from compression, dermal congestion, or intraarterial embolization can produce rare but devastating sequelae including skin necrosis or embolic occlusion of the retinal artery.[133–136] Fundamental steps to minimize complications include the following:

- Judicious choice of filler material with appropriate viscosity and elasticity for the region being injected.
- Localization of the lateral and dorsal nasal arteries (anatomical landmarks, manual palpation).
- Consideration of altered vascular anatomy (e.g., previous rhinoplasty, fillers).
- Retrograde injection; with verification of the absence of flashback before injection when possible (a technique used successfully with lower viscosity hyaluronic acid fillers).
- Avoidance of high tissue tension by superficial or high-volume injection.
- Close monitoring for signs of ischemia.
- Use of reversal agents (i.e., hyaluronidase for hyaluronic acid).
- Avoidance of unnecessary external compression (e.g., glasses, splints, jewelry) for 1 week.
- Proper patient education to recognize potential signs of delayed complication (e.g., skin changes, abnormal swelling, pain).

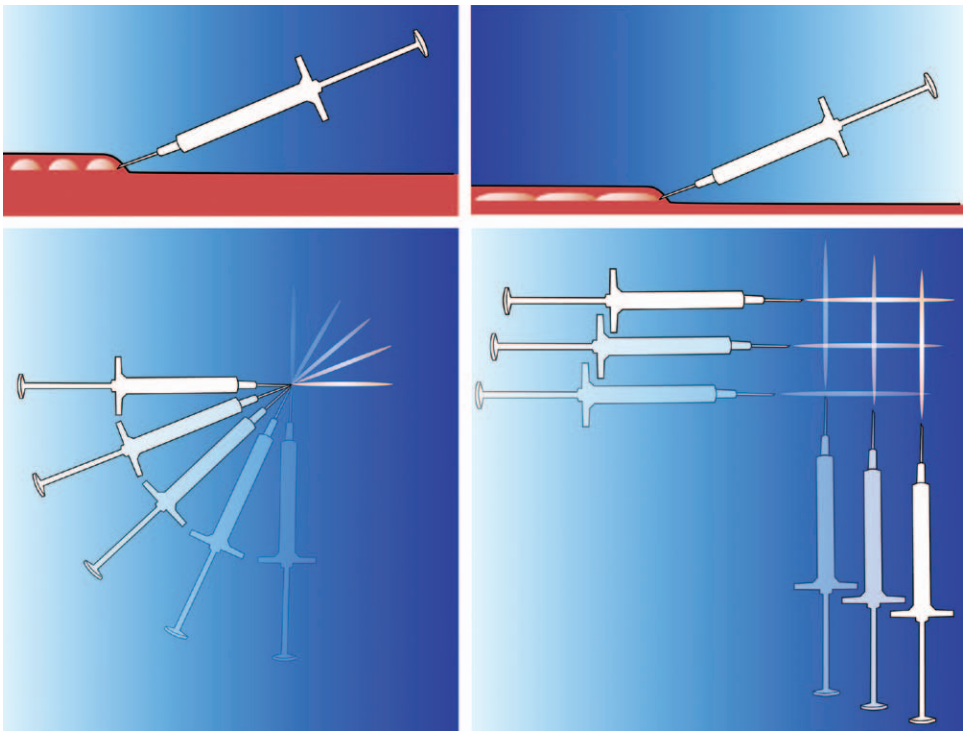

Fig. 5. Injection techniques for soft-tissue fillers: serial puncture (*above*, *left*), linear threading (*above*, *right*), fanning (*below*, *left*), and crosshatching/radial (*below*, *right*). [Reprinted from Rohrich RJ, Ghavami A, Crosby MA. The role of hyaluronic acid fillers (Restylane) in facial cosmetic surgery: Review and technical considerations. *Plast Reconstr Surg.* 2007;120:41S–54S.]

Autogenous Fat

With regenerative properties attributed to adipose cells, deficits and irregularities of the nose requiring long-term, large-volume correction may be better addressed with autologous filler material.[137,138] The process of fat injections for augmenting facial soft-tissue volume has been well established.[139–142] Nevertheless, the literature pertaining to aesthetic nasal augmentation remains sparse.[143–146] Monreal[145] reports a series of 36 consecutive procedures using volumetric fat grafting in lieu of or as a complement to surgical rhinoplasty. Final graft take in all cases was estimated at 60 to 75 percent, with the most extensive volume resorption occurring in the first 2 weeks after treatment and stabilizing by 1 month. Baptista et al.[146] treated nasal defects of 20 women after primary or secondary rhinoplasty. No resorption rate or final take is estimated, but only two subjects with severe saddle nose deformity required repeated injection at 6 months because of insufficient volume. Both studies report no complications and objective evaluation of results that are overwhelmingly satisfactory at least 1 year out. Beneficial secondary changes in skin and scar quality around the augmentation sites were noted but not formally studied.

Evidence on Management of Postoperative Edema and Ecchymosis

Corticosteroids

To date, no universal evidence-based guidelines aimed at routine administration of perioperative

Table 4. Properties of Soft-Tissue Fillers

Product	Total HA Concentration (mg/ml)	Cross-Linked (Stable) HA Concentration (mg/ml)	CaHA Concentration (%)	G′ (Pa)	Viscosity (cPa)
Restylane	20	15	—	513	119,180
Perlane	20	15	—	541	124,950
Juvéderm Voluma	20	15	—	274	62,902
Juvéderm Ultra Plus	24	14	—	75	17,699
Juvéderm Ultra	24	14	—	28	7307
Radiesse	—	—	30	1407	349,830

HA, hyaluronic acid; CaHA, calcium hydroxylapatite.

Fig. 6. Filler rhinoplasty. Correction of asymmetric dorsal aesthetic lines and narrow midvault in a 42-year old woman treated with hyaluronic acid. Preprocedure views (*left*) and postprocedure views (*right*) following treatment with 0.4 ml of Restylane to the left nasal sidewall and 0.1 ml of Restylane to the right nasal sidewall. (Reprinted from Kurkjian TJ, Ahmad J, Rohrich RJ. Soft-tissue fillers in rhinoplasty. *Plast Reconstr Surg*. 2014;133:121e–126e.)

Table 5. Recommended Soft-Tissue Filler for Each Anatomical Region

Soft-Tissue Filler	Injection Technique	Note
Dorsum		
Restylane, Juvéderm Voluma	Retrograde; linear threading along long axis of nasal dorsum	May layer deep to superficial for volume
Radiesse	Retrograde; linear threading along long axis of nasal dorsum	Single supraperiosteal/perichondrial layer
Sidewall		
Restylane, Juvéderm Voluma	Retrograde; cross-hatching along flat plane of nasal sidewall	
Radiesse	Retrograde; cross-hatching along flat plane of nasal sidewall	
Tip		
Juvéderm Ultra or Ultra Plus	Serial puncture	Small volume deposits totaling 0.1–0.3 ml
Radiesse	Serial puncture	Small bolus at tip defining points
Ala		
Juvéderm Ultra or Ultra Plus	Single puncture	
Columella		
Juvéderm Ultra or Ultra Plus	Single puncture	Bolus injection at the columella base for simple tip ptosis
Radiesse	Single puncture and/or linear threading	Subcutaneous bolus at the nasal spine and retrograde injection to lengthen and strengthen the columella

corticosteroids for rhinoplasty exist. Variables including type of corticosteroid; dose strength; timing, route, and duration of administration have produced conflicting data as to its efficacy. Pulikkottil et al.[147] published a thorough literature review highlighting the variable findings in controlled trials of corticosteroid administration with rhinoplasty.

Hatef et al. published a systematic review to evaluate the efficacy of perioperative steroid dosing in decreasing edema and ecchymosis following rhinoplasty (**Level of Evidence: Therapeutic, II**).[148] Four prospective randomized trials quantifying upper and lower eyelid changes with single and extended dosing regimens were included.[149–152] A meta-analysis demonstrated that perioperative use of corticosteroids led to a significant reduction in edema and ecchymosis at all sites of assessment, with an ideal time of administration occurring before surgical induction. In addition, continued oral administration for up to 3 days postoperatively was significantly more effective than a single perioperative dose. Youssef et al.[153] published a systematic review with meta-analysis of four studies examining corticosteroid administration versus placebo on postrhinoplasty days 1, 3, and 7. They concluded that administration of perioperative steroids for reduced eyelid edema lost any significant effect after postoperative day 3.

Other Methods

In a recent survey of facial plastic surgeons,[154] the most commonly reported postoperative interventions to reduce edema and ecchymosis following rhinoplasty were head-of-bed elevation (93 percent) and application of ice packs (75 percent). Only 21 percent of high-volume rhinoplasty surgeons routinely prescribe postoperative steroids, whereas 82 percent of all those surveyed do not administer corticosteroids at any time in the perioperative period. Interestingly, in this same group of high-volume surgeons, 61 percent prescribe *Arnica montana*, an herbal medication thought to have antiinflammatory properties but which has not unequivocally been shown to bestow any benefit (Table 6) (**Reference 157 Level of Evidence: Therapeutic, II**).[155–158] Other compounds including *Ananas sativus* (bromelain/pineapple extract) and pseudoephedrine have been recognized in the literature as potential compounds to alleviate postoperative edema and ecchymosis following rhinoplasty.[158,159]

Secondary Rhinoplasty

Altered anatomy, functional irregularities, scar formation with obliterated tissue planes, diminished autogenous graft material, and warping of previous grafts all pose potential challenges in revision rhinoplasty.[160] A recent survey of 1923 plastic surgeons and otolaryngologists revealed that wide access through an open approach for revision is embraced by a majority of respondents; however, 20 percent still rely primarily on endonasal revision.[161] The safety of creating a transcolumellar incision while preserving the vascularity of the tip is well established,[162,163] and a well-positioned incisional scar provides an excellent point for reentry. When an ideal scar does not exist, reentry through a poorly designed or malpositioned scar can compromise exposure

Table 6. Properties of *Arnica montana*

Habitat: perennial herb; indigenous to Central Europe
Synonyms
Wolf's bane
Leopard's bane
Mountain tobacco
Active compounds
Arnicin
Helenalin
Formulation (most common as 30× dilution of active compounds)
Pill
Ointment
Tincture
Mouthwash
Properties
Antiinflammatory
Stimulant
Diuretic
Common uses
Bruising
Muscle spasm
Swelling
Muscle/joint pain
Sprains
Swollen gums
Secondary uses
Acne
Motion sickness
Epilepsy
Abortion
Superficial phlebitis
Side effects (primarily attributed to helenalin toxicity)
Rash/eczema
Prolonged bleeding time
Hypertension
Nausea
Dizziness
Tremors
Irregular heartbeat
Gastroenteritis/gastrointestinal bleeding
Hepatic inflammation
Lymphatic inflammation
Drug interactions (prolonged bleeding time)
Heparin
Warfarin
Enoxaparin
Dalteparin
Clopidogrel
Ticlopidine
Aspirin
Pregnancy risk
Avoid because of effects of uterine stimulation; possible transmission to breast milk
Precaution
Use with caution with known allergy to plants in
Asteraceae family
Ragweed
Chrysanthemum
Marigold
Daisy

and the surgical result. Unger et al.[164] performed a retrospective review of 100 secondary rhinoplasties in patients undergoing sequential open procedures to assess the safety and scar quality of a second transcolumellar access site (**Level of Evidence: Therapeutic, IV**). No wound-related complications, including delayed healing, notching, contracture, scar hypertrophy, or pigmentary changes, were noted. In addition, there was no significant change in objective evaluation of the scar between the primary and secondary procedures. They concluded that a prior columellar incision could be safely ignored when planning access for revision rhinoplasty.

Complications

Complications following rhinoplasty include bleeding, infection, prolonged edema, iatrogenic deformity, and nasal airway obstruction. Postoperative epistaxis, one of the most common complications, can be minimized with good perioperative blood pressure control and cessation of aspirin and other nonsteroidal antiinflammatory drugs for 1 week before and 2 weeks after nasal surgery.[165,166] Bleeding originating from the incision line or traumatized mucosa is generally mild and can be treated with head elevation, gentle pressure, or intranasal vasoconstrictors (e.g., oxymetazoline nasal spray). Continuous bleeding requiring repeated nasal packing may benefit from administration of desmopressin, a synthetic analogue of the antidiuretic hormone L-arginine vasopressin shown to increase coagulation activity through a rise in plasma concentrations of factor VIII and tissue plasminogen activator. Faber et al.[167] reviewed the hospital records of 268 consecutive nasal procedures and identified nine patients who presented to the emergency department with refractory bleeding (**Level of Evidence: Therapeutic, IV**). All nine had bleeding controlled with administration of 0.3 μg/kg of intravenous desmopressin over 30 minutes. Major or persistent epistaxis always warrants a return trip to the operating room for exploration.

CONCLUSIONS

Successful outcomes in rhinoplasty rely on proper patient selection and evaluation, grounding patient expectations within the limits of the procedure, a graduated surgical approach using a combination of techniques, attentive perioperative management, and judicious use of nonsurgical adjunct procedures. Significant literature on patient evaluation and surgical techniques is available; however, few studies with a high level of evidence are available to guide perioperative and nonsurgical management. Until these studies are available, the rhinoplasty surgeon must be vigilant in the use of up-to-date best evidence data to ensure safe, high-quality results.

Daniel O. Beck, M.D.
Department of Plastic Surgery
University of Texas Southwestern Medical Center
1801 Inwood Road
Dallas, Texas 75390-9132
doliverbeck@gmail.com

PATIENT CONSENT

The patient shown in Figure 6 provided written consent for the use of her images.

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