Chapter 1

Surgical Anatomy of the Nose

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Core Messages

- Expert knowledge of nasal anatomy and function is the key to success in rhinoplasty surgery.
- Facial analysis and facial aesthetic principles must always be a part of the initial patient evaluation.
- Surgical manipulations of the nasal anatomy have functional and aesthetic impact.
- A skilled rhinoplasty surgeon understands the interaction between anatomical units and takes care to preserve these functional relationships to avoid future complications.

Contents

Introduction

Rhinoplasty alone or in combination with septoplasty is one of the most commonly performed surgical procedures in the field of plastic surgery. The nose is a vital part of a person's cosmetic appearance, and any preexisting or postoperative appearance that is unattractive may result in unwanted attention or focus. Although a rhinoplasty or septoplasty is theoretically a relatively straightforward procedure, performing a good rhinoplasty with both a successful cosmetic and functional outcome is challenging. Comprehensive knowledge of facial aesthetics and nasal anatomy is paramount for any surgeon undertaking septoplasty or rhinoplasty procedures. This chapter will discuss both the external and internal anatomy of the nose and septum, particularly with regard to septoplasty and/or rhinoplasty.

Facial Aesthetics

Prior to discussion of rhinoplasty goals, the face must be objectively evaluated in order to determine the patient's existing aesthetics and anatomy, and their goal aesthetics and anatomy. Throughout the history of plastic surgery, the concept of beauty has been objectively analyzed, resulting in specific nasal–facial relationships that comply with these perceptions of beauty. According to facial aesthetic principles, the vertical height of the face can be divided into thirds: from the trichion to the glabella, the glabella to the subnasale, and from the subnasale to the menton. Therefore, the length of the nose should constitute approximately one-third of the vertical height of the face. The lower third of the face is typically subdivided, with the distance from the subnasale to oral commissure being one-third, and the distance from the oral commissure to the menton being two-thirds. Horizontally, the face is divided into fifths – approximating the distance from the helical rim to the lateral canthus, the lateral canthus to the medial canthus, from the medial canthus to the contralateral medial canthus, from the medial canthus to the lateral canthus, and then back to the helical rim. The intercanthal distance should be equal to the distance from alar crease to alar crease at the base of the nose. These fundamental principles should be used to assess the width and length of the nose.

Patients presenting for rhinoplasty often need changes in these dimensions in order to create a harmonious facial balance.

Once the basic width and length of the nose have been assessed, the surgeon should next consider other nasal dimensions and the facial angles. The order of analysis of the facial proportions is not necessarily important, but it is essential to adhere to a consistent, reproducible pattern of analysis. For our purposes, a stepwise analysis will begin from the upper third to the lower third of the nose.

The profile view is often the greatest area of concern for the patient. Initially, the nasofrontal angle is evaluated. This is the angle between lines drawn from the nasion or radix to the glabella, and from the nasion to the tip, and typically measures 115–130°. The nasion or radix should be the most depressed area of the nose in profile. In Caucasian patients, the nasion should lie on a horizontal plane with the supratarsal crease. In Asian patients, the nasion is more poorly defined, and is usually located at the pupillary line, making the nasofrontal angle more obtuse. The second important nasofacial angle is the nasolabial angle, which determines the rotation of the nose. This angle lies between a line running from the subnasale to the tip and an intersecting vertical line approximating the upper lip vermilion. In women, this angle should lie between 95 and 110°, and 90 and 95° in men.

Nasal Aesthetics

Projection is another important consideration in preoperative assessment, and can be measured in multiple ways. In a method described by Goode, a line is drawn through the alar crease perpendicular to the Frankfort horizontal plane. A second line is drawn from this line to the nasal tip. A third line is then drawn from the nasion to the nasal tip. For ideal nasal tip projection, the length of the alar–nasal tip line divided by the length of the nasion–nasal tip line should be 0.55 to 0.6. A nose whose ratio is greater than 0.6 is considered to be over-projected [1]. Crumley and Lancer described a 3-4-5 triangle in which nasal projection (the distance from the alar–facial crease to the tip) is approximately 60% of the nasal length (the distance from the nasion to the subnasale) [2]. Yet another alternative is to measure the distance from the subnasale to the nasal tip, and compare it with the distance from the subnasale to the upper lip vermilion border. If the distance from the subnasale to the tip is greater than the distance from the subnasale to the upper lip vermilion border, then the nose is over-projected [3].

Lastly, the relationship of the dorsum to the tip should be analyzed. The dorsum of the nose should be a straight line in profile, just 1–2 mm posterior to the nasal tip. If the nasal dorsum is significantly lower or higher than the nasal tip in profile, it may need augmentation or reduction respectively. Just superior to the tip's defining points should be a slightly more depressed area, corresponding to the supratip. If there is no supratip break, then a 1- to 2-mm depression just above the tip should be fashioned to create an aesthetically optimal result.

Frontal views of the patient also need to be analyzed with regard to aesthetic relationships. Most important to consider is whether or not the nose is straight. This is determined by drawing a vertical line from the glabella to the menton. This preoperative assessment can affect patient expectation, predict intraoperative anatomy, and help formulate a surgical plan. Additionally, the brow-tip aesthetic line, which immediately draws the eyes' attention, must be considered. This line, originating from the brow curvature, follows inferiorly along the nasal sidewall to end at the nasal tip. Any break in the flow of this line will draw the eyes' attention.

Once this overview is completed, a more focused, systematic analysis should take place. For the upper third of the nose from a frontal view width is most important. The width of the upper third, or bony vault, should approximate 70–80% of the interalar distance or the intercanthal distance [4]. This width of the upper third should continue and be consistent inferiorly along the nasal sidewalls through the middle vault. Around the inferior portion of the middle vault, the nose gradually becomes wider until the full width of the interalar distance is reached.

In between the alar creases lies the nasal tip, which is often the most complicated part of the nose to evaluate and surgically correct. The nasal tip has two tip-defining points, which are light reflections seen on a photograph. They are defined as the most projected area on each side of the tip, and correspond to the anterior-most portion, or domes, of the lower lateral cartilages. These reflective points should lie on the same horizontal plane. Bulbosity, bossae, asymmetry, valve collapse, pinching, etc., can all be evaluated from the frontal view. As with the profile view, the relationships of the columella should also be evaluated from the frontal view when the tip is under consideration. In Caucasian patients, the inferior-most point of the columella usually lies on the same horizontal plane as the inferior extent of the ala. Many Asian patients have a retracted columella, which is apparent from the frontal view as a short columella that terminates superior to the ala.

Finally, after the profile and frontal views of the nose have been analyzed, the base view should be evaluated. The base view may provide important information about the nasal anatomy that will be helpful in the operating room. According to aesthetic principles, the soft tissue of the infratip lobule should comprise one-third of the height from the base view, while the columella comprises two-thirds. Postoperatively pinched tips may unevenly increase the height of the infratip lobule. The width of the columella may also be assessed from a base view – this corresponds to the anatomy of the medial crural footplates and/or septum. The contour of the alar rim is the last portion of the nose to be evaluated. Any concavity or collapse seen at rest or on inspiration should prompt the rhinoplasty surgeon to consider cartilage grafting for added support of the external valve.

The unique anatomy of the nose complicates rhinoplasty and septoplasty surgery, and makes them two of the most challenging operations to undertake. It is for this reason that it is imperative to take preoperative photographs, analyze the patient's aesthetics, and realistically alter their photographs to create improvements. Once the aesthetics have been analyzed, the surgeon should have an accurate conception of the underlying anatomy, and the surgical plan.

Nasal anatomy can be subdivided into several categories including the skin-soft tissue envelope (S-STE), septum, lateral nasal walls, bony pyramid, cartilaginous vault, and nasal tip.

The external areas of the nose can be further broken down into aesthetic subunits: the dorsum, side-walls, columella, soft tissue triangle, ala, and tip. Each of these areas will be addressed.

Skin Envelope

To begin, one must evaluate the skin-soft tissue envelope. Thin skin can be very challenging as it exposes every contour irregularity of the osseocartilaginous structures. Furthermore, skin will thin over time, leaving the constant potential of unmasking even the slightest irregularities or asymmetries. Thin skin does have the one advantage of faster postoperative healing due to less tissue edema [5]. Thick skin, on the contrary, complicates rhinoplasty by masking refinements. Even if the underlying bony and/or cartilaginous structures are dramatically changed, the patient's thick skin may mute these results. It may redrape ineffectively, leaving a dead space to be filled in by scar tissue. This can result in bulbous tips and suboptimal supratip contours, or a "pollybeak" deformity. Patients of Asian and African heritage in particular need to be wary of this. In general, skin is thickest near the glabella, thins out toward the middle vault, becomes thinnest in the area of the rhinion (corresponding to the nasal bone/upper lateral cartilage junction), and thickens again at the nasal tip. Lessard and Daniel reported the thickness at the nasofrontal groove to be 1.25 mm, and only 0.6 mm at the rhinion [6]. This differential in skin thickness should be considered during dorsal hump removal. Since the skin is thinner at the rhinion, a slight protrusion of the underlying bony/cartilaginous framework should be maintained at the rhinion in order to create a straight external dorsal profile. Toward the tip, the skin becomes thicker again, due to the increased density of sebaceous glands. Extremely thick skin with large numbers of sebaceous glands can limit skin redraping and good tip definition [7]. Skin thickness is often overlooked in both evaluation and patient expectations, but should not be forgotten.

Subcutaneous Tissue

Subcutaneous tissue is another important consideration in rhinoplasty. This layer lies between the skin and the osseocartilaginous framework. Schlesinger et al. further divided this area into four discrete layers: the superficial panniculus, the fibromuscular layer or nasal superficial musculoaponeurotic system (SMAS), the deep fatty layer, and the periosteum or perichondrium [8]. Ideally, surgical dissection during open rhinoplasty is performed deep to all of these layers. Since the blood supply to the skin-soft tissue envelope flap raised during open rhinoplasty runs into the deep fatty layer, this results in elevation in a relatively avascular plane. Elevating in this plane also prevents disruption of the subcutaneous tissues, decreasing scar formation.

The muscles associated with the nose are covered in a nasal equivalent of the SMAS, and are raised in this S-STE flap during open rhinoplasty. These muscles include elevators, depressors, compressors, and minor dilators [9, 10]. The procerus, levator labii superioris alaeque nasi, and anomalous nasi are elevator muscles, the alar nasalis and depressor septi nasi are depressor muscles, the transverse nasalis and compressor narium minor are compressor muscles, and the dilator naris anterior is a minor dilator [7]. Elevator muscles shorten the nose and dilate the nostrils while the depressor muscles lengthen the nose and dilate the nostrils. Overly active depressor septi nasi muscles can result in tip ptosis during laughing or smiling, which may be bothersome to the patient. The compressor muscles lengthen the nose and narrow the nostrils. Elevating in the proper plane deep to these muscles and the perichondrium/periosteum not only results in an avascular plane with preservation of the soft tissue envelope, but also preserves blood supply to these muscles, which lie within the flap, thus reducing intraoperative bleeding, and postoperative edema and scarring.

Blood Supply

Blood supply to both the skin and the lining of the nose is also worth mentioning, as it is important to consider during preoperative injection for hemostasis, flap design, and nasal incisions. The blood supply to the nose is derived from branches of both the internal and external carotid arteries. Branches of these major arteries form a subdermal plexus, which is most dense in the nasal tip. Superiorly, the anterior and posterior ethmoid arteries branching off of the internal carotid artery supply both the lining of the nose, as well as some of the skin via the external nasal or dorsal nasal arteries. Inferiorly, the labial and angular arteries come off of the facial artery to supply the tip area. The lateral nasal arteries typically branch over the alar groove, while the superior labial arteries continue superiorly through the columella [5, 11]. These arteries are important considerations in open septorhinoplasty. The columellar incision typically bisects the columellar arteries, so the tip of the flap is largely dependent on supply from the lateral nasal arteries coming in over the ala. This anatomy has important implications if alar base reductions are undertaken during open rhinoplasty – in order to preserve an adequate blood supply to the tip, alar base incisions should be no more than 2 mm above the alar groove [5]. Defatting the nasal tip, which is occasionally done in thicker skinned patients, may also endanger nasal tip supply by interrupting the arcade between these two arterial supplies. Branches of the infra-orbital, supra-orbital, and supratrochlear arteries also contribute to the nasal blood supply. Venous drainage is through the facial and angular veins.

Nerve Supply

Nerve supply to the nose is externally derived from branches of the trigeminal nerve. The skin of the nose superiorly at the radix and rhinion is supplied from branches of the supratrochlear termination of the ophthalmic nerve. The anterior ethmoidal nerve, another branch of the ophthalmic, may traverse the dorsum of the nose to supply the tip [12]. In endonasal or in open rhinoplasty, this nerve bundle may be damaged by over-aggressive endonasal incisions violating the fibromuscular layer, or elevation of the S-STE in the wrong plane, resulting in a numb

nasal tip. The infraorbital nerve may also contribute branches to the lateral nasal walls, columella, and vestibule. Knowledge of this external nerve supply is necessary to perform adequate nerve blocks for closed reductions, or for rhinoplasty under local anesthesia with sedation.

Intranasal anesthesia is also a prerequisite for these procedures. This may be performed with intranasal cocaine pledgets or other strategically placed topical anesthetics. Perhaps the most important target is the sphenopalatine ganglion located in the posterior portion of the nose just posterior to the middle turbinate. Internal branches of the anterior ethmoid must also be anesthetized in the superior portion of the nose to complete a total nasal block.

Bony Septum

Internally, the nose can be divided into the septum and the lateral wall. The septum can be further divided into a bony and a cartilaginous portion. Unlike the paired nasal bones, the bony septum is a singular, midline structure comprising the perpendicular plate of the ethmoid superiorly, and the vomer inferiorly (Fig. 1.1). The perpendicular plate of the ethmoid is continuous superiorly with the cribriform plate. Any unintended or traumatic manipulation of the superior bony septum, therefore, has the potential to cause a CSF leak and/or anosmia. If this superior portion of the septum is contributing to an obstruction, it must be resected sharply rather than pulled or twisted during a septoplasty procedure. Inferoposteriorly, the vomer forms the midline bony nasal septum. It is typically described as a keel-shaped bone that extends anteriorly from the sphenoid, and superiorly from the nasal crests of the maxilla and the palatine bone. Inferior to the vomer, the nasal crest of the maxilla is positioned anteriorly, and the nasal crest of the palatine bone is positioned posteriorly. These are both thin pieces of bone, but may be deviated or dislocated to form inferior septal spurs that should be resected during septoplasty. The anterior nasal spine and, more posteriorly, the palatine process of the maxilla, are located inferiorly to the nasal crests of the maxilla and palatine bones. The anteroinferior edge of the caudal septum is attached to the anterior nasal spine. In patients with a retruded or underdeveloped maxilla, the anterior nasal spine, and, therefore, the anterior edge of the caudal septum, will be more posteriorly located.

Cartilaginous Septum

The septal cartilage is typically described as being quadrangular in shape. It lays in the midline of the nasal septum nestled between the nasal bones, the perpendicular plate of the ethmoid superiorly, and the vomer and palate inferiorly. The septal cartilage is a major support mechanism of the nose and projects anteriorly to form part of the dorsal profile. The anterior and posterior septal angles are important landmarks during septoplasty and rhinoplasty (Fig. 1.1) The anterior septal angle is the area at the junction of the dorsal and caudal septum. The posterior septal angle is the area where the septum articulates with the nasal spine anteroinferiorly.

Lateral Nasal Wall

Along the lateral nasal wall are bony projections called turbinates. These are paired scroll-shaped bones covered in nasal mucosa, which protrude into the nasal cavity. The inferior, middle, and superior turbinates function to direct airflow through the nose. They also serve as important landmarks for sinus surgery. In rhinoplasty, contact with the turbinates is largely avoided in order to prevent bleeding. The inferior turbinate is useful in osteotomies – mucosal incisions for osteotomies are placed just superior to the inferior turbinate to allow access to the pyriform aperture. Also, the middle turbinate serves as a landmark for the sphenopalatine ganglion, which is an important consideration in nerve blocks for complete intranasal anesthesia.

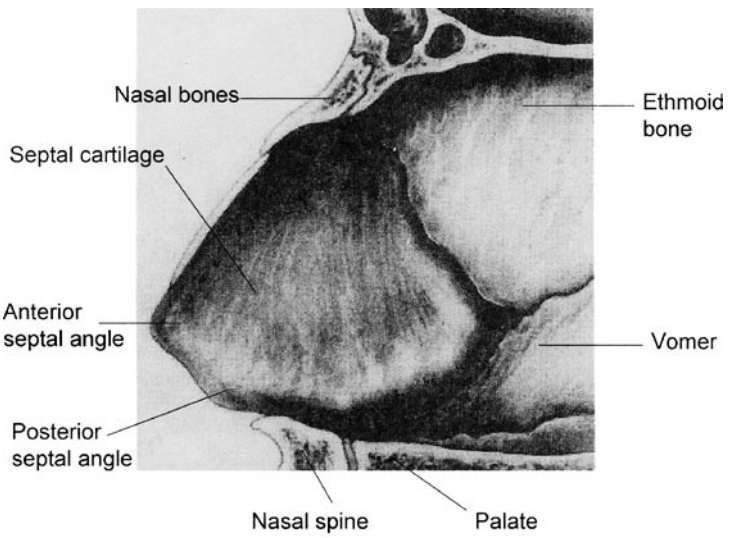

Fig. 1.1 Nasal septal anatomy

Bony Vault

Perhaps the simplest portion of the external nose to discuss anatomically is the bony vault. The bony vault comprises the upper or cephalic third of the nose. The paired nasal bones articulate with the nasal processes of the frontal bones superiorly and the nasal or ascending process of the maxilla laterally. Nasal bones exhibit great variability in their length and width. Generally, though, they assume a pyramidal configuration – wide at the nasofrontal suture, narrowing at the level of the medial canthus, then flaring out laterally as they proceed caudally [13]. The nasal bones are thickest at the nasofrontal junction in the cephalomedial portion of the bones and thin as they broaden inferolaterally [7]. This is the reason why most traumatic nasal fractures occur through the middle or inferior portion of the nasal bones rather than superiorly through the nasofrontal suture [14]. As mentioned previously, from a lateral view, the nasal bones have a natural depression at the radix or nasion area at the level of the supratarsal crease in Caucasian patients. Patients of Asian and African heritage tend to have a more inferiorly located radix approximating the pupillary line. Augmentation or reductions in this area can significantly reduce or deepen the nasofrontal angle, and change the relationship of the nose to the forehead.

Nasal bones average approximately 25 mm in length in Caucasians, but tend to be shorter and lower in profile in patients of Asian and African heritage [15]. It is important to consider the length of the nasal bones prior to surgery, particularly since short nasal bones can be challenging during surgery. Shorter nasal bones can make osteotomies more difficult because of the increased risk of fragmentation. Short nasal bones are also often associated with long upper lateral cartilages that predispose the middle vault to collapse. During any open or closed septorhinoplasty that includes manipulation of the bony vault, the periosteum over the nasal bones should be elevated carefully to avoid tearing. This preserves a pocket lined with periosteum to stabilize the nasal bones after osteotomies [7]. The subperiosteal dissection should continue superiorly, almost to the level of the nasofrontal suture, but at least to the level of the radix.

Typical manipulation of the nasal bones during rhinoplasty involves narrowing of the paired bones via medial and lateral osteotomies. Medial osteotomies are performed in a plane through the midline of the paired nasal bones, and fade out laterally, essentially bisecting the nasal bones in the area of the radix. It is important not to continue the osteotomy superiorly to the level of the nasofrontal suture since this may result in a "rocker deformity" in which the nasal bones are left mobile. Lateral osteotomies are performed through the ascending or nasal processes of the maxilla – not through the nasomaxillary suture. Performing osteotomies through the nasomaxillary suture will result in a palpable step-off, a contour deformity, and an undesirable cosmetic result. Lateral osteotomies should continue medially more superiorly in order to join the lateral extent of the medial osteotomy in the area of the radix.

Another important consideration during osteotomies or any manipulation in the area of the nasal bones is the location of surrounding structures. Posterior to the cephalic portion of the nasal bones are the lacrimal bones – part of the medial orbit. The lacrimal system is situated within a depression in the middle of the lacrimal bone. If surgical osteotomies are too posterior, this area can be easily violated and fractured, with significant sequelae. Just under or posterior to the nasal bones are the nasal septum and perpendicular plate of the ethmoid. Converse first referred to this area where the septum, perpendicular plate of the ethmoid, upper lateral cartilages, and nasal bones meet as the keystone area [16, 17]. In this area, the perpendicular plate of the ethmoid and the septal cartilage provide support for the dorsum. This relationship is important during dorsal hump removal and osteotomies, when the foundation of the nasal dorsum is disrupted.

Cartilaginous Vault

Upper Lateral Cartilages

Inferiorly, the nasal bones are attached to and overlap the cephalic borders of the upper lateral cartilages by 7–10 mm [7]. The upper lateral cartilages comprise the middle third of the nose, or middle vault. These cartilages are extremely important both functionally and cosmetically, and represent a transition zone from the rigid nasal bones to the flexible lower lateral cartilages. They are trapezoidal in shape from a lateral view, flaring out laterally as they proceed inferiorly, smoothing the transition from the more narrow nasal bones to the wider nasal tip. Fibrous connections superior to the nasal bones, medial to the cartilaginous septum, and lateral to the pyriform aperture support the upper lateral cartilages.

Superiorly, the upper lateral cartilages are tucked under the inferior portion of the nasal bones (Fig. 1.2). During rhinoplasty with dorsal hump reduction, removal of significant amounts of dorsal cartilage and bone may alter the relationship of the upper laterals to the septum and nasal bones. Inverted-V deformities and open roof deformities may be the consequence if corrective maneuvers, such as osteotomies, are not performed. Similarly, during rasping of the nasal bones or dorsal hump, the upper lateral cartilage attachments to the nasal bones are at risk of becoming avulsed. Remembering this important anatomic relationship and rasping in an oblique direction should prevent avulsion, and its postoperative sequelae of an inverted-V deformity [7].

Endonasally, the junction of the upper lateral cartilages with the nasal septum forms the internal nasal valve. This valve angle should be between 10 and 15° for adequate nasal airflow, and must be preserved or recreated during rhinoplasty. Even in an unoperated nose, collapse of the internal nasal valve is a concern. Over time, with continued inspiratory negative pressure, the upper lateral cartilages may gradually collapse, resulting in narrowing of the middle vault. This potential is compounded in patients with short nasal bones and poorly supported, long upper lateral cartilages. During rhinoplasty, dorsal hump removal often results in an open roof deformity, which leaves a wider, non-anatomic space between the septum and upper lateral cartilages. If the internal nasal valve is not recreated, inward collapse of the upper lateral cartilages against the septum will narrow the valve, causing functional airway obstruction. Interruption of the mucoperichondrial attachments of the upper lateral car-

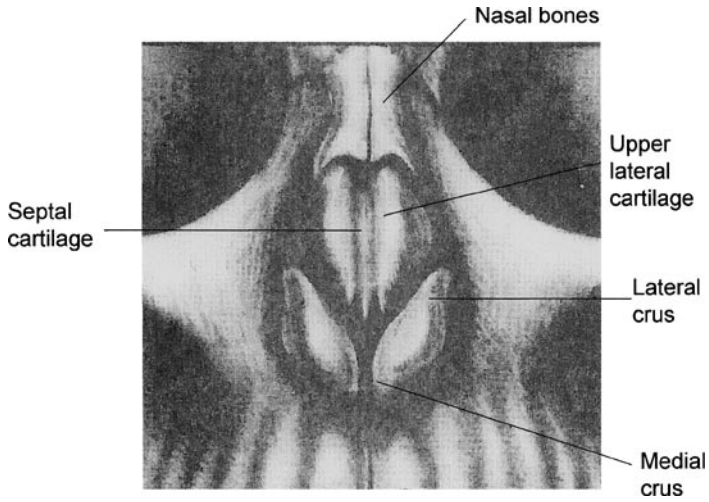

Fig. 1.2 Nasal cartilage anatomy – frontal view

tilages to the septum may also cause nasal valve inadequacy due to problematic scarring. Preservation of this mucosa minimizes collapse and/or posterior displacement of the upper lateral cartilages [18]. In order to prevent this problem of internal valve collapse, a significant percentage of rhinoplasties will require reconstruction of the internal valve with placement of bilateral spreader grafts [19]. These rectangular shaped grafts typically measure 6–18 mm in length, 3–5 mm in height, and 2–4 mm in thickness, and are placed between the cartilaginous septum and remaining upper lateral cartilages [20]. It is important to tuck these grafts under the nasal bones superiorly in order to prevent inverted-V deformities. These grafts are then sutured into place, and act as mechanical bolsters to prevent inward collapse of the upper lateral cartilages.

Lower Third

The tip and ala are largely supported by the lower lateral crura, or alar cartilages. These are C-shaped cartilages typically divided into medial, middle, and lateral crura (Fig. 1.3) [14, 19]. These lower lateral cartilages typically overlap the upper lateral cartilages superiorly in the scroll region, but may underlay or approximate the upper lateral cartilages. This relationship in the scroll region is a major tip support mechanism [7]. Loose areolar tissue and fibrous attachments connect the upper and lower lateral cartilages. With aging, these attachments weaken, contributing to senile ptosis, in which the tip loses its cephalic rotation. In rhinoplasty, transection of these attachments occurs with transcartilaginous or intercartilaginous incisions. These incisions violate this major tip support mechanism, and must be considered and accounted for during tip refinement.

In addition to fibrous attachments to the upper lateral cartilages, the lower lateral cartilage complex is also supported by fibrous attachments to the caudal end of the septum and to the pyriform aperture. The attachments of the medial crura to the membranous septum are important contributors to tip projection. Partial transfixion incisions preserve this support, but complete transfixion incisions, which separate the medial crural footplates from the membranous septum, sever these attachments and deproject the tip. Similarly, the attachments of the lower lateral cartilages to the pyriform aperture maintain tip rotation and must be preserved. These lateral attachments are most at risk during osteotomies. Therefore, lateral osteotomies are performed in a high-low-high fashion. The initial "high" portion of the osteotomy refers to starting the osteotomy high on the nasal process of the maxilla in order to preserve the fibrous attachments of the lower lateral cartilages, and also the insertions of the nasofacial muscles.

The medial crus of the lower lateral cartilage begins inferiorly at the footplate, and extends into the columella. The middle crus begins inferiorly at the columellar lobule junction, and ends superiorly at the medial extent of the lateral crus. The middle crus may also be referred to as the intermediate crus [7, 21]. The lateral crus starts medially at the lateral end of the middle crus, and ends with a free edge laterally [19]. The transition point from the middle crus to the lateral crus contains the most projected portion of the cartilage, and is referred to as the tip-defining point, or dome. This tip-defining point always lies on the medial aspect of the lateral crus [8].

The medial crura form the cartilaginous support for the columella. They are further divided into a footplate segment and a columellar segment. From a lateral view, the angle of cephalic rotation of the medial crus between these two subdivisions corresponds to the double break portion of the columella. The soft tissue structure of the columella reflects the anatomy of the underlying footplates of the medial crura and their interaction with the caudal septum. Aesthetically, only 2–4 mm of columellar show should be present below the alar margins from a profile view [7]. Anything more than this reflects a "hanging columella" or alar retraction, while any smaller distance represents columellar retraction. Both of these discrepancies are aesthetically displeasing. During an open rhinoplasty approach, it is important to remember that the medial crura have convexities in the area of the columella. Dissection must proceed immediately deep to the skin in order to prevent transecting this convex portion of

the cartilages. Occasionally, however, the inferior convexities of the medial crural footplates are intentionally resected to correct a hanging columellar deformity. The membranous septum and caudal edge of the cartilaginous septum also contribute to the columellar shape from this view. All of these relationships must be considered when determining how much of the caudal septum or medial crura to resect or reposition during rhinoplasty. Overaggressive resection of the caudal septum can lead to overrotation and an unnatural, operated look, while inadequate resection leaves a long caudal septum that pushes the tip down. If no change in tip projection is desired, a transfixion incision should be avoided unless the relationships among the medial crura, membranous septum, and caudal septum are restored. Transfixion incisions are indicated if a significant amount of complex tip work is needed or if deprojection is desired.

From a base view, the divergence of the medial crural footplates determine the width of the columella [8]. These medial crura can be asymmetric, but parallel, flared, or straight. Soft tissue coverage in this area can also change its appearance. If the medial crura are flared, and there is minimal soft tissue coverage, a bifid appearance can result. However, if there is adequate tissue, then the columella just appears wide. Sutures between the medial crural footplates can narrow this area and correct bifidity.

Similar to the medial crura, the middle crura can also be further divided into two segments: the domal and lobular segments. The lobular segment is the more inferior portion of this subdivision, and typically follows the pattern of the columellar segment of the medial crus. That is, if the columellar segment of the medial crus is divergent, then the lobular segment of the middle crus usually is too [22]. The lobular segment does not contribute much to the tip's appearance since it is covered by a thick soft tissue envelope. The domal segment, however, can contribute significantly to the appearance of the tip. It is located between the lobular segment of the middle crus, and the medial portion of the lateral crus. Wide divergence of the middle crura may result in a bifid appearance of the tip, which can be corrected by interdomal sutures during rhinoplasty. Other variations in angulations and convexities of this domal segment of the middle crus can make a tip boxy, narrow or pinched [6, 19]. During rhinoplasty, a variety of suture techniques in this area can significantly change the shape of the tip, increase projection, and improve definition.

Lateral crura also make a large contribution to tip definition and shape, and, therefore, can be manipulated or sculpted in various ways to change its appearance. At their medial extent, the lateral crura begin at the superior edge of the domal segment of the middle crus. This medial segment of the lateral crus contains the tip-defining point – the most anteriorly projected portion of the tip. The lower lateral crura should then take on an outwardly convex configuration laterally over the ala, then curve slightly internally again at their lateral end. This lateral convexity results in a nice arch in the nasal tip and ala. Occasionally, excessive internal recurvature at the lateral aspect of the lateral crura is present, and can cause nasal obstruction. This can be corrected with lateral crural strut grafts during rhinoplasty to reverse the curvature [23].

Typically, as they arch laterally, the lower lateral cartilages also move cephalically. This is an important point to remember during marginal incisions for rhinoplasty – the incision should proceed more cephalically in the lateral portion of the incision to parallel the inferior border of the lateral crura. During tip refinement, however, the caudal margin of the lateral crura should be repositioned to approximate the same plane as the cephalic margin in order to maximize alar support and create a smooth transition from the tip to the supra-alar creases. Alterations in this relationship can give the nasal tip a pinched look, and should be avoided. Interdomal sutures can occasionally change the orientation to a more favorable relationship, but lateral crural strut grafts may be necessary to reposition the lateral crura [23].

Width, length, thickness, and curvature of the lateral crura vary greatly between patients. These cartilages can be cephalically oriented, laterally oriented, thin, thick, extremely wide, deformed, buckled, or concave. Ideally, the lateral crura should deviate from the midline at approximately a 45° angle [23]. More cephalically oriented lateral cartilages cause fullness in the lower third of the nose and a ptotic tip. Fullness is due to excessive width of the cartilages tenting up the skin superior to the alar crease. Typically, only 4–8 mm of lateral crural width

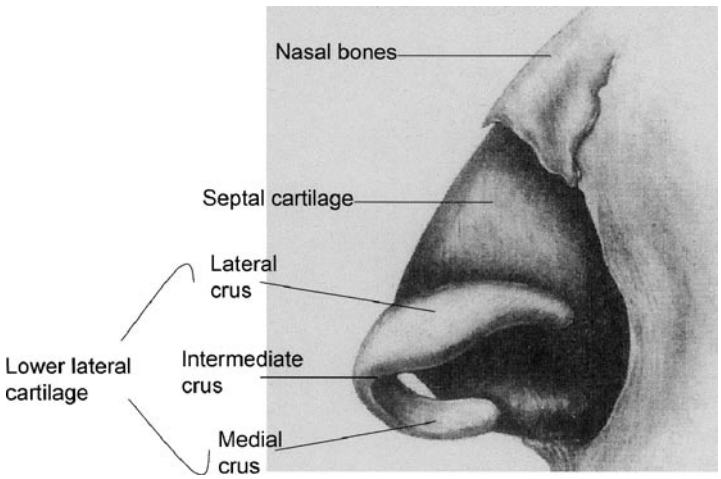

Fig. 1.3 Nasal cartilage anatomy – lateral view

at the medial edge of the lower lateral is required for adequate alar support. More aggressive resection can lead to a pinched tip and/or alar collapse. Cephalically oriented cartilages can also cause derotation of the tip by resisting upward rotation. Excessively long lateral crura may have a similar effect. Trimming the lateral crura (i.e., lateral crural overlay or cephalic trim) and repositioning the lower lateral cartilages in a more horizontal direction (with interdomal sutures or lateral crural strut grafts) may help decrease fullness and increase tip rotation to create a more aesthetic tip.

Soft Tissue of the Nasal Tip

The alar rim is an area of soft tissue adjacent to the caudal edge of the lower lateral cartilages. This area is composed of soft tissue, with no underlying cartilaginous support. Historically in rhinoplasty, the base view was sculpted to become more concave as the alar rims moved toward the nasal tip. This type of sculpting has been proven to contribute to a pinched tip look, long-term alar and/or external valve collapse, and nasal obstruction. The convex structure of the alar rim should be preserved at the nasal tip, not only for functional reasons, but for cosmetic reasons. Leaving this convexity intact creates a smooth transition from ala to tip on the base view. Occasionally, alar rim grafts, which are cartilage grafts measuring 1–2 mm wide and 10 mm long, need to be placed in a pocket immediately adjacent to the alar rim (caudal to the marginal incision) to recreate this contour [23].

The area sandwiched among the alar rim, nostril, infratip lobule, and columella is referred to as the soft tissue triangle. There is no underlying cartilaginous support in this area. During rhinoplasty, any violation of the soft tissue in this area can cause scarring, and may result in notching of the ala. This is an undesirable result, and is a tell-tale sign of rhinoplasty.

At the base of the nose is the nostril sill – a horizontal soft tissue portion at the junction of the nose and upper lip. Just posterior to this is the nasal vestibule, which is the entry to the internal portion of the nose. During rhinoplasty, it is occasionally necessary to perform nasal sill excision or alar base reductions. Internal alar base reductions can reduce flaring, which is a side effect of deprojection of the nose during rhinoplasty.

Conclusion

Although nasal and septal anatomy seems straightforward, there are many intricate anatomic relationships that occur in the nose, particularly in the lower third. A comprehensive understanding of nasal anatomy and the relationships among its individual structures are essential to performing a successful septoplasty or rhinoplasty. Patients must see a visible cosmetic improvement, without compromised function. Furthermore, both the cosmetic result and the functional result must be durable. This is a truly challenging part of rhinoplasty, but it can be accomplished with a solid understanding of the nasal anatomy and relationships.

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Rhinology and Facial Plastic Surgery

Stucker, F.J.; de Souza, C.; Kenyon, G.S.; Lian, T.S.; Draf, W.; Schick, B. (Eds.)

2009, XXIX, 946 p., Hardcover
ISBN: 978-3-540-74379-8