Introduction

Producing a predictable eventual outcome in nasal tip surgery is considered the most difficult aspect of this surgery. The fundamental anatomy of the nasal tip including the alar cartilage strength and contour, as well as the investing skin, controls what the surgeon can and cannot accomplish. Many factors must be included into the preoperative surgical planning.

The nasal tip must be approached as a separate part of the rhinoplasty operation because of its mobility and animation. The objective is to create a clearly defined stable, and properly projecting tip that appears symmetric on frontal and basal views, that is triangular on basal views, and that flows and blends well with the rest of the nose. This is difficult because of the unpredictable and uncontrollable nature of scar contracture during healing. Experience has taught that more conservative, preservative, and even augmentation procedures allow more predictable control over long-term healing. Surgical principles are common to all rhinoplasty procedures, but no single technical scheme suffices for the endless anatomical variations encountered.

Anatomy

The anatomic dome of the nasal tip in reality is a domal segment whose configuration varies from concave to smooth to convex. The alar cartilages can be thought of as three crura (medial, middle, and lateral), each composed of two segments with distinct junction points of aesthetic importance.

The medial crura are the pillar on which the nasal tip rests and are the primary component of the columella. They can be subdivided into two segments: the lower footplate segment and the superior columellar segment. The superior columella segment is vertically oriented and represents the narrow waist of the columella. Its overall length has a critical correlation with the visual length of the nostril. The paired medial crura generally have one of three shapes: straight, divergent symmetrical curve, or reciprocal curve.
The columella-lobular junction marks the transition from nasal base to tip lobule. It serves as the breakpoint in the columella’s double break and is the basis for the columella-lobular angle. It can be seen upon dissection as the point where the vertically oriented medial crura become the divergent and angulated middle crura.

The middle crus begin at the columella-lobular junction and ends at the lateral crus. It can be further subdivided into a lobular segment and a domal segment. The lobular segment is subject to extreme variability in width and length. In virtually all cases, the cartilages abut in the midline cephalically and diverge caudally. The domal segment extends from the medial genu, marking its juncture with the infralobular segment, to the lateral genu, terminating at the lateral crus. The segment has a distinct domal notch that corresponds to the shape of the soft tissue triangle of the lobule. The shape of the domal segment varies.

The domal junction is the transition from middle to lateral crus and is the critical landmark in the refined tip. In a study by Daniel, the surface markings of the tip defining points were found to fall consistently on the domal junction line. The axis of the domal junction is about 45 degrees from the midline, with the intersecting angle of the two sides being 90 degrees.

The lateral crus is the primary component of the nasal lobule that influences its shape, size, and position. It begins at the domal junction and ends in a chain of accessory cartilages that make up the narial ring. The caudal border is often a cuff that is set back significantly from the nostril rim. Cephalically, a distinct scroll formation with the caudal border of the upper lateral cartilages is seen. The interdomal sling is formed from the caudal condensation of the transverse fascial tissues which ensheath the midline abutment of the lateral crus. Thus, the alar cartilages can be viewed as distinct components that can be surgically altered.

Sheen defines four landmarks on the nasal tip: 1) the point of tip differentiation (supratip breakpoint), 2) the right dome, 3) the left dome, and 4) the columella-lobular breakpoint. The two domes are interconnected by the intercrural distance, whereas the two breakpoints are interconnected by the nasal midline. Recently they have added two important angles: the angle of divergence, which refers to the separation between the two middle crura, and the angle of rotation, which is essentially the columella-lobular angle. The nasal tip extends longitudinally from the supratip to the columella breakpoint and transversely from one domal prominence to the other. The supratip breakpoint is important aesthetically because it defines nasal tip volume and is a secondary determinant of nasal bridge length.

Analysis and Diagnosis

In order to achieve outstanding results the surgeon must be able to diagnose the possibilities and limitations inherent to each patient’s unique anatomy. Patients with only minor deformities are usually the best candidates for near-perfect surgical results.
However, this group often expects or demands perfection. More dramatic surgical results are possible in patients who demonstrate significant deformities. It is the surgeon’s responsibility to balance the patient’s desires with what is realistically possible given the anatomical limitations of each individual nose.

The preoperative examination of a patient for rhinoplasty should begin with evaluation of their nasal skin. Skin type is evaluated by inspection and palpation. The physician should roll the skin over the bony dorsum and gently pinch the skin between the fingers. The quality of skin is an essential indicator of the surgical outcome and plays a significant role in preoperative planning. Extremely thick skin is the least likely to achieve desirable refinement and definition. The thick skin may fail to contract favorably and lead to excessive soft tissue scar. Extremely thin skin provides almost no cushion to camouflage even the minute skeletal irregularities or contour imperfections. The ideal skin type falls somewhere in between these two types. There needs to be enough subcutaneous skin to provide adequate cushioning over the nasal skeleton, but still allow critical definition to the nasal tip.

Tip recoil is defined as the inherent strength and support of the nasal tip. This can be evaluated by depressing the tip towards the upper lip and watching for the tip’s supportive structure to spring back into position. If the recoil is good, and the tip cartilages resist the deforming influence, then tip surgery can usually be performed without fear of substantial support loss. The size, shape, attitude, and resilience of the alar cartilages should be assessed by palpation of the lateral crus between two fingers. Any asymmetry of the alar cartilage should be noted.

The surgeon should palpate the internal vestibules of the nose with the thumb and forefinger for twists and angulations of the nasal septum, which may influence the final functional and aesthetic appearance. The width and length of the columella and medial crura are determined. The potential for the tip to undergo desirable cephalic rotation can be gained by palpation with the fingers. The size and position of the nasal spine and its related caudal septal angle must be evaluated. The position and inclination of the nasolabial and nasofrontal angles, the shape and size of the alae, the overall width of the upper and middle thirds of the nose, and the relationship of the nose to the rest of the facial features and landmarks are evaluated. The surgeon should look for facial asymmetries and the relationship of the chin projection to the nose should be documented. Detecting the minute, but critical structural distinguishing characteristics of each patient’s nasal anatomy is the first and most important step toward a good surgical result.

The nasal tip represents the most anterior projecting point on the nose. A natural, smooth angulation at this confluence, in conjunction with a slight external convexity of the adjacent lateral crura, culminates in a pleasant, well-defined lobule. A flat, nondistinct angle, on the other hand, results in a bulbous or amorphous, and often underprojected nasal tip. Tip projection refers to the posterior to anterior distance that the tip extends from the facial plane at the alar crease. Nasal tip rotation is defined as movement of the tip along a circular arc consisting of a radius centered at the nasolabial angle that extends
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February 2000

to the defining point. A change in rotation reflects either in an upward or downward repositioning of the tip, manifesting itself by a corresponding change in nasal length and the inclination of the columella. The lower lateral cartilages of the nose may be compared to a tripod. The conjoined medial crura form one leg and the lateral crura represent the other two legs. Shortening or loss of integrity of any of the limbs changes the spatial position of the apex of the tripod or nasal tip.

Preoperative Planning

Standardized photodocumentation is essential in the planning process. Realistic expectations and thoroughly informed consent should be discussed between the patient and the surgeon. Any asymmetries should be pointed out to the patient preoperatively. Computer imaging techniques, properly performed and honestly explained to the patient, will play an increasing role in the planning and preparation for surgery. Because all patients differ in anatomy and preferred outcome, seldom do any two patients undergo the same tip procedure. The surgeon should identify what is good and what is less than ideal about the tip, planning to preserve the normal, favorable anatomy while correcting the abnormal anatomy.

Surgical Techniques

The ultimate goal of nasal tip surgery is to satisfy the patient's functional, esthetic, and psychological expectations for the procedure. The nose should appear natural and not have an “operated” look. The endpoint should be a nose with satisfactory nasal length, projection, and rotation. The nasal lobule should be refined, symmetric, and harmonious with the other nasal features. The columella should be symmetric and have an appropriate relationship with the alar margins. There should be a satisfactory nasal base width and nostrils of appropriate size and shape.

Tip sculpture cannot be successfully undertaken until the major and minor tip-support mechanisms are appreciated, respected, and preserved. Loss of tip projection and support in the postoperative healing period is one of the most common surgical errors in rhinoplasty and is usually the inevitable result of the sacrifice of tip supports. The major tip support mechanisms consists of: 1) the size, shape, and resiliency of the medial and lateral crura; 2) the wrap-around attachment of the medial crural footplates to the caudal end of the quadrangular cartilage; and 3) the soft-tissue attachment of the caudal margin of the upper lateral cartilages to the cephalic margin of the alar cartilage. If any of these are disturbed during the procedure then compensatory support procedures must be considered. The minor tip-support mechanisms, which in certain anatomic configurations may assume major support importance, include 1) the dorsal cartilaginous septum, 2) the interdomal ligaments, 3) the membranous septum, 4) the nasal spine, 5) surrounding skin and soft tissues, and 6) the alar sidewalls. The appropriate tip incisions and approaches should be planned to preserve as many tip supports as possible. Similarly, alar cartilage sculpturing should respect this principle by conserving the volume and integrity of the lateral crus and avoiding radical excision and sacrifice of tip cartilage. Ideally, conservative reduction of the cephalic margin of the lateral crus, preserving the majority
of the crus while maintaining a complete, uninterrupted strip of alar cartilage, is preferred.

There are three main types of incisions use to gain access to the underlying supportive structures of the nose. They are the transcartilaginous, intercartilaginous, and marginal. Approaches to the nasal tip provide important exposure to the skeletal structures and consists of procedures to either deliver the tip cartilages or to avoid complete delivery. For patients who require minimal tip-cartilage modeling and have satisfactory preoperative projection and minimal interdomal distance, a non-delivery (cartilage-splitting or retrograde-eversion) approach is preferred. A single incision through the vestibular skin is made several millimeters cephalic to the caudal margin of the lower lateral cartilage. The vestibular skin is dissected free from the portion of the lower lateral cartilage that is to be removed. Most of the lateral crus is left intact as a complete strip, with resection of only a few millimeters of the medial-cephalic portion of the lateral crus to effect refinement. This operation is useful in many patients because it mimics nature, disturbs little of the normal anatomy of the tip, and consistently heals predictably and symmetrically with minimal scarring.

More complex surgical techniques are needed, as the tip anatomy becomes more abnormal or asymmetric. In these patients a delivery approach is used which allows the visual presentation of the alar cartilages as a bipedicle chondrocutaneous flap. This allows further analysis of the cartilages and reconstruction under direct visualization. The delivery approach utilizes and intercartilaginous and marginal incision. The intercartilaginous incision is created along and above the projecting rim of the upper lateral cartilages. Dissection is continued in a supraperichondrial plane elevating skin and soft tissue from the cartilaginous pyramid and septal angle. The marginal incision is created in the vestibular skin precisely at the caudal margin of the lower lateral cartilages. The alar cartilages can then be delivered as individual bipedicled chondrocutaneous flaps for remodeling. Excision of greater volume of the medial portion of the lateral crus is usually necessary, still maintaining a complete strip of at least 8-10 mm. If further refinement of the tip is necessary, the convexity of the complete strip can be weakened by various methods. In patients with extremely thin skin, delicate alar sidewalls, and bulbous cartilage, narrowing refinement of the tip may be achieved by transdomal suturing of the complete strips. Transdomal sutures strengthen tip support and can be used to enhance tip projection slightly. With the delivery approach narrowing refinement of the tip is obtained, vital tip supports are preserved, and symmetric healing is facilitated. The surgical outcome is highly predictable because a complete strip is preserved and only its shape has been modified. Delivery approaches are indicated when significant defatting or scar resection is required.

In more severe tip deformities, and particularly when more significant cephalic tip rotation is indicated to improve the tip relationship to the face and nose, the surgeon must consider interrupted strip techniques for maximal results. Here the complete strip is divided somewhere along its course (usually at or near the angle), excessive portions of the lateral and medial crura are removed, and the cartilages are reconstructed so that their cut ends abut or overlap. Asymmetric healing and scarring are possible anytime the strip
is interrupted, and some tip support is almost always sacrificed. Interrupted strip techniques tend to foster cephalic tip rotation. This tip rotation can be further accentuated by shortening the caudal septum and placement of cartilage plumping grafts to efface the nasolabial angle further.

An open approach to the tip may be helpful in patients with cleft lip and nose deformities, asymmetric tips, and some markedly overprojecting tips with variant anatomy. Although more operative edema and scarring result from this approach, the advantages of precise direct-vision diagnosis, bimanual surgery, and extraordinary exposure render this approach useful in certain patients. With the open approach, the soft tissues of the nose are elevated off the underlying cartilaginous and bony skeleton to reveal the exact anatomy responsible for the nasal shape. A columellar incision combined with a marginal incision is used for the open or external approach to the nasal tip. Reduction and augmentation procedures can be effected precisely with suture control. Because both sides of the nose are viewed simultaneously, surgical symmetry may be easily achieved. A decided advantage to the open approach is its use in teaching; the otherwise difficult learning curve time is reduced significantly by the direct exposure to open anatomy.

A critical preoperative decision involves the need for preservation, enhancement, or reduction of existing tip projection. If the patient has adequate projection, then it is the surgeon’s responsibility to ensure that the major and minor tip supports remain largely intact or are reconstructed to prevent an eventual loss of projection. Complete strip techniques are recommended whenever possible to aid in maintaining projection. If additional projection is required, it may be achieved in several ways. Autogenous cartilage struts positioned below or between the medial crura are effective in establishing permanent projection. Cartilage struts should be shaped with a gentle curve to match the anatomy of the curved columella, at times aiding in the creation of a distinct double break, but should never extend to the apex of the tip skin creating a tent-pole appearance. If the medial crural footplates diverge in a widely splayed fashion, further tip projection can be gained by resecting excessive intercrural soft tissue and suturing the medial crura together. The Goldman procedure involves complete vertical division of the alar cartilage and the underlying vestibular skin at the dome. The surgeon controls the amount of tip projection obtained by varying the location of the cartilage cut. This technique has been modified over the years by several surgeons to give better postoperative and long term results. Autogenous tip grafts from the nasal septum or auricular cartilage can be used to add height and contour to the tip of the nose. Since the grafts lie immediately subcutaneously, great care must be taken in their positioning. A precise pocket is fashioned into which the graft fits snuggly. Tip grafts may accentuate favorable tip-defining points and highlights and can give a more normal appearance to tips with congenital or postsurgical inadequacies. The tip grafts are shaped a variety of ways including triangular, trapezoidal, or shield-like.

Cephalic rotation of the tip may increase projection of the tip by advancing the lateral crura medially and suturing them to lie above the cut ends of the medial crura. Transdomal sutures positioned between two complete alar cartilage strips can create additional projection of the tip.
Some patients will have an over projected tip, which is treated in a variety of ways. The aim of procedures used to correct the projected tip is to recess the tip to a degree that will produce a desirable profile angle. In addition to the tip reconstruction, complete transfixion of the membranous septum and the lowering of the septal angle will facilitate the healing of the tip in a less projected position. Specific projecting-tip techniques usually involve the weakening of the lateral arms of the tip tripod by removal of the bulk of the cephalic edges of the lateral crura. A vertical division is made in the region of the angle and the lateral crura are advanced and overlapped on the superior aspect of the medial crura. The degree of overlap is usually 2-5 mm and the crura are resutured to hold them in this position. The projection of the lower lateral cartilages can also be reduced through a marginal incision. The projection of the lower lateral cartilages at the dome may be accurately reduced by this method if the projection is not excessive.

Many patients need cephalic rotation of the nasal tip complex to achieve proper balance, but in other patients upward rotation as a consequence of tip surgery must be prevented. The dynamics of healing play a critical role in tip rotation principles. The planned degree of tip rotation depends on a variety of factors, often including the length of the nose, face, and upper lip; facial balance and proportions; the patient’s aesthetic desires; and the surgeon’s aesthetic judgement. Tip rotation and projection are complementary and are interrelated in each patient. Favorable modifications in the tip-lip complex profile area with autogenous implants may obviate the need for any actual tip rotation at all. Nasal tip rotation results fundamentally from planned surgical modifications of the alar cartilages, but smaller increments of rotation can also result from adjuvant procedures on nasal structures adjacent to the alar cartilages. Shortening of the caudal septum, excision of overlong caudal upper lateral cartilages, and septal shortening with a high transfixion incision are regularly used to enhance the effects of a planned degree of tip rotation.

There are 6 basic tip rotation techniques. Three involve a complete strip technique and three involve an incomplete strip technique. Complete strip techniques are preferred when the nasal anatomy permits because it contributes to a more stable and better supported nasal tip that tends to resist cephalic rotation during healing. In addition, tip projection is usually better preserved with a complete strip technique and asymmetrical healing is less likely. Complete strip techniques preserve the normal anatomy of the nasal tip and avoid the possibilities of alar retraction, notching, and collapse.

Volume reduction of the alar cartilages results in a tissue deficit of minimal, moderate, or maximal proportions. Essentially no cephalic tip rotation results from minimal volume reduction alone, whereas greater tissue void resulting from moderate to maximal volume reduction tends to create progressively greater degrees of minimal tip rotation. When complete strip techniques are used, substantial tip rotation depends on the addition of adjunctive procedures to achieve cephalic elevation of the tip complex. These include caudal septal reduction, upper lateral cartilage reduction, and septal shortening with a high septal transfixion. Illusions of tip rotation can be achieved by using cartilage battens, struts, or plumping implants.
Interrupted strip techniques break the integrity and spring of the alar cartilages and cephalic rotation results from the upward scar contracture forces acting on alar cartilage segments that are more frail and less well supported. These techniques are particularly useful when the attitude of the alar cartilages is one of a profound downward inclination. Caution must be exercised in using interrupted strip techniques in patients with thin skin or delicate alar cartilages because the loss of good tip support sets the stage for loss of projection, alar collapse, notching, pinching, and asymmetry.

When cephalic rotation is desired and the anatomy of the bridge between the medial and lateral crus or the dome is aesthetically pleasing, a lateral interrupted strip technique could be used. Avoiding interruption of the strip medially aids in symmetrical healing and reduces the likelihood of uneven tip-defining points becoming evident postoperatively. Lateral interruption allows the reduced alar cartilage to be pulled moderately upward by scar tissue during healing, but because the dividing cut is more lateral and more deeply in the soft tissues of the tip, notching, pinching, and other asymmetries are essentially prevented.

There have been multiple medial interruption techniques described. The complete strip is interrupted at or near the dome leading to some degree of cephalic rotation. The rotation is gained during the healing process as the complete strip is converted to two or more segments of frail cartilage. Planned rotation using this technique is reserved for patients with thicker skin and supporting structures to minimize the undesirable consequences of asymmetric healing and even overrotation.

An ideal method for significant tip rotation combines the lateral strip interruption technique with a calibrated triangular excision of cartilage laterally and stabilized with suture fixation. This allows the degree of rotation to be controlled by the surgeon, and essentially eliminates most of the undesirable sequelae of interrupted strip techniques. It changes in a predictable and permanent way the attitude of the alar cartilages. The suture fixation helps to diminish the potential loss of tip support inherent in most interrupted strip techniques. This method can be used in patients with moderately thin skin and more delicate cartilages. Overrotation must be religiously avoided with any of the above techniques, as correction of this undesirable postoperative situation is often difficult or impossible.

**Adjunctive Tip Rotation Techniques**

Profound tip rotation depends on the alar cartilage modifying techniques described above. There are however multiple adjuvant techniques that can be used to enhance the above techniques. Indeed, when the complete strip techniques are indicated, rotation often depends primarily on these adjuvant methods, individually or combined. Useful adjuncts to tip rotations include the following. Shortening the caudal septum by resection of a geometrical triangle based upward will shorten the middle segment of the nose and provide room for the infratip lobule to be lifted upward during healing. The medial crural footplates should be left attached to the inferior caudal septum during this modification. This technique is useful if the caudal septum is judged to be overlong or overdeveloped.
A limit to the degree of rotation possible by caudal septal reduction exists because overaggressive sacrifice of the inferior septum can result in ptosis of the nasal tip. Excess vestibular skin or mucosa apparent after septal shortening is best excised to avoid redundancy.

Once the tip rotation is completed by whatever primary technique has been selected, the caudal and medial ends of the upper lateral cartilages should be directly inspected for redundancy and excessive length. Usually their inferior margins project into the nasal airway after tip rotation and the offending margin must be shortened. Redundant scrolls of the upper lateral cartilages interfere with the space needed to effect adequate upward tip rotation and may limit desirable tip-definition procedures. These problems can be corrected with conservative excision. When the anatomy of the tip and its surrounding structures is ideal, predictable tip rotation can be obtained from a vertical excision of a calibrated triangle of septal cartilage removed through a high transfixion incision. Suture repair effects a rotational shortening of the nose while preserving medial crural and membranous columellar attachments to the caudal septum.

When the caudal aspect of the medial crura is overly convex, a hanging appearance results and the nose appears to be overlong. In this variant the medial crura are overdeveloped in their vertical dimension as well as appearing overly convex. Delivery and reduction contouring of the caudal margins of the medial crura can restore proper profile and frontal configuration without sacrificing tip support, thereby resulting in a desirable lifting rotation of the infratip lobule portion of the nasal tip.

Conclusion

The dramatic refinement of the nasal tip is a trap for both the patient and the surgeon, who may have unrealistic expectations and unobtainable goals, respectively. The patient must be educated about what is realistic and what is not. Perfection is a dangerous expectation and will lead to disappointment. Multiple techniques are available and must be incorporated with an understanding of the structural and aesthetic impact on adjacent components of the nasal tip and its relationship to the remainder of the nose.
References


