Introduction

Nasal tip surgery is one of the most challenging areas in rhinoplasty. In this article, we present safe and reliable procedures. We provide a practical overview of the techniques which can be used by the majority of rhinoplastic surgeons. It is wise to be conservative when altering the tip. Cartilage suturing and incision techniques are now preferred procedures compared to aggressive cartilage excision techniques to achieve the desired result. Surgery of the tip can be performed in either an external or endonasal approach. We believe that the external approach ensures more predictable results because of the improved exposure of the surgical field and because the surgeon can use both hands.

Surgical anatomy

The size, form and proportions of the human face vary widely. It is difficult to determine what is normal or abnormal and it is even more complicated to define “the beautiful face”. In the analysis of nasal deformity, four major adjacent aesthetic units have to be considered: the forehead, eyes, lips and chin. Changing the proportions and angles of the nose has a direct impact on the other aesthetic units. Beauty results when all these units are in harmony with each other. A knowledge of facial proportions is therefore important when performing rhinoplastic surgery. We prefer an external approach because it provides the best overview and because the possibility of bimanual working makes manipulation of the lower lateral cartilages easier. The techniques described here can be used to alter the nasal tip in a controllable way.

Key-words. Rhinoplasty; nasal tip; projection; rotation; tip refinement

Abstract. In this article, we give an overview of safe and consistent techniques for nasal tip surgery. A change in the morphology of the tip has an impact on the profile of the face. A knowledge of facial proportions is therefore important when performing rhinoplastic surgery. We prefer an external approach because it provides the best overview and because the possibility of bimanual working makes manipulation of the lower lateral cartilages easier. The techniques described here can be used to alter the nasal tip in a controllable way.
glabella) and one along the nasal dorsum (between the nasion and the nasal tip). The angle is normally between 115 and 135 degrees (Figure 2a). The nasomental angle is formed at the intersection of a line drawn from glabella to pogonion with a line drawn from nasion to nasal tip. The ideal range is between 120° and 132° (Figure 2a). The nasofacial angle is between 30° and 40° (Figure 2b). The nasolabial angle is formed where a line parallel to the columella and a line along the upper lip meet (Figure 2b). Tip rotation is defined by this angle and should be 90° to 105° in men and 105° to 120° in women. For instance, a prominent nasal tip causes a relatively large nasofacial angle but also has the opposite effect on the nasofrontal and nasomental angle. However, it does not affect the nasolabial angle.

Another way to express facial beauty and proportions is the sectio divina or golden ratio. This phenomenon was probably first recognised in ancient Egypt and later used by the ancient Greeks, where it is found in architecture and art. This ratio can be stated as the division of a line into two parts, with the ratio of the smallest part to the largest part being the same as the ratio of the largest part to the whole line. The golden ratio – 1.61803 – is a mathematical constant derived from the Fibonacci series. It is denoted by the Greek letter Φ. This divine proportion is probably encoded in our genes and contributes to our appreciation of universal beauty regardless of differences in race, age, and sex.

The lobule is the lower third of the external nasal pyramid. It consists of the alar cartilages, the nasal alae, the columella, and the tip. The tip consists of the two domes, the interdomal connective tissue fibres, and the overlying skin. The two tip-defining points are the most prominent areas of the dome. In a frontal view, a line drawn from the supraorbital rim to the tip-defining point is smooth and unbroken. In a Caucasian
nose, the ala does not extend beyond the medial corner of the eye by more than 1 mm. The nasal lobule should be symmetric and in harmony with the rest of the face. The width of the tip is mainly determined by the position of the domes. When the interdomal distance is more than 4 mm, the lobule is widened or divergent. The width of the lobule is dependent on the morphology of the lateral crura. Nasal tip and nasal lobular width can be measured by tip index and lobular index respectively (Figure 3). The nasal tip index (TI) is the ratio of the tip width at the ventral border of the nares to the maximum lobular width times 100. The lobular index (LI) is the ratio of the width of the lobule outer contours at the ventral end of the nostrils to the width between the nasal alar roots times 100.7

In a lateral view, there should be a small depression just cephalic to the tip, the “supratip break”. This is particularly important in women. The columellar double break has a lobular and a columellar part. Tip rotation is defined by the nasolabial angle. A prominent anterior nasal spine or overdevelopment of the caudal septum results in upward rotation, and vice-versa. Tip projection is the distance between the nasal tip and a facial plane. It can be expressed, for example, by Goode’s method: the length from nasal alar groove (Al) to nasal tip (NTi) divided by the length from nasion (Na) to tip, which is about 0.55-0.6. This ratio is shown in Figure 4. This ratio is therefore lower when the tip is under-projected and higher when it is over-projected.8 The extension of the columella below the nares, the columellar show, is normally about 3-5 mm.3

Anderson’s tripod concept of the nasal tip is very useful in tip surgery.9,10 Both lateral crura and the conjoint medial crura of the alar cartilages are viewed as the legs of a tripod. The lateral crura are longer then the median ones, resulting in a somewhat asymmetrical feature (Figure 5). Different factors play a role in the support of the tripod, such as the
caudal end of the septal dorsum, the membranous septum and the soft tissues at the columnellar base, and the lateral ends of the lateral crura. With the tripod model in mind, the rhinological surgeon can predict the effect of his intervention on the position of the nasal tip. For instance, strengthening the medial leg will result in upward rotation and an increase in projection; removing a cephalic portion of the lateral crura will increase tip rotation.

There are several tip support mechanisms that need to be respected during surgery. The size, shape and resilience of the medial and lateral crura, as well as the medial footplates attached to the caudal border of the septum and the scroll region are major tip supporting mechanisms. Minor tip supporting mechanisms are the ligamentous attachments of the skin to the interdomal region, the cartilaginous and membranous septum, the sesamoid complex extending the support of the lateral crus onto the piriform aperture, and the anterior nasal spine. Especially after previous rhinoplasty, tip support can be lost subsequent to damage to one or several tip support mechanisms. The tip then de-projects and “slides off the cartilaginous nasal dorsum”. This causes a cartilaginous or soft tissue “polly-beak”.

**Pre-operative assessment**

The external nose is investigated for abnormalities of the bony and cartilaginous pyramid and lobule. The rest of the face is examined, with a particular focus on mid-face and lower facial deformities, as well as the nose-chin relation. The tip of the nose is palpated to evaluate skin thickness, the shape and resilience of the cartilages, irregularities, and the relation to the caudal septum. By gently pressing and releasing the tip, the surgeon gets an impression of nasal tip support. Intranasal examination is performed to determine possible causes of nasal obstruction.

**Photography**

Both pre- and post-operative photographic documentation is essential for pre-operative planning and the assessment of rhinoplastic results. It is also required for medico-legal reasons. Standardisation of photographs is needed to compare the pre- and post-operative situations. Computer simulation can be helpful in planning the surgery. Two-dimensional photographs are used routinely. However, the nose is the most outspoken three-dimensional structure of the face and so 3D stereophotogrammetry would seem to be more appropriate. The advantages of this procedure are much better reproducibility than with 2D photography, the possibility of measuring differences in volume, and of evaluating the ratio of bone tissue to soft tissue when 3D images are combined with 3D cone beam computed tomography. We believe that, in the future, 3D stereophotogrammetry will become as important for facial plastic surgery as audiometry is for otology (Figure 6).
Surgical techniques

Multiple techniques have been described for changing tip morphology, rotation and projection. It is necessary to know the effect of the different techniques on each of these parameters. Suturing has become very popular as a cartilage sparing technique, but sometimes cartilage has to be removed or transected to obtain the desired result.

Cartilage sparing techniques

The great advantage of cartilage sparing techniques is that all changes can be reversed at any point during the surgery when the results are not acceptable. On the other hand, the effects of suturing are more subtle than those of cartilage cutting techniques. The results of sutures depend mostly on the degree of suture tightening, the intrinsic forces of the cartilages, cartilage thickness, and the degree of soft-tissue undermining. Table 1 shows the effects of the various suturing techniques on projection, rotation, and shape.

Intradomal suturing

The goal of intradomal suturing is to accentuate the dome by using a mattress suture incorporating the intermediate and lateral crura. This technique results in a more acute angle of domal definition, creating more pointed domes and therefore increasing tip projection. A more pronounced effect is achieved when the vestibular skin is first released below the dome.

Interdomal suturing

Interdomal sutures reduce the interdomal distance by suturing both domes together. This method can also equalise asymmetric domes. This technique has no effect on tip projection, but the nasal tip index will decrease. Intradomal and interdomal sutures are often used in conjunction.

Transdomal suturing

This suture runs from the left intermediate crus to the left lateral crus and back, after which it continues to the contralateral alar cartilage, where an identical kind of mattress suture is made. In this way, the knot is buried between the two domes. A transdomal suture narrows the tip while pulling the lateral crura more medially. It also increases tip projection slightly. In effect, this technique combines the effects of bilateral intradomal sutures and an interdomal suture.

Lateral crural steal

The lateral crural steal technique can be used in patients with droopy underprojected domes. This procedure can create powerful projection and rotation and it is frequently used in rhinoplasty surgery on cleft-lip patients. Preoperative evaluation is important if a V-Y advancement incision is needed to lengthen the columella in order to make adequate tip projection possible. Unilateral lateral steal is often required in cleft-lip rhinoplasty. Once the lateral crus has been freed from the vestibular skin, the crus is positioned more medially and cephalically, causing the more medial part of the lateral crus to move on to the intermediate crus. It is fixed with mattress sutures (PDS 5/0) to the contralateral lower lateral cartilage, as in transdomal suturing, but it can also be sutured to a cartilaginous strut.

Lateral crura spanning suture

A lateral crura spanning suture reduces the width of the lobule rather than the tip. It also increases the concavity of lateral crura, reduces the interdomal distance, and causes a subtle increase in tip rotation. In this procedure, the lateral crura are sutured together above the septum, with the knot being buried between the two cephalic margins of the cartilage. The suture does not need to be tightened completely because

<table>
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<tr>
<th>Technique</th>
<th>Projection</th>
<th>Rotation</th>
<th>Shape</th>
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<tbody>
<tr>
<td>Intradomal suture</td>
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<tr>
<td>Interdomal suture</td>
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<td>Transdomal suture</td>
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<tr>
<td>Lateral crural steal</td>
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<td>Rotation suture</td>
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<tr>
<td>Lateral crura spanning suture</td>
<td>0</td>
<td>+</td>
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<td>Tongue-in-groove</td>
<td>++</td>
<td>+++</td>
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<td>Lateral crura convexity control</td>
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<tr>
<td>Medial crural-septal suture</td>
<td>- or +</td>
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+, ++, +++: positive effect; 0: no effect; -: negative effect; ±: possibly some effect.
the cephalic margins do not necessarily have to be close.\textsuperscript{12} A lateral spanning suture can also be used to capture part of the dorsal end of the septum, creating a supratip depression. If the lateral crus is too long, resulting in too much widening and/or projection of the tip, a lateral crural transection can be performed, causing the cartilaginous ends to shift in an overlapping way (lateral crural overlay).

\textit{Tongue-in-groove technique}

When there is a substantially under-rotation of the tip (drooping tip), a tongue-in-groove technique can be used, in which the medial crura are sutured to the caudal septum with two or three mattress sutures PDS 5/0.\textsuperscript{5, 14, 15} In this way the tip can be adjusted to the dorsum as far as rotation and projection are concerned. The tongue-in-groove technique can also be combined with a septum extension graft to lengthen both the ventral and the caudal vector of the original septum and in this way to correct a retracted columella. The adverse effect of suturing the medial crura to the septum is an increase in tip rigidity.\textsuperscript{9}

\textit{Additional suturing procedures}

The tip rotation suture shifts the tip cephalically while retracting the columella. The suture passes the intermediate crus from medial and is then secured to the anterocaudal septum, after which it passes to the other intermediate crus.\textsuperscript{12}

The lateral crura convexity control suture can be helpful in correcting excessive convexity of the lateral crura.\textsuperscript{12} It is placed as a horizontal mattress suture on the lateral crus. The extent to which the knot is tightened can be used to control the level of change. If this is not adequate, weakening of the lateral crura can be achieved by removing a cephalic rim, as described below.

When no strut is needed, the two medial crura are brought together with mattress sutures. This narrows and strengthens the columella and provides additional tip support. A medial crural-septal suture is considered when an alteration of tip projection is needed. For instance, the tip will deproject when the suture is passed through both medial crura anteriorly and below the caudal septum close to the anterior nasal spine.\textsuperscript{12} A suture is sometimes placed through the medial footplates to reduce flaring.\textsuperscript{16}

\textit{Cartilage grafts}

A columellar strut strengthens the medial and intermediate crura and improves tip support. This strut is between 15-20 mm long, 3 mm wide, and 1-3 mm thick. It is positioned in a pocket between the medial crura, 1-2 mm above the anterior nasal spine. The strut is fixed to the medial crura with at least two horizontal mattress sutures (PDS 5/0). Although it is widely accepted that placing a strut increases projection, several studies have demonstrated that placing a strut actually maintains nasal tip projection and prevents deprojection.\textsuperscript{5, 17} The increase in projection depends on the length of the strut and its relative position with respect to the anterior nasal spine. The tripod concept indicates that placing a strut will also rotate the tip. In the study by Ingels and Orhan,\textsuperscript{9} the use of a strut caused an average increase of 6.9° in the nasolabial angle.

A tip graft is generally used to create symmetry in the nasal tip, but it can also provide more tip definition. A shield graft is a tip graft with an extension towards the columella, which therefore combines the effects of a tip graft with more columellar show. It can also be used to accentuate the double columellar break. Tip grafts are frequently 10-12 mm long, 5-7 mm wide, and 1-3 mm thick.\textsuperscript{18, 19} Care must be taken to taper the edges of tip and shield grafts, especially in patients with thin skin, in order to ensure that the graft is not visible. This problem can be eliminated by placing crushed cartilage on the tip. Crushed cartilage can be glued on the domes or introduced in a minimalised pocket, after the partial closure of the incisions, as the very last procedure in rhinoplasty. A final suture then completes the closure of the incision as it holds the crushed cartilage in situ. Gentle pressure can then be used to mould the graft to its desired form and position (Figure 7). In order to prevent visible edges, it can be advisable to camouflage thin skin with fascia.

\textit{Fillers}

Even though conventional aesthetic rhinoplasty is of course the treatment of preference, injectable facial fillers may provide an attractive alternative for augmentation, increasing projection and restoring symmetry. They can also be used to smoothen sharp or pointed tip edges. This can be a valuable technique for the optimisation of post-operative results. Hyaluronic acid (HA) is the most widely used filler material today. It is safe, reliable, easy to apply, and has a relatively long-lasting
Surgical management of the nasal tip

65

...technique in cases, for example, with a bossa at the level of the lateral crus, or when there is under-rotation in association with over-projection. The distal part of the lateral crus is transacted after undermining of the vestibular skin. The proximal and distal ends of the cartilage are then overlapped and they can be fixed with a 5/0 PDS suture, although some surgeons do not re-attach both ends. 9

The medial crural overlay technique can be used to bring about a reduction in rotation and projection by shortening the medial crura. It is safe to transect the lower third of the medial crus (footplates). The tip will then move downwards, with the proximal ends overlapping the distal ends medially.

Transecting all the legs of the tripod reduces tip projection. This combination of lateral and medial crural overlay techniques is a powerful tool for reducing tip projection without affecting tip rotation (Figure 8). In general, the skin envelope will adapt. It is

Figure 7
Crushed cartilage is placed on the domes as described in the text (a, b, c). Situation before (D) and after (E) placement of crushed cartilage.
seldom necessary to shorten the columellar skin flap.

Vertical dome division

The principle of vertical dome division is the transection of the cartilage of the intermediate crus near the dome and the resulting adaptation of tip anatomy. This is however, a technique which demands a lot of surgical experience because it is difficult to predict the final outcome.

In the classic Goldman technique, the alar cartilages are transected just laterally from the domes. The medial sections (intermediate + medial crura) are sutured together, resulting in outspoken tip definition, rotation, and projection. One of the drawbacks of this technique is the collapse of the lateral crus, which may cause nasal valve problems.25

Conclusion

Tip surgery is mainly indicated for aesthetic reasons. We are well aware of the fact that numerous other techniques have been described for nasal tip surgery. However, in this article, we have tried to present safe and reliable procedures which are not the exclusive domain of super-experts. Many of the techniques described here can be performed using either an external or endonasal approach. In our view, the bimanual external approach guarantees more predictable results and is more suitable for surgeons without extensive experience. It is important for each individual surgeon to analyse post-operative results continuously.

Figure 8
Patient pre-operative and post-operative after hump reduction and letting down the tripod
so that they can predict morphological changes associated with specific techniques.

References


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