Rhinology, 35, 124-129, 1997

A quantitative appraisal of change in nasal tip projection after open rhinoplasty*

H.D. Vuyk, C. Oakenfull, R.E. Plaat

Department of Otolaryngology/Facial Plastic Surgery, Gooi Noord Hospital, Blaricum, The Netherlands

SUMMARY *Exact knowledge about the magnitude of the factors influencing nasal tip projection (NTP) as a result of surgery are scarce. This study focuses on NTP changes after primary rhinoplasty using open transcolumellar approach in combination with a columellar strut, while specifically addressing four different nasal tip surgery techniques. Measurements were taken from standardised pre- and post-operative profile photographs of 73 patients with a minimal follow-up of one year. No statistically significant differences in pre- and post-operative NTP could be noted for the total group of patients. Only the group of patients in whom a nasal tip graft was applied a mean increase in NTP could b e measured. A comparison of selected data from our study to data of previous studies on NTP changes after endonasal rhinoplasty demonstrates the effectiveness of the columellar strut for maintenance of NTP. Overall, our findings testify to the versatility of cartilage-structuring techniques including columellar struts and tip grafts for NTP maintenance or increase. The quantitative effect of the open approach itself on NTP remains elusive and needs further study.*

Key words: rhinoplasty, endonasal approach, transcolumellar approach, nasal tip projection

INTRODUCTION

The three main characteristics of the nasal tip are shape, rotation and projection. Predictably maintaining or changing these nasal tip characteristics remains a challenge, even for the most experienced facial plastic surgeon. Projection is notably the most difficult to control. In recent years, the open transcolumellar approach has become an accepted alternative to the endonasal approach because of its increased exposure, especially of the nasal tip. Detailed knowledge of the effect of the open approach, while applying various nasal tip surgery techniques, on *nasal tip projection*(NTP) intra -and post-operatively, will hopefully increase surgical predictability and improve long-term results.

Factors influencing nasal tip projection

Numerous soft tissue relationships and structural components support the nasal tip in its position. Major and minor tip support mechanisms are listed in Table 1. Some of the "routine" steps in rhinoplasty cause damage to these important support mechanisms. With the (hemi-)transfixion and inter- (or intra-)cartilaginous incision (a combination used in the closed approach) two major support structures may be violated possibly causing tip ptosis. Reducing the size and resilience of the lateral crurae, another "routine" step in rhinoplasty, may weaken the support of the nasal tip even more. A minor tip support mechanism is weakened when the skin and muscles are dissected off the alar cartilages and the interdomal ligaments are divided, a manoeuvre inherent to every external rhinoplasty and to the endonasal approach with delivery of the alar cartilages.

Table 1. Tip support mechanisms

MAJOR
1. the medial crural foot plate attachment to the caudal border of the septum
2. the attachment of the alar cartilages to the upper lateral cartilages
3. the size, shape and resilience of the medial and lateral crurae

MINOR
1. the ligamentous attachment between both lower lateral cartilages over the superior septal angle
2. premaxillary spine and soft tissue support of the medial crural feet
3. sesamoid cartilages extending support to piriform aperture
4. cartilaginous septal dorsum
5. attachment of skin and muscles to lower lateral cartilages
6. membranous septum

* Received for publication October 21, 1996; accepted May 23, 1997

Knowledge of major and minor tip support mechanisms and how they are influenced during rhinoplasty leads to the assumption that in most rhinoplasties NTP is lost rather than gained if adequate supportive measures are not applied.

Nasal tip projection studies

Joseph (1944) has made a first attempt to measure facial contour using a "rhinometer." NTP was indirectly calculated from nasal length and nasal facial angle measurements. Webster et al. (1977) described a simplified "projectometer" for direct measurements of NTP on the patient. Using this instrument Petroff et al. (1991) demonstrated that maintaining and increasing NTP during and after endonasal rhinoplasty is indeed a formidable challenge. In another study (Rich et al, 1991), profile photographs have been used for measurements of NTP, demonstrating loss of NTP in almost every non-augmentive endonasal rhinoplasty.

Study purpose

This study focuses on NTP changes after primary rhinoplasty using the open transcolumellar approach. Specifically we wanted to study the following issues: (1) the effect of the external approach on NTP; (2) comparison of these data to data of two previous studies concerning the endonasal approach (Petroff et al., 1991; Rich et al, 1991); and (3) the effect of four different nasal tip surgery techniques used in this series on NTP, including structural grafting of the nasal tip.

PATIENTS AND METHODS

Method of measurement

The measurements were done on life-size projections of standardized pre- and post-operative right-sided profile slides of non-smiling patients. The minimal follow-up was l year.

Figure 1. Pre-operative lateral view with three lines superimposed on the face. *Point A:* The nasal frontal angle defined by a line from the superior aspect of the external auditory canal through the lateral canthus extended on to the nasal root. *Point B:* The vermilion cutaneous junction of the upper lip. *Line C-D:* Perpendicular to line A-B, extending to the most projecting part of the nasal tip. The length of line C-D is used as a determinant for NTP.

The pre- and post-operative photographs were analysed using three lines superimposed on the face (Figure 1). One line drawn from the superior aspect of the external auditory canal through the lateral canthus and extended over the nasal root was used to define the nasal frontal angle, which is often difficult to locate in a reproducible fashion (Rich et al, 1991). A second line is drawn from the defined nasal frontal angle (A) to the vermilion cutaneous junction of the upper lip (B). A third line, drawn perpendicular to the second, meets the most projecting part of the nasal tip (D). The length of this third line (C-D) in millimetres was used as a determinant of NTP. These figures present the absolute value of NTP as measurements were done on life-size projections.

Patients

Out of a series of 460 rhinoplasties, 73 patients were studied. To prevent too many variables to be introduced in this study, patients who underwent revision rhinoplasty were excluded. Also excluded were patients with changes in nasal frontal angle (augmentation or reduction) and nasal tip rotation, as this would interfere with pre- and post-operative measurement comparisons. Obviously patients with inadequate photographs and follow-up of less than one year were excluded as well. The study encompasses 43 males and 30 females with a mean age of 31, ranging from 17-68 years. The mean follow-up was 23 months, ranging from 12 to 52 months.

In all of the 73 primary rhinoplasty patients an external transcolumellar approach was used in combination with autogenous cartilage columellar strut. A columellar strut is a piece of cartilage inserted in between and suture-fixed to the medial crurae, while reaching till just above the nasal spine (Vuyk and Olde Kalter, 1993). The purpose of the medial crural strut is to lengthen and strengthen the conjoint medial crural complex in order to increase nasal tip support. A separate hemitransfixion incision was used to gain approach to the septum.

Patients were divided into four groups according to the following nasal tip surgery techniques: (1) intact alar cartilage; (2) cephalic resection of the alar cartilage with intact strip; (3) transdomal sutures (Vuyk, 1995; Tebbets, 1994); and (4) cartilage tip grafts (Sheen, 1993; Zijlker and Vuyk 1993) in combination with one or two of previously mentioned techniques.

The number of patients in each subgroup was 18 (Group I), 14 (Group II), 11 (Group III) and 30 (Group IV), respectively. These four groups were comparable in terms of male/female ratio and follow-up. But minor technical differences between patients in the same group do exist, such as the amount of cartilage resected (Group II), the suture tension (Group III) and size/shape and position of tip cartilage grafts, which were all sewn in. In previous publications the author's philosophy and techniques for transdomal suturing (Vuyk, 1995) and cartilage tip grafts (Zijlker and Vuyk, 1993) have been discussed in detail.

RESULTS

Increase in NTP was noted in 33 patients (45%), while decrease occurred in 29 (40%). NTP remained unchanged in 11 patients (15%). Figures 2A/B, 3A/B and 4A/B show representative

examples of three patients with respectively NTP decrease, maintenance and increase after open primary rhinoplasty, columellar strut and three different nasal tip surgery techniques. Figure 5 depicts NTP maintenance, increase and decrease for each nasal tip surgical category in percentages. The number of patients in this group is also given. Group IV shows the largest percentage of patients with increase in NTP and lowest percentage of patients with decrease in NTP.

Figure 6 demonstrates the mean NTP in millimetres pre- and post-operatively for each surgical category as well as the total group. The mean NTP for the total group varied from 20.03±3.5 (SD) pre-operatively to 20.07±2.96 post-operatively. This difference in NTP is statistically not significant (Kruskal Wallis: $p > 0.1$). Only in Group IV an increase in NTP could be noted. This difference between Group IV compared to groups I, II and III is statistically significant (Kruskal Wallis: $p < 0.1$).

Figure 2A+B. NTP decrease of 2 mm three years after open rhinoplasty with intact alar cartilages and columellar strut.

Figure 3A+B. NTP maintenance one year after open rhinoplasty with cephalic resection, transdomal suturing and columellar strut.

Figure 4A+B. NTP increase of 2 mm one year after.

with intact alar cartilages, nasal tip grafting and columellar strut.

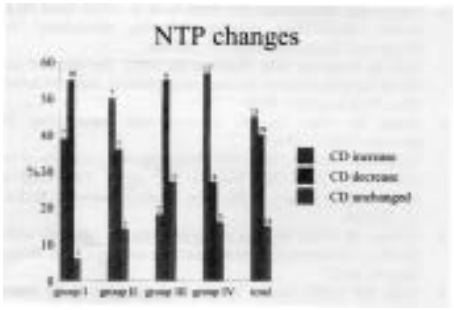

Figure 5. NTP changes in number of patients and percentages of total series as well as each surgical category.

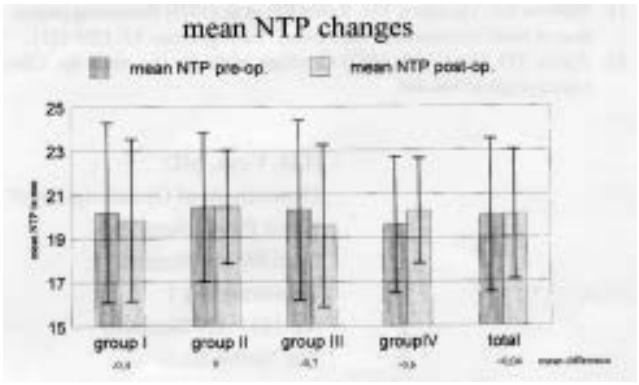

Figure 6. Mean NTP values in millimetres pre- and post-operatively, including standard deviation of total series as well as each surgical category.

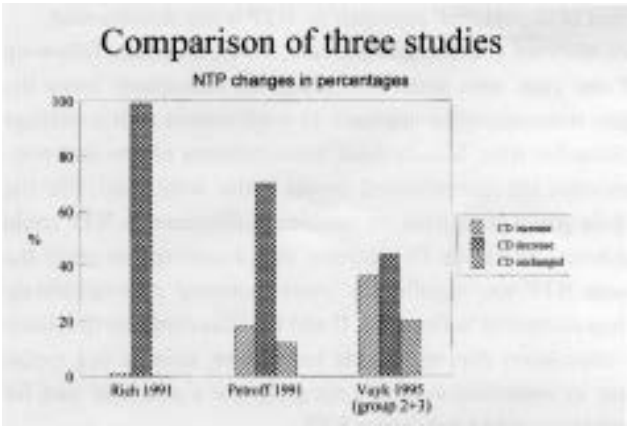

Figure 7. Comparison of three studies on NTP changes including clo-sed (Petroff et al., 1991; Rich et al, 1991) and open rhinoplasty (this study Group II and III combined). Increase, decrease and unchanged NTP is given in percentage of patients for each study.

In order to compare our data on external rhinoplasty to the endonasal rhinoplasty studies, only data from Groups II and III were used. In 24 of 25 patients from Groups II and III, a cephalic resection of the lower lateral cartilages was performed making only this particular combination of groups in this study comparable to the two endonasal rhinoplasty studies (PetrofF et al, 1991; Rich et al., 1991). No cartilage tip grafts were used in the latter two studies.

In Figure 7 the increase, decrease and maintenance of NTP are given (number of patients) from the combined Groups II and III of our series together with data of two previously mentioned endonasal rhinoplasty studies (PetrofF et al, 1991; Rich et al,

1991). An important difference between these three studies is the frequency of application of a columellar strut. In Rich's study, no patiënt had a columellar strut applied, while in Petroffs studies a columellar strut was used in 40% of the cases. This contrasts with our series of patients all of whom had a columellar strut applied.

DISCUSSION

An important anatomical element of successful rhinoplasty is nasal tip support and its influence on NTP (Tardy and Toriumi, 1992). Exact knowledge about the magnitude of the factors influencing NTP pre-, intra- and post-operatively, will give the facial plastic surgeon guidance for better control of NTP. Various instruments and methods have been used over the years to quantify NTP. Only recently sophisticated measure-ments were systematically used to evaluate the effect of endo-nasal approach in combination with different nasal tip surgery techniques on NTP (Petroff et al, 1991; Rich et al., 1991). However, the authors have not confirmed the validity of their observation in terms of statistical significance. Moreover, the maximum follow-up in one study (Petroff et al, 1991) was only 6 months, while decrease in NTP may still occur after a 6-monthpost -operative period.

During the past decade, the external approach for rhinoplasty has become increasingly popular as an alternative to the endo-nasal approach for rhinoplasty (Anderson and Reis 1986; Adamson, 1987; Vuyk and Olde Kalter, 1993) However, the effect of the external approach on NTP is not documented. We analysed a series of 73 patients, with a minimum follow-up of one year, who underwent a primary rhinoplasty using the open transcolumellar approach in combination with a cartilage columellar strut. Standardised measurements of pre- and post-operative life-size-projected proflle slides were used. For the whole group of patients no significant difference in NTP could be noted. In Group IV (patients with a cartilage tip graft) the mean NTP was significantly more increased post-operatively when compared to Groups I, II and III. This confirms the clinic-al impression that structuring techniques, using a columellar strut in combination with a tip graft, are a powerful tooi for maintenance and enhancing NTP.

To compare our data to data of previous studies on endonasal rhinoplasty only Groups II and III were used (cephalic resection with or without transdomal suturing but no cartilage tip grafts). Between these three studies large differences do exist in the frequency of the application of a columellar strut. While ignoring the different approaches used in these 3 studies, one may conclude that more frequent application of a columellar strut is associated with improved NTP maintenance. But are we permitted to conclude from the comparison of these three studies that the open approach does cause less damage to the NTP mechanisms? Our division of patients in nasal tip surgery subgroups has been partly dictated by loss of NTP during the operation. More specifically, some patients in whom too much NTP was lost during the operation, may have had a tip graft applied to regain NTP. This eliminated them from Groups I, II or III and included them in group IV. This implies that Groups II and III may be a relatively favourable group in terms of NTP maintenance. This possible bias does preclude a defmite conclusion on the damaging effect of the external approach compared to the endonasal approach. However, it does further strengthen our fmding that structuring techniques, including nasal tip grafting is an extremely versatile method for maintenance and even increase of NTP.

CONCLUSION

A successful rhinoplasty must maintain or change NTP in a controlled, predictable way. A systematic statistical analysis of the effect of four nasal tip surgery techniques on NTP while using the open approach in primary rhinoplasty did show that structuring techniques like columellar strut, in combination with a tip graft is a helpful tooi to maintain and even enhancing nasal tip projection.

REFERENCES

1. Adamson PA (1987) Open rhinoplasty. Otolaryngol Clin N Amer 20: 837-852.
2. Anderson JR, Reis WR (1986) Rhinoplasty: Emphasizing the External Approach. Georg Thieme Verlag, Stuttgart.
3. Joseph J (1944) quoted in: Powell and Humphreys (1984) Proportions of the Aesthetic Face. Georg Thieme Verlag, Stuttgart, p. 41.
4. Petroff MA, McCollough EG, Hom D, et al. (1991) Nasal tip projection. Quantitative changes following rhinoplasty. Arch Otolaryngol Head Neck Surg 117: 783-788.
5. Rich JS, Friedman WH, Pearlman SJ (1991) The effect of lower lateral cartilage excision on nasal tip projection. Arch Otolaryngol Head Neck Surg 117: 56-59.
6. Sheen JH (1993) Tipgraft: A twenty-year retrospective. Plast Reconstr Surg 91: 48-63.
7. Tardy ME, Toriumi DM (1992) Philosophy and principles of rhinoplasty. In: Papel ID, Nachlas ME (Eds.) Functional and Reconstructive Surgery of the Nose. Mosby's Yearbook, St. Louis, pp. 278-294.
8. Tebbets JB (1994) Shaping and positioning the nasal tip without structural interruption: A new systematic approach. Plast Reconstr Surg 94: 61-77.
9. Vuyk HD (1995) Suture tip plasty. Experience in 80 patients. Rhinology 33: 30-38.
10. Vuyk HD, Olde Kalter P (1993) Open septorhinoplasty. Experiences in 200 patients. Rhinology 31: 175-182.
11. Webster RC, Davidson TM, Rubin FF, et al. (1977) Recording projection of nasal landmarks in rhinoplasty. Laryngoscope 87: 1207-1211.
12. Zijlker TD, Vuyk HD (1993) Cartilage grafts for the nasal tip. Clin Otolaryngol 8: 446-458.

H.D. Vuyk, MD
Department of Otolaryngology/
Facial Plastic Surgery
Gooi Noord Hospital
Rijksstraatweg l
NL-1261 AN Blaricum
The Netherlands