

# Evaluation of nasal tip projection

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## ABSTRACT

**Objectives:** Determination of the nasal tip position with respect to the facial plane is a key element of pre-and post-operative assessments of rhinoplasties. Despite their limitations, objective methods can be proposed. The aim of this study was to investigate Goode's index, to undertake critical analysis of the results and to propose a new method of assessment of nasal tip projection.

**Materials and Methods:** A retrospective study was carried out using patients' records with reduction rhinoplasty performed in our department. We applied Goode's index to 100 cases chosen at random. A group of experienced surgeons performed a subjective clinical analysis, which was used as the reference opinion. We also tested a new index which does not take into account dorsum length and its post-operative shortening.

**Results:** Analysis with Goode's index revealed 11 cases that were discordant with the subjective impression of the surgeons. In these cases shortening of dorsum was very pronounced after surgery and facial plane-nasal tip ratio was distorted. Any discordance of these cases calculated with Goode's index disappeared when using our new index without taking into account the dorsum length.

**Conclusion:** This method is interesting but any validation will require further studies on larger numbers of cases.

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**Key words:** Nasal tip projection, Rhinoplasty, Goode's index.

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### INTRODUCTION

Anomalies of nasal tip projection represent the most complex aspect of rhinoplasty. In fact, the position of nasal tip in relation to the nose itself or to the face is as much a result of the position of nasal septum as the structure of the alar cartilages, their muscular attachment points and even the quality of the covering skin [1-2]. Before all corrections a surgeon must be able to define a normo, hyper or hypoprojected nasal tip, meaning that he/she must try to increase or, on the contrary, decrease the nasal tip projection. And the surgeon must be able to assess post-operative results from this point of view.

Nasal tip projection could be defined by the antero-posterior distance separating the nasal tip from the facial surface at the level of the alar fold [3]. The measure of naso-facial angle is used by certain authors to determine the ideal nasal tip projection since all modifications of the nasal tip projection cause ipso facto a modification of naso-facial angle. Ideally it should be between  $36^\circ$  and  $40^\circ$  [4]. The assessment of the naso-frontal angle must systematically be part of the pre-operative assessment, as an intervention at this level is sometimes sufficient to modify the appearance of an apparently hyper- or hypoprojected nose.

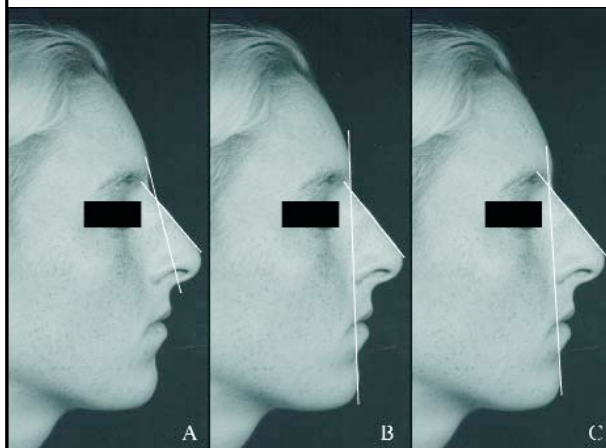
Three methods of construction were proposed by Leach [6] to determine the naso-frontal angle (Figure 1): Method A measures the angle between the line of the dorsum and a vertical line connecting the glabella in the midline between the alar line and the subnasion. The dorsum line [7] connects the nasion and the tip of

the nose passing through a potential bony prominence. Method B uses as its vertical the straight line passing through the glabella and the chin. It is the most commonly used method in practice. Method C uses a vertical line which connects the nasion and the chin. Nevertheless, all of these methods are insufficient in the case of filling in or hollowing out the root of the nose, which can modify the outcome without objective changes in the nasal tip position. This optical illusion can be misleading and a precise determination of nasal tip projection is required.

According to Simons [8] nasal tip projection is determined by the height of the border of the skin of the upper lip. In this the ratio between the lip-subnasion and subnasion-nasal tip distances approaches 1 [6, 10] (Figure 2). Simons' method has the advantage of being simple and easily applied, including on the operating table. Upper lip examination remains essential especially during smiling [11]. A "slanting" aspect of the latter is a sign of an over-short frenulum that requires correction in the same operation. On the other hand, when the nasal tip descends while smiling, this could indicate section of the musculus depressor septi. However, Simons' method has never been objectively assessed and has come in for criticism [3] because of the large variability in lip size and the absence of relation to other nasal dimensions.

Baum [9] proposed a construction between two straight lines (Figure 3). The first line is drawn between the nasion and subnasion and then the perpendicular is drawn to the nasal tip. The projection is considered to

**Figure 1: Determination of the naso-frontal angle according to Leach. Three methods of construction of the naso-facial angle after Leach.**



**Figure 2: Simons' method for the determination of the nasal tip projection according to the height of the cutaneous border of the upper lip.**



be correct when the ratio between two segments of the straight line (nasion-intersection and tip-intersection) is 2:1. This ratio creates a naso-facial angle of  $42^\circ$ , which is considered by certain authors as being the limit of excess. Powell and Humphreys [4] tried to correct this interpretation. They would obtain a naso-facial angle of  $36^\circ$  and therefore a less obvious projection if the ratio was decreased to 2.8:1. They use the entire vertical distance (denominator) of the straight line from nasion to subnasion.

Goode's method [3-4, 10] is based on trigonometric analyses of the whole nose. The technical construction is a little fastidious as it is based on a global analysis of the nasal dimensions. The first vertical straight line is drawn between the nasion and the alar sulcus, a second is perpendicular to the line going through nasal tip (Figure 4). The calculation is made based on the relative lengths of the segments. In 1988 Crumley and Lanser [3, 12] carried out a critical study of different methods of assessment of nasal tip projection. They tested Simons, Baum's, Powell's and Goode's methods on 51 patients before surgery. The profiles of each patient were analysed by five experienced rhinoplasty surgeons and their findings were compared with the results of each method. It was clearly shown that Simons method based on the upper lip was not sufficient to assess nasal tip projection. The other methods obtained similar results to one another and were approximately consistent with the subjective judgement of rhinoplasty surgeons.

For this reason we present a new method of assessment of nasal tip projection, inspired by Goode's method, but which does not take into account the rotation phenomena (and thus, shortening of the dorsum).

## MATERIALS AND METHODS

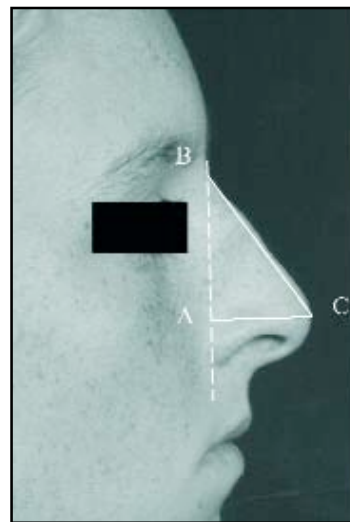
### Methods of Calculation

Goode's index is calculated as follows: 3 points are defined: B (nasion), C (nasal tip), and A (Projection of C onto the nasion-alar line). Goode's index is calculated using the ratio:  $AC/BC$  (Figure 4). A Goode's index between 0.55 and 0.6 corresponds to a normal projection. An index greater than 0.6 corresponds to hyperprojection and less than 0.55 to hypoprojection. When the ratio is within normal limits, it corresponds to naso-facial angle of about  $36^\circ$ .

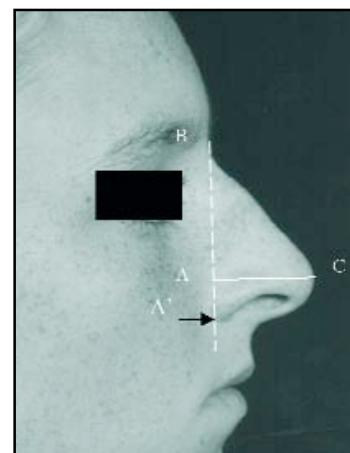
**Figure 3: Baum's method.**



**Figure 4: Goode's method (see text for the details).**



**Figure 5: Modified Goode's method (see text for details).**



## Evaluation of nasal tip projection

Our index derives from this previous index (Figure 5). We maintained the same reference points: B (nasion), C (nasal tip), A (Projection of C on the nasion-alar line). On the vertical line we have defined a new point, A', corresponding to the projection onto the vertical line of a line from C (nasal tip) and tangent to inferior edge of the posterior part of the nostril. Our new index corresponds to the ratio  $AC/BA'$ , where  $BA'$  is independent of dorsum shortening. While awaiting analyses using a sufficiently large database, we have decided to compare pre— and post-operative indices to assess the direction of variation. This preliminary study does not permit statistical assessment at this time.

All indices and calculations were performed on white and black photos in profile printed on 13x18 cm format matte paper. Photos taken by a professional photographer were digitized using a scanner and stored. In total, there were 200 profiles (100 before and 100 after intervention). Adobe Photoshop® software was used to calculate the different results in a precise manner. This allowed us to define anatomic reference points needed for the study and also to measure precisely the distances between different points.

### Patients and Evaluation of Data

This was a retrospective randomized study performed using on 100 files, involving 31 men and 69 women, operated for reduction rhinoplasty (external and dissimulated approach) in the ENT department. Patient sampling was performed in a randomized manner, irrespective of age. Only patients operated by particular surgeons (AG, MZ) and possessing complete photographic files (pre— and post-operative) were included in the study. Index calculations were performed by a team member (fellowship resident), who was not operating on the patients. The measurements were controlled at 2 months by the same clinician. Photos were reviewed again by individual practitioners within the department to assess whether resultant indices were correlated with clinical impressions.

Members of jury (3 in number) did not perform measurements but some operated on the patients. The global opinion was considered regarding the correlation between the index and the pre/post operative photos.

## RESULTS

Pre and post-operative Goode's and modified Goode's indices are presented in Table I.

**Table I: Results of Goode's index and modified Goode's index (clinical correlation).**

Pre-operative index	Post-operative Goode's index	Post-operative modified Goode's index (direction of variation)
Hypoprojection: 7	Hypoprojection: 0	Increase: 3
	Normo projection: 3	No change: 0
	Hypoprojection: 4	Decrease: 4
Normal projection: 34	Hyperprojection: 4	Augmentation: 0
	Hyperprojection: 4 <b>(4 discordant results according to expert opinion)</b>	
	Normo projection: 27	No change: 29
	Hypoprojection: 3	Decrease: 5
Hyperprojection: 59	Hyperprojection: 23 <b>(7 discordant results according to expert opinion)</b>	Increase: 17 <b>(1 discordant result according to expert opinion)</b>
	Normo projection: 31	No change: 37
	Hypoprojection: 5	Decrease: 5

Figure 6 is an example of the concordance of the two indexes. These patients underwent reduction rhinoplasty using an external approach to treat a prominent osteocartilagenous prominence. We have also corrected a tip that was drooping, large and poorly defined. Before intervention Goode's index approached 0.70, demonstrating hyperprojection, and was 0.59 after surgery. The values for our new index were similar, together with critical opinions of surgeons.

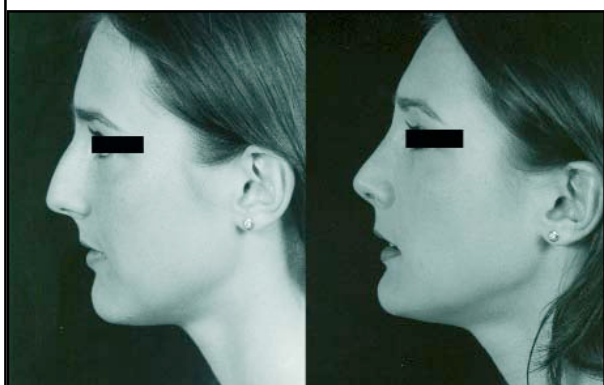
On the other hand, there were certain discordant results between the objective indices and the expert opinions: among 34 patients with a normal nasal tip projection pre-operatively, 27 had a normal Goode's index post-operative, 3 had hypoprojection and 4 had an index consistent with hyperprojection, which contradicted with the subjective assessment of the photos. Similarly, among 27 patients that had a Goode's index corresponding to post-operative hyperprojection, seven were judged as normal projection by the authors.

Indices calculated using the modified Goode's method are shown in the been shown in the right column (Table I) and most discordant results were corrected.

**Figure 6: Example of agreement between Goode's index, the new index and expert opinion of the experts.**



**Figure 7: Example of a discordance between the subjective assessment and Goode's index; discordance corrected with the modified Goode's index.**



For instance, Figure 7 shows a comparison between the two indexes:

this patient clinically has a marked kyphosis, an elongated dorsum and good nasal tip definition (from the front), in which the nasal tip projection was considered as normal. She underwent a simple reduction rhinoplasty by the dissimulated intercartilaginous approach without manipulation of the alar cartilages. The post-operative results clearly showed that there was significant dorsal shortening with cephalic rotation of the nasal tip. The projection which seemed to be decreased was, in fact, normal. Goode's index measured preoperatively was 0.58 corresponding to a normal projection. On the other hand, the post-operative index was more than 0.60 (hyperprojection). We undertook a secondary calculation of our new index (modified Goode's). The results were similar to the clinical impression of the jury: the ratio was decreased.

## DISCUSSION

The objective of our study was to present an objective index for the determination of nasal tip projection which should be as consistent as possible with the subjective impression of the jury members. It appears that our results are encouraging and that this index could be proposed for clinical use: in fact, in 10 out of 11 cases of discordance between the clinical view and Goode's index, the modified Goode index matched the clinical opinion.

In general terms, the method chosen must be as simple as possible and must take into account inevitable differences in scale between pre- and post-operative photos and also between photos from different patients. It is simpler if the method is based on relative measures of angle and length rather than absolute values.

The results obtained with Goode's index require several comments. Indeed, a certain number of subjects that underwent reduction rhinoplasty, had a hyperprojected post-operative nasal tip measurement, which was difficult to understand on mechanical level as neither the plastic surgeons nor the patients appreciated this hyperprojection. In reality the mode of calculation of Goode's index was responsible for this result. Goode's index is defined by the ratio  $AC/BC$ . "BC" represents the length of the nose and "AC" the perpendicular distance between the nasal tip and the nasion-alar line. Thus, Goode's ratio decreases when there is a greater decrease in the length of the alar-nasal tip line than in the length of the nose.

On the other hand, when the change in length of the dorsum is relatively larger (rotation of the nasal tip), the ratio increases and the calculated Goode index is paradoxically higher than before the intervention. Thus, this index tends to include the cephalic rotation of the nasal tip in the calculation of projection since dorsal shortening automatically involves modification of the index. This logically represents the projection of the nasal tip compared to the facial plane.

This can limit the relevance of the index when it is compared with the subjective impression of nasal tip projection as judged by the practitioner or the patient. These cases were better analyzed by the modified Goode's index since it was then decreased. Other groups [13] have also studied this problem and tried to evaluate the nasal tip rotation separately.

### CONCLUSION

The determination of measurable indices is not incompatible with the subjective analysis of the nose and the aesthetics of the face in general. It allows for comparisons between various techniques, particularly as in this case when the nasal tip position is compared to the facial plane. Goode's index is widely used but, as we have demonstrated, it has a certain number of limitations related to the method of calculation. The modified index that we have presented is quite promising but more systematic studies are required to validate these results on a statistical basis.

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