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ORIGINAL ARTICLE

Evaluation of Nasal Tip Projection and Rotation of Nasal Tip after Orthognathic Surgery by Using Goode's Method

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Abstract
Introduction The aim of this study was to evaluate the projection and rotational tipping(upturning) changes in the nose after orthognathic surgery by using the Goode Method.
Materials and Methods In this retrospective study, 21 adult patients (12 males, 9 females) who had double jaw surgery (Lefort I Maxillary Advancement and Impaction + Mandibular Setback) were evaluated by using Goode's method(nasal projection) and by evaluation of NLA(Nasolabial Angle)(Nasal rotation) on pre-op and post-op standardized photographs.
Results There was no statistically significant difference between NLA baseline and outcome mean values (p: 0.519), while there was a statistically significant difference between Goode ratios baseline and outcome values (p: 0.025). There was no statistically significant relationship between NLA values and Goode ratios changes and, age, Maxillary Advancement, Impaction and Setback. Gender did not have an effect on the changes of NLA values and Goode ratios.
Conclusion The results of this study presented significant sagittal direction nasal changes in the form of nasal tip protrusion after double jaw surgery, while no statistical effect was found on nasal tip rotation in the vertical direction.

Keywords Goode's method · Nasal projection · Nasal tipping · Orthognathic surgery · Orthodontics

Abbreviation
NLA Nasolabial angle

Introduction

The main aim of orthognathic surgery is both to correct the malocclusion and to form ideal orofacial esthetics [1]. The nose must be a part of the evaluation for patients which will be treated with orthognathic surgery, to be able to achieve a satisfying surgical result [2, 3]. Surgical interventions in the maxilla will undoubtedly have an impact on the nose [3]. Maxillary surgery can be applied in upward, downward, forward, and backward directions, and each can result with different changes in nasal structures [4]. However, the effects of orthognathic surgery on bone, cartilage, and soft tissues of the nose can be unpredictable sometimes [5].

It has been reported that changes in the tip of the nose are associated with surgical maxillary vertical and sagittal movements, and the movement of the maxilla affects the position of the nasal tip, and as a result, nasal aesthetics improves after orthognathic surgery [6].

Following maxillary advancement changes effecting nasal tip rotation, supratip fracture, and the dorsal hump may occur. The various components that support the tip of the nose are the nasal septum, the lower lateral cartilages,

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the medial crura footplates, the upper and the lower lateral cartilages, and the anterior nasal spine. For this reason, operations and changes in this region are likely to have an effect on the nasal tip position. The most reported relationship is increased projection and rotational turning up of the nasal tip with maxillary advancement [7, 8]

Hereby, this study aimed to assess the impact of orthognathic surgery on nasal projection and rotational tipping(upturning).

Materials and Methods

The ethical approval for the study was given by Istanbul Medipol University by approval number of 5302017. This retrospective study was based on the clinical medical records of the patients in the data pool of Istanbul Medipol University, School of Dental Medicine. 21 patients (12 males and 9 females) were enrolled in the study. All of the patients, who had Skeletal Class III malocclusion which was characterized by mandibular prognathism and maxillary deficiency, were applied double jaw surgery. Exclusion criteria were: major congenital deformities, cleft lip and/or palate; previous facial and/or orthognathic surgery.

All surgeries were performed by the same surgeon and same surgical team in the same center. With regarding to surgical technique, all patients had same treatment: LeFort I osteotomy for maxillary advancement with impaction (at least to a degree because of diameter of the routine burs used for the corticotomy of the bone segments), combined with bilateral sagittal osteotomy of mandibular ramus. None of additional surgical procedures like: septal trimming, removal of ANS, widening of piriform rims, were used during operations. All patients had the same preoperative and postoperative care.

Standardized orthodontic profile photographs were obtained before the operation (T0) and at least 6 months after the operation (T1) to be able to avoid the possible effects of edema. Preoperative (T0) and postoperative (T1) nasal soft tissue parameters of all of the patients were evaluated by using the Goode's method on profile photographs. Preoperative (T0) and postoperative (T1) (Nasolabial Angle) NLA values of the patients were also calculated on the profile photographs. All of the evaluations and calculations were made by the same one researcher. (Fig. 1).

Statistical Method

Data were analyzed with IBM SPSS V23. Dependent samples t-test was used to compare NLA and Goode ratios baseline and outcome values. The relationship between NLA values, Goode ratios, age, Maxillary Advancement, Impaction and Setback was examined by Spearman's rank correlation. Independent samples t-test was used for gender comparisons. Analysis results are presented as mean ± s.d. The significance level was taken as $p < 0.05$.

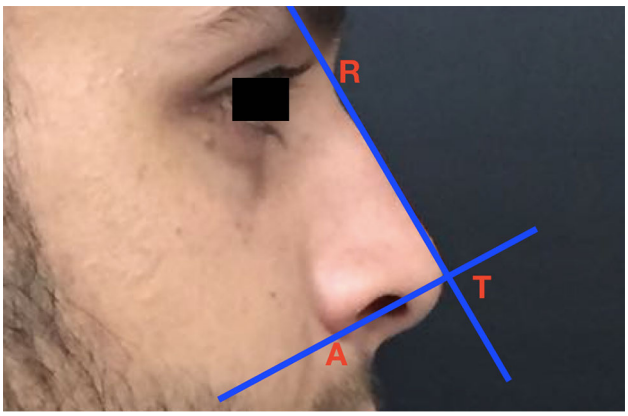

Fig. 1 Goode's method

Results

The rate of males was 57.01% among the total 21 subjects, and the rate of women was 42.9%. The mean age was 24.48, and the standard deviation was 3.92.

There was no statistically significant difference between Nasolabial Angle (which pre-sents vertical nasal changes meaning nasal tip rotation) baseline and outcome mean values according to gender (p = 0.519). While the initial average value was 100,95 degrees, the result average value was 102,04 degrees. There was a statistically significant positive correlation between baseline and outcome values (r = 0761).

There was a statistically significant difference between Goode ratios (which presents sagittal nasal changes meaning nasal tip projection) baseline values and mean values (p = 0.025). While the initial average ratio value was 0.62, the result average ratio value was 0.60. There was a statistically significant positive correlation between baseline and outcome values (r = 0.801). (Table 1).

There was no statistically significant relationship between 'NLA values and Goode ratio changes' and 'age, Maxillary advancement, Setback and Impaction'. (Table 2).

Means of NLA baseline value, outcome value, and 'difference between baseline and outcome value' did not differ by gender (p values 0.058, 0.535, and 0.097, respectively). Similarly, the means of Goode ratios

Table 1 Comparison of NLA and Goode ratios baseline and outcome values

	Baseline	Outcome	Correlation	*p* value
NLA	100,952 ± 10,975	102,048 ± 11,16	0.761	0.519
Goode	0.628 ± 0.072	0.605 ± 0.060	0.801	0.025

Table 2 Correlation analysis results

	Max-Ad	Set-Back	Impaction	NLA change	Goode change
Set-Back					
r	0.277				
p	0.224				
Impaction					
r	0.087	0.359			
p	0.707	0.11			
NLA Change					
r	– 0.238	0.041	– 0.186		
p	0.3	0.861	0.419		
Goode Change					
r	0.28	– 0.114	0.06	0.117	
p	0.219	0.622	0.796	0.612	
Age					
r	– 0.154	– 0.171	-0.016	0.008	0.010
p	0.506	0.459	0.947	0.974	0.966

r: Spearman correlation coefficient

p: *p* value

baseline value, outcome value, and 'difference between baseline and outcome value' did not differ by gender (p values 0.150, 0.421, and 0.267, respectively). (Table 3).

Discussion

The purpose of treating of dentofacial skeletal anomalies by orthognathic surgery is to provide a more functional and esthetic maxillomandibular relationship. [5] In our study, all of the patients had maxillary advancement and maxillary impaction with mandibular setback. Mean maxillary advancement, maxillary impaction and mandibular setback amounts in this study were 5.90 4.61, and 2.95 mm., respectively.

The ideal values of nasolabial angle are 95–110 for females and 90–95 for males [9]. There are contradictory findings about the nasolabial angle changes after orthognathic surgery in the literature [10–13]. In their study, Worasakwutiphong S et al.[14] found an increase in the nasolabial angle with no change on the nasal height, and nasal length. Yılmaz A et al.[4] also found no changes in nasolabial angle after maxillary surgery. They explained this finding with the change of position of lip with maxillary surgery. In their study, Khamashta-Ledezma L, Naini [15] also reported an increase in the nasolabial angle following surgery. In this study, no statistically significant difference was found between NLA baseline and outcome mean values in both genders. We thought that this perception of nasal tipping increase could be related to the perception of the total change in the face.

Goode's method is used to evaluate nasal projection after nasolabial surgeries. This value is obtained by the division of the distance between the alar root and the tip of nose by the distance between nasion (root of nose) and nasal tip. The average value of this ratio is 0.55–0.60. (Fig. 2) [6, 16, 17]

In their studies, Yılmaz A et al. [4] found more vertical nasal changes(tipping) rather than sagittal nasal changes(projection) and in consistency with those results Tartaro et al. [18] presented a significant increase in nasal tip projection. In contrary to those findings, we found a statistically significant decrease between the baseline and outcome results of nasal projection values. This was thought to be related to the amount, direction and the

Table 3 Comparison by gender

	Male (n = 12)	Female (n = 9)	*p* value
NLA			
Baseline	97,333 ± 12,759	105,778 ± 5,608	0.058
Outcome	100,833 ± 14,25	103,667 ± 5196	0.535
Difference	– 3500 ± 8383	2111 ± 5419	0.097
Goode			
Baseline	0.608 ± 0.073	0.654 ± 0.066	0.150
Outcome	0.596 ± 0.064	0.618 ± 0.056	0.421
Difference	0.013 ± 0.027	0.037 ± 0.057	0.267

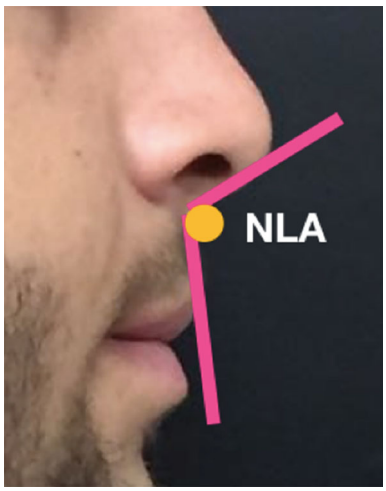

Fig. 2 Nasolabial Angle (NLA)

application of the surgery done. DeSasa et al. [8] mentioned that maxillary advancement had a significant effect on nasal tip projection. In accordance with our findings, they reported an increase in nasal tip prominence, while they also reported an increase in nasolabial angle in contrary to our findings. In contrast to the findings of the present study, Atakan and Özçırpıcı [6] reported a significant increase in postoperative nasal tip inclination and rotation while they reported a decrease in nasal tip protrusion.

Denadai et al. [19] stated that there were a small change in nasal tip height parameter in maxillary intrusion and extrusion movement rather than in advancement and setback maxillary movements. However, the same authors noted that the main obvious changes were in alar width, alar base width, and nostril angle parameters. In contrary to their findings, Van Loon et al. [20] in their study, comparing two groups of Lefort I osteotomy combined with and without alar base cinch suture, found that there were no significant differences in nasal transversal dimensions and nasal volume following Lefort I osteotomy. However, in the present study, values like: alar width, alar base width, and nostril angle, etc., were not examined because the present study was constructed on 2D sagittal photographs of the subjects.

In the present study, it was found that there was no statistically significant relationship between NLA values and Goode ratio changes; which means there were no statistically significant relationship between nasal tip rotation and nasal tip projection. It can be interpreted that, deviations between outcomes and findings across different studies depend on the types and amounts of maxillary and mandibular movements which were performed, methods of the surgery and, the operators.

Although this study reached such findings, the results cannot be generalized due to some limitations. In this age where science has more examination and research technology than before, and in this "selfie age" where aesthetic perception gains more importance day by day and people pay more attention to their appearance, there is need for studies that include 3D examinations, examine more parameters related to nose and nasal aesthetics, and include larger sample numbers. Another last and perhaps important suggestion is to conduct further comparative studies between methods such as: the Goode method, the Crumley method [21], the Baum ratio, the Simons ratio and the Powell ratio [22], which evaluate nose tipping and projection.

Conclusion

It cannot be ignored that soft tissues are affected to a certain extent by orthognathic surgical movements. The results of this study presented significant sagittal direction nasal changes in the form of nasal tip protrusion after double jaw surgery, while no statistical effect was found on nasal tip rotation in the vertical direction.

Authors Contribution All authors contributed to the study conception and design. Material preparation, data collection were done by all authors. The first draft of the manuscript as well as the data analysis was written and performed by all authors. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Conflict of interest The authors declare that they have no competing interests.

Ethical Approval The ethical approval for the study was given by Istanbul Medipol University by approval number of 5302017.

Consent for Publication Written consent for publication was obtained from each patient.

References

1. Hu J, Wang D, Luo S, Chen Y (1999) Differences in soft tissue profile changes following mandibular setback in Chinese men and women. J Oral Maxillofac Surg 57(10):1182–1186
2. Warner JP, Chauhan N, Adamson PA (2010) Alar softtissue techniques in rhinoplasty: algorithmic approach, quantifiable guidelines, and scar outcomes from a single surgeon experience. Arch Facial Plast Surg 12:149–158

3. Khamashta-Ledezma L, Naini FB, Manisalı M (2017) Review of nasal changes with maxillary orthognathic surgery. J Istanb Univ Fac Dent 51:52–61
4. Yılmaz A, Polat-Ozsoy O, Arman Ozcırpıcı A, Uckan S (2015) Short-term evaluation of nasal changes after maxillary surgery. Turkish J Orthod 27:158–163
5. Dantas WR, Silveira MM, Vasconcelos BC, Porto GG (2015) Evaluation of the nasal shape after orthognathic surgery. Braz J Otorhinolaryngol 81(1):19–23
6. Atakan A, Özçırpıcı AA (2021) Correlation between cephalometric nasal changes and patients' perception after orthognathic surgery. Am J Orthod Dentofac Orthop 159(6):449–460
7. Khamashta-Ledezma L, Naini FB, Manisali M (2017) Review of nasal changes with maxillary orthognathic surgery. J Istanb Univ Fac Dent 51(3):S52
8. DeSesa CR, Metzler P, Sawh-Martinez R, Steinbacher DM (2016) Three-dimensional nasolabial morphologic alterations following Le Fort I. Plast Reconstr Surg Glob Open 4(8):e848
9. Niamtu J (2016) Cosmetic facial surgery. Elsevier Health Sciences, Amsterdam
10. Marsan G, Cura N, Emekli U (2009) Soft and hard tissue changes after bimaxillary surgery in Turkish female Class III patients. J Craniomaxillofac Surg 37:8–17
11. Misir AF, Manisalı M, Egrioglu E, Naini FB (2011) Retrospective analysis of nasal soft tissue profile changes with maxillary surgery. J Oral Maxillofac Surg 69:190–194
12. Esenlik E, Kaya B, Gulsen A, Cukurluoglu O, Ozmen S, Yavuzer R (2011) Evaluation of the nose profile after maxillary advancement with impaction surgeries. J Craniofac Surg 22(6):2072–2079
13. Radney LJ, Jacobs JD (1981) Soft tissue changes associated with surgical total maxillary intrusion. Am J Orthod 80:191–212
14. Worasakwutiphong S, Chuang YF, Chang HW, Lin HH, Lin PJ, Lo LJ (2015) Nasal changes after orthognathic surgery for patients with prognathism and Class III malocclusion: Analysis using three-dimensional photogrammetry. J Formos Med Assoc 114(2):112–123
15. Khamashta-Ledezma L, Naini FB (2015) Prospective assessment of maxillary advancement effects: maxillary incisor exposure, and upper lip and nasal changes. Am J Orthod Dentofac Orthoped 147(4):454–464
16. Erdem T (2010) Long-term effectiveness of projection control suture in rhinoplasty. Rhinology 48:189
17. Abbou R, Bruant-Rodier C, Wilk A, Meningaud JP, Khan JL, Bosc R, Bodin F (2014) Open rhinoplasty: influence of incisions, alar resection, and columellar strut on final appearance of the tip. Aesthetic Plast Surg 38(6):1077–1082
18. Tartaro G, Santagata M, Corzo L, Rauso R (2008) Tip turning and maxillary advancement: the UT angle. J Craniofac Surg 19:1387–1390
19. Denadai R, Chou PY, Lin YY, Yao CF, Chen YA, Huang CS, Lou LJ, Chen YR (2021) Type of maxillary segment mobilization affects three-dimensional nasal morphology. J Plast Reconstr Aesthet Surg 74:592–604
20. Van Loon B, Verhamme L, Xi T, de Koning MJJ, Bergé SJ, Maal TJJ (2016) Three-dimensional evaluation of the alar cinch suture after Le Fort I osteotomy. Int J Oral Maxillofac Surg 45:1309–1314
21. Crumley RL, Lanser M (1988) Quantitative analysis of nasal tip projection. Laryngoscope 98:202–208
22. Devcic Z, Rayikanti BA, Hevia JP, Popenko NA, Karimi K, Wong BJ (2011) Nasal tip projection and facial attractiveness. Laryngoscope 121:1388–1394