Original Article

Short-Term Evaluation of Nasal Changes After Maxillary Surgery

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ABSTRACT

Objective: To determine the nasal soft-tissue profile changes in skeletal Class III patients who underwent maxillary or bimaxillary orthognathic surgery.

Materials and Method: This clinical retrospective study consists of 40 patients (19 male and 21 female) who had undergone orthognathic surgery. All patients received single jaw maxillary (9 patients) or bimaxillary surgery (31 patients). Standardized lateral cephalograms obtained before operation and at least 6 months after the operation were used. Twelve measurements (4 skeletal and 8 soft-tissue measurements) were made. The distributions of the variables were checked by Shapiro-Wilk test. Paired-samples *t* test was used for parametric data and Wilcoxon sign rank test for nonparametric data, to analyze the differences between pre- and postoperative measurements.

Results: After orthognathic surgery, SNA and ANB increased; SNB decreased significantly. A significant reduction in nasofrontal angle, TH-Prn, and nasal tip projection and a significant increase in nasofacial angle were found. In addition, superior movement of the nasal tip was found, and as a result, the nasal hump decreased. The N-Sn/Pr ratio, nasal tip angle, and nasolabial angle did not show any significant changes.

Conclusion: It can be concluded that more vertical nasal changes rather than sagittal nasal changes are observed after maxillary surgery. (*Turkish J Orthod*. 2014;27:158–163)

KEY WORDS: nasal changes, orthognathic surgery

INTRODUCTION

The orthognathic surgical approach is routinely used to correct underlying skeletal deformities and soft-tissue imbalance.[1–6] Beside this, it has the potential to significantly change the facial soft-tissue profile. The desire to improve facial appearance is a strong motivational factor for patients who decide to undergo orthognathic surgery.[7] Both the middle and lower thirds of the face can be altered efficiently when combined orthodontic and surgical treatment is performed.[4,8–11] Thus, the predictability of soft-tissue changes resulting from hard-tissue alterations is essential.[3]

Maxillary surgical movements involve 4 basic directions: upward, downward, forward, and backward. Each of these movements can lead to changes of nasal structures in various degrees. The success of orthognathic surgery depends on proper planning and accurate estimation of the results of operation as well as the surgeon's abilities. Hard-tissue changes affect the soft tissues to a certain extent; thus, soft-tissue movements should also be taken into account in surgical planning. Bailey *et al*.[12] reported that changes occurring in the upper and lower parts of the facial profile can be predicted more easily, but nose and lips changes are inconsistent.

Researchers conducted 3 different studies using video imaging techniques and reported that the

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Table 1. Distribution of the subjects according to surgery performed.

	n	Total
Bimaxillary	23	31
Bimaxillary + Genioplasty	8	
Maxillary	4	9
Maxillary + genioplasty	5	

predictability of changes is lowest in subnasale, pronasale, and upper lip.[13–15]

Aydil *et al*.[16] investigated the soft-tissue changes after bimaxillary surgery in Class II patients and did not find a significant movement of the nose in the anteroposterior direction. However, they found a 1.25-mm significant upward movement of the nose. They also reported a correlation between this vertical movement and the insignificant decrease of the nasolabial angle. Vasudavan *et al*.[1] examined the nasolabial soft-tissue changes after Le Fort 1 advancement and found 1.26 mm decrease in nasal length, 1.14 mm increase in nasal tip protrusion, and 9.76° decrease in nasofrontal angle. Altug-Atac *et al*.[2] reported 0.90 mm and 1.42 mm forward movement of the pronasale and subnasale, respectively, after bimaxillary surgery in Class III patients.

There is limited research regarding soft-tissue prediction, especially nasal profile changes.[4,17–20] The soft-tissue response to any surgical procedure is the end result, and it is what matters to the patients. The nose is a keystone of facial aesthetics and thus should be given considerable importance in planning of orthognathic surgery.

The aim of our study was to analyze the nasal soft-tissue profile changes of skeletal Class III patients who underwent maxillary or bimaxillary orthognathic surgery.

SUBJECTS AND METHODS

This study was conducted as a clinical retrospective study. The study group consisted of 40 patients who had undergone orthognathic surgery for the correction of dentoskeletal Class III deformity, between 2004 and 2012 at the Başkent University, Faculty of Dentistry. Subjects were included in the study based on the following inclusion criteria: (1) they had no congenital deformities, such as cleft lip and/or palate; (2) they had received no other midface surgery, such as rhinoplasty; (3) they had undergone orthodontics and orthognathic surgery; and (4) preoperative and postoperative (taken at least 6 months after the operation) lateral cephalometric radiographs were available.

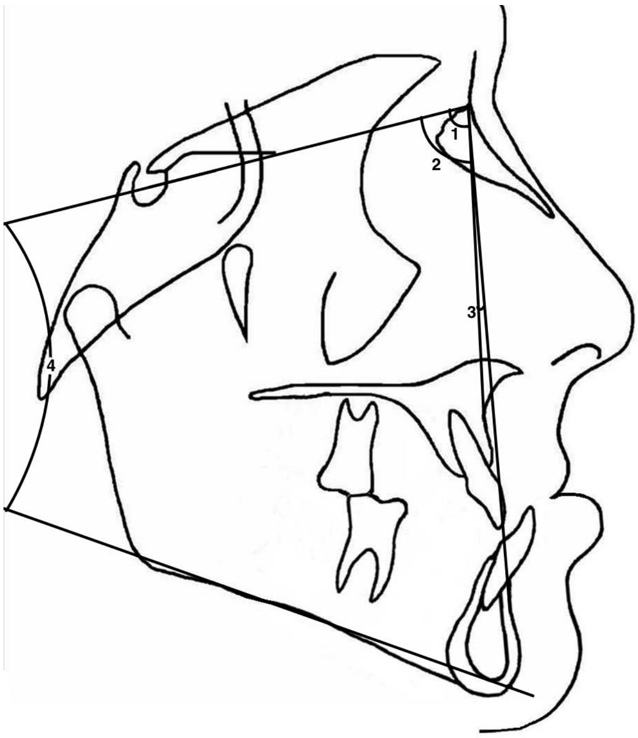

Figure 1. Skeletal measurements used in the study: (1) SNA, (2) SNB, (3) ANB, (4) GoGnSN.

The sample comprised 19 male and 21 female patients (mean age, 20 years 8 months). All patients were operated by the same surgical team and received single jaw maxillary (9 patients) or bimaxillary surgery (31 patients) with rigid fixation. Also, in 13 cases, an additional genioplasty was performed in the same operation. In some patients, if it was necessary, recontouring of ANS was performed. Distribution of the subjects according to surgery performed is shown in Table 1.

Standardized lateral cephalograms were obtained while the teeth were in centric occlusion and without soft-tissue tension. Thirteen anatomical landmarks were identified in cephalometric radiographs, and 12 measurements (4 skeletal and 8 soft-tissue measurements) were made (Figs. 1–3). Also the distance of the A point and PNS to the line 7° to SN was measured on pre- and postoperative films. The average vertical movement was calculated by taking the average of the amount of anterior and posterior impaction. All radiographs were traced by the same investigator on a light box in a dark room using a 0.3-mm lead pencil.

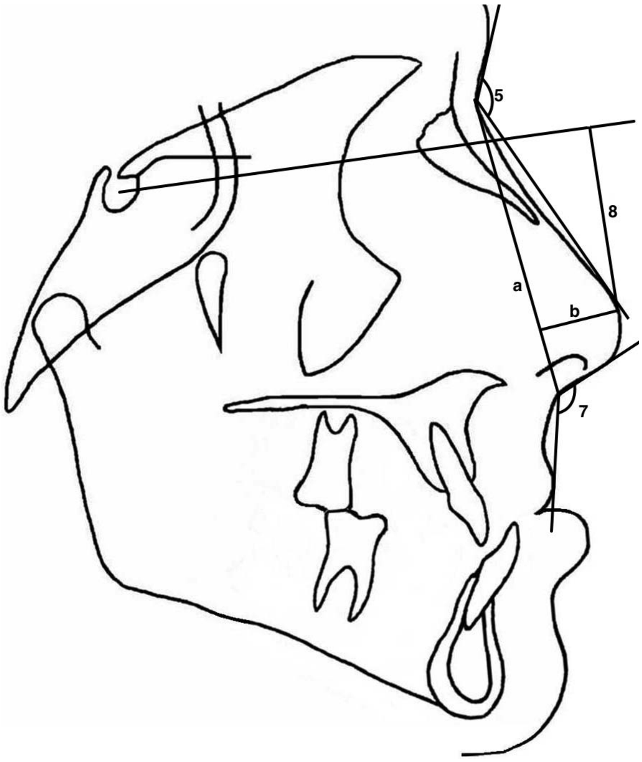

Figure 2. Soft-tissue measurements used in the study: (5) nasofrontal angle: the angle between nasion-glabella line and nasion-pronasale; (6) N-Sn/Prn: (a/b) ratio between nasion-subnasale line (a) and the distance between this line and pronasale (b); (7) nasolabial angle: the angle between lines drawn tangent from subnasale to pronasale and to columella; (8) TH-Prn: the vertical distance between pronasale and the line 7° to SN.

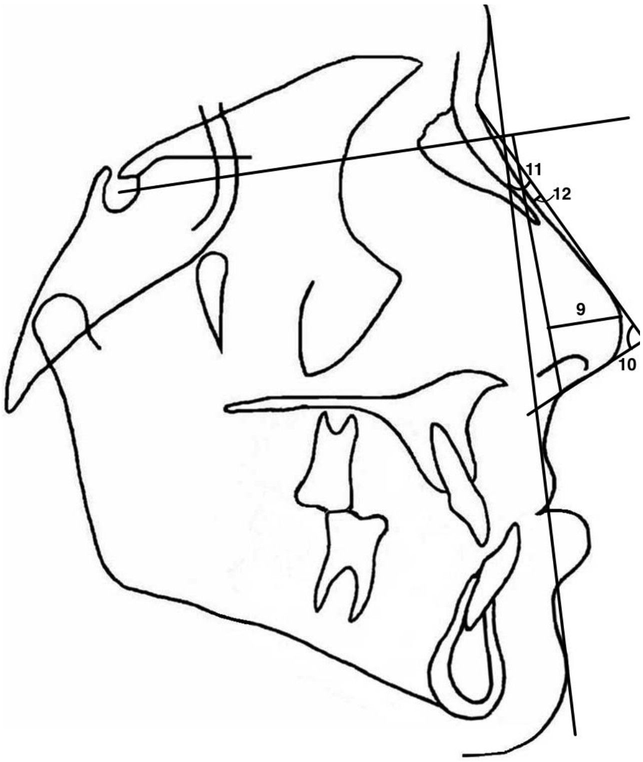

Figure 3. Soft-tissue measurements used in the study: (9) nasal tip projection: the horizontal distance from pronasale to the line drawn perpendicular from subnasale to the line 7° to SN; (10) nasal tip angle: the angle between nasal dorsum and columella; (11) nasofacial angle: the angle between facial plane (glabella-pogonion) and nasion-pronasale line; (12) nasal dorsal line: the distance between nasal dorsum and the line drawn from nasion to pronasale.

Statistical Analysis

Statistical analysis was performed using SPSS for Windows, version 15 (SPSS Inc, Chicago, IL, USA). The distribution of the variables was checked using the Shapiro-Wilk test. The differences between pre- and posttreatment measurements regarding parametric data (nasal tip projection) were analyzed by paired-samples *t* test and Wilcoxon sign rank test for nonparametric data. A *p* value less than 0.05 was considered statistically significant. Data were shown as mean ± standard deviation ($\bar{X} \pm S_x$). To calculate the error of measurements, cephalometric films of 15 randomly selected patients were retraced and remeasured by the same author. Intraclass correlation coefficients were found to be higher than 0.9.

RESULTS

The mean amount of maxillary advancement was 5.11 mm, and the mean amount of maxillary anterior impaction was 0.85 mm (Table 2). Table 3 summarizes the means and standard deviations of the hard- and soft-tissue changes. After orthognathic surgery, a significant increase in SNA ($p<0.001$) and ANB ($p<0.001$) and a significant decrease in SNB ($p=0.002$) were observed. Soft-tissue measurements showed a statistically significant reduction in nasofrontal angle ($p=0.035$), TH-Prn ($p<0.001$), and nasal tip projection ($p=0.007$), while the N-Sn/Pr ratio ($p=0.770$), nasal tip angle ($p=0.963$), and nasolabial angle ($p=0.990$) did not show any significant changes. The nasofacial angle ($p<0.001$) increased significantly. Also, a significant

Table 2. Amount of maxillary advancement and maxillary anterior impaction.[a]

	$\bar{X} \pm s_x$	Min-Max
Advancement, mm	5.11 ± 2.57	0 to 12
Anterior impaction, mm	0.85 ± 2.77	3 to −9

[a] $\bar{X}$, average; *s*, standard deviation; min, minimum; max, maximum.

Table 3. Descriptive statistics of pre- and postoperative measurements and significance of treatment changes.[a]

Parameter	T1 ($\bar{X} \pm s_x$)	T2 ($\bar{X} \pm s_x$)	T2-T1 ($\bar{D} \pm s$)	p
Skeletal measurement				
SNA, °	79.87 ± 4.72	84.38 ± 5.07	4.51 ± 2.27	0.000***
SNB, °	83.22 ± 5.97	81.99 ± 5.08	−1.23 ± 2.70	0.002**
ANB, °	−3.36 ± 5.14	2.25 ± 2.80	5.60 ± 3.55	0.000***
GoGn-SN, °	34.62 ± 8.19	33.98 ± 7.68	−0.64 ± 4.31	0.302
Soft-tissue measurements				
Nasofrontal, °	142.25 ± 9.45	136.37 ± 19.89	−5.89 ± 18.99	0.035*
N-Sn/Prn	3.22 ± 0.34	3.24 ± 0.32	0.01 ± 0.27	0.770
Nasolabial, °	95.02 ± 17.26	95.00 ± 14.09	−0.02 ± 11.82	0.990
TH-Prn, mm	37.64 ± 5.70	36.42 ± 5.69	−1.22 ± 1.97	0.000***
Nasal tip projection, mm	16.53 ± 2.60	16.02 ± 2.30	−0.51 ± 1.26	0.007**
Nasal tip angle, °	71.85 ± 9.69	71.81 ± 8.54	−0.04 ± 6.05	0.963
Nasofacial, °	28.43 ± 4.06	31.04 ± 3.64	2.61 ± 3.13	0.000***
Nasal dorsal, mm	0.08 ± 1.70	−0.70 ± 1.71	−0.62 ± 1.13	0.000***

[a] Paired-samples *t* test for parametric data and Wilcoxon sign rank test for nonparametric data were used. $\bar{X}$, average; $\bar{D}$, difference; *s*, standard deviation.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

decrease was observed in the distance between the nasal dorsum and dorsal line ($p<0.001$).

DISCUSSION

LeFort I maxillary osteotomy is a surgical procedure that has presented successful outcomes over the years and has provided pleasing results for patients in terms of profile changes. However, soft tissues do not show changes that are as predictable as those of the hard tissues. While desired correction of occlusion and function can be obtained after orthognathic surgery, it is also very important for clinicians to be able to predict the soft-tissue changes. Further studies are needed for more accurate prediction of the response of soft tissues, especially the midfacial area, to surgery.

Satisfactory soft- and hard-tissue changes were obtained in all patients included in our study. As only the nasal area was examined, the records of the patients who underwent both maxillary and bimaxillary surgery were also included in the study. Eckhardt and Cunningham[3] reported that the soft-tissue response of patients undergoing single and double jaw surgery was different, but the differences were mostly limited to the lip and chin area. In this study, the maxillary advancement was performed in all patients. Besides, superior repositioning in either anterior, posterior, or both anterior and posterior maxilla was performed in most patients. The average amounts of maxillary advancement and maxillary anterior impaction were calculated as 5.11 mm and 0.85 mm, respectively. In some of the patients, ANS was recontoured and alar cinch suture was applied to minimize the broadening of the alar base.

All postoperative radiographs included in this study were taken after orthodontic debonding and no sooner than 6 months postoperatively. Thus, transitory soft-tissue changes in different stages of healing were eliminated.

The results of this study revealed a significant increase in nasofacial angle and significant decreases in nasofrontal angle, nasal tip projection, and TH-Prn distance. All of these findings were compatible with each other. An increase in the distance between the nasal dorsum and nasal dorsal line indicated superior movement of the nasal tip, and as a result of this movement, the nasal hump decreased. Based on these results, it can be concluded that the nose shows more vertical changes than sagittal changes after maxillary surgery. The nasolabial angle did not show a significant change, and this may be because of a similar amount of upper lip and nose movements.

Tartaro *et al.*[21] showed upward movement of the nose tip after maxillary surgery. They reported that 0.6° to 0.8° of nasal tip rotation could occur for each millimeter of maxillary forward movement. Rauso *et al.*[6] concluded that maxillary anterior repositioning had a great effect on the nose. They reported that the length of the base of the nose (Sn-Prn) decreased by 0.04 to 0.05 mm for each millimeter of maxillary advancement. The study by Esenlik *et al.*[22] is the only study that investigated the changes occurring in the dorsum of the nose. They compared the nasal profile changes of patients who underwent maxillary advancement and maxillary advancement with impaction. They reported that the changes in nasal hump, nasal length, and forward movement of pronasale were more evident in the group with maxillary advancement with impaction. They also found a 0.3-mm nasal length reduction and a 0.24-mm forward movement of the nasal tip for each millimeter of maxillary advancement.

There is no consensus about the changes in nasolabial angle in the literature. There are studies[4,22,23] reporting significant changes of nasolabial angle, whereas others[4,8] did not find any significant changes. In our study, the nasolabial angle did not change despite the upward movement of the nose. We thought that this might be due to accompanying movement of the upper lip. The position of ANS has a great impact on the changes in nasolabial angle. Freihofer[24] reported that the nasolabial angle showed fewer changes if the ANS was recontoured during the surgical procedure. In the literature, the amount of maxillary impaction is reported to have an effect on the nasolabial angle.[4,23] Another reason for not observing changes in nasolabial angle may be the large differences in the amount of vertical maxillary movement performed in the subjects included in this study. Evaluation of long-term changes for future studies may provide more reliable data.

We aimed to evaluate 2-dimensional changes in nasal profile after orthognathic surgery on lateral cephalograms in this study. However, maxillary surgery also causes significant changes in the frontal plane. Further studies are needed with 3-dimentional tomography and volumetric measurements to evaluate all these changes.

CONCLUSION

The results of this study showed that significant nasal changes were seen after maxillary surgery, which were mainly observed at the vertical level. The sagittal relationship between the nose and the lip showed only minor changes. The clinician should take into account these changes during the time of surgery.

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