

Facial soft-tissue changes after anterior maxillary osteotomy: A prospective study

ABSTRACT

Aims: The aim of this study was to analyze and assess the soft-tissue response in patients treated by anterior maxillary osteotomy (AMO) in the postoperative period at 3, 6, and 9 months and to qualitatively assess the outcome of the surgery by the patients.

Patients and Methods: The study included twenty adult healthy patients between 18 and 25 years with skeletal Class II malocclusion and requiring AMO setback for the correction of facial deformity. Preoperative and postoperative lateral cephalograms were taken and soft-tissue changes that occurred following AMO were compared at 3, 6, and 9 months postoperatively. The stability and acceptance of the soft-tissue changes were analyzed, and the patient's acceptance for the soft-tissue changes was measured on the surgical rating scale (SRS).

Results: All the soft-tissue parameters showed noticeable changes following AMO. Statistically significant difference was observed with nasolabial angle, upper lip, and lower lip inclination. All the patients were moderately satisfied with the outcome of the surgery.

Conclusion: This study aims in quantifying the soft-tissue changes following the AMO and the quality of the changes were recorded based on the SRS by the patients. Although there are changes associated with all the parameters assessed, significant differences was observed in nasolabial angle, upper lip, and lower lip inclination. The surgeon must be aware of the soft-tissue adaptation following the surgery for better outcomes.

Keywords: Anterior maxillary osteotomy, Class II malocclusion, Cupar's method, soft-tissue changes, surgical rating scale

INTRODUCTION

Orthognathic surgery is considered to be the principal tool for correcting severe dentofacial skeletal discrepancies. It is not only important to achieve functional occlusion but also to improve the patient's profile and aesthetics which improves the patient's quality of life. It is important to be able to predict the postsurgical profile accurately in the planning process before treatment.^[1] The anterior maxillary osteotomy (AMO) was the workhorse for the correction of skeletal malocclusion before Le Fort I Osteotomy. AMO is indicated for the correction of dentoalveolar protrusion, correction of an anterior open bite, excessive inclination, and excessive vertical, or anteroposterior development of the maxillary dentoalveolar process in patients where occlusion of posterior teeth is acceptable.^[2] It is not only important to achieve good occlusion but the satisfactory aesthetic outcome is also important. Proper surgical planning and knowledge

about the effects of osteotomy of the maxilla on soft tissues are necessary to achieve both functional and aesthetic results. Thus, the addition of soft-tissue evaluation to lateral cephalometric analysis is needed. Furthermore, many studies have evaluated the precision of these computerized programs concerning the prediction of postoperative profile following different surgical procedures.^[3-5] With regard to

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the surgical outcome, there have been several reports on the relationships between soft/hard tissue based on linear and angular measurements.^[6] The purpose of this study is to evaluate the soft-tissue changes in patients with class II malocclusion treated by AMO setback on lateral cephalogram at 3,6, and 9 months compared with the preoperative values, and to assess the patient's acceptance of the outcome based on the surgical rating scale (SRS).

PATIENTS AND METHODS

This is a prospective study conducted on 20 healthy patients with protruded maxilla who requires surgical correction by AMO setback. Patients with cleft lip and palate and other craniofacial anomalies, previous trauma to dento-osseous structures, patients with previous soft-tissue surgery, and medically compromised patients were excluded from the study.^[7] The maxillary excess in all cases was treated by anterior segmental maxillary osteotomy using the Cupar method by extraction of maxillary 1st Premolar. All 20 patients underwent preoperative and postoperative orthodontic treatment. Preoperative and postoperative records consisted of photographs [Figures 1-4] and lateral cephalograms [Figures 5 and 6]. Lateral cephalograms were analyzed using cephalometrics for orthognathic surgery.^[8] Preoperative and postoperative assessment was done on lateral cephalogram with the following landmarks. Institutional Ethical Committee Clearance was obtained with reference no MNRDC/EC/027/2019 - 2020 : dated on 23/10/2019 Consent form for all the patients who were included in the study was obtained.

- Hard tissue landmarks:
 - Reference planes constructed were FH– plane [H line] and nasion vertical plane (Vline), which were perpendicular to FH– plane



Figure 1: Preoperative frontal view of a patient with skeletal class II malocclusion

- Incision anterior (IA)– The most prominent point on the maxillary incisor as determined by a tangent to the incisor passing through subspinale
- Incision anterior (IB)– The most prominent point on the mandibular incisor as determined by a tangent to the incisor passing through supramentale.
- Soft-tissue landmarks:
 - Soft tissue nasion (N')– Deepest point on the concavity overlying the area of frontonasal suture
 - Pronasale (Prn)– The most prominent point on the nose tip
 - Columella point (Cm)– The most anterior point on columella of nose
 - Subnasale (Sn)– A point located at the junction between the lower border of the nose and the beginning of the upper lip at the mid-sagittal plane
 - Labrale superius (Ls)– Most prominent point on the vermilion border of the upper lip in the mid-sagittal plane
 - Stomion (Sto)–Imaginary point at crossing of vertical facial midline and the horizontal labial fissure between gently closed lips, with teeth in a natural position
 - Labrale inferius (Li)– Most prominent point on vermilion border of the lower lip in the midsagittal plane
 - Soft-tissue point 'B' (B')– The point at the deepest concavity between the Labrale inferius and soft-tissue pogonion
 - Soft tissue pogonion (Pg')– Most prominent or anterior point on the soft tissue chin in the mid-sagittal plane.

Clinical assessment on the patient:

- Lateral aspect
 - Upper lip protrusion: Ls to V line
 - Lower lip protrusion: Li to V line
 - Nasolabial angle: Cm-Sn-L.



Figure 2: Preoperative lateral view of patient with skeletal class II malocclusion



Figure 3: Postoperative frontal view after AMO setback procedure



Figure 4: Postoperative lateral view after AMO setback procedure



Figure 5: Preoperative cephalogram of a patient with soft tissue landmarks

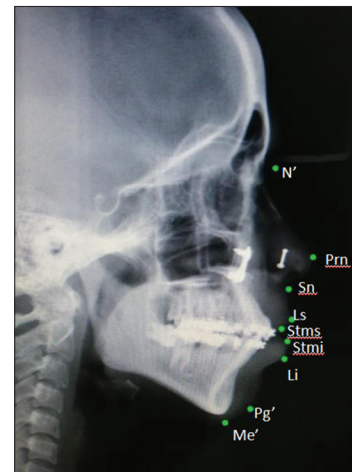


Figure 6: Postoperative cephalogram of a patient with soft tissue landmarks

Table 1: Surgical rating scale/score (SRS)

Score	Patient acceptance
1	Mild acceptance
2	Moderate acceptance
3	High acceptance

- Frontal aspect
 - Nasal width: Alar to alar width
 - Lip width: Commissure to commissure.

Surgical rating scale

SRS enables the surgeon or patient to quantify surgical outcome. Thus, the patient's acceptance for the soft-tissue changes was measured using the SRS at 6 months postoperatively [Table 1].^[9]

RESULTS

Patients were evaluated preoperatively and postoperatively at 3, 6, and 9 months. Parameters assessed were upper lip protrusion, lower lip protrusion, nasolabial angle, nasal width, and lip width.

Entire data has been tabulated and statistical analysis were performed using SPSS version 23. Descriptive, Paired *t*-test was done for inter duration comparison.

Changes in soft-tissue were observed in frontal and profile aspects. Evaluation of soft-tissue changes was done using cephalometric analysis [Table 2]. Statistical analysis demonstrated significant postoperative changes.

Upper lip protrusion (Ls-V)

From the most prominent point on the vermillion border of the upper lip in the mid-sagittal plane (Ls) to nasion vertical plane (V).

In the present study, the mean preoperative upper lip proclination recorded was 7.10 mm. At the 3rd-month postoperative period, the mean upper lip proclination reduced to 5.40 mm. At the 6th-month postoperative period, the mean upper lip proclination reduced to 5.25 mm. No significant difference in the mean upper

lip proclination was observed between 6 and 9 months. Thus, the change observed was stable after 6th month. There was a decrease in the upper lip and upper incisor proclination. There was a statistically significant difference noted in a decrease in upper lip proclination after AMO procedure ($P < 0.001^{**}$).

Lower lip protrusion (Li-V)

From the most prominent point on vermillion border of the lower lip in the mid-sagittal plane (Li) to nasion vertical plane (V).

In the present study, the mean preoperative lower lip proclination recorded was 5.40 mm. At the 3rd month postoperative period, the mean lower lip proclination reduced to 4.10 mm. In the 6th month postoperative period, the mean lower lip proclination reduced to 3.90 mm. No significant difference in the mean lower lip proclination was observed between 6 and 9 months. Thus, the change observed was stable after 6th month. There was a statistically significant difference noted in a decrease in lower lip proclination after the AMO procedure ($P < 0.001^{**}$).

Nasolabial angle (Cm-Sn-Ls)

The most anterior point on columella of nose (Cm) to– A point located at the junction between the lower border of nose and beginning of upper lip at the mid-sagittal plane (Sn) to the most prominent point on the vermillion border of the upper lip in the mid-sagittal plane. (Ls).

The mean preoperative nasolabial angle recorded was 90.70°. At the 3rd-month postoperative period, the mean nasolabial angle increased to 104.80°. At 6th-month postoperative period, the mean nasolabial angle increased to 104.90°. No significant difference in the mean nasolabial angle was observed between 6 and 9 months. Thus, the change observed was stable after 6th month. There was a statistically significant difference noted in the increase in nasolabial angle after the AMO procedure ($P < 0.001^{**}$).

Table 2: Mean values of the parameters recorded preoperatively and postoperatively

	Preoperative	Postoperative		
		3 months	6 months	9 months
Upper lip proclination (mm)	7.10	5.40	5.25	5.10
Lower lip proclination (mm)	5.40	4.10	3.90	3.85
Nasolabial angle (°)	90.70	104.80	104.90	105.70
Nasal width (mm)	24.55	24.625	24.650	24.650
Lip width (mm)	39.35	39.450	39.475	39.475

Table 3: Scoring of SRS at 6th month postoperative period

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18
Score	2	2	1	3	2	3	3	2	1	3	2	2	3	3	3	2	2	3

Nasal width: Alar to alar

In the present study, the preoperative mean nasal width recorded was 24.55 mm. In the 3rd-month postoperative period, the mean nasal width recorded was 24.62 mm. In the 6th and 9th month postoperative period, the mean nasal width recorded was 24.65 mm. There was no statistically significant difference noted in the nasal width after the AMO procedure ($P = 0.083$).

Lip width: Commissure to commissure

The preoperative mean lip width recorded was 39.35 mm. At the 3rd-month postoperative period, the mean lip width recorded was 39.45 mm. In the 6th- and 9th month postoperative period, the mean lip width recorded was 39.47 mm. There was no statistically significant difference observed in the lip width after the AMO procedure ($P = 0.104$).

Surgical rating scale

The patient’s acceptance for the soft-tissue changes measured using the SRS mentioned below at 6 months postoperatively [Table 3].

The average score is 2.3, i.e., most of the patients are moderately satisfied with the soft-tissue changes following AMO. Thus, the SRS enables the surgeon to evaluate if any new techniques or interventions are required to improve the surgical technique for high patient acceptance.

DISCUSSION

Orthodontics alone in patients with skeletal discrepancy leads to compromised results in patients with greater magnitude of discrepancy. In such cases, orthodontics along with surgical correction provides both aesthetically and functionally acceptable results. AMO is a simple procedure in the management of deformities of the dentoalveolar region with stable occlusion. AMO procedures have shown significant changes in soft tissues with aesthetically pleasing results. Various studies were carried out to evaluate soft-tissue changes postoperatively with the movements of underlying hard tissue structures.

The randomized prospective study was designed to evaluate the facial soft-tissue changes after the AMO setback procedure. The study was conducted among 20 patients with class II malocclusion. The parameters taken for the study were upper lip protrusion, lower lip protrusion, nasolabial angle, nasal width, and lip width.

The present study recorded a reduction in the upper lip and lower lip proclination which is in accordance with Harshitha *et al.*^[10] and Ayoub *et al.*^[11] This is because of the backward displacement of the hard tissues.

In the present study, lower lip and lower incisor protrusion decreased but not as significant as the upper lip and upper incisor changes which correlates with Brock *et al.* Correlation between the upper lip and lower lip protrusion was observed. An increase in upper lip protrusion was correlated with an increase in lower lip proclination. Correlation between Ls (the most prominent point on the vermilion border of the upper lip in the mid-sagittal plane) to FH (the most prominent point on the vermilion border of the upper lip in the mid-sagittal plane to Frankfort horizontal plane) and lip thickness was observed. An increase in Ls to FH is correlated with an increase in lip thickness.

Brock and colleagues showed, in patients with maxillary protraction, that retraction of the upper incisor by orthodontic treatment induced backward displacement of both the upper and lower lips. Thus, the backward displacement of upper incisors may influence both upper and lower lips.^[12]

In the present study, the increase in nasolabial angle following the AMO procedure correlates with Legan and Burstone.^[13] This is because of the movement of soft-tissue point Ls (The most prominent point on the vermilion border of the upper lip in the midsagittal plane) and Sn (A point located at the junction between the lower border of the nose and the beginning of the upper lip at midsagittal plane). The movement of soft-tissue point Ls is related to maxillary incisor retraction and also to the anterior maxillary segment retrusion. In a case report, Natao Suda *et al.*,^[14] have stated that the AMO causes an increase in the value of nasolabial angle with a mean of + 3.5° to 11.0°.

In the present study, the widening of the nasal width was observed in 35% of the patients. The widening of the nasal base is due to the elevation of the mucoperiosteum from the anterior surface of the maxilla, along with the muscles stabilizing the alar region. The alar cinch suture minimizes the alar base widening.

Betts and colleagues studied the soft-tissue response to maxillary surgery and noted that soft-tissue changes may be more affected by the type and position of the soft-tissue incision and methods used in closure than by the surgically induced hard tissue changes.^[15]

The soft-tissue changes associated with the maxillary segmental setback osteotomy include an increase in the

nasolabial angle because of posterior lip rotation around subnasale, reduction in upper, and lower lip proclination due to setback of an anterior portion of maxilla and retrusion of maxillary incisors, increase in nasal width, decrease in lip width, and lip thickness.

Thus, the goal of the surgery must be to improvise the soft-tissue aesthetics. Hence, proper preoperative surgical planning with soft-tissue analysis specific to lip and nasal morphology in patients undergoing orthognathic procedures is very important.

The quality of the changes recorded on the SRS by the patients shows moderate acceptance, thus enabling the surgeon to evaluate if any new modifications or interventions are required to improve the surgical technique for high patient acceptance.

CONCLUSION

Soft-tissues always envelop the hard tissues and hence, there exist soft-tissue changes with the shift in the underlying hard tissues. The study aimed in both quantitatively and qualitatively assessing the soft-tissue changes after AMO setback. There was a significant improvement in upper lip protrusion, lower lip protrusion, nasolabial angle following AMO setback. Surgeons must be aware of preexisting deformities to control the soft-tissue changes. The surgeon should predict the soft-tissue changes after AMO to explain the outcome to the patient and also for the better results.

Declaration of patient consent

The authors declare that they have obtained consent from patients. Patients have given their consent for their images and other clinical information to be reported in the journal. Patients understand that their names will not be published and due efforts will be made to conceal their identity but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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