Evaluation of Soft and Hard Tissue Changes after Anterior Segmental Osteotomy

ABSTRACT
Objective: To determine the relationship between the changes of soft and hard tissues after anterior segmental osteotomy and to evaluate these changes using cephalometric and photometric analyses.

Materials and Methods: Ten patients aged 18-30 years who underwent anterior segmental osteotomy were included in the study. Preoperative and postoperative records consisted of lateral cephalogram and frontal and lateral photographs. Postoperative measurements were taken six months after surgery.

INTRODUCTION
Aesthetics plays an important role in modern society. People have come to understand the contribution of well aligned teeth, to beauty of face. Gone are the days when people feared knife to modify god’s creation. Osteotomies in association with orthodontics are efficient means to correct skeletal protrusion.

Facial harmony and balance are determined by the facial skeleton and its soft tissue drape. The architecture and topographic relationships of the facial skeleton form a “foundation” on which the aesthetics of the face is based. However, it is the structure of the overlying soft tissues and their relative proportions that provide the visual impact of the face.

Osteotomies of the facial skeleton can alter the form and function of facial structures. Alteration in face after these surgical procedures is not only confined to hard tissues. A degree of soft tissue alteration was noted for each bony movement.

There have been many reports in the literature of soft and hard tissue changes after orthognathic surgery but very few about anterior segmental surgery of maxilla and mandible [1]. Segmental maxillary surgery was performed for many years before total maxillary osteotomy became popular. Anterior maxillary osteotomy allows for improvement of occlusion, but often at the expense of dental stability and soft tissue changes [2].

First reported anterior maxillary segmental osteotomy was performed in 1921 by Cohn-Stock. The procedure has since been modified with variation in incision design depending on the desired osseous movement [2]. Single stage set-back osteotomy through a vestibular approach was first described by Wassmund. Wunderer presented an important improvement of Wassmund’s technique in that he recommended a predominantly palatal approach, which simplified the procedure. Bell introduced the concept of ‘down-fracturing’ in which the anterior segment is approached through a horizontal vestibular incision [3].

First description of an anterior subapical mandibular osteotomy was by Hullihan in 1849. Hofer made this procedure popular by recommending its use for dentoalveolar set-back as well as advancement. Kole advocated this osteotomy to treat anterior skeletal open bite by interposition of a bone graft taken from the lower border of the mandibular symphysis [3].

Variation in individual skeletal patterns and consequent variation in orthodontic, surgical and suturing procedures may account for some of this variability. The tonicity of the facial musculature can vary with skeletal patterns and influence the integumental response to hard tissue movement.

RESULTS: Statistical analysis showed changes in both soft and hard tissue parameters. Changes were not uniform for all the parameters. Upper lip and upper incisor protrusion showed very large effect size whereas nasal tip inclination showed small effect and mentolabial angle showed no effect.

CONCLUSION: Skeletal protrusion pose problem to orthodontists as they can’t be corrected by orthodontics alone. Anterior segmental osteotomy in association with orthodontia is the choice of treatment. Anterior segmental osteotomy allows for functional and aesthetical correction with good success rate and minimal complication.

Keywords: Anterior segmental osteotomy, Frontal and lateral photographs, Lateral cephalogram, Functional and aesthetic correction
of the compensation that is occurred due to skeletal deformity, align upper and lower teeth and co-ordinate upper and lower arch. In postoperative orthodontic treatment residual space distal to canine is closed, minor leveling and alignment is done to correct the occlusion. Preoperative and postoperative records consisted of lateral cephalogram and frontal and lateral photographs. Lateral cephalograms were analysed using Cephalometrics for orthognathic surgery (COGS). COGS system describes horizontal and vertical portion of the facial bones by use of constant versatile system. Preoperative cephalometric measurements were taken before starting orthodontic treatment. Postoperative measurements were taken six months after surgery. Preoperative and postoperative measurements were carried out by the author. Reference plane constructed were FH – plane [H line] and nasion vertical plane (V line), which were perpendicular to FH – plane. Following landmarks were used [Table/Fig-3].

**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 nose and beginning of upper lip at mid-sagittal plane.

**Labrale superius (Ls)** – Most prominent point on the vermilion border of upper lip in the mid-sagittal plane.

**Stomion (Sto)** – Imaginary point at crossing of vertical facial midline and horizontal labial fissure between gently closed lips, with teeth in natural position.

**Labrale inferius (Li)** – Most prominent point on vermilion border of lower lip in the mid-sagittal plane.

**Soft tissue point ‘B’ (B’)** – The point at the deepest concavity between the Labraleinferius and soft tissue pogonion.

**Soft tissue pogonion (Pg)** – Most prominent or Anterior point on the soft tissue chin in mid-sagittal plane.

**Hard tissue landmarks**

**Incision anterius (IA)** – The most prominent point on maxillary incisor as determined by a tangent to the incisor passing through subspinale.

**Incision anterius (IB)** – The most prominent point on the mandibular incisor as determined by a tangent to the incisor passing through subspinale.

In lateral aspect 4 linear and 3 angular measurements were evaluated [Table/Fig-4].

1. Upper lip protrusion: Ls to V line
2. Upper incisor protrusion: LA to V line
Preoperative and postoperative changes were calculated by subtracting the corresponding values for each patient. Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Student t-test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group. Wilcoxon signed rank test has been used to find the significance of parameters on non-parametric scale between Pre-op and post-op variables. Effect size is performed to find the effect of intervention.

Statistical analysis showed changes in both soft and hard tissue parameters [Table/Fig-6,7]. Changes were not uniform for all the parameters. Few parameters had significant changes where as others had suggestive significance or moderate significance.

Upper lip protrusion(mm) Pre-operative 21.55 ±6.53 Post-operative 17.25 ±4.69 Delta 4.30 ±3.16 0.002** Effect size 1.36(VL)

Upper incisor protrusion(mm) Pre-operative 15.15 ±5.17 Post-operative 7.10 ±4.09 Delta 8.05 ±3.27 <0.001** Effect size 2.46(VL)

Lower lip protrusion(mm) Pre-operative 15.10 ±7.2 Post-operative 12.30 ±5.91 Delta 2.80 ±3.74 0.042* Effect size 0.75(M)

Lower incisor protrusion(mm) Pre-operative 6.50 ±3.17 Post-operative 4.80 ±2.74 Delta 1.70 ±2.06 0.028* Effect size 0.83(L)

Nasolabial angle(deg) Pre-operative 93.40 ±22.71 Post-operative 101.30 ±21.5 Delta ±7.90 ±10.85 0.032* Effect size 0.73(M)

Nasal tip inclination(deg) Pre-operative 60.60 ±11.1 Post-operative 66.80 ±23.77 Delta ±6.20 ±21.01 0.683 Effect size 0.3(S)

Mentolabial angle(deg) Pre-operative 96.25 ±23.9 Post-operative 94.20 ±16.92 Delta 2.05 ±12.28 0.594 Effect size 0.17(N)

** Strongly significant (p-value : p<0.01)
+ Suggestive significance (p-value: 0.05 < p <0.10)
Very large effect (VL) d>1.20
Large effect (L) 0.80<d<1.20
Moderate effect (M) 0.50 <d<0.80
Small  effect (S) 0.20 <d<0.50
d<0.20

3. Lower lip protrusion: Li to V line
4. Lower incisor protrusion: IB to V line
5. Nasolabial angle: Cm-Sn-Ls
6. Nasal tip inclination: N-Prn to H line
7. Labiomental angle: Li-B-Pg

In frontal aspect 4 linear measurements were evaluated [Table/Fig-5].
1. Nasal width: alar to alar
2. Lip width: commissure to commissure
3. Philtrum length: subnasale to stomion
4. Vermilion length: top of cuspid bow to stomion

**DISCUSSION**

Various studies have been carried out to evaluate the postoperative changes. Mild alteration in the surgical techniques yields aesthetically pleasing results. To control the soft tissue changes associated with maxillary surgery, the surgeon must be aware of any pre-existing deformity, the anticipated soft tissue adaptation to the surgical procedure being planned, and the importance of the effects of orofacial muscles in form, function, and aesthetics [4].

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 [5]. For example, the horizontal incision in the upper labial vestibule commonly used to gain access to the maxilla causes shortening of the lip with loss of vermilion and a decrease in lip thickness, whereas vertical incisions with a tunneling approach and palatal flap for the same surgical procedure show minimal postoperative lip changes [6].

The importance of muscle repositioning following superior repositioning of the maxilla was stressed by many investigators [7-9]. They state that the muscles detached during stripping of the periosteum required for maxillary surgery shorten and retract laterally. The muscles reattach in this position if they are not reapproximated at the time of surgery. The lateral movement of the muscles and subcutaneous tissues causes the alar base to flare and the upper lip to thin. The loss of visible vermilion may be a result of other causes. These include a rolling under vermilion of the upper lip secondary to an incision made high in the vestibule with associated scarring and retraction and inclusion of large amounts of tissue during closure. This loss of vermilion is especially unattractive in those individuals with thin lips [4].

The upper lip closely follows the movement of the maxillary incisor in the horizontal plane. The lip follows approximately 40% of the vertical maxillary change. This lip shortening is accentuated with combined anterior and superior maxillary movements. The amount of vertical soft tissue change increases progressively from the nasal tip to Stomion superius, with loss of vermilion [4].

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, lengthening of the upper lip, decrease in interlabial gap, uncurling and retraction of the lower lip, prominent nasal tip projection, increase in nasal width [8,10,11], decrease in lip width [8,10,11] and lip thickness [6,8,10,11].

One of the important concerns of oral surgeon and orthodontist should be preoperative distance between Labralesuperius and stomion. In past this was the most overlooked measurements, yet most talked by patients postoperatively. Decrease in lip length was initially thought to be due to intrusion of anterior segment of maxilla. For a given amount of maxillary intrusion, stomion moves farther superiorly than Labralesuperius, the distance between these two points would decrease, resulting in vertical upper lip thinning. This
response was not only due to vertical movement but also due to horizontal movement [12].

While significant advances in the stability and predictability of maxillary surgery have been made over the years, minimal attention has been focused on the influence of maxillary surgery on the nose and facial soft tissues. Tissue dissection and horizontal bone cutting performed from the inferior aspect of the aperture performis minimize unfavorable nasal changes [1]. Maxillary setback procedures result in loss of nasal tip support because of posterior movement of the anterior nasal spine and the bony support area around the piriform aperture [4]. Several surgical techniques have been suggested which help to control the detrimental soft tissue changes associated with maxillary surgery. Changes in facial aesthetics and occlusion following orthognathic surgery depend highly on the stability achieved following surgery [4].

In our study we have used following techniques to achieve aesthetically pleasing results. The alar cinch sutures marginally increase postoperative nasal width resulting in acceptable postoperative nasal width. Contouring of the anterior nasal spine supports the columella and Septoplasty prevents postoperative buckling of nasal septum. We noticed that adequate elevation of periosteum and replacement of muscle attachment resulted in minimal postoperative oedema and acceptable postoperative changes.

Various authors have evaluated soft and hard tissue changes after anterior segmental osteotomy and have concluded that highest correlation coefficient was obtained between the soft and hard tissue changes in the upper lip region [13,14] and minimal changes in nasal and genial landmarks [15]. Reduction of labial prominence with an increase in nasolabial angle and philtrum length [15,16], upper incisor and vermillion length decreases [16].

Rajan Gunasheelan et al., did a retrospective study in 103 patients to evaluate intraoperative and postoperative complication in anterior segmental osteotomy and concluded that 30% of the patients in 103 series had complications attributed to different causes. Most commonly observed were soft tissue injuries (43.4%), dental complication (36.6%) and other complication attributed for 20%. Mechanical and technical complications depend to a great extent on the technique employed. Anterior segmental osteotomy is safe and reliable in hands of skilled surgeon [17].

CONCLUSION

Anterior segmental osteotomy allows for improvement of occlusion and facial aesthetics which cannot be achieved by orthodontic treatment alone. Versatility and reliability of the procedure helps correcting various dentoalveolar defects. Complications associated with the procedure are rare.

REFERENCES