

## SOFT TISSUE CHANGES AFTER ORTHOGNATHIC SURGERY : A STUDY

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### ABSTRACT

**Aim and objective:** The main aim and objectives of this study was to determine the changes in the facial soft tissue profile following orthognathic surgery, to evaluate eventual treatment effects on stability of facial aesthetics and degree of predictability of these changes. **Materials and method:** 15 numbers of patients underwent with le fort I, anterior maxillary osteotomy, genioplasty and bimaxillary surgery. The alar base cinch suture and the V-Y closure techniques were used in each maxillary procedure. The criteria applied included an average follow-up of 6 months post-operatively. **Results:** In this study preoperative and postoperative cephalometric tracing were compared to analyze the soft tissue profile changes in relation to hard tissue changes in both upper and lower lip and chin regions after double jaw surgery. Only horizontal changes were analyzed for which an X-Y coordinate system was used. The upper lip responded variably to the direction and amount of maxillary positioning. The predictability and the significance of changes of soft tissue in relation to hard tissue are variable as it reaches towards the nose. **Conclusion:** It is important for the clinician to realize that numerous factors of variability exist so that he can understand that the soft-tissue profile will sometimes deviate quite markedly from what is expected, in spite of careful planning.

### INTRODUCTION

The principal goal of orthognathic surgery is the establishment of a balanced and stable dentoskeletofacial complex. One of the objectives to this end is the achievement of an esthetically pleasing facial soft tissue envelope. This mandates that the surgeon be acutely aware of the dentalskeletal components of the face. Close collaboration between surgeon and orthodontist should allow for the correction of dentoskeletofacial deformities in order to improve function while optimizing facial esthetics.<sup>1</sup> Survey of the human race even from prehistoric era and analyzing archeological artifacts show awareness of beauty and facial esthetics. The study of facial esthetics has been primarily the domain of painters, sculptors and philosophers. In the 13<sup>th</sup> century Thomas Aquinas states a fundamental truth of esthetics "the senses delight in things duly proportioned". St. Thomas was expressing the direct and very often measurable relationship that exists between beauty and mathematics, a relationship that applies to both natural beauty and art.<sup>2</sup> Despite many theoretical advantages of surgery for correction of dentoalveolar and skeletal disharmony; many orthodontists still view such treatment as radical, dangerous and unpredictable. Only during the last decade has the concept of surgical orthodontics won acceptance among Oral & Maxillofacial surgeons and

Orthodontists. Until recent years, surgical correction was focused exclusively on the mandible, but it frequently failed because the clinical manifestations of many severe adult dentofacial deformities defy correction by a single surgical procedure. However with the introduction of anterior and posterior maxillary osteotomy, total maxillary osteotomy, anterior mandibular subapical osteotomy and genioplasty; restoration of occlusal balance and facial harmony was attainable practically in all cases.<sup>3</sup>

### AIM AND OBJECTIVE

The aim and objective of this study was to determine the changes in the facial soft tissue profile following orthognathic surgery, to evaluate eventual treatment effects on stability of facial aesthetics and degree of predictability of these changes, and to analyze the extent of improvement in the postoperative facial soft tissue profile.

### MATERIALS AND METHOD

The study was done on 15 patients who had been treated at the Department of Oral & Maxillofacial Surgery, Manipal College of Dental Sciences, Mangalore, India during 2004-2007 period. The criteria applied included an average follow-up of 6 months post-operatively. Patients underwent

orthognathic surgeries with le fort I, anterior maxillary osteotomy, genioplasty and bimaxillary surgery. The alar base cinch suture and the V-Y closure techniques were used in each maxillary procedure. All patients received antibiotics on the day of surgical treatment and 5 to 7 days postoperatively.

## RESULTS

In this study preoperative and postoperative cephalometric tracings were compared to analyze the soft tissue profile changes in relation to hard tissue changes in both upper and lower lip and chin regions after double jaw surgery. Only horizontal changes were analyzed for which an X-Y coordinate system was used. The X-axis was determined as a line rotated 7 degrees upward from SN line through N. This line is called “constructed horizontal plane” which was used as a reference line for this study.<sup>4</sup> A perpendicular line was dropped from point N for hard tissue analysis and from point G for soft tissue analysis to quantify changes in horizontal direction.<sup>4</sup> Soft tissue analysis by Legan and Burstone was used for standards of evaluation of results.<sup>7</sup> Soft tissue and hard tissue landmarks are depicted in Figure 1 and 2 respectively.

SOFT TISSUE LANDMARKS:		HARD TISSUE LANDMARKS:	
Glabella (G)	Glabella (G)	Sella (S)	Sella (S)
Columella Point (Cm)	Columella Point (Cm)	Nasion (N)	Nasion (N)
Subnasale (Sn)	Subnasale (Sn)	Anterior Nasal Spine (ANS)	Anterior Nasal Spine (ANS)
Labrale Superius (Sim)	Labrale Superius (Li)	Point A	Point A
Stomion Inferius (Stm)	Stomion Superius (Stm)	Upper Incisal Edge (UIE)	Upper Incisal Edge (UIE)
Stomion Inferius (Stm)	Stomion Inferius (Stm)	Lower Incisal Edge (LIE)	Lower Incisal Edge (LIE)
Labrale Inferius (Li)	Labrale Inferius (Li)	Point B	Point B
Soft Tissue Pogonion (Pg <sup>1</sup> )	Soft Tissue Pogonion (Pg <sup>1</sup> )	Pogonion (Pg)	Pogonion (Pg)
Soft Tissue Gnathion (Gr <sup>1</sup> )	Soft Tissue Gnathion (Gr <sup>1</sup> )	Gonion (Go)	Gonion (Go)
Soft Tissue Menton (Me <sup>1</sup> )	Soft Tissue Menton (Me <sup>1</sup> )	Gnathion (Gn)	Gnathion (Gn)
		Menton (Me)	Menton (Me)

Figure 1: Soft tissue landmarks Figure 1: Hard tissue landmarks

### STUDY 1:

Two measurements Shift UIE and Shift Ls were developed to describe the stability of surgical treatment and to relate the movement of underlying skeletal structure to resultant soft tissue profile changes. Point UIE was defined as the point corresponding to upper incisal edge. Point Ls was defined as a point indicating mucocutaneous border of the upper lip. Shift UIE was defined as the millimeter movement

of the incisal edge of the maxillary incisor along a perpendicular dropped from X-axis. Shift Ls was defined to relate movement of upper lip to that of maxillary incisor with respect to a line dropped between Subnasale and Pogonion.

### STUDY 2:

Shift LIE and Shift Li were compared to know the soft tissue profile changes of the lower lip corresponding to lower incisor movement. Point LIE was defined as the point corresponding to lower incisal edge. Point Li was defined as a point indicating mucocutaneous border of the lower lip. Shift LIE was defined as the millimeter movement of the incisal edge of mandibular incisor along a perpendicular dropped from X-axis. Shift Li was defined to relate movement of lower lip to that of mandibular incisor with respect to a line dropped between Subnasale and Pogonion.

### STUDY 3:

Shift N-A and Shift G-Sn were compared to know the soft tissue profile changes occurring with respect to the hard tissue changes at the Subnasal area. Point A (Subspinale) was defined as the deepest point in the midsagittal plane between the anterior nasal spine and prosthion. Subnasale (Sn) was defined as the point at which the nasal septum merges with the upper cutaneous lip in the midsagittal plane. Shift N-A was defined as the millimeter movement of point A along a perpendicular dropped from X-axis. Shift G-Sn was defined as the millimeter movement of subnasale along a perpendicular dropped from G.

### STUDY 4:

Shift N-Pg and Shift G-Pg<sup>1</sup> were compared to know the soft tissue changes occurring corresponding to the movement of hard tissue chin. Pogonion (Pg) was defined as the most anterior point in the midsagittal plane of the contour of the chin. Soft tissue pogonion (Pg<sup>1</sup>) was defined as the most anterior point in the midsagittal plane on soft tissue chin. Shift N-Pg was defined as the millimeter movement of point Pg along a perpendicular dropped from X-axis. Shift G-Pg<sup>1</sup> was defined as the millimeter movement of soft tissue chin along a perpendicular dropped from G.

Table 1: Descriptive Statistics of Study 1

Variable	No.	Minimum	Maximum	Mean	Std. Deviation
NUE	15	4.00	6.00	5.0933	0.70959
LS	15	3.00	5.10	4.1267	0.65407
RNUELS	15	0.60	0.86	0.7993	0.06584

**Table 2: Descriptive Statistics of Study 2**

Variable	No.	Minimum	Maximum	Mean	Std. Deviation
NUE	15	1.00	6.50	4.5467	1.50136
LI	15	1.00	5.10	3.3467	1.30212
RNLELI	15	0.50	1.00	0.7780	0.15817

**Table 3: Descriptive Statistics of Study 3**

Variable	No.	Minimum	Maximum	Mean	Std. Deviation
NA	15	4.00	5.60	4.8467	0.68020
GSN	15	2.50	4.80	3.7600	0.85423
RNAGSN	15	0.60	0.90	0.7480	0.09167

**Table 4: Descriptive Statistics of Study 4**

Variable	No.	Minimum	Maximum	Mean	Std. Deviation
NPG	15	2.00	6.00	4.0000	1.33631
GPG	15	1.50	5.00	3.2667	1.17817
RNPGGPG	15	0.66	1.00	0.8007	0.09020

## Discussion

The goals of orthognathic surgery in most cases, is not only to correct the malocclusion involving the stomatognathic function but also to improve facial esthetics. Therefore it is important for the clinician to be able to forecast the soft tissue changes resulting from alteration of the hard tissue. This study was done to compare and analyze soft tissue profile changes in relation to hard tissue changes after orthognathic surgeries. These changes can be studied by cephalometric tracings. This study was aimed at analyzing the horizontal changes as they were more productive and predictable according to various authors.<sup>6</sup>

The study group consisted of fifteen adult patients (six male and nine female) who had undergone double jaw orthognathic procedures for various dentofacial deformities. Presurgical orthodontics was carried out in required cases. Ten cases underwent bilateral sagittal split osteotomy along with le fort-1 surgery, five cases underwent with anterior maxillary osteotomy along with genioplasty.

The results showed a mean change of  $0.799 \pm 0.0658$  for shift Ls/ shift UIE which concludes a soft tissue change of 0.799 for every one millimeter of hard tissue change. Paul Lines *et al*<sup>8</sup> in 1974 reported soft tissue change of 0.67 mm per millimeter of underlying hard tissue change while comparing the points I and VB. Alan C J *et al*<sup>9</sup> in 1992

concluded that in cases of posteriorly displaced maxilla upper lip moved back by the ratio of 0.33:1 to 0.76:1. Bell<sup>10</sup> in 1973 concluded that after anterior segmental osteotomy of maxilla a mean change of -0.68:1 was obtained at point Ls and UIE. Mansour *et al*<sup>11</sup> in 1983 described the soft tissue changes associated with maxillary impaction reporting a ratio of Upper lip (H) 0.89:1.

Schendel *et al*<sup>12</sup> in 1976 described soft tissue changes associated with maxillary setback which showed a mean change of 0.76:1 Ls:Incisor in cases of vertical maxillary excess. Radney, Jacobs<sup>13</sup> in 1981 showed a mean change of -0.67:1 Ls:Is in upper lip. McCance *et al*<sup>14</sup> in 1993 in their 3-D Analysis of facial soft tissue changes described a change of upper lip (H) in a ratio of 1:1.

The results of our study complement the aforementioned findings by showing the correlation between movements of upper lip to that of upper incisal edge. Since in all the cases maxillary alveolar setback was done in conjunction with maxillary impaction of the maxilla a ratio of 0.788:1 was obtained which is a significant correlation. A mean change of  $0.77 \pm 0.158$  was seen when shift at point Li and LIE were compared.

Lines and Steinhauser<sup>8</sup> (1974) in their study have shown a mean change of 0.75:1 (Li:Li) following anterior mandibular subapical osteotomy. Proffit and Epker<sup>15</sup> (1980) concluded

that a change of -0.67:1 (Li:Li) occurred at the area of lower lip following mandibular alveolar setback. Lew *et al*<sup>16</sup> (1989) noted a change of -0.71:1 (Li:Li) in a similar type of study. In this study, there is a significant correlation between the change of the shift of point Li and LIE compared to previous studies. This can be attributed to the fact that the sample also included cases of mandibular advancements where the soft tissue of lip follows the lower incisal edge. A mean change of  $0.748 \pm 0.916$  was seen when shift at point A and Subnasale were compared.

Rosen<sup>17</sup> (1988) in his study noted that subnasale moved in a ratio of 0.51:1 with respect to point A. Stella *et al*<sup>18</sup> (1989) in a similar study stated a mean change of 0.46:1. Alan C Jensen *et al*<sup>9</sup> (1992) concluded that only about 70% of horizontal maxillary soft tissue response in the area of subnasale following maxillary setback procedures. Mansour *et al*<sup>11</sup> (1983) stated that the horizontal change at the base of the upper lip was unpredictable, but substantial movement was noted.

The results obtained in our study was higher than previous studies probably owing to the fact that in all cases V-Y closure was done and in cases of maxillary impaction slight amount of ANS trimming was done for proper positioning of the segment. A mean change of  $0.80 \pm 0.90$  was seen when shift at hard and soft tissue pogonion were compared. Lines and Steinhäuser<sup>8</sup> (1974) concluded that a change at lower lip (H) was in the ratio of 0.62:1(Li: Li) and in the area of chin (H) 1:1 Pgs: Gn. Talbott<sup>19</sup> (1975) in the cases of mandibular advancement noted changes at the lower lip (H) in the ratio of 0.85:1 (Li:Li) and at chin (H) in the ratio of 1.04:1 (Pgs:Pg). Proffit and Epker<sup>15</sup> (1980) showed a mean change of 0.75:1 at lower lip (H) and 1:1 at chin (H) following mandibular advancement. Mommaerts<sup>20</sup> (1987) in his study on soft tissue changes after mandibular advancement stated a change of 0.56:1 (Li:Li) at lower lip (H) and 1.03:1 (Pgs:Pg) in the area of chin (H). Hernandez *et al*<sup>21</sup> (1989) concluded that a mean change of 0.43:1(Li:Li) at lower lip (H) and 0.94:1 (Pgs: Pg) chin (H). McCance *et al*<sup>22</sup> (1993) in his study on soft tissue changes by 3-D analysis concluded that the Lower lip (H) followed the hard tissue in the ratio of 1.25:1 and at a ratio of 1.25:1 in the area of chin (H).

Various authors described soft tissue changes associated with mandibular autorotation. Lines and Steinhäuser<sup>8</sup> (1974) stated that chin (H) autorotates leading to a mean change of 1:1 following Le fort I maxillary impaction surgery. Similar results were drawn by Radney, Jacobs<sup>22</sup> in 1981. Mansour

*et al*<sup>11</sup> (1983) in his study concluded that lower lip (H) changes in a ratio of 0.75:1 (Li:Li) following maxillary impaction.

Soft tissue changes associated with advancement genioplasty were described by various authors. Bell, Dann<sup>10</sup> (1973) in their study concluded that soft tissue pogonion at a ratio of 0.57:1 (Pgs: Pg) to hard tissue pogonion, Scheidmann<sup>23</sup> (1981) showed a ratio of 0.97:1 (Pgs: Pg), Gallagher *et al*<sup>24</sup> (1984) in his study concluded that chin (H) changed in a mean ratio of 0.97:1 (Pgs: Pg). Other studies<sup>25, 26</sup> have also found 1:1 ratio movement in the chin area.

The results of our study complement the aforementioned findings by showing the correlation between movement of soft tissue pogonion closely follows the hard tissue counterpart in a ratio of  $0.93 \pm 0.099$ .

Research on this topic is compromised by the difficulty in obtaining a reliable data. To avoid introduction of extraneous or interactive soft tissue alterations, subjects must be limited to those on whom only similar type of surgery is performed. High quality cephalograms are also required and more importantly the radiographic technique should be standardized. Furthermore, a more procedure specific sample would be desirable. The stringency of these criteria, while making results more reliable, unfortunately reduces the size of the qualified sample pool. Clearly, the major limitation of this investigation is the relatively small and non-uniform sample, which calls into question some of the conclusions. Obviously, this underscores the necessity of continued research in this area. Repetition of studies to verify the ratios of soft-tissue to hard-tissue change used for prediction is critical. The results, in general, support most of the previously published data, but it is essential that an ongoing effort be established to verify the prediction schemes.

## Conclusion

The upper lip responded variably to the direction and amount of maxillary positioning. The predictability and the significance of changes of soft tissue in relation to hard tissue are variable as it reaches towards the nose. These ratios can be used for treatment planning to obtain predictable results. It is important for the clinician to realize that numerous factors of variability exist so that one can understand that the soft-tissue profile will sometimes deviate quite markedly from what is expected, in spite of careful planning.



## Clinical cases



Figure 1: Case 1; Pre-operative & Post-operative



Figure 2: Case 2; Pre-operative & Post-operative

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