

Orthognathic Surgery and Facial Changes - A Review

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Abstract

Overlying facial soft tissue is influenced by both surgical movement of bony segment and orthodontic movement of the teeth. That is why supportive evidence about calculation of surgical movement and changes in soft tissue positions should be considered before making any treatment plan to predict soft tissue changes that can occur with dental and skeletal tissue alteration after surgery. Thus, soft tissue consideration is an important factor for any orthognathic surgical treatment planning for excellent, acceptable and satisfactory results. This review article is focused on soft tissue changes associated with various orthognathic surgeries.

Keywords: Facial aesthetics; Orthognathic surgery; Soft tissue changes

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Introduction

The word orthognathic comes from the Greek word 'orthos' meaning to straighten, and 'gnathos,' meaning jaw. Thus, in simple terms orthognathic surgery means to straighten a jaw. Achieving the orthognathic facial form eventually relies upon achieving the ideal facial aesthetics of the individual patient, not only restoring the average normative values of individual population. It is not just the upper and lower jaws; when deformities extend to involve the other facial skeletal, diagnosis and its treatment expands the scope of oral surgery to craniofacial surgery. Improving facial esthetics as well as the functional benefits have been shown to be a strong motivating factor in patients who decide to undergo orthognathic surgery [1-3].

Determining the management for orthognathic cases require multidisciplinary collaboration of the surgeon working with the dentist, the orthodontist, and at times the restorative prosthodontist. Combination of certain dental specialties may offer services with certain advantages for patients as well as practitioners [4]. Unlike many surgical procedures, final results do not depends only on the surgical procedure but also on numbers of other factors that may have begun long before the actual surgical day along with several other factors long after surgery. Preliminary goal of orthognathic surgery is to significantly improvisation of facial and dental esthetic. Combination of orthodontic and surgical procedures are used to rectify many dental or facial or both deformities. In this regards, many patients come to the orthodontic clinics to seek treatment for soft tissue improvement, which is the prime motivating factor. Surgical movement of bony segment and orthodontic movement of the

teeth both influences overlying soft tissue. Therefore, quantitative data on the surgical movement and soft tissue changes need to be considered during treatment planning process to predict soft tissue changes that can occur with dental and skeletal tissue alteration after surgery [5,6].

Thus, soft tissue consideration is an important factor for any orthognathic surgical treatment planning for excellent, acceptable, and satisfactory results. This review article is focused on soft tissue changes associated with various orthognathic surgeries.

Soft Tissue Changes with Maxillary Orthognathic Surgeries

Maxillary vertical

Stephen Mansour et al. published a cephalometric study, which showed that there was substantial movement of the soft-tissue structures in the vertical plane. Following the soft tissue profile, the amount of vertical soft-tissue change increased progressively from a moderate change at the nasal tip (Pn) to substantial change at the lowermost point on the upper lip (Stm-s). Approximately 10 percent reduction in Ls (vermilion border of the upper lip) resulted from the maxillary impaction surgery (a reduction in the dimension Ls to Stm-s). The upper lip (Stm-s) position changes in vertical plane followed in a ratio of 0.4: 1 the change in the vertical plane of the maxillary incisor. A decrease in the upper lip length was documented. There was a superior movement of the

lowermost point on the upper lip (Stm-s) with a mean vertical change of 2 mm. The nasal tip (Pn) also moved in a superior direction in majority of cases. Misir et al. after the maxillary intrusion alone or the maxillary intrusion with protraction surgery concluded that there was no statistically significant change in CLA (columella labial angle) and NLA (nasolabial angle). Gassman et al. declared that after maxillary surgery, which leads to removal of anterior nasal spine, does not lead to change in nasal morphology significantly. Radney and Jacobs mentioned that the direction of maxillary movement after orthognathic surgery has impact on change in the NLA. On the contrary, Baris Aydil et al. have concluded that maxillary impaction does not have any significant effect in CLA or NLA. However, they stated that there are significant positive correlations between the reduction of NASALSI (nasal superioinferior) and NLA as well as marked upward movement of the NASALSI. There was significant reduction of ITIPAP (anterioposterior movement of upper incisor tip) due to retrusive movement of upper incisor and it was significantly correlated with an insignificant reduction in CLA [7-11].

Maxillary horizontal

According to study conducted by Stephen Mansour et al. there is gradual increase in the soft-tissue movement from the base of the upper lip (Sn) to the free end of the upper lip (Ls) [7]. After maxillary advancement surgery Ubaya et al. used 3D soft tissue analysis, which measures soft tissue changes following the surgery. Group of 112 volunteers were selected as a control group and they were compared with group of 35 patients who went through the maxillary advancement surgery [12]. In conclusion, they reported that the NLA was smaller in both groups with only significant change in the female group. The width of nasal base was also noted to be increased. Marsan et al. noticed that Le Fort I advancement procedures lead to decrease in NLA. They added that after orthognathic surgery for maxillary advancement, labiomental angle decreases and upper lip length increases [13].

Schendel et al. in 1976 described soft tissue changes associated with maxillary setback, which showed a mean change of 0.76:1 Labiale inferior(Li): Incisor inferior(li) in case of vertical maxillary access [14]. Randy and Jacobs showed a mean change of -0.67:1 Ls:ls in upper lip [10]. Rosen studiens in 1988 noted that subnasale moved in a ratio of 0.51:1 with respect to point A, which is almost similar to another study conducted by Stella et al. in 1989, which showed mean change of 0.46:1. Jensen et al. concluded that only about 70% of the horizontal maxillary soft tissue response in area of subnasale following maxillary setback procedure. Mommaerts et al. mentioned that bimaxillary surgery leads to increased CLA [15-18].

Soft Tissue Changes with Mandibular Orthognathic Surgeries

Several authors pointed out on the high-degree of uncertainty in the lower lip position following the mandibular surgeries. The mandibular soft-tissue usually follows the arc of the mandibular skeletal autorotation. Both the soft-tissue chin (Pg') and the mandibular sulcus (Si) followed approximately 90 percent of the underlying skeletal change. The lower lip (Li), however,

followed only 75 percent of the lower incisor movement in the horizontal plane indicating that the lower lip fell lingual to the arc of mandibular autorotation. This represented a slight increase in the labiomental angle. The soft tissue in the mandible also closely followed the skeletal rotation of the mandible in the vertical plane. Change in hard tissue menton is actually less than that of soft-tissue menton. Soft tissue stretching following the mandibular autorotation could be the possible reason behind this phenomenon. It is also interesting to note that the lower lip (Stm-i) followed only 93 percent of the lower incisor (li) change. Ingervall et al. reported that increasing displacement of the mandible results in greater retraction and extension of the upper lip [19].

Mandibular Setback

Lines and Steinhüser in 1974 shown a mean change of 0.75:1 (Li:li) following anterior mandibular subapical osteotomy [20]. Profitt and Epker concluded that change of -0.67:1 (Li:li) occurred in area of lower lip following mandibular setback [21]. Hu et al. did comparative study to find out the differences in soft tissue profile changes following mandibular setback between Chinese men and women [22]. The soft tissue to hard tissue change ratios (Li:li, Si:B, and PogS:Pog) were 0.82, 0.92, and 1.06 for females and 0.71, 0.90, and 0.94 for males respectively. There was a significant difference between females and males with respect to the ratios of L:li and PogS:Pog. Mobarak et al. reported the ratios of Li:li, Si:B, and PogS:Pog as 1.0, 1.08, and 1.02 in females and 0.97, 1.02, and 0.89 in males respectively [23]. Furthermore, they mentioned that female subjects showed higher percentages of soft tissue movement than did males and statistical significant variation in the ratio of PogS:Pog. Marşan et al. investigated difference in hard and soft tissue profiles following the mandibular setback surgery [24]. The mean setback amount was 5.6 mm in the Pog. In their study, the ratio of the horizontal displacement from the lower lip (Li) to the mandibular incisal tip (li) was 0.55:1. They concluded that there is a ratio of 0.59:1 for the horizontal displacement from the labiomental sulcus (Si) to Point B along with a ratio of 0.51:1 for the horizontal change from soft tissue pogonion (PogS) to pogonion (Pog).

Mandibular Advancement

Quast has stated that following the mandibular advancement there is a tendency of increasing the lower lip length [25]. Ewing and Ross had noticed significant inconsistency in the behavior of the lower lip after mandibular advancement [26]. A variation of 2-3 mm in either direction from the predicted movement could be expected and an accurate prediction of the structural changes that occur when often everted lower lip is allowed to unfurl as the jaw relationship is normalized is difficult. Lines and Steinhüser (1974) concluded that change at lower lip (H) was in ratio of 0.62:1 (Li:li) as compared to 1:1 in the area of chin [20]. Talbott (1975) in the case of mandibular advancement noted changes at the lower lip (H) in the ratio of 0.85:1 (Li:li) as compared to 1.04:1 at chin [27]. Profitt and Epker (1980) showed mean change of 0.75:1 (Li:li) at lower lip area and 1:1 in area of chin following a mandibular advancement surgery. In reference to E-line to upper lip, the variable showed a significant increase in the value in T2 by

a mean of 1.6 mm in contrary the lower lip showed no significant changes following mandibular advancement [21]. They added that there was forward movement of the point Pg' following the mandibular surgical advancement in reference to E-line. Furthermore, the lower lip is brought forward while there is no change in the sagittal position of the upper lip. The difference in the change of upper and lower lips could be explained by this. However, in T3, these changes were found to be adequately stable.

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