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Soft tissue profile changes after setback genioplasty in orthognathic surgery patients

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ABSTRACT

Purpose: The aim of this study was to assess the soft tissue/hard tissue ratio after setback genioplasty for a more precise surgical prediction.
Patients and methods: The surgical records of 22 patients with skeletal class III malocclusion who underwent orthodontic-surgical treatments were analyzed retrospectively. All patients had undergone bimaxillary orthognathic procedures with setback genioplasties. Lateral cephalometric tracings at four time points, T0, T1, T2, and T3, were superimposed to analyze the horizontal and vertical changes of the hard and soft tissues at eight reference points in the lower face.
Results: The thickness of the soft tissue was statistically significantly increased 1 year after the operation. Analysis showed that the horizontal movements of the soft and hard tissue were significantly correlated in the horizontal direction with ratios of 0.9:1 at the lip, B-point, 0.7:1 at the Pogonion, and 1:1 at the menton. The vertical movements were not statistically correlated except for the B-point. The chin setback independently made by genioplasty was also analyzed and the horizontal ratio was 1.1:1 at the menton.
Conclusions: Considering the soft tissue thickening and the soft/hard tissue ratios, the soft tissue profile of the chin can be predicted more precisely after setback genioplasty. Setback genioplasty can be used to effectively and reliably correct horizontal chin protrusion.
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1. Introduction

Genioplasty in orthognathic surgery is frequently performed in order to improve the facial profile. Over the last 20 years, several studies addressing the predictability of soft and hard tissue changes after genioplasty have been reported. Unfortunately, most of these studies focused mainly on the results of advancement genioplasty. Lines and Steinhauser (1974) concluded that the lower lip advanced at a 0.66:1 ratio to the mandibular incisor advancement, and the soft tissue pogonion advanced at a simple 1:1 ratio to the hard tissue pogonion. Other studies have confirmed the 1:1 ratio for the soft tissue pogonion (McDonnell et al., 1977; Busquets and Sassouni, 1981; Wittbjer and Rune, 1989; Krekmanov and Kahnberg, 1992; Polido and Bell, 1993; Van Sickels et al., 1994), but predictive ratios for the lower lip have been are highly variable, ranging from 0.26:1 to 0.85:1 in the advancement genioplasty cases (Lines and Steinhauser, 1974; Ewing and Ross, 1992; Mobarark et al., 2001; Talbot, 1975; Quast et al., 1983; Mommaerts and Marxer, 1987; Dermaut and DeSmit, 1989; Hernandez-Orsini et al., 1989; Thuer et al., 1994; Keeling et al., 1996). The correlations associated with these ratios were poor, with most correlation coefficients ranging from 0.38 to 0.72, indicating significant variance.

Reviewing literature showed there are relatively few articles exploring the results of genioplasty in the skeletal class III population (Chou et al., 2005; Kim et al., 2010). Several articles handled studied the posterior repositioning of the transversely prominent chin and evaluated soft tissue changes after reduction genioplasty (Bell et al., 1981; Krekmanov and Kahnberg, 1992; Hohl and Epker, 1976). Each study suggested the soft/hard tissue ratio was 0.58 (Bell et al., 1981), 0.53 (Krekmanov and Kahnberg, 1992), and 0.27 (Hohl and Epker, 1976) with horizontal reduction genioplasty at the Pogonion. However in most studies, fewer than 12 patients were included and the ratio of soft to hard tissue at various reference points was not mentioned. Correlation analysis tests were not performed in every study. One of the conclusions was that the results were not highly predictable and varied greatly (Hohl and Epker, 1976). There were several studies measuring hard and soft tissue correlations in class III malocclusion cases, but genioplasty

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was excluded (Marsan et al., 2009). In view of this we felt that a study of soft tissue responses after horizontal setback genioplasty was indicated. The study needed to have an appropriate sample size to provide statistically significant data and correlation analysis in terms of soft and hard tissue changes at various cephalometric reference points, measured at several post-operative time points.

The specific goals of this study were to investigate:

(1) The relationship between both horizontal and vertical soft and hard tissue changes following setback genioplasty in patients undergoing bimaxillary orthognathic surgery.
(2) To make the prediction more accurate, we took the soft tissue thickness into consideration and examined the soft tissue thickness change in the lower lip area at the different time points.

To gather this information, the nature and consistency of the soft tissue profile of the chin must be understood in order to make the results of chin setback surgery more aesthetic.

2. Material and methods

2.1. Patients

A retrospective analysis was performed on the records of 22 patients (12 females, 10 males, mean age 25.2 years ranging from 21 to 33 years) with a pre-surgical diagnosis of skeletal class III malocclusion without a craniomaxillofacial syndrome were reviewed retrospectively. The inclusion criteria were as follows:

(1) Patients who had undergone combined orthodontic-surgical treatment with Le Fort I osteotomy, bilateral sagittal split ramus osteotomy and setback genioplasty. Patients were offered genioplasty if the surgeon thought that mandibular setback alone would not produce a good aesthetic result.
(2) Patients with minimal growth potential (female patients over the age of 15 years, male patients over the age of 17 years).
(3) Patients with no history of congenital defects or syndromes.
(4) Patients without prior surgery involving the maxilla or the mandible.
(5) The operations were performed by the conventional surgical method with the same guidelines. A sliding osteotomy was performed, where the chin periosteum was detached to the menton point for setback genioplasty.
(6) Standardized lateral cephalogram radiographs were taken at three time points: pre-surgically (T0: within 4 weeks prior to surgery), immediately after surgery (T1: within 48 h after surgery), post-operative follow-up 1 (T2: 6 months after surgery), and post-operative follow-up 2 (T3: 12 months after surgery) with the teeth in centric relation and the lips in repose. All cephalographs were taken with the same cephalostat (Asahi CX-90SP, Asahi Roentgen Ind., Japan) at the Department of Oral and Maxillofacial Radiology at Seoul National University Dental Hospital.

2.2. Analysis of radiographs

Tracings of the radiographs were made on acetate paper and the points used in the cephalometric analysis were identified. The definitions of the points used in this study are listed in Fig. 1 and Table 1. The Cephalometric analysis method for OrthoGnathic Surgery (COGS) developed by Bustone and Legan was used (Burstone et al., 1978). All cephalographic tracings and measurements were performed twice by two examiners to verify measurement congruence.

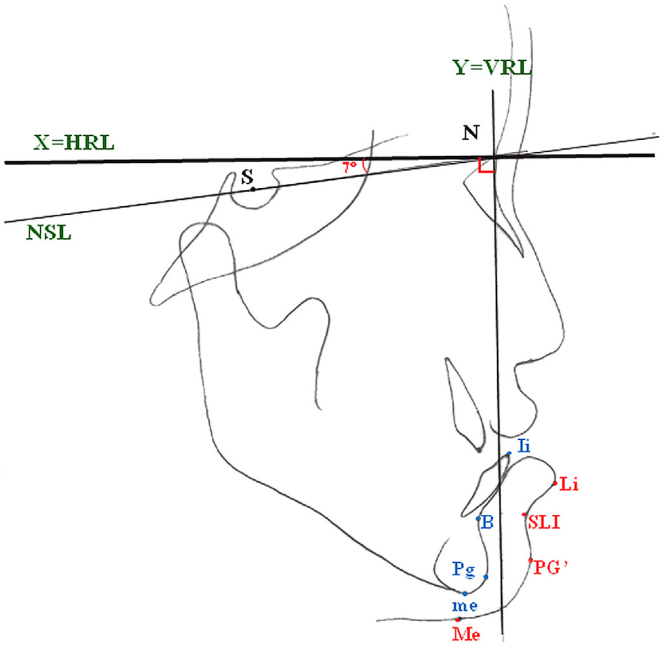

Fig. 1. Reference lines and cephalometric landmarks used in this study Cephalometric analysis method for OrthoGnathic Surgery (COGS) developed by Bustone and Legan was used in this study. An *x*-axis was drawn 7 seven degrees from the sella-nasion line (NSL) as a horizontal reference line (*x*-axis; HRL). A line perpendicular to the *x*-axis was drawn through the sella as a vertical reference line (*y*-axis; VRL). All of the horizontal measurements were taken from the VRL and vertical measurements were taken from the HRL. The hard and soft tissue landmarks are defined in Table 1.

Table 1
Cephalometric landmarks used in this study.

Hard tissue landmarks	
B	The innermost point on contour of mandible between incisor tooth and bony chin
Ii	Incisor inferior: midpoint of incisal edge of most prominent mandibular central incisor
me	Menton: the most inferior midline point on mandibular symphysis
Pg	Pogonion: the most anterior point on osseous contour of chin
S	Sella: centre of sella turcica
N	Nasion: most anterior point of frontonasal suture
Soft tissue landmarks	
Li	Labrale inferious: the most anterior point of lower lip
SLI	Inferior labial sulcus: a point of greatest concavity in midline of lower lip between labrale inferious and soft tissue pogonion
PG'	Soft tissue pogonion: the most prominent or anterior point on chin in midsagittal plane
Me	Soft tissue menton: the lowest point on contour of soft tissue chin

As a basis for the measurement, an *x*–*y* cranial base coordinate system was constructed on the radiographs. An *x*-axis was drawn 7 seven degrees from the sella-nasion line (NSL) as a horizontal reference line (*x*-axis; HRL) (Fig. 1). A line perpendicular to the *x*-axis was drawn through the sella as a vertical reference line (*y*-axis; VRL). All horizontal measurements were performed taken perpendicularly to the VRL and vertical measurements were taken perpendicularly to the HRL. Fig. 1 shows the cephalometric landmarks and the reference lines used. The definitions of the cephalometric landmarks are presented in Table 1. A superimposition method was used to for measurement of the horizontal and vertical changes at each landmark.

Initially, changes of in soft tissue thickness between preoperative T0 and 6 months post-operative T2, and between preoperative T0 and 12 months post-operative T3 cephalograms were measured

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