The Effect of Mandibular Setback Surgery on Lower Anterior Facial Height

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Abstract:
Aim: To examine the effect of single jaw surgery (mandibular setback) on the vertical relationships of skeletal class III patients and also examine the relationship between these probable changes and occlusal plane angle.
Material and methods: The measurements were evaluated on the preoperative and postoperative cephalometric radiographs of 33 skeletal class III Patients, that preoperative lateral cephalograms were taken before surgery and after insertion of surgical stabilizing arch wires and the postoperative lateral cephalograms were taken before the starting of postoperative orthodontic treatment. Vertical relationships were measured by the analysis of Legan and Burstone.
Results: The results showed that sagittal correction of mandibular prognathism caused significant reduction of lower anterior facial height ($p< 0.001$, mean =1.8mm ±1.44mm), and no significant correlation was found between lower anterior facial height change and occlusal plane angle and the amount of setback lonely and with together.
Conclusion: After mandibular setback surgery lower anterior facial height was reduced significantly, but it is not possible to find a significant correlation between lower anterior facial height changes and occlusal plane angle and/or amount of mandibular setback, so no prediction is possible for lower anterior facial height changes after mandibular setback surgery. These issues have to be considered to reduce the incidence of this problem in a developing country such as ours (IJO 2006;1: 158-62).
Key Words: Mandibular surgery, Mandibular setback, Lower Anterior facial height.
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Mandibular prognathism is a skeletal disharmony commonly associated with a class III malocclusion.[1] It is also one of the most frequent skeletal discrepancies for which patients request treatment in clinical practice. It may be the result of excessive mandibular growth [2,5] and / or a changed growth pattern with an obtuse gonial angle. [1,6,7]

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Orthognathic surgery is the most frequently preferred treatment alternative in these patients because of the difficulty in controlling mandibular growth with extra oral devices and the poor stability of the treated patients due to the mandibular growth.[8] The aim of orthognathic surgery, in most cases, is not only to correct the malocclusion involving the stomatognathic function, but also to improve facial esthetics[9] Therefore, it is important for the clinician to be able to forecast the hard and soft tissue changes resulting from these procedures.
Changes in the facial profile and in the hard tissue to soft tissue ratio after surgical correction of mandibular prognathism had been widely reported.[14,15] On the other hand, setting the

mandible back-ward along the occlusal plane may affect the vertical relationship of the jaws, so it is important to verify this change in orthognathic treatment planning to obtain more harmonious and esthetically pleasing facial proportions.[8]

The purpose of this study was to examine the effect of single jaw (mandibular setback) surgery on the vertical relationships of skeletal class III patients and also examine the relationship between these probable changes and occlusal plane angle.

MATERIALS AND METHODS

The sample consisted of 33 Iranian adult patients with mandibular prognathism (13 men and 21 women), aged 18 to 30 years. All patients were treated for the correction of mandibular prognathism by bilateral sagittal split osteotomy after preoperative orthodontic treatment with standard 022×028 edgewise appliances. Some patients had extraction of upper first premolars in the orthodontic treatment plan, but none of them had genioplasty, rhinoplasty or other plastic surgeries during orthognathic surgery. Both the preoperative and the postoperative lateral cephalometric radiographs were taken in centric occlusion with the lips in repose.

The preoperative lateral cephalograms were taken before surgery and after insertion of surgical stabilizing arch wires and the postoperative lateral cephalograms were taken before the starting of postoperative orthodontic treatment. All of the patients had a period of inter-maxillary fixation before the postoperative orthodontic treatment.

The cephalometric radiographs were traced on 0.003 inch tracing paper by the same researcher.

The analysis included landmarks and reference lines, as defined by Legan and Burstone [15] and Burstone et al. [16] and vertical relationships were measured.

The base line in this analysis is a constructed plane called the Constructed Horizontal Plane (CHP), which is a replacement of Frankfort plane, constructed by drawing a line 7 degree to the SN.

With a line perpendicular to this line from N, a vertical line was drawn and the assessment was made by measuring the upper facial height from N to ANS and lower facial height from ANS to Me.

1-Upper facial height (N-ANS) (mm)

2- Lower facial height (ANS-Me) (mm)

The occlusal plane angle is the angle formed between occlusal plane and CHP.[16]

3- Inclination of the occlusal plane (degrees)

Steiner's analysis [17] was used to measure the following variables.

1-SNA	(degrees)
2-SNB	(degrees)
3-ANB	(degrees)
4-SN-Pog	(degrees)

The amount of wit's appraisal was measured for all subjects and the amounts of setback of the mandible also were measured by calculating the amount of pogonion displacement after superimposition of the cephalograms on the SN.

To estimate the error of tracing, location of the landmarks and measurements, 20 randomly selected radiographs were retraced and remeasured by the first examiner. The mean and standard errors were calculated between the 2 recordings. The mean error was 0.4 degrees and 0.3 mm for this sample.

Statistical analyses were performed with SPSS.[12] (SPSS software,Version12)

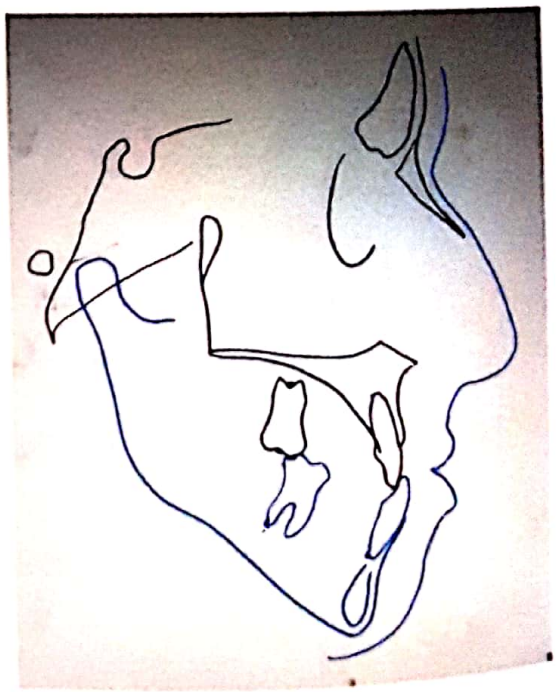

Figure 1: Preoperative lateral cephalograms tracing Stable parts in black and changeable part during surgery in blue

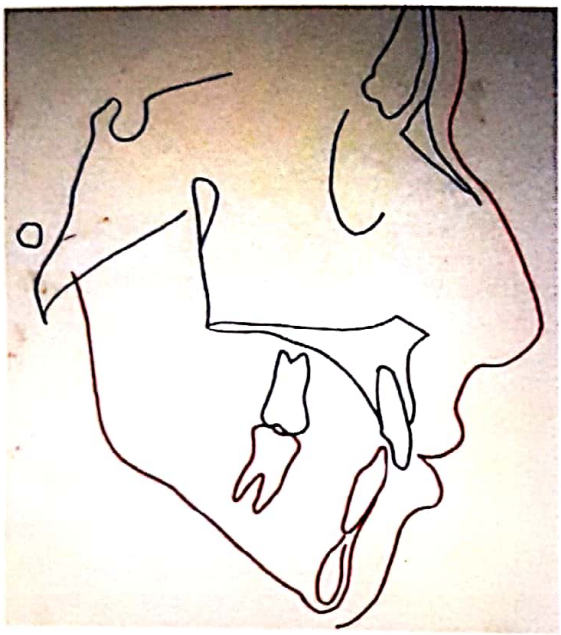

Figure 2: Postoperative lateral cephalograms tracing. Stable parts in black and parts that changed during surgery in red.

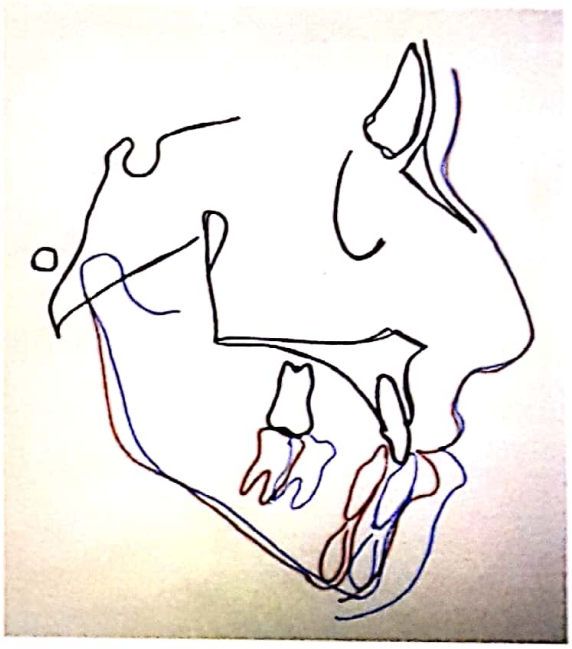

Figure 3: Pre and postoperative lateral cephalograms tracings superimposed (on SN plan). Preoperative tracing in blue, postoperative tracing in red. Reduction in lower anterior facial height is visible.

RESULTS

Table1 shows the mean and SD of the variables enrolled in this Study. ANB, SNB, SN-Pog angles and wit's appraisal decreased significantly ($p<0.05$). No significant change in occlusal plane inclination was observed ($p=0.845$). The lower anterior facial height was reduced 1.8 mm on average that is significant on statistical analysis.

The range for the lower anterior facial height change was 1 to 5 mm.

The results for correlation between LAFH change and cant of occlusal plane and the amount of the setback lonely and with together can be seen on tables 2 and 3. No significant correlation was found.

Table 1: Comparison of the mean and SD for cephalometric variables before and after mandibular setback

Variables	Pre surgical (mean± SD)	Post surgical (mean± SD)	*P*-Value
LAFH	75.85± 8.01	74.01± 7.61	0.001*
UAFH	56.01± 5.36	56.01± 5.17	1.000 **
Occlusal plane angle	12.19± 14.18	12.29± 4.06	0.845 **
SNA angle	78.91± 3.13	78.72± 3.07	0.098 **
SNB angle	81.45± 13.71	74.72± 3.59	0.000 *
ANB angle	-2.35± 2.57	1.61±3.77	0.000 *
SN-Pog angle	82.42± 4.36	78.26± 4.22	0.000 *

LAFH: Lower Anterior Facial Height
UAFH: Upper Anterior Facial Height
*$P<.05$ significant
**$P>.05$ not significant

Table2: The correlation coefficient between difference LAFH and the cant of occlusal plane (CHP-Occ), the amount of set-back before and after surgery in skeletal class III patients.

LAFH change	CHP-Occ setback	Amount of
Correlation coefficient	0.039	0.686
Sig.(2-tail)	0.415 •	0.317•
N	33	33

LAFH: Lower Anterior Facial Height
CHP-Occ: The cant of occlusal plane
P>.05• Not significant

Table 3: The correlation coefficient between difference LAFH and the amount of setback and cant of occlusal plane before and after setback surgery in skeletal class III patients.

Independent variables	Standardized coefficient	significancy
Amount of setback	0.085	0.642 •
CHP-Occ	-0.037	0.839 •

Dependent variable: LAFH change
LAFH: Lower Anterior Facial Height
CHP-Occ: The cant of occlusal plane
P>.05• Not significant

DISCUSSION

Conventional sagittal split osteotomies were used in this study to set the mandible back. No adjunctive surgical procedure (e.g. rhinoplasty, genioplasty) were done in this sample of patients. A vertical discrepancy severely complicates the horizontal discrepancy in class I patients. It was shown that anteroposterior chin position could be controlled by selective alteration of the maxillary occlusal plane angulation.[18] On the other hand, it was equally important to predict the effect of mandibular setback on vertical relationship of the jaws.

In this regard patients with no vertical skeletal disharmonies were included in the present study group to test the effect of mandibular setback surgery on vertical proportions. Parts of several cephalometric analyses taken from several different authors[15,17] were used to assess the vertical relationship differences following surgery.

SNB, ANB and SN-Pog angles decreased significantly (6.73, 5.15, 4.16 degrees respectively). The decrease in these angles (variables) was the result of backward movement of symphysis. Similar results were shown in different studies.[8, 13, 19]

Burstone's cephalometric analysis was used to measure the vertical relationship of the jaws.[16] The lower anterior facial height was decreased significantly (1.8 mm on average) in this sample ($p<0.001$), that was in contrast to Athanasiou[13] and Enacar[8] who found that anterior facial height was not altered following mandibular setback surgery; and in accordance with Ingervall[19] who found that the setback procedure also implied a mean decease of 1.3 to 2.0 mm in the anterior facial height, but there were considerable individual variations. Although lower anterior facial height was reduced significantly after mandibular setback procedure, the amount of this change was only 1.8 mm on average, therefore if a change in facial vertical dimension is planned, posterior maxillary impaction or genioplasty procedures should also be included in treatment plan to obtain more harmonious vertical facial proportions; that is dependent on diagnostic criteria of the patient.

In other part of this study the correlation between LAFH change and occlusal plane angle and the amount of setback lonely and together was investigated to predict the probable change in LAFH after setback osteotomy; but no significant correlation was found between LAFH change and occlusal plan angle and the amount of mandibular setback. As a consequent it is not possible to predict LAFH change from known occlusal plane angle and the amount of mandibular setback before doing orthognathic surgery.

CONCLUSION

1) After mandibular setback surgery lower anterior facial height was reduced significantly.
2) It is not possible to find a significant correlation between lower anterior facial height changes and occlusal plane angle and/or amount of mandibular setback, so no prediction is possible for lower anterior facial height change after mandibular setback surgery.
3) The cephalometric variables that locate anteroposterior position of the symphysis were reduced significantly after mandibular setback.
4) If a significant change in vertical proportions of the face is the main goal of orthognathic surgery, bimaxillary osteotomy or other surgical

procedures (e.g. reduction genioplasty) should be included in the treatment plan.

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