Taiwanese Journal of Orthodontics

Volume 21 | Issue 2 Article 3

January 2009

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Recommended Citation

Wang, Yu-Ching; Tsai, I-Ming; and Chen, Hui-Ling (2009) "Changes in the Morphology of Mandibular Symphysis Secondary to Pre-surgical Dental Decompensation in Class III Malocclusion," *Taiwanese Journal of Orthodontics*: Vol. 21: Iss. 2, Article 3.
DOI: 10.30036/TJO.200906.0003
Available at: https://www.tjo.org.tw/tjo/vol21/iss2/3

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Abstract

The purpose of this study is to evaluate the changes in morphology of mandibular symphysis in Class III malocclusion after pre-surgical dental decompensation. Thirteen patients underwent orthognathic surgery to correct Class III skeletal and dental malocclusions. The dental decompensation was indicated for these patients to gain greater setback amount of bilateral sagittal split ramus osteotomy. The morphology was assessed through lateral cephalograms obtained initially and preoperatively. After pre-surgical dental decompensation, the sagittal discrepancies were maintained. There was statistically significant lower incisor proclination, and both the FMIA and IMPA approximated the norms. When the mandibular incisors were labially inclined, the thinner cancellous bone was characterized by the decreased width between B to B' point. The symphyseal height and total height were greater after dental decompensation due to orthodontic tooth movement affecting the position of the alveolar landmark such as malv point (midpoint of anterior alveolus). Therefore, we must pay attention to the boundary limit for tooth movement in presurgical dental decompensation for subjects with lingual inclination of the mandibular incisors and the thin cancellous bone.

Keywords

mandibullar symphysis, pre-surgical orthodontic treatment

CHANGES IN THE MORPHOLOGY OF MANDIBULAR SYMPHYSIS SECONDARY TO PRE-SURGICAL DENTAL DECOMPENSATION IN CLASS III MALOCCLUSION

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The purpose of this study is to evaluate the changes in morphology of mandibular symphysis in Class III malocclusion after pre-surgical dental decompensation. Thirteen patients underwent orthognathic surgery to correct Class III skeletal and dental malocclusions. The dental decompensation was indicated for these patients to gain greater setback amount of bilateral sagittal split ramus osteotomy. The morphology was assessed through lateral cephalograms obtained initially and preoperatively. After pre-surgical dental decompensation, the sagittal discrepancies were maintained. There was statistically significant lower incisor proclination, and both the FMIA and IMPA approximated the norms. When the mandibular incisors were labially inclined, the thinner cancellous bone was characterized by the decreased width between B to B′ point. The symphyseal height and total height were greater after dental decompensation due to orthodontic tooth movement affecting the position of the alveolar landmark such as malv point (midpoint of anterior alveolus). Therefore, we must pay attention to the boundary limit for tooth movement in presurgical dental decompensation for subjects with lingual inclination of the mandibular incisors and the thin cancellous bone. ***(J. Taiwan Assoc. Orthod. 21(2): 17-23, 2009)***

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INTRODUCTION

Dentoskeletal Class III malocclusion is a structural deviation in the sagittal relationships of the maxillary and mandibualr bony arches. It is characterized by maxillary retrusion, mandibular protrusion, or by their combination.[1] The prevalence of this type of malocclusion in white populations is less than 5%, but it rises to as much as 12% in Chinese and Japanese population.[2] Because the advances in surgical technique have improved the predictability of orthoganthic surgery, the number of adults electing orthodontic treatment combined with orthognathic surgery has increased over the years.

Received: May 1, 2008 Revised: May 6, 2008 Accepted: May 16, 2008
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Surgical-orthodontic treatment of nongrowing Class III patients includes pre-surgical orthodontic treatment to decompensate the malocclusion, followed by surgical detailing and finishing of occlusion. Typical dental decompensation is to retrocline the proclined maxillary incisors and procline the retroclined mandibular incisors to more normal axial inclinations. This increases the severity of the Class III dental malocclusion and often results in the patient's facial profile becoming more unesthetic before surgery.[3] The pre-surgical dental decompensation dictates the magnitude and type of surgical change and is a major factor in the success of treatment. Lack of optimal dental decompensation compromises the quality and quantity of the orthognathic correction. Johnston et al[4] studied the effects of pre-surgical incisor position on quality and quantity of Class III skeletal surgical correction. In this sample, most patients achieved normal overjet, but the skeletal improvement was not as successful, with only 40% having a normal ANB angle after treatment. Fifty-two percent still had excessive SNB angles at posttreatment.

The morphology of mandibular symphysis is important because it serves as the primary reference for the esthetics of the facial profile and is a determinant in planning the mandibular incisor position during orthodontic and orthognathic surgery. During orthodontic treatment, limiting incisor movement within the bone structure is believed to be essential for achieving better results stability, and periodontal health, as well as avoiding root resorption.[5,6] In particular, in the case of a severe adult skeletal Class III malocclusion, the proper amount of decompensation of the mandibular incisors is necessary.[5] On the other hand, incisor movement confined with the bone is recommended.[7] However, the changes of the symphysis combined with proclination of mandibular incisor have not been fully evaluated. Therefore, this study focused on the changes of morphological characteristics of the symphyseal region and axial inclination of mandibular incisors during pre-surgical dental decompensation.

MATERIAL AND METHOD

Thirteen Taiwanese adults (6 men and 7 women; mean age, 20 years; range, 17 years to 28 years) seeking orthodontic treatment because of mandibular prognathism and malocclusion participated in this study. Each was cephalometrically diagnosed as having a skeletal Class III relationship based on the ANB angle (mean, -5.4° ; range, -1.7° to -10.0°). Means and ranges of several cephalometric variables are shown in Table 1. The subjects had good general and dental health, complete or nearly complete dentition and no history of temporomandibular joint disorders. Lateral cephalometric radiograhs were obtained initially and preoperatively to evaluate the equivalence of morphological characteristics. The lateral cephalogram were obtained with the same machine, which produced magnification factors of 8%. One investigator made the landmark identifications and tracing. The tracings were digitized. These angles and distances were measured by using Image J (provided by NIH). Additional landmarks and measurements were based on previous reports in order to allow a more comprehensive study of the mandibular structure.[7,8] The symphyseal landmarks are described in Figure 1.

STATISTICAL TESTS

All statistical analyses were performed with a commercial statistical package (SPSS, version 10.0, Chicago, Il). The nonparametric tests were chosen because of the limited number of observations. Differences within patients were evaluated with Wilcoxon signed-rank test. The significance level was set at p<. 05. To assess the error of localizing reference points and measurement procedure, total 26 lateral cephalometric radiographs of 13 patients were retraced and re-measured by the same examiner four weeks later. The casual errors were assessed by Dahlberg's formula ($\sqrt{\Sigma d^2/2n}$), where d is the difference between duplicated measurements and

n is the number of double measurements.[9] The casual error didn't exceed 0.38 mm and 0.43° and wasn't significant enough to affect the credibility of the study.

RESULTS

The means and standard deviations for the skeletal and dental measurements are shown in Table 2, including upper and lower 95% confidence intervals and significant differences before and after dental decompensation. The sagittal discrepancies were maintained. After decompensation, there was statistically significant lower incisor proclination, and both the FMIA (67.9°) and IMPA (85.6°) approximated the norms. The pretreatment and posttreatment measurements of symphysis are summarized in Table 3. The Id width, basal width, pogonion width, and symphyseal thickness were similar before and after dental decompensation. However, the point B width significantly decreased. There was no significant difference in the alveolar height. But the symphyseal height and total height increased significantly.

DISCUSSION

We examined a sample of surgically treated Class III malocclusions; the study was designed as a cephalometric investigation. In this study, only patients with initial cephalometric radiographs recorded at minimum ages of 19 years for girls and boys were included in the sample. Although some late mandibular growth can occur up to 20 years of age, a survey of more than 300 orthodontists reported that the recommended earliest ages for orthognathic surgery were 14.9 years for girls and 16.5 years for boys.[10] By these age of our study, it is generally accepted that the circumpubertal growth is complete or almost complete,[11] and thus the possible effects of facial growth in our sample were minimized.

The orientation of the lower incisors related to the rest of the facial skeleton has come to play a leading role in the treatment of orthodontic cases. In Tweed's diagnostic triangle the lower incisors are related to the ML line and the Frankfort horizontal. In Steiner's analysis particular interest is placed in the position of the lower incisors before and after treatment. The labio-lingual inclination of the mandibular central incisor correlated with the associated cancellous bone thickness. It also correlated with the distance between the central incisor root apex and the inner contour of the lingual cortical plate. Judging from our results, when the mandibular incisors were labially inclined, the associated cancellous bone was thinner. The thin cancellous bone was characterized by the decreased width between B to B' point. It has been shown that if the incisor root apex is moved against the cortical plate of the alveolus or beyond the alveolus, severe root resorption and/or bony dehiscence may occur.[12,13] Therefore, we must pay attention to the boundary limit for tooth movement in pre-surgical dental decompensation for subjects with lingual inclination of the mandibular incisors and the thin cancellous bone. A previous report in which the alveolar bone thickness was evaluated documented that a narrow alveolus is frequently found around the mandibular incisors in subjects with a high mandibular plane angle and in subjects with Class III malocclusion.[12]

The mandibular bone is strongly influenced by masticatory function.[14,15] The maxillofacial region contains essentially membranous bone and is more susceptible to environmental factors such as the stimulating influence of muscles and extrafunctional forces.[16] During the power stroke of mastication, the middle and lower third of the labial aspect of the symphysis is predominantly sheared dorsoventrally, twisted and bent[14] according to the magnitude and position of the bite force.[15] Pre-surgical dental decompensation results not only the change of the incisor inclination but also the absence of the incisor contact. Therefore, it was hypothesized that, due to the difference in bite force direction of the mandibular incisors, the morphological characteristics of the

mandibular symphysis can vary after dental decompensation. In Class III openbite group, the width and height of the mandibular symphysis was significanty lower indicating that overbite rather than the overjet was the major influencing factor.[17] However, our results only indicate a decrease in point B width. This suggests that the basal bone of the symphyseal region didn't show an adaptive alteration to achieve functional neuroskeletal balance due to the short-term absence of an incisor contact caused by dental decompensation.

Differing from the symphyseal width, the symphyseal height and total height were greater after dental decompensation. This change may be due to orthodontic tooth movement affecting the position of the alveolar point such as malv (midpoint of anterior alveolus). Despite the minimum age restrictions in the sample, some late residual facial growth might also contributed to the skeletal and dentoalveolar changes. A few patients had atypical horizontal movements of skeletal point (ie, some had forward movement of point B or backward movement of point A).[4]

Table1. *Cephalometric measurements (N=13)*

Variables	Mean±SD	Minimum	Maximum
SNA (°)	82.1±5.0	75.6	94.5
SNB (°)	87.7±4.9	80.1	100.5
ANB (°)	-5.6±2.5	-1.7	-10.0
FMA (°)	26.7±5.6	17.0	36.0
FMIA (°)	74.8±9.2	53.8	86.6
IMPA (°)	80.0±7.5	66.0	91.2

Table2. *Comparison of cephalometric measurements*

	Initial		Pre-surgical		Difference	Significance
	Mean	SD	Mean	SD		
SNA (°)	82.1	5.0	81.5	4.8	-0.6	.376
SNB (°)	87.7	4.9	87.9	5.2	0.2	.635
ANB (°)	-5.6	2.5	-6.4	1.9	-0.8	127
FMA (°)	26.7	5.6	27.2	5.9	0.5	.470
FMIA (°)	74.8	9.2	67.9	9.5	-6.7	.001*
IMPA (°)	80.0	7.5	85.6	7.4	5.6	.002*

** P<.05*

Table3. *Comparison of symphyseal dimension of the initial and pre-surgical cephalograms*

	Initial		Pre-surgical		Difference	Significance
	Mean	SD	Mean	SD		
Id with (Id-Idl)	5.8	0.5	5.4	0.5	-0.4	.094
Basal width (B-Bl)	7.3	2.0	6.9	2.1	-0.4	.168
Point B width(B-B')	7.8	2.4	7.2	2.4	-0.6	.021*
Pogonion width (Pog-Pgl)	14.4	1.7	14.6	1.5	-0.2	.553
Symphyseal thickness	14.1	1.6	14.0	1.5	0.1	.907
Alveolar height (Malv-Saj)	14.4	2.0	14.2	1.5	-0.2	.839
Symphyseal height (Saj-Me)	22.1	2.3	23.3	2.4	1.2	.013*
Total height (Malv-Me)	35.8	3.2	36.9	3.7	1.1	.010*

** P<.05*

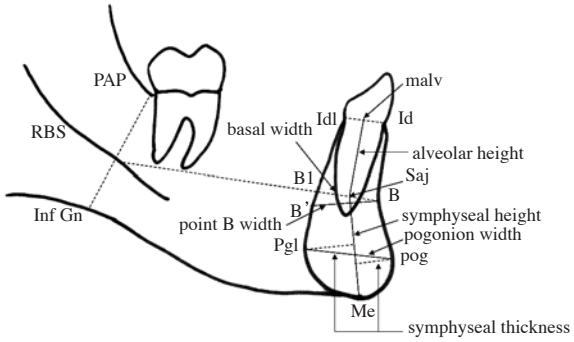

Fig 1. *Landmarks and measurements of the symphyseal region. Conventional mandibular landmarks: Me, menton; Pg, pogonion; B, supramentale; Id, infradentale; Idl, lingual point infradentale. Landmarks based on Suri et al;[8] PAP, posterior alveolar point, most posteroinferior midplane point on the anterior border of the ascending ramus; Inf Go, inferior gonion, midplaned point on the lower border of the mandible where the convexity at Go merges with the concavity of the antegonial notch; RBS, ramus body syncline, the point of intersection of a line drawn from Inf Go to PAP with the cortical outline of the midplaned mandibular nerve; Bl, lingual point B, the point of intersection of a line drawn from RBS to B, with the lingual contour of symphysis; saj, symphysis alveolar junction, the midpoint of a line drawn from Bl to B; Pgl, lingual point pogonion, the highest point on the lingual contour of the symphysis , located by the greatest perpendicular distance form a line drawn from the saj to Me; malv, (midpoint of anterior alveolusP, midpoint of a line drqwn from Idl to Id. Landmark base on Nojima et al.[7] B', point on the lingual outline of the symphysis drawn from B perpendicular to a line connecting malv to Me. Mandibular measurements: alveolar height, length of a line drawn from malv to saj; symphyseal height, length of a line drawn from saj to Me; symphyseal thickness, the sum of the lengths of the perpendiculars dropped from Pg and Pgl to a line drawn from saj to Me; basal width, length of a line drawn from Bl to B. (modified from Chung C, Jung S, Baik H. Morphological characteristics of the symphyseal region in adult skeletal Class III crossbite and opentibte malocclusions. Angle Orthod 2008; 78: 38-43.)*

CONCLUSION

- After pre-surgical dental decompensation, the sagittal discrepancies were maintained. There was statistically significant lower incisor proclination, and both the FMIA (67.9°) and IMPA (85.6°) approximated the norms.
- When the mandibular incisors were labially inclined, the thinner cancellous bone was characterized by the decreased width between B to B' point.
- The symphyseal height and total height were greater after dental decompensation due to orthodontic tooth movement affecting the position of the alveolar point such as malv (midpoint of anterior alveolus).
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安格列氏三級咬合在術前矯正後下顎骨聯合的形態變化

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本研究的目的是以測顱X光片分析安格列氏三級咬合的病患在術前矯正治療後，其下顎骨聯合的形態變化。有13位要接受正顎手術的三級咬合病患，為使下顎經雙側矢狀劈開術能獲得更大的後退量，必須先以矯正治療改善下顎門牙角度。經由治療開始前及術前測顱X光片的比較可以得知：術前矯正將下顎門牙向唇側傾斜，使其與下顎骨的角度趨於正常，此移動會使下顎骨聯合的B點寬度變窄、骨聯合高度及骨聯合總體高度增加。因此在進行術前矯正時，需注意下顎骨聯合的厚度與下顎門牙的移動量，避免將牙齒移動到齒槽骨之外。***(J. Taiwan Assoc. Orthod. 21(2): 17-23, 2009)***

關鍵詞：下顎骨聯合、術前矯正

收文日期：98年5月1日　修改日期：97年5月6日　接受日期：98年5月16日
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