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Evaluation of Alveolar Bone Changes Around Mandibular Incisors During Surgical Orthodontic Treatment of Patients with Mandibular Prognathism

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KEYWORDS

Alveolar
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ABSTRACT:

Background: The present study was conducted for evaluating alveolar bone changes around mandibular incisors during surgical orthodontic treatment of patients with mandibular prognathism.

Materials & methods: A total of 20 patients who presented with jaw deformities diagnosed as skeletal Class III mandibular prognathism. To evaluate the change of the surgical orthodontic treatment progress including alveolar bone around the lower incisors, lateral and frontal cephalograms and CBCT images were obtained before treatment (T0), after presurgical orthodontic treatment (T1), and after debonding (T2). A CBCT scanner was used to scan the patients while they were upright and with maximal intercuspation. All the results were assessed by SPSS software.

Results: The lower central and lateral incisors demonstrated that, following presurgical orthodontic therapy, there was a reduction in the vertical alveolar bone level and the alveolar bone thickness of the labial and lingual plates; however, there was no degradation during the postsurgical orthodontic treatment.

Conclusion: People with mandibular prognathism should receive extra consideration because excessive forward movement of the lower incisors during presurgical orthodontic therapy may result in alveolar bone loss surrounding the lower incisors.

Introduction

The number of patients who have chief compliant of an improvement in skeletal disharmony is increasing recently. A nationwide survey in Japan revealed that 67.6% of orthognathic patients was mandibular prognathism. Those patients have frequently showed

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horizontal skeletal deviations in addition to anteroposterior and/or vertical abnormality. Malocclusion or facial asymmetry in patients with jaw deviation is difficult to improve by orthodontic treatment alone, so that surgical orthodontic treatment is indicated in such cases.[1-3] Mandibular prognathism (MP) or skeletal Class III malocclusion with a prognathic mandible is one of the most severe maxillofacial deformities. Facial growth modification can be an effective method of resolving skeletal Class III jaw discrepancies in growing children with dentofacial orthopedic appliances including the chincup, face mask, maxillary protraction combined with chincup traction and the Fränkel functional regulator III appliance. Orthognathic surgery in conjunction with orthodontic treatment is required for the correction of adult MP. The two most commonly applied surgical procedures to correct MP are sagittal split ramus osteotomy (SSRO) and intraoral vertical ramus osteotomy.[4-6] Implementing the surgery-first orthognathic approach (SFA) in orthognathic surgical protocols has altered the management of patients with dentofacial skeletal deformities. Unlike conventional orthognathic surgery (COS), the SFA eliminates the presurgical orthodontic treatment phase and facilitates immediate resolution of the skeletal and soft-tissue imbalance, followed by orthodontic tooth movement.[5, 6] Hence; the present study was conducted for evaluating alveolar bone changes around mandibular incisors during surgical orthodontic treatment of patients with mandibular prognathism.

Materials & methods

The present study was conducted for evaluating alveolar bone changes around mandibular incisors during surgical orthodontic treatment of patients with mandibular prognathism. A total of 20 patients who presented with jaw deformities diagnosed as skeletal Class III mandibular prognathism. All of the subjects underwent presurgical and postsurgical orthodontic treatment and mandibular setback sagittal split ramus osteotomy with rigid internal fixation. To evaluate the change of the surgical orthodontic treatment progress including alveolar bone around the lower incisors, lateral and frontal cephalograms and CBCT images were obtained before treatment (T0), after presurgical orthodontic treatment (T1), and after debonding (T2). A CBCT scanner was used to scan the patients while they were upright and with maximal intercuspation. The highest coronal level of the alveolar bone was described as the alveolar crest. Parallel to the tooth's long axis, measurements were taken at the labial and lingual surfaces of the left lower central incisor and lateral incisor to determine the distances between the alveolar crest and the cementoenamel junction. This indicated the degree of bone loss in the vertical alveolar region. Alveolar bone thickness at the midroot and root apex were measured perpendicular to the long axis of the tooth, from the midroot and root apex to the limit of the alveolar cortex, respectively. These measurements were recorded as horizontal bone thickness at the midroot and horizontal bone thickness at the root apex. Furthermore; evaluated were the root length and the incisor tilt to the mandibular plane. The CBCT data were overlaid using the novel superimposition approach in order to assess the incisor inclinations on the same mandibular plane before to treatment (T0), during presurgical orthodontic therapy (T1), and following debonding (T2). All the results were assessed by SPSS software.

Results

The lower central and lateral incisors demonstrated that, following presurgical orthodontic therapy, there was a reduction in the vertical alveolar bone level and the alveolar bone thickness of the labial and lingual plates; however, there was no degradation during the postsurgical orthodontic treatment.

Table 1: Cephalometric measurements

Measurement	T0 stage	T1 stage	T2 stage	p-value
SNA	80.68	80.71	81.96	0.0001*

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SNB	**83.96**	**84.55**	**78.13**	**0.0000***
ANB difference	**-2.56**	**-2.94**	**2.12**	**0.0000***
Interincisal angle	**131.23**	**126.28**	**122.74**	**0.0001***

***: Significant**

Table 2: Comparison of alveolar bone change of lower central incisor

Measurement	T0 stage	T1 stage	T2 stage	p-value
VBL	**1.35**	**2.52**	**1.76**	**0.0001***
Root length	**10.35**	**9.86**	**9.31**	**0.0012***
Incisor inclination	**81.28**	**87.32**	**86.99**	**0.0022***

***: Significant**

Table 2: Comparison of alveolar bone change of lower lateral incisor

Measurement	T0 stage	T1 stage	T2 stage	p-value
VBL	**1.12**	**2.21**	**1.66**	**0.0000***
Root length	**10.12**	**9.71**	**9.20**	**0.0019***
Incisor inclination	**81.01**	**87.077**	**86.13**	**0.0000***

***: Significant**

Discussion

Mandibular prognathism is defined as an abnormal forward projection of the mandible beyond the standard relation to the cranial base and it is usually categorized as both a skeletal Class III pattern and Angle Class III malocclusion. The etiology of mandibular prognathism is still uncertain, with various genetic, epigenetic, and environmental factors possibly involved. However, many reports on its coexistence in both twins and segregation in families suggest the importance of genetic influences. A multifactorial and polygenic background with a threshold for expression or an autosomal dominant mode with incomplete penetrance and variable expressivity are the most probable inheritance patterns.[7- 9] Hence; the present study was conducted for evaluating alveolar bone changes around mandibular incisors during surgical orthodontic treatment of patients with mandibular prognathism.

In the present study, the lower central and lateral incisors demonstrated that, following presurgical orthodontic therapy, there was a reduction in the vertical alveolar bone level and the alveolar bone thickness of the labial and lingual plates; however, there was no degradation during the postsurgical orthodontic treatment. Lee KM et al evaluated the alveolar bone loss around lower incisors incurred during surgical orthodontic treatment in individuals with mandibular prognathism. The samples consisted of 25 patients (13 men, 12 women; mean ages: 26.3 ± 2.7 years) treated with jaw surgery and orthodontic treatment. Lateral and frontal cephalograms and cone-beam computed tomography (CBCT) images of the patients were obtained before treatment (T0) and after presurgical orthodontic treatment (T1) and after debonding (T2). After measurement of variables, repeated-measures analysis of variance with Bonferroni's multiple comparison test and Pearson and Spearman correlation analysis were performed. The lower central and lateral incisors showed that the vertical alveolar bone level and the alveolar bone thickness of the labial and lingual plates were reduced after presurgical orthodontic treatment but were not deteriorated during postsurgical orthodontic treatment. Excessive forward movement of lower incisors during presurgical orthodontic treatment could cause alveolar bone loss around the lower incisors; thus, special care

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should be considered in individuals with mandibular prognathism.[10]

In a similar study conducted by Kee YJ et al, authors investigated the alveolar bone changes around mandibular incisors in patients with skeletal Class III malocclusion treated with surgery-first orthognathic approach (SFA) and conventional orthognathic surgery (COS) using cone-beam computed tomography scans. Sixty-four patients were divided into 2 groups according to the inclusion of presurgical orthodontic treatment; the SFA group included 32 patients treated without presurgical orthodontic treatment, and the COS group included 32 patients treated with presurgical orthodontic treatment. Cone-beam computed tomography scans were obtained before treatment, after presurgical orthodontic treatment, and after treatment for the COS group and were obtained before and after treatment for the SFA group. The measurements of vertical alveolar bone height and horizontal bone thickness at 4 levels and the alveolar bone area surrounding the mandibular incisors were compared according to the treatment progress and groups. The vertical bone levels and horizontal bone thickness of the labial and lingual sides and the area of the alveolar bone around the mandibular incisors were reduced after treatment in both SFA and COS groups. Vertical bone loss was more prominent than horizontal bone loss after treatment in both groups, and alveolar bone loss was greater on the lingual side than on the labial side. There were no significant differences in alveolar bone changes around the mandibular incisor between the SFA and COS groups. However, the alveolar bone was reduced more in the COS group than in the SFA group. The results indicated that SFA and COS may trigger degeneration of the alveolar bone around the mandibular incisors after treatment in patients with mandibular prognathism.[11] Yamada C et al examined if there was any correlation between the labio-lingual inclinations of the mandibular central incisor and the associated alveolar bone. High-resolution computed tomography images of the mandible were recorded in 20 adult patients with mandibular prognathism. The labio-lingual inclination of the central incisor significantly correlated with the labio-lingual inclination of the associated alveolar bone, the thickness of cancellous bone, and the distance from the central incisor root apex to the inner contour of the lingual cortical bone. The distance from the central incisor root apex to the inner contour of the labial cortical plate of bone was significantly smaller than that to the lingual cortical plate. In adults with untreated mandibular prognathism, when the mandibular central incisor was more lingually inclined, the associated alveolar bone was also more lingually inclined and thinner.[12]

Conclusion

People with mandibular prognathism should receive extra consideration because excessive forward movement of the lower incisors during presurgical orthodontic therapy may result in alveolar bone loss surrounding the lower incisors.

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