Mandibular Alveolar Bone Remodeling Following Maximum Incisor Retraction

Kwiatkowski J1, Chung C2, Panigagua B3, Jackson T4, Nguyen T4

1University of North Carolina at Chapel Hill, Chapel Hill, NC, 2Department of Orthodontics, Gonzagararena School of Dentistry, 3Institute of Craniofacial Deformity, College of Dentistry, Yonsei University, Seoul, Korea, 4Departments of Psychiatry, Orthodontics and Computer Science, University of North Carolina at Chapel Hill Adams School of Dentistry, 5Department of Orthodontics, University of North Carolina at Chapel Hill Adams School of Dentistry

ABSTRACT

Objectives: The objective of this study is to evaluate changes in mandibular alveolar bone with following maximum incisor retraction. Methods: Patients with Class I malocclusion treated with premolar extractions and maximum incisor retraction with skeletal anchorage were selected. Pre-treatment (T1) and post-treatment (T2) Cone Beam Computed Tomography (CBCT) volumes were registered using voxel-based morphological regions of interest (ROI), and alveolar bone loss was measured using geometric morphometric analysis. Results: The mean lower incisor retraction was 6.12 mm +/- 1.25. At the crestal level, the inter-radicular alveolar showed an average decrease of 1.02 mm +/- 0.44 (20% reduction) while the mid-root alveolar showed an average decrease of 0.48 mm +/- 0.36 (8% reduction) after incisor retraction. There was a statistically significant difference (P<0.05) between T1 and T2 crestal levels. Results: The mean lower incisor retraction was 6.12 mm +/- 1.25. At the crestal level, the inter-radicular alveolar showed an average decrease of 1.02 mm +/- 0.44 (20% reduction) while the mid-root alveolar showed an average decrease of 0.48 mm +/- 0.36 (8% reduction) after incisor retraction. There was a statistically significant difference (P<0.05) between T1 and T2 crestal levels. Conclusions: There was a decrease in buccal/lingual width of the alveolus following maximum incisor retraction. At the crestal level, the reduction of alveolar width was more significant in the inter-radicular region.

INTRODUCTION

• The emergence of temporary anchorage devices (TADs) has allowed a larger range of possible orthodontic tooth movement and, in some instances, reduced the need for orthognathic surgical correction1.
• Moving teeth greater distances comes with possible risks that must be more understood in order to decide between orthodontic treatment or surgery.
• Cone beam computed tomography (CBCT) is an accurate tool for assessing alveolar changes2 and overcomes many of the limitations of 2-D radiography, including magnification, head positioning error, and challenges in superimposition of 3-D anatomical regions.
• Reductions in alveolar bone width and/or height following orthodontic treatment have been demonstrated across an array of treatment techniques and sites3.
• A recent study by Zhang et al. used geometric morphometric analysis to show decrease in bone height and bone width following retraction of the maxillary incisors.
• To date, no such studies have evaluated alveolar bone changes in the mandible following maximum incisor retraction using skeletal anchorage.
• The objective of this study is to further characterize the nature of these alveolar changes in the mandible, utilizing 3D mandibular regional superimposition4.
• Of particular interest, is the comparison of the mid-root alveolus with the inter-radicular area.

RESULTS

1. The mean lower incisor retraction was 6.12 mm +/- 1.25.
2. At the crestal level, the inter-radicular alveolar showed a mean decrease of 1.02 mm +/- 0.44 (20% reduction) while the mid-root alveolar showed an average decrease of 0.48 mm +/- 0.36 (8% reduction) following incisor retraction.
3. At the level of the root apex, the inter-radicular and mid-root alveolus showed a mean decrease of 0.28 mm (6.2%) and 0.38 mm (4.5%) respectively.

CONCLUSIONS

• There was a decrease in buccal/lingual width of the alveolus following maximum incisor retraction.
• At the crestal level, the reduction of alveolar width was more significant in the inter-radicular region.

METHODOLOGIES

METHODS

• This retrospective study consisted of 125 consecutive patients (age range 18-47) treated in the Department of Orthodontics, Gonzagararena School of Dentistry, Yonsei University between 2011 and 2017. The subjects were diagnosed as skeletal Class I or II malocclusion (20° < ANB < 70°) with bimaxillary dental anomaly. Skeletal treatment was treated with premolar extractions and four premolar extractions and incisor retraction greater than 4mm using temporary skeletal anchorage.
• Patients were excluded if they had distinct facial asymmetry (Menton deviation to facial midline <2 mm).

Imaging Analysis

• Pre-treatment (T1) and post-treatment (T2) CBCTs were taken using Pax Zenith 3D (Vatech, Seoul, Korea). Each scan captured 632 images surrounding the face, jaw, and cranial base with 105 kV, 5.4 mA exposure parameters, 0.3 mm voxel size and 24 x 19 cm FOV (field of view) for 24 seconds.
• T1 CBCTs were oriented into a standardized Frankfort Horizontal plane using both oblique and right porion3.
• T2 CBCTs were superimposed and registered on the T1 mandibular symphysys using ITK-SNAP 3.8 (open-source software, http://www.itksnap.org).

Statistical Analysis

• Data sets of ten subjects were randomly selected and the measurements were repeated with an interval of two weeks to confirm the reliability. The range of intraclass correlation coefficient (ICC) ranged from 0.89 to 1.00 indicating high reproducibility (p <0.001).
• Corresponding paired T- Test and one-way ANOVA was performed to compare pre- and post-treatment measurements using the SPSS statistics (Version 24, SPSS Institute, Chicago, IL, USA) and SAS (Version 9.3, SAS Institute, Cary, NC, USA).

RESULTS

<table>
<thead>
<tr>
<th>Crestal</th>
<th>Midroot</th>
<th>Inter-radicular</th>
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</thead>
<tbody>
<tr>
<td>T1 Mean</td>
<td>5.75</td>
<td>5.08</td>
</tr>
<tr>
<td>T2 Mean</td>
<td>5.26</td>
<td>4.08</td>
</tr>
<tr>
<td>Δ</td>
<td>0.48</td>
<td>1.00</td>
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<td>p-Value</td>
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REFERENCES


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