Changes in the morphology of the labial alveolar bone of protruded permanent maxillary incisors secondary to orthodontic alignment

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Aim: Treatment of protruded maxillary incisors involves retraction. Lingual positioning of protruded incisors improves the width of the attached gingiva. This study was conducted to document changes in the buccal alveolar bone upon retraction of protruded permanent maxillary central incisors. Methods: Cephalometric radiographs of 13 patients, ages 12 to 18 years, whose orthodontic treatment involved lingual positioning of protruded permanent maxillary central incisors were selected. Results: Comparison of tracings from radiographs taken before and after treatment indicated that the alveolar bone height increased in 76.9% of cases. In addition, a significant positive correlation ($r = 0.95$) was found between the changes in the distance from the M point to the incisal edge and alveolar bone height. Conclusion: The present study indicated that an increase in the amount of buccal alveolar bone was a result of orthodontic treatment that involved lingual positioning of protruded maxillary permanent central incisors. Orthodontics (CHIC) 2011;12:196–201.

Key words: buccal, cephalometric, protruded

In the practice of orthodontics, patients with proclined incisors in addition to attachment and bone loss are encountered. Several studies have indicated that an improvement in gingival morphology may be achieved after tooth alignment.¹⁻³ Karring⁴ et al demonstrated that lingual movement of maxillary incisors may result in bone regeneration in areas of dehiscence. This finding led to the hypothesis that the height of the labial alveolar process could increase as a result of orthodontic uprighting of protruded permanent maxillary incisors.

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The purpose of this study was to determine the possible morphologic changes in the buccal alveolar bone after orthodontic alignment of protruded permanent maxillary central incisors.

METHODS

Included in this study were the dental records of 13 patients (12 to 18 years of age; mean age at beginning of treatment, 15 years) whose orthodontic treatment involved lingual positioning of protruded maxillary incisors (Fig 1). The dental records included pre- and posttreatment lateral cephalograms.

Tracings from the lateral cephalograms were made prior to treatment (Fig 2). The tracings were coded. Another person, unaware of to whom each tracing belonged and whether the tracing was pre- or posttreatment, measured the angulation between the SN plane and the long axis of maxillary central incisor as well as the distances from the incisal edge to the alveolar crest, from the incisal edge to the M point, and from the alveolar crest to the M point.

Ten tracings were randomly selected for a second evaluation to determine the reliability of the examination.

To locate the M point, the SN plane was measured in millimeters. The result was bisected, and the midpoint was determined to be the M point.

The Student t test was used to determine the significance of the difference between the baseline and second measurements. The correlation coefficient between pairs of differences was obtained by means of a linear regression analysis from standard statistical analysis software (SPSS for Windows 15, IBM).
RESULTS

Comparison of measurements showed a statistically significant decrease in the distance between the incisal edge and the alveolar bone crest \((t = 1.70, P = .000)\) and in the angulation between the maxillary central incisor and the SN plane \((t = 1.78, P = .000)\) (Table 1).

The alveolar bone height expressed as the distance between the M point and the alveolar crest was shorter in the baseline radiograph than in the second radiograph in 10 cases (increase group) (Table 2), the same in one case, and shorter in two cases (same/decrease group) (Table 3).

Analysis of the measurements in the increase group revealed a significant increase in the distances from the incisal edge to the M point \((t = 1.83, P = .0002)\) and from the M point to the alveolar crest \((t = 2.26, P = .53)\) and a significant decrease in the angulation between the maxillary central incisor and SN plane \((t = 1.83, P = .000)\).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean ± SD measurements for the total population</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>First measurement</td>
</tr>
<tr>
<td>A (mm)</td>
<td>12.07 ± 1.23</td>
</tr>
<tr>
<td>B (mm)</td>
<td>79.73 ± 1.78</td>
</tr>
<tr>
<td>C (mm)</td>
<td>67.73 ± 1.48</td>
</tr>
<tr>
<td>D (degrees)</td>
<td>118.76 ± 5.03</td>
</tr>
</tbody>
</table>

SD, standard deviation; A, distance from the incisal edge to the alveolar crest; B, distance from the incisal edge to the M point; C, distance from alveolar crest to the M point; D, angulation between SN plane and the long axis of permanent maxillary central incisor.
On the other hand, in the same/decrease group, a significant decrease was evident in the measurements from the incisal edge to the M point \((t = 2.9, P = 0.4)\) and the M point to the alveolar crest \((t = 2.9, P = .018)\) and in the angulation between the SN plane and the long axis of the maxillary central incisor \((t = 2.9, P = .019)\).

**DISCUSSION**

An increase in periodontal support as a result of orthodontic treatment is crucial in periodontally compromised teeth and also prevents relapse.5–7

Several studies have indicated that deleterious effects of orthodontic treatment on periodontal tissue may be nonexistent to minimal and transient.8,9 In some cases, tooth alignment has a beneficial effect on gingival or osseous morphology.1–3

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**Table 2**  Mean ± SD measurements for patients \((n = 10)\) who showed an increase in the distance from the M point to the alveolar crest

<table>
<thead>
<tr>
<th>First measurement</th>
<th>Second measurement</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (mm) 12.25 ± 1.18</td>
<td>10.20 ± 1.31</td>
<td>–2.05</td>
</tr>
<tr>
<td>B (mm) 80.10 ± 1.59</td>
<td>81.50 ± 1.58</td>
<td>1.40</td>
</tr>
<tr>
<td>C (mm) 67.85 ± 1.59</td>
<td>68.40 ± 3.68</td>
<td>0.55</td>
</tr>
<tr>
<td>D (degrees) 119.00 ± 5.14</td>
<td>95.20 ± 3.45</td>
<td>–23.80</td>
</tr>
</tbody>
</table>

SD, standard deviation; A, distance from the incisal edge to the alveolar crest; B, distance from the incisal edge to the M point; C, distance from alveolar crest to the M point; D, angulation between SN plane and the long axis of permanent maxillary central incisor.

**Table 3**  Mean ± SD measurements for the patients \((n = 3)\) who showed the same or decreased distance from first to the second examination at the distance from the M point to the alveolar bone crest

<table>
<thead>
<tr>
<th>First measurement</th>
<th>Second measurement</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (mm) 11.50 ± 1.50</td>
<td>10.00 ± 1.73</td>
<td>–1.50</td>
</tr>
<tr>
<td>B (mm) 78.50 ± 2.18</td>
<td>78.66 ± 1.52</td>
<td>0.16</td>
</tr>
<tr>
<td>C (mm) 67.33 ± 1.15</td>
<td>66.00 ± 2.00</td>
<td>–1.33</td>
</tr>
<tr>
<td>D (degrees) 116.33 ± 0.55</td>
<td>99.66 ± 5.68</td>
<td>–16.67</td>
</tr>
</tbody>
</table>

SD, standard deviation; A, distance from the incisal edge to the alveolar crest; B, distance from the incisal edge to the M point; C, distance from alveolar crest to the M point; D, angulation between SN plane and the long axis of permanent maxillary central incisor.
Labial alveolar bone changes secondary to orthodontic alignment

The hypothesis of the present study was that the height of the labial alveolar process would increase as a result of orthodontic uprighting of protruded permanent maxillary incisors.

The decrease in angulation between the SN plane and the maxillary central incisor was significant ($t = 1.78$, $P = .000$). An increase in alveolar height, expressed as the distance from the M point to alveolar crest, was not evident in 23.07% of cases.

No correlation was found between the changes in the alveolar height and those in the angulation between the SN plane and the long axis of the permanent maxillary central incisor.

These findings could be related to several parameters, such as duration of treatment, force applied, relapse, individual response to orthodontic treatment, and normal development.

In the present study, the findings of significant increase in the distance from the incisal edge to the M point in the increase group (mean difference ± standard deviation, 1.4 ± 1) and of significant decrease in the same/decrease group (mean, −1.5) suggests that changes in the alveolar bone height may be influenced not only by the change in angulation between the SN plane and the angulations between the permanent maxillary central incisor but also by the orthodontic intrusion of the teeth.

The reliability of radiographic studies may be limited by the lack of standardization among radiographs. In the present study, these problems were minimized by the use of standardized cephalometric radiographs. Also, all tracings were performed by an orthodontist.

Another factor that may complicate the interpretation of changes in anatomical structures is the fact that changes in the gingival and osseous morphology may be related to normal growth and development processes. This probability was minimized in the present study by the fact that the M point was used as the main anatomical reference point, since it has been shown to be a stable landmark.

CONCLUSION

The present study indicates that an increase in the amount of buccal alveolar bone may take place as a result of orthodontic treatment involving lingual positioning of protruded permanent maxillary central incisors.

"...changes in the gingival and osseous morphology may be related to normal growth and development processes."
REFERENCES