Effect of orthodontic treatment and comorbidity risk factors on interdental alveolar crest level: A radiographic evaluation

Ronen Zoizner,[a] Yael Arbel,[b] Nirit Yavnai,[c] Tal Becker,[d] and Galit Birnboim-Blau[a]
Tel Aviv and Ramat Gan, Israel

Introduction: Alveolar bone loss is regarded as a potential adverse event during orthodontic treatment, especially in adults. The purposes of this study were to evaluate the prevalence and severity of interdental alveolar crest height loss in adult orthodontic patients compared with an untreated control group and to identify comorbidity risk factors for such bone loss (high BMI score, high blood pressure, high cholesterol levels, and smoking). **Methods:** Standardized bitewing radiographs of patients' buccal segments were taken before and after treatment of 34 consecutive adults treated in an orthodontic clinic. The control group included 29 patients from the operative dental clinic matched according to age and sex. Mean ages of the participants before treatment were 35.7 ± 6.7 and 35.6 ± 7.3 years for the control and treatment groups, respectively. Before orthodontic treatment, the patients were evaluated, treated as needed, and approved by a periodontist. They were periodontically healthy before treatment. Interdental alveolar crest height loss was calculated by subtracting the distance on a bitewing x-ray from the cementoenamel junction to the interdental alveolar crest at each interproximal tooth surface from the mesial aspect of the first premolar to the distal aspect of the second molar (8 sites per quadrant). Changes in interdental alveolar crest height were calculated by subtracting the cementoenamel junction-interdental alveolar crest distance before treatment from the corresponding distance after treatment. **Results:** The mean individual bone losses of all interproximal surfaces were 0.130 ± 0.192 and 0.072 ± 0.280 mm in the treatment and control groups, respectively. These differences did not reach statistical significance ($P = 0.353$). Twenty-two patients (65%) from the treatment group and 10 patients (34%) from the control group had an increase in the cementoenamel junction-interdental alveolar crest distance of more than 1 mm in at least 1 site, with borderline significance between the groups ($P = 0.079$). Notably, no association was observed between bone loss with any comorbidity factor. **Conclusions:** The results of this study correspond to the conventional understanding in the orthodontic and periodontal literature that orthodontic tooth movement per se does not cause attachment loss. However, orthodontists should always be aware of the possibility of periodontal deterioration during orthodontic treatment. Therefore, comprehensive periodontal examination is necessary during orthodontic treatment, especially in adults. (Am J Orthod Dentofacial Orthop 2018;154:375-81)

[a]Department of Orthodontics, Medical Corps, Israel Defense Forces, Ramat Gan, Israel.
[b]Department of Periodontology, Medical Corps, Israel Defense Forces, Ramat Gan, Israel.
[c]Academy and Research Branch, Medical Corps, Israel Defense Forces, Ramat Gan, Israel.
[d]Department of Endodontology, Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.
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Address correspondence to: Ronen Zoizner, Orthodontic Department, Mouth and Jaw Institute, Sheba Medical Center, 2 Sheba Road, Ramat Gan 52621, Israel; e-mail, ronen.zoizner@gmail.com.
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Experimental studies in dogs[1-4] and data from human epidemiologic studies[5,6] have indicated that microbial plaque is the main etiologic factor in marginal periodontal breakdown. Orthodontic treatment is considered a risk factor for periodontal disease. Experimental studies in animals have indicated that orthodontic tooth movement, especially tipping or intrusion of plaque-infected teeth, may cause a shift of the supragingival plaque to a subgingival position, inducing an apical shift of the connective tissue attachment and formation of infrabony pockets.[7] Bodily movement along the dental arch does not cause loss of connective tissue attachment, irrespective of the height of the periodontium, if the periodontal tissue is

kept free of inflammation.[8,9] However, after placement of a fixed orthodontic appliance, there is a shift in the bacterial composition of the plaque toward a more anaerobic gram-negative microbiota.[10] Moreover, attachment loss is more prominent next to banded molars than bonded molars.[11] New imaging techniques, such as cone-beam computed tomography (CBCT), can produce accurate 3-dimensional (3D) architecture of osseous defects. Misch et al[12] compared CBCT measurements of periodontal defects with traditional methods (periapical radiography and direct measurements using a periodontal probe) on dry skulls. They found that all 3 modalities are useful for identifying interproximal periodontal defects. Compared with radiographs, the 3D capability of CBCT offers a significant advantage because all defects can be detected and quantified. Castro et al[13] evaluated the distance between the cementoenamel junction (CEJ) and the alveolar crest before and after nonextraction orthodontic treatment using CBCT. They found bone dehiscence in 11% of the teeth before treatment and in 19% of the teeth after nonextraction treatment in adolescents. Lund et al[14] evaluated the distance between the CEJ and the marginal alveolar bone crest before and after extraction orthodontic treatment (extraction of 4 premolars). They found major decreases in the distance from the CEJ to the marginal crestal bone in the lingual aspect of the mandibular incisors (>2 mm in 84% and 64% of central and lateral incisors, respectively). The changes in other teeth were minor. Only young orthodontic patients were included in this study.

In the last decades, the numbers of adults undergoing orthodontic treatment have increased significantly. According to a survey from the American Association of Orthodontists, the number of adult patients treated in 2012 by its members was 1,226,000, about 20% of all patients (www.aaoinfo.org). Epidemiologic studies showed a close relationship between age and cumulative loss of attachment.[5,15] With age, there is a decrease in the percentage of subjects with gingival disease without bone involvement and a concomitant increase in the percentage of subjects with chronic, destructive periodontal disease.[16] In addition, since adults are no longer growing, orthodontic intrusion and tilting are frequently needed, as opposed to differential and guided tooth eruption. For these reasons, adults may have a higher risk than adolescents for periodontal breakdown during active appliance therapy.

In a study that evaluated the prevalence and severity of interdental alveolar bone height loss in adult orthodontic patients using periapical radiographs of maxillary anterior teeth before and after orthodontic treatment, only 2.5% of them had an average bone loss of 2 mm or more, whereas 36% of the patients had at least 1 surface with bone loss of 2 mm or more.[17]

Boyd et al[18] monitored the periodontal status of 20 adults and 20 adolescents undergoing fixed orthodontic treatment. Ten adults had generalized periodontitis and received periodontal treatment, including periodontal surgery, before orthodontic treatment. For loss of attachment, there were no significant differences between adolescents, adults with normal periodontal tissues, and adults with reduced but healthy periodontal tissues who had treatment for periodontal disease.

Smoking is considered a risk factor for periodontal breakdown.[19] Smokers with severe periodontal disease do not differ from nonsmoking patients with respect to the occurrence of the periopathogenic bacteria.[20] Postoperative studies of patients on a maintenance program did not detect a difference in the subgingival microbiota between smokers and nonsmokers even though the clinical outcome was inferior in smokers.[21] Smoking suppresses the inflammatory reaction to plaque accumulation; therefore, smokers will seldom show highly increased gingivitis levels, even with severe disease.[22]

There are several comorbidity conditions that influence periodontal status: diabetes mellitus, immunodeficiency syndromes, pregnancy and hormonal changes, osteoporosis,[23] and cardiovascular diseases.[24] However, whether additional comorbidity conditions, such as hypercholesterolemia,[25,26] hypertension,[27] and obesity[28,29] influence the periodontal tissues and how remain unclear. The association between those comorbidity factors and periodontal diseases is hard to establish because of common risk factors and confounding variables.

The purposes of our study were to evaluate the prevalence and severity of interdental alveolar crest height loss during active appliance therapy in a group of consecutively treated adult patients compared with an untreated control group and to identify comorbidity risk factors for bone loss.

MATERIAL AND METHODS

The study population was randomly collected from the records of patients in the Medical Corps orthodontic department, Ramat Gan, Israel, who were treated between 2002 and 2012. All patients were adults who had full orthodontic treatment (both jaws) using twin brackets, edgewise slot 18 × 25-in Roth prescription (Master Series; American Orthodontics, Sheboygan, Wis). According to the orthodontic department's routine protocol, all patients were evaluated, treated as needed,