Incisor malalignment and the risk of periodontal disease progression

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Introduction: The objective of this study was to investigate the association between incisor crowding, irregularity, and periodontal disease progression in the anterior teeth. **Methods:** Data collected over 35 years from men enrolled in the Veterans Affairs Dental Longitudinal Study included information concerning pocket depth and alveolar bone loss. Plaster casts of the maxillary (n = 400) and mandibular (n = 408) arches were available for baseline measurements. Periodontal disease in the anterior teeth was defined as per arch sum of pathologic pocket depth and sum of teeth with any alveolar bone loss in the anterior sextants. Incisor malalignment status was defined by the anterior tooth size-arch length discrepancy index and Little's Irregularity Index. Adjusted mixed effects linear models computed the beta (β) estimates and 95% confidence intervals (95% CI) of the amounts of change in periodontal disease outcomes by the level of malalignment. **Results:** In the anterior maxillary arch, crowding and spacing were significantly associated with an increased per-arch sum of pathologic pocket depth (β, 0.70 mm; 95% CI, 0.20-1.21, and β, 0.49 mm; 95% CI, 0.06-0.91, respectively). In the anterior mandibular arch, incisor crowding and irregularity were significantly associated with an increased per-arch sum of pathologic pocket depth (mild crowding: β, 0.47 mm; 95% CI, 0.01-0.93; severe irregularity: β, 0.94 mm; 95% CI, 0.50-1.38), and the sum number of teeth with alveolar bone loss (mild and moderate-to-severe crowding: β, 0.45 teeth; 95% CI, 0.08-0.82; and β, 0.45 teeth; 95% CI, 0.13-0.83, respectively; moderate irregularity: β, 0.34 teeth; 95% CI, 0.06-0.62). **Conclusions:** Certain incisor malalignment traits (ie, maxillary incisor crowding, maxillary incisor spacing, mandibular incisor mild crowding, mandibular incisor moderate-to-severe crowding, mandibular incisor moderate irregularity, and mandibular incisor severe irregularity) are associated with significant periodontal disease progression. (Am J Orthod Dentofacial Orthop 2018;153:512-22)

Periodontal disease is a major public health concern globally.[1] In the United States, approximately 50% of the adult population (≥30 years) has periodontitis.[2,3] Several risk factors have been associated with periodontal disease, and modification of these factors has an important role in treatment planning and patient management.[4-6] However, because of the high prevalence of periodontitis and the importance of the identification and modification of risk factors, additional research is warranted.

One often-overlooked possible causative factor for periodontal disease is the malalignment of teeth. The mechanism by which dental irregularity and crowding affect periodontal health is intuitive because dental

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irregularity and crowding offer a poor environment for maintaining periodontal health and cause harm to the periodontal tissues due to food retention and subsequent plaque accumulation.[7] This plausible mechanism typically exists in the maxillary and mandibular incisor segments.[8,9]

Periodontal disease is a localized disease,[10] and crowding or irregularity is greater in the anterior area.[11] In the current literature, results from early cross-sectional studies that investigated the association between periodontal disease parameters and anterior irregularity or crowding were often controversial because of several factors: (1) the use of invalid indexes to measure periodontitis and malalignment (eg, composite indexes), (2) difficulty in differentiating between crowding and irregularity, and (3) large statistical variability caused by a small sample size.[8,9,11-18] One cohort study showed no significant association between incisor irregularity and either pocket depth or bone loss.[19] This study had several limitations, including a short follow-up period (140 days), small sample size (n = 50) of dental students, and the use of neither reliable nor validated methods in measuring irregularity. Although the authors of this study attempted to investigate the association between incisor irregularity and periodontal disease, its limitations did not fill the gaps in the current knowledge of identifying whether irregularity or crowding is a true risk factor for periodontal disease.

Identifying irregularity and crowding as risk factors for periodontal disease may prioritize orthodontic treatment as a preventive measure over its esthetic or functional indicators. However, this action is not easily accomplished because periodontal disease advances intermittently or in bursts.[10,20] To overcome these obstacles in recognizing risk factors for periodontal disease, a longitudinal study design is needed with a long follow-up time and a relatively large sample. To the best of our knowledge, the associations between incisor irregularity, crowding, and periodontal disease have not been evaluated in a longitudinal study with a long-term follow-up. Therefore, the objective of this retrospective cohort study was to investigate the association between incisor crowding, irregularity, and periodontal disease progression using rigorous longitudinal analyses.

MATERIAL AND METHODS

In 1969, the Department of Veterans Affairs (VA) started a closed-panel dental longitudinal study by enrolling 1231 mostly white, medically healthy, community-dwelling male veterans drawn from the parallel VA Normative Aging Study. The participants had their medical and dental treatments in the private sector and were not patients of the VA care system. The first examination at which plaster casts were consistently made began in 1971. Thereafter, periodontal examinations were conducted approximately every 3 years (triennial examination) from 1971 to 2009 (total of 12 examinations). The inclusion criteria included participants who attended at least 3 examinations between 1971 and 2009, were completely dentate in the anterior sextants at baseline (1971), had measurable baseline plaster casts, and had not undergone orthodontic treatment. A retrospective sample of 400 maxillary and 408 mandibular plaster casts was available for measurements and longitudinal analysis. Mean follow-up times for subjects with maxillary and mandibular plaster casts were 23.7 ± 8.4 years and 23.5 ± 8.5 years, respectively (range, 9-36 years). All participants gave their informed consent before each examination. The study was approved by institutional review boards at Boston University Medical Center (Boston, Mass) and the VA Boston Healthcare System (Boston, Mass). This report complies with STROBE guidelines for observational studies.

At every triennial examination, calibrated periodontists performed a clinical and radiographic dental examination on all teeth and, when applicable, recorded the absence of teeth. Pocket depth and alveolar bone loss (ABL) data, limited to the anterior sextants (maxillary and mandibular central and lateral incisors and canines), were evaluated. A Williams probe (Hu-Friedy, Chicago, Ill) was used to obtain the maximum pocket depth (mesial, distal, labial, and lingual) per tooth and recorded on an interval score scale (score 1, 0-3 mm; score 2, >3-5 mm; score 3, >5 mm). The interval score scale was transformed to a continuous variable of pathologic pocket depth (PPD) in millimeters per tooth by using the midpoint of each recorded pathologic category (score 2, 4 mm; score 3, 6 mm).[21] Afterward, the PPD in millimeters per tooth was summed per arch segment (anterior maxillary and mandibular sum of PPD).[21] Periapical radiographs were taken with a paralleling method with Rinn holders. ABL was measured with a modified Schie score,[22] which superimposed a translucent ruler on the radiograph with assigned reference points at the cementoenamel junction and root apex. ABL scoring was done in the interproximal sites in 20% increments (score 0, no bone loss; score 1, bone loss ≤20%; score 2, bone loss >20% to ≤40%; score 3, bone loss >40% to ≤60%, score 4, bone loss >60% to ≤80%, score 5, bone loss >8,%). For ABL, the interval score scale was transformed into a continuous variable by calculating the total number of teeth with any bone loss (ABL score 1 or higher) per arch segment.[23] Based on repeated