Association between Signs of Trauma from Occlusion and Periodontitis*

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The purpose of this study was to evaluate the association between signs of trauma from occlusion, severity of periodontitis and radiographic record of bone support. The maxillary first molars of 300 individuals were independently evaluated by two examiners for signs of trauma from occlusion, pattern of occlusal contacts and severity of periodontitis. Each site was also evaluated radiographically by an independent third examiner. The results indicated that: (1) teeth with either bidigital mobility, functional mobility, a widened periodontal ligament space or the presence of radiographically visible calculus had deeper probing depth, more loss of clinical attachment and less radiographic osseous support than teeth without these findings, (2) teeth with occlusal contacts in centric relation, working, nonworking or intrusive positions did not exhibit any greater severity of periodontitis than teeth without these contacts, (3) teeth with both functional mobility and a radiographically widened periodontal ligament space had deeper probing depth, more clinical attachment loss and less radiographic osseous support than teeth without these findings and (4) given equal clinical attachment levels, teeth with evidence of functional mobility and a widened periodontal ligament space had less radiographic osseous support than teeth without these findings.

It has been well established that the diseases of gingivitis and periodontitis are caused primarily by bacterial irritants. Another possible factor in the pathogenesis of the periodontal diseases is trauma from occlusion. In monkeys, greater crestal bone loss in the presence of jiggling trauma combined with periodontitis has been reported than with periodontitis alone. Others have reported increased loss of both connective tissue attachment and crestal bone when occlusal trauma was combined with periodontitis. Although there have been several animal and human histologic studies, there have been few clinical studies concerning the association of trauma from occlusion and periodontitis. One human study, using diagnostic casts to identify wear facets, reported increased tooth mobility, pocket depth and bone loss associated with nonworking contacts. Shefter and McFall, using a clinical examination reported that occlusal disharmonies were not associated with increased pocket depth or tooth mobility.

An important consideration which limits clinical studies is the lack of established criteria for identifying periodontal trauma from occlusion. A variety of both clinical and radiographic signs of trauma from occlusion have been suggested. However, there is little information concerning their relation to severity of periodontal disease. The purpose of this study was to evaluate the association of possible signs of trauma from occlusion with the severity of periodontal disease and radiographic evidence of osseous support.

MATERIALS AND METHODS

The maxillary first molars of 300 individuals, ages 20 to 40, having an initial dental examination were evaluated by two trained and calibrated examiners. Periapical radiographs were taken using a long cone technique with a paralleling device. None of the subjects had a history of significant systemic disease or periodontal therapy and none had received a dental prophylaxis or antibiotic therapy during the previous 6 months.

Each of the examiners independently scored various clinical parameters for the maxillary first molars with no knowledge of the others' findings. These included: (1) probing depth, (2) clinical attachment level as measured from the cemento-enamel junction to the most
apical extent of probe penetration, (3) gingival and plaque indices of Löe,20 (4) calculus index (OHI-S)21 and (5) mobility. Probing depth and clinical attachment level were recorded at the mesio-buccal interproximal surface parallel to the long axis of each tooth adjacent to the contact point. Gingival, plaque and calculus indices were recorded at the buccal, mesio-buccal and mesio-lingual surfaces. The value used in data analysis for these indices and the periodontal measurements was the mean of those obtained by the two examiners for each tooth. Mobility of each maxillary first molar was recorded for presence or absence in two ways. Bidigital mobility was detected by simply applying bucco-lingual force to the teeth with a finger on one side of the tooth and the handle of a dental mirror on the other side. Functional mobility was detected by placing the index finger on the buccal surface of the maxillary first molars and feeling for movement during repeated habitual centric closure and excursive mandibular movements.

Several other clinical parameters were scored for presence or absence to characterize the occlusal status of each maxillary first molar. These included wear facets, uneven marginal ridges and occlusal contacts. Occlusal contacts were classified as occurring in centric relation, working, nonworking or intrusive positions. Occlusal contacts were identified by placing a 0.018-mm thick cellophane strip between the occluding tooth surfaces and guiding the subjects through the appropriate mandibular movements to determine if contact occurred. Since tooth mobility and occlusal findings were quite subjective, data were only included for analysis when both examiners independently agreed on the presence or absence of these parameters.

Radiographic findings were scored by a third independent examiner who had no knowledge of the results of the clinical examination. The radiographic parameters included: (1) widened periodontal ligament space, (2) root resorption, (3) hypercementosis, (4) root fracture and (5) thickened lamina dura. Each was scored as being present or absent based on a subjective evaluation of the radiographs projected at magnification × 6.3. The percentage mesial osseous support for each maxillary first molar was determined at the same magnification using the technique of Bjorn et al.22 The percentage of osseous support was measured with respect to total tooth length using the mesio-buccal root. The presence or absence of calculus radiographically visible on the mesial surface of the maxillary first molars was also recorded. Examiner reproducibility for each radiographic finding was determined by repeated but non-consecutive scoring by the third examiner of a random subset of 102 radiographs.

Data were analyzed by several methods. Calibration data for the radiographic parameters were simply tabulated to reflect the number and percentage agreement or disagreement between the two trials. Mean probing depth, clinical attachment level and percentage of osseous support were compared for teeth with and without each possible clinical and radiographic sign of trauma from occlusion. Selected criteria were then used to classify the first molars into two categories. These categories included teeth with and without functional mobility and a radiographically widened periodontal ligament space. An unpaired t test was then used to test for statistically significant differences between these two groups of teeth with respect to each periodontal variable and the radiographic measure of percentage of mesial osseous support. Furthermore, regression analysis was performed on teeth with similar clinical attachment levels to determine if those with functional mobility and a widened periodontal ligament space had less osseous support than teeth without these signs.

RESULTS

Data from the trial designed to test reproducibility of the radiographic parameters indicated that only two of these signs occurred with any appreciable frequency. Root resorption, hypercementosis and root fracture were virtually never detected in any of the first molar radiographs. Since these signs occurred with such low frequency, an accurate estimate of reproducibility from these data was not possible. The intra-examiner agreement for scoring presence or absence of a thickened lamina dura was 98% while the agreement was 94% for the presence or absence of a widened periodontal ligament space. In the total sample of 496 maxillary first molar radiographs, a thickened lamina dura was judged to be present in 22% and a widened periodontal ligament space was judged to be present in 19%. Calculus was visible in 19% of the radiographs and the intra-examiner reproducibility for its presence or absence was 97%. Intra-examiner reproducibility data using the radiographic measurement technique of Bjorn et al.22 revealed that there was no difference in per cent mesial osseous support in 81% of the repeated measurements. Furthermore, all differences between the repeated measurements were within 5% of the total tooth length.

A comparison using an unpaired t test for tooth mobility and occlusal findings with respect to mesio-buccal probing depth, clinical attachment level and percentage osseous support is given in Table 1. Teeth scored independently by both examiners to have bidental or functional mobility had statistically (P ≤ 0.001) deeper probing depth, more loss of clinical attachment and less osseous support than teeth scored by both examiners as not having these findings. Teeth with wear facets had less (P ≤ 0.05) loss of clinical attachment and greater (P ≤ 0.01) percentage osseous support than teeth without wear facets. Teeth with uneven marginal ridges had more loss of clinical attachment and deeper probing depth than those with even marginal ridges (P ≤ 0.05). Furthermore, it is clear from Table 1 that teeth with centric relation, nonworking, working or protru-
Table 1  
Comparison of Probing Depth, Clinical Attachment Loss and Radiographic Osseous Support for Teeth with (+) and Without (−) Examiner Agreement for Various Clinical Findings. N = number of teeth

<table>
<thead>
<tr>
<th></th>
<th>Probing depth</th>
<th>Clinical attachment loss</th>
<th>Per cent osseous radiographic support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean (mm)</td>
<td>P</td>
</tr>
<tr>
<td>Bidigital mobility</td>
<td>−</td>
<td>426</td>
<td>3.23</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>33</td>
<td>5.12</td>
</tr>
<tr>
<td>Functional mobility</td>
<td>−</td>
<td>412</td>
<td>3.27</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>31</td>
<td>4.86</td>
</tr>
<tr>
<td>Wear facets</td>
<td>−</td>
<td>120</td>
<td>3.58</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>183</td>
<td>3.36</td>
</tr>
<tr>
<td>Uneven marginal</td>
<td>−</td>
<td>276</td>
<td>3.33</td>
</tr>
<tr>
<td>ridges</td>
<td>+</td>
<td>122</td>
<td>3.58</td>
</tr>
<tr>
<td>Centric relation</td>
<td>−</td>
<td>100</td>
<td>3.34</td>
</tr>
<tr>
<td>contacts</td>
<td>+</td>
<td>197</td>
<td>3.48</td>
</tr>
<tr>
<td>Nonworking contacts</td>
<td>−</td>
<td>396</td>
<td>3.40</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>32</td>
<td>3.64</td>
</tr>
<tr>
<td>Working contacts</td>
<td>−</td>
<td>286</td>
<td>3.46</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>89</td>
<td>3.41</td>
</tr>
<tr>
<td>Protrusive contacts</td>
<td>−</td>
<td>444</td>
<td>3.42</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>11</td>
<td>4.14</td>
</tr>
</tbody>
</table>

sive contacts did not have any statistically significant difference in probing depth, clinical attachment level or percentage osseous support than teeth without these contacts.

A comparison of three radiographic parameters with respect to probing depth, clinical attachment level and percentage osseous support is given in Table 2. Teeth with a widened periodontal ligament space or the presence of calculus had deeper probing depth, more loss of clinical attachment and less osseous support (p ≤ 0.001) than teeth without these findings. However, teeth with a thickened lamina dura had less probing depth, less loss of clinical attachment and more osseous support than teeth without this parameter (P ≤ 0.005).

Two clinical signs were selected to define possible trauma from occlusion in the sample of first molars from the 300 subjects in this study. These signs included functional mobility and the presence of a radiographically widened periodontal ligament space. To be certain that the most critical criteria be used to define possible signs of trauma from occlusion, further restrictions were included. Only those teeth judged independently by both clinical examiners to have functional mobility and judged by the radiographic examiner to have a widened periodontal ligament space were classified as having possible signs of trauma from occlusion. Teeth categorized as not having signs of trauma from occlusion required agreement by both clinical examiners on the absence of functional mobility and judgment by the independent radiographic examiner that a normal periodontal ligament space was present. These restrictions severely limited the number of teeth in the sample classified as having signs of occlusal trauma. Only 14 teeth of the total sample satisfied these criteria. A total of 319 teeth satisfied the criteria of not having possible signs of occlusal trauma.
Table 2  
Comparison of Probing Depth, Clinical Attachment Loss and Radiographic Osseous Support for Teeth with (+) and Without (−) Various Radiographic Findings. N = number of teeth

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Probing depth</th>
<th>Clinical attachment loss</th>
<th>Percent osseous radiographic support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N  Mean (mm)</td>
<td>P</td>
<td>N  Mean (mm)</td>
</tr>
<tr>
<td>Widened periodontal ligament space</td>
<td>− 395 3.26</td>
<td>≤0.001</td>
<td>399 0.88</td>
</tr>
<tr>
<td></td>
<td>+ 91 3.82</td>
<td></td>
<td>84 1.71</td>
</tr>
<tr>
<td>Thickened lamina dura</td>
<td>− 385 3.43</td>
<td>≤0.005</td>
<td>345 1.18</td>
</tr>
<tr>
<td></td>
<td>+ 101 3.11</td>
<td></td>
<td>98 0.54</td>
</tr>
<tr>
<td>Calculus</td>
<td>− 391 3.27</td>
<td>≤0.001</td>
<td>359 0.84</td>
</tr>
<tr>
<td></td>
<td>+ 95 3.75</td>
<td></td>
<td>84 1.87</td>
</tr>
</tbody>
</table>

The results of an unpaired t test for differences between the 14 teeth in the group classified as having possible signs of trauma from occlusion and the 319 teeth classified as not having these signs are given in Table 3. Teeth with these signs of trauma from occlusion had significantly (P ≤ 0.001) deeper probing depth, more clinical attachment loss, less radiographic osseous support and greater gingival and calculus indices than teeth without these signs. There was, however, no statistically significant difference in the plaque index between the two groups of teeth.

In order to investigate whether the lower percentage osseous support for teeth having possible signs of occlusal trauma was due solely to greater severity of periodontitis, or whether trauma from occlusion may have been contributory, regression analysis was performed. The regression of mesial osseous support on mesio-buccal clinical attachment level for two groups of teeth is given in Figure 1. One group consisted of the 14 teeth judged independently by two examiners to have functional mobility and by the third examiner to have a widened periodontal ligament space. The second group included teeth from the 319 judged to have no functional mobility by two examiners and to have a normal periodontal ligament space by the third examiner. The second group of teeth was matched to the first group for similar clinical attachment level and similar gingival, plaque and calculus indices. Only 10 of the 319 teeth satisfied these criteria and were used for the regression analysis. Thus, the two groups of teeth were alike with respect to clinical attachment level, gingival inflammation, and clinical measures of local irritants. However, the two groups were dissimilar with respect to the signs of occlusal trauma. From Figure 1, it may be seen that for any given attachment loss, teeth with a widened periodontal ligament space and functional mobility had about 10% less osseous support than teeth without these parameters. The actual difference was calculated to be 11.6% and was statistically significant at P ≤ 0.001.
DISCUSSION

There is little evidence that various occlusal contact patterns are related to the severity of periodontitis. Shefter and McFall were unable to document any association between various occlusal contact patterns and the severity of disease. Similarly, data from the present study indicated no difference in probing depth, clinical attachment level or percentage osseous support between teeth with and without centric relation, working, nonworking or protrusive contacts. Data from this study did indicate that maxillary first molars with wear facets or a thickened lamina dura had less clinical attachment loss and more osseous support than teeth without these findings. The explanation for this appears straightforward. Without loss of periodontal support, it is likely that heavy function induced a thickened lamina dura and caused wear facets.

The results of this study also indicated that teeth with either bidigital mobility, functional mobility, a widened periodontal ligament space or radiographic evidence of calculus had greater probing depth, more loss of clinical attachment and less osseous support than teeth without these findings. When very strict limitations were used to define possible trauma from occlusion, similar results were found. These limitations included the requirement that both examiners independently agree on the presence of mobility and a third examiner score the presence of a widened periodontal ligament space. Results from this analysis also indicated greater probing depth, more loss of clinical attachment and less osseous support than for teeth without these findings. This might have been expected since teeth with more severe periodontitis would have less support and therefore more mobility accompanied by widening of the periodontal ligament space.

To investigate the question of whether decreased osseous support resulted from periodontitis alone or whether excessive forces also may have been contributory, a different method of data analysis was used. Since both periodontitis and trauma from occlusion may ultimately result in tooth mobility accompanied by compensatory widening of the periodontal ligament space, two different groups of teeth were compared. The two groups of teeth had equal levels of local irritants, inflammation and clinical attachment loss but were different in terms of signs of trauma from occlusion. Regression analysis revealed that for equal severity of periodontitis as measured by clinical attachment loss, teeth with functional mobility and a widened periodontal ligament space had about 10% less radiographic evidence of osseous support than teeth without these signs. This could only occur if forces had resulted in crestal remodeling or resorption without concurrent equal loss of clinical attachment. While the present study cannot document any effect on connective tissue attachment level, the results are consistent with histologic studies in humans and animals. Ramfjord and Kohler reported that in humans, increased functional forces caused crestal bone remodeling without any effect on the supra-crestal connective tissue fibers. With respect to traumatic force, several studies have reported crestal bone remodeling in monkeys without concurrent loss of connective tissue attachment.

CONCLUSIONS

From this cross-sectional study of maxillary first molars in individuals 20 to 40 years of age, it may be concluded that:

1. Teeth with bidigital mobility, functional mobility, a widened periodontal ligament space or the presence of radiographically visible calculus had deeper probing depth, more loss of clinical attachment and less percentage radiographic osseous support than teeth without these findings.

2. Teeth with occlusal contacts in centric relation, working, nonworking or protrusive positions did not exhibit any greater severity of periodontitis than teeth without these contacts.

3. Teeth with both functional mobility and a radiographically widened periodontal ligament space had deeper probing depth, more clinical attachment loss and less radiographic evidence of osseous support than teeth without these findings.

4. Given equal clinical attachment levels, teeth with evidence of functional mobility and a widened periodontal ligament space had less osseous support than teeth without these findings.

REFERENCES


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Announcement

PANAMERICAN ASSOCIATION OF PERIODONTOLOGY

The Fourth Congress of the Panamerican Association of Periodontology will be held at the Plaza Hotel, Buenos Aires, Argentina from November 26-29, 1986.

Speakers will include Drs. Simao Kon, Juan J. Carraro, Fermin Carranza, Raul Caffesse and Sture Nyman.