Periodontics

Periotest values and tooth mobility in periodontal disease: a comparative study

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Defined total deflection of maxillary central incisors was ascertained in the orofacial direction. The extent of bone atrophy resulting from marginal periodontitis was determined by radiography. Both values were compared with the Periotest value. A correlation and regression analysis demonstrated a significant relationship, such that the Periotest provided accurate information about bone atrophy. (Quintessence Int 1990;21:289–293.)

Introduction

The Periotest method (Siemens Dental Div) for determining periodontal function was developed between 1972 and 1984 by an interdisciplinary group of researchers. The Periotest method measures periodontal damping characteristics and, indirectly, tooth mobility with an excitation pulse of approximately 1 millisecond. Qualitative and quantitative structural changes of the periodontium are recorded with extreme accuracy.

This article investigates the interrelationship between the Periotest value and tooth deflection.

Method and materials

Tooth deflection is measured using the Lukas et al. and Scholz and Lukas methods, with reference to Körber. This noncontact electronic measuring method corresponds to mechanical periodontometry, which has been described by Mühlemann. A distinct correlation between the Periotest method and periodontometry as described by Mühlemann has been found. Recording tooth deflection in this way is a static method and differs from the clinical low-frequency looseness test.

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Figure 1 Measuring system for determining the total deflection of maxillary central incisors. The tooth to be examined is deflected to the left for 20 seconds by pulling the indicated looped thread over a deflection roller and attaching weights. Tooth deflection is measured with two noncontact inductive displacement transducers.

Figure 1 illustrates the measuring system. The tooth to be examined is deflected to the left when the indicated looped thread is pulled over a deflection roller.
and weights (2 N, 3 N, and 4 N) are attached. Tooth deflection is measured with two noncontact, and therefore noninteracting, inductive displacement transducers in a half-bridge connection. A U-shaped plastic molded block is fastened to the cutting edge of the tooth. The facial surfaces of this block are covered with soft iron. The air gap between block and inductive displacement transducers is initially 2 x 0.3 mm. During tooth deflection, the block displacement between the transducers leads to a change in inductivity, which is measured using an amplifier. Both a continuous-line recorder and a digital storage oscilloscope record the measured results. To calibrate the measuring device, a micrometer screw was used to shift the plastic block between the inductive displacement transducers in 5-μm steps.

The maxillary central incisors of 12 patients who were being treated for periodontal pathologies in the Policlinic of Dental Surgery and Periodontology, University of Tübingen, were examined.14 The subjects exhibited ten cases of marginal periodontitis (seven without previous gingival pocket therapy and three after flap surgery), one case of gingivitis, and one case of generalized recession. Four persons without periodontal pathology made up the control group.

Periotest measurements were performed using the standard methods.15,16

Clinical tooth looseness was defined according to the classification of the German Periodontics Society (degree of looseness 0: firm; degree of looseness I: palpable looseness; degree of looseness II: visible looseness; degree of looseness III: looseness in response to lip or tongue pressure).

The bone atrophy was determined from radiographs and measured in gradations of one tenth of normal bone height. In determining this relative bone atrophy, it was assumed that in the healthy periodontium the vestibular and palatal lingual courses of the alveolar ridge follow those of the cervical line. The lowest point of the cervical line (CL) is measured for the calculation:

$$\text{relative bone atrophy} = \frac{(\text{CL} - 2 \text{ mm}) - \text{alveolar ridge}}{(\text{CL} - 2 \text{ mm}) - \text{root apex}}$$

The healthy alveolar ridge is generally 2 mm apical to the cervical line. To find the relationship between the Periotest value and tooth deflection, a regression analysis was carried out.

Results

Figure 2 and Table 1 demonstrate the relationship between the Periotest value and tooth deflection about 20 seconds after the start of loading. The clinical stage...
of loosening and bone loss found in the radiographs is also shown for each measurement point. Table 2 lists the results of a linear correlation analysis. All correlation coefficients differentiate significantly from zero.

The following equation demonstrates the relationship between the Periotest value and total deflection with a loading of 3 N:

\[
\text{deflection} = (5.78 \times \text{Periotest value} - 21.0) \mu m.
\]
Table 1  Measurement values and clinical findings

<table>
<thead>
<tr>
<th>Degree of looseness*</th>
<th>Bone atrophy</th>
<th>Periotest value</th>
<th>Total deflection (µm)</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.1</td>
<td>4</td>
<td>38</td>
<td>Control</td>
</tr>
<tr>
<td>0</td>
<td>0.2</td>
<td>6</td>
<td>41</td>
<td>Control</td>
</tr>
<tr>
<td>0</td>
<td>0.0</td>
<td>4</td>
<td>45</td>
<td>Control</td>
</tr>
<tr>
<td>0</td>
<td>0.2</td>
<td>5</td>
<td>46</td>
<td>Control</td>
</tr>
<tr>
<td>0–I</td>
<td>0.2</td>
<td>11</td>
<td>25</td>
<td>Generalized gingival retraction, lingual parafunction</td>
</tr>
<tr>
<td>0–I</td>
<td>0.2</td>
<td>4</td>
<td>38</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>0–I</td>
<td>0.2</td>
<td>9</td>
<td>55</td>
<td>Gingivitis</td>
</tr>
<tr>
<td>0–I</td>
<td>0.2</td>
<td>8</td>
<td>73</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>0–I</td>
<td>0.2</td>
<td>11</td>
<td>78</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>I</td>
<td>0.2</td>
<td>5</td>
<td>29</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>I</td>
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</tr>
<tr>
<td>I</td>
<td>0.4</td>
<td>14</td>
<td>65</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>I</td>
<td>0.4</td>
<td>19</td>
<td>138</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>II</td>
<td>0.5</td>
<td>13</td>
<td>89</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>II</td>
<td>0.5</td>
<td>9</td>
<td>108</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>II</td>
<td>0.5</td>
<td>24</td>
<td>111</td>
<td>Marginal periodontitis</td>
</tr>
<tr>
<td>II</td>
<td>0.5</td>
<td>25</td>
<td>137</td>
<td>Marginal periodontitis</td>
</tr>
</tbody>
</table>

* According to the classification of the German Periodontics Society.

Table 2  Results of linear correlation analysis

<table>
<thead>
<tr>
<th>Deflecting force</th>
<th>Correlation coefficient (r)</th>
<th>Coefficient of determination (r²)</th>
<th>Regression coefficient (a₀)</th>
<th>(bₓ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 N</td>
<td>0.7751</td>
<td>60.1%</td>
<td>21.3</td>
<td>4.12</td>
</tr>
<tr>
<td>3 N</td>
<td>0.7789</td>
<td>60.7%</td>
<td>21.0</td>
<td>5.78</td>
</tr>
<tr>
<td>4 N</td>
<td>0.7905</td>
<td>62.5%</td>
<td>27.9</td>
<td>6.01</td>
</tr>
</tbody>
</table>

The squared correlation coefficient (r²) indicates that 60.7% of the total deflections were related to Periotest values according to the equation, whereas 39.3% were affected by other factors.

Discussion

When the Periotest values are compared with total deflection, it should be noted that the direction of deflection in Periotest measurements are opposite to those in the Lukas and Scholz methods.

According to Mühlemann17 and Hofmann,18 all periodontal tissues, and even the hard tissue of the tooth, are loaded during total deflection. Because of the short period of tooth deflection (approximately 1 millisecond) during the Periotest measurement, the displacement of the fluids in the vascular system of the periodontium plays only a subordinate role. In spite
of these differences, results demonstrate a significant correlation between the Periotest value and tooth deflection.

Diagnostic radiology can only identify bone loss in the approximal region: the buccal, lingual, and oral regions are not taken into account. However, there is still a significant correspondence between the Periotest value and bone loss.

In Fig 2b, two measurement points with the same total deflection of 140 µm and the same bone atrophy of 0.5 can be found. However, the Periotest values (19 and 24) and the degrees of looseness (I and II) were both different. The diagnosis in both cases was of marginal periodontitis. The patient with a degree of looseness I had not yet been treated. The gingival pockets were 2 and 4 mm deep. The patient with degree of looseness II, on the other hand, had been previously treated with scaling and root planing. The gingival pockets of that patient were 4 mm deep mesially and distally.

Another example can be found in the two measurements with the lowest total deflections at a force of 3 N. In both cases, the total deflections were 36 and 34 µm, with bone losses of 0.2. The patient with degree of looseness I had a Periotest value of 5, and the pocket depths were 3 and 4 mm. The diagnosis was of marginal periodontitis. The patient with degree of looseness 0—I and a Periotest value of 11 had no pathological pockets. The diagnosis was of generalized gingival recession. Thus, the Periotest method quantitatively recorded the facial periodontal substance loss as a result of noninflammatory gingival recession with otherwise uniform horizontal resorption. In total tooth deflection, however, only a minor difference existed.

Conclusion

Results indicated that the Periotest method provides accurate information about bone atrophy. Therefore, fewer radiographs are necessary and patients are exposed to less radiation.

References