Correlations between endotoxin and clinical symptoms or radiolucent areas in infected root canals

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Samples were collected from the root canals of 30 teeth of patients with apical periodontitis and assayed for endotoxin content. The detection rates of endotoxin and endotoxin content were higher in symptomatic teeth, teeth with radiolucent areas, and teeth with exudation than in those without them. (ORAL SURG ORAL MED ORAL PATHOL 1991;71:492-5)

The cause of apical periodontitis may be bacterial, chemical, mechanical, or of another nature; however, it appears that bacteria are the most important factor. In view of this fact, there are many reports with respect to the isolation and identification of bacteria found in the root canal.1-4 However, we often do not know how the bacteriologic status compares with the clinical appearance. Recently it has become possible to obtain higher rates of detection of strict anaerobic bacteria from infected root canals because of improvements in techniques for culturing anaerobic bacteria. As a result, gram-negative bacteria predominantly were identified and isolated from specimens taken from infected root canals.

Gram-negative bacteria contain endotoxin, a lipopolysaccharide complex that has many biologic activities including fever induction, adjuvant activity, Shwartzman reaction, cytotoxicity, and the like.5-9 Therefore it is very important to evaluate the endotoxin content of infected root canals.

Morishima et al.10 and Schein and Schider11 have suggested that there is a correlation between endotoxin content and symptomatic teeth or radiolucent areas. However, they have not reported a correlation between endotoxin content and degree of exudation observed frequently in infected root canals.

The purpose of the present study was to evaluate the correlation between endotoxin content and clinical symptoms such as spontaneous pain, percussion pain, exudations, or radiolucent areas.

MATERIAL AND METHODS

Experimental teeth

The material consisted of 30 teeth of 27 patients in whom root canal treatment had been performed by members of the endodontics staff at the School of Dentistry, Aichi-Gakuin University. None of the patients reported in this study received antibiotic therapy during the course of root canal treatment or 6 months before treatment.

Sampling of the substance in the root canals

After intraoral examination the outline form of the endodontic preparation in the teeth was made with a high-speed bur (No. 1557, Maillefer Co., Zurich, Switzerland). The teeth, all of which had a single canal, were isolated with a rubber dam and sterilized with tincture of iodine and 70% ethyl alcohol. Subsequently, access was gained to the pulp chamber and instrumentation with a No. 20 or No. 25 hand file (Sybron/Kerr Co., Romulus, Mich.) was carried out. A fresh, sterile absorbent point (No. 20, GC Co., Tokyo, Japan) saturated with physiologic salt solution was inserted into the apical portion of the root canal. The absorbent point was allowed to remain in the canal for 1 minute to absorb periapical exudate and mi-
**Clinical symptoms and endotoxin content**

### Table I. Correlation between symptoms and endotoxin content

<table>
<thead>
<tr>
<th></th>
<th>Symptomatic</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>No. of teeth with endotoxin</td>
<td>16 (100%)†</td>
<td>4 (28.6%)</td>
</tr>
<tr>
<td>Endotoxin content (µg/ml)</td>
<td>8.7 ± 4.7*</td>
<td>0.7 ± 1.6</td>
</tr>
</tbody>
</table>

Symptomatic, Teeth with spontaneous and/or percussion pain; asymptomatic, teeth without either spontaneous or percussion pain.

* p < 0.005.
† p < 0.001 as compared with asymptomatic teeth (Fisher's exact probability test and Student's t test).

### Table II. Correlation between radiolucent areas and endotoxin content

<table>
<thead>
<tr>
<th>Radiolucent areas</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>No. of teeth with endotoxin</td>
<td>19 (86.4%)*</td>
<td>1 (12.5%)</td>
</tr>
<tr>
<td>Endotoxin content (µg/ml)</td>
<td>5.9 ± 5.2†</td>
<td>0.8 ± 2.1</td>
</tr>
</tbody>
</table>

* p < 0.01.
† p < 0.005 as compared with teeth without radiolucent areas (Fisher's exact probability test and Student's t test).

### Table III. Correlation between exudation in root canal and endotoxin content

<table>
<thead>
<tr>
<th>Exudation</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>No. of teeth with endotoxin</td>
<td>19 (95.0%)†</td>
<td>1 (10.0%)</td>
</tr>
<tr>
<td>Endotoxin content (µg/ml)</td>
<td>6.8 ± 5.0*</td>
<td>0.1 ± 0.2</td>
</tr>
</tbody>
</table>

† p < 0.005 as compared with teeth without exudation (Fisher's exact probability test and Student's t test).

### Table IV. Correlation between pyogenic exudation and endotoxin content

<table>
<thead>
<tr>
<th>Pyogenic exudation</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>No. of teeth with endotoxin</td>
<td>7 (100%)</td>
<td>12 (92.3%)</td>
</tr>
<tr>
<td>Endotoxin content (µg/ml)</td>
<td>9.4 ± 4.9</td>
<td>5.5 ± 4.8</td>
</tr>
</tbody>
</table>

### Statistical analysis

The correlation between clinical symptoms or radiolucent areas and the detection rates of endotoxin was evaluated statistically with Fisher's exact probability test. The correlation between those and endotoxin content was evaluated by means of Student's t test.

### RESULTS

**Correlation between symptomatic teeth and endotoxin content**

Endotoxin was detected in all 16 of the teeth with symptoms and in 4 (28.6%) of 14 teeth without symptoms, and this difference in percentage was highly significant (p < 0.001) (Table I). Endotoxin content was higher in symptomatic teeth (average value 8.0 µg/ml) than in asymptomatic teeth (0.7 µg/ml) (p < 0.005).

**Correlation between radiolucent area and endotoxin content**

Endotoxin was detected in 19 (86.4%) of 22 teeth having a radiolucent area (Table II). In terms of endotoxin content, there was a significant difference between teeth with a radiolucent area (5.9 µg/ml) and those without it (0.8 µg/ml) (p < 0.005). The detection rate of endotoxin was higher in teeth with a radiolucent area than in those without it (p < 0.01).
Correlation between exudation and endotoxin content

Endotoxin was detected in 19 (95.0%) of 20 teeth with exudation (both pyogenic and serous exudations) (Table III). The detection rates of endotoxin and the average endotoxin content were higher in teeth with exudation than in those without it \((p < 0.001\) and \(p < 0.005\), respectively). No significant difference in endotoxin content was found when the data derived from seven teeth with pyogenic exudates were compared with those of 13 teeth having serous exudates (Table IV).

DISCUSSION

Our results showed that teeth with clinical symptoms contain high levels of endotoxin. A few investigators have demonstrated a correlation between clinical symptoms and endotoxin content.\(^2,10,11\) Morishima et al.\(^10\) and Schein and Schider\(^1\) reported the endotoxin level detected in symptomatic teeth to be 0.098 to 20.978 \(\mu g/ml\) and 0.256 to 2.048 \(\mu g/ml\), respectively. In our study the average levels of endotoxin detected in samples from symptomatic and asymptomatic teeth were 8.0 \(\mu g/ml\) and 0.7 \(\mu g/ml\), respectively. These facts indicate that the endotoxin plays an important role in the appearance of symptoms.

With respect to the presence of radiolucent areas, Morishima et al.\(^10\) and Schein and Schider\(^1\) reported that the endotoxin content of teeth with radiolucent areas was five times as great as that from teeth without such areas. In our study, the average concentration of endotoxin was 5.9 \(\mu g/ml\) in samples from teeth with a radiolucent area and 0.8 \(\mu g/ml\) in those without it. Thus our results are similar to theirs. Schonfeld and coworkers\(^7\) reported that endotoxin was detected in 75% of human apical granulomas and in 20% of both human apical scars and cysts. Hausman et al.\(^13\) reported the effect of lipopolysaccharides on bone resorption in tissue culture. In addition, Norton and associates\(^14\) showed that in vitro bone growth was inhibited in the presence of endotoxin. These facts suggest that endotoxin may be one of the factors involved in the resorption of alveolar bone.\(^15,18\)

We could find no report in the literature of association between the presence of exudations and endotoxin content. In our study endotoxin was detected in 19 (95.0%) of 20 teeth with exudation. There was a significant difference in endotoxin level between teeth with exudation and those without it. Although the average endotoxin content detected in samples from teeth with pyogenic exudation was 1.7 times greater than that from those with serous exudation, the difference was not statistically significant. However, our results indicate that the endotoxin may be associated with the production of exudate.

Our study indicates a positive correlation between endotoxin and clinical symptoms or radiolucent areas. Such correlations suggest that an increase in endotoxin level in infected root canals may be associated with an increased degree of periapical disease.

SUMMARY

Endotoxin content of samples obtained from the single root canals of 30 teeth displaying apical periodontitis was measured. A correlation between endotoxin content and clinical symptoms or radiolucent areas was sought.

The rates of detection of endotoxin and endotoxin content in symptomatic teeth exceeded those in asymptomatic teeth. These rates for teeth with radiolucent areas differed significantly, as was also noted for teeth with exudations. Endotoxin was present in all seven samples from teeth with pyogenic exudations and in 12 of 13 samples from teeth with serous exudations. The concentration of endotoxin was essentially the same for teeth with either type of exudate.

REFERENCES

12. Schonfeld SE, Greening AB, Glick DH, Frank AL, Simon JH,


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