Influence of Time of Calcium Hydroxide Iodoform Paste Replacement in the Treatment of Root Perforations

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A method for sealing endodontic perforations with calcium hydroxide iodoform paste was experimentally carried out in root canals of dogs. The material was changed according to a prefixed combination of every 7, 15, 30 or 60 days. Different histological responses occurred depending on the time of material replacement. The best results occurred when the paste was changed after 7 or after 7 and 15 days. New mineralized tissue was observed when material was replaced after 60 days; however, at the end of this experimental period, some inflammatory cells were still present.

Key Words: root perforations, calcium hydroxide iodoform paste, root canal therapy.

Introduction

Root canal perforation can be one of the causes of failure of endodontic treatment leading to tooth loss. Various procedures have been recommended to solve the problem (Nicholls, 1962; Cattoni, 1963; Bramante and Berbert, 1977). Several materials have been used to seal perforations, such as, gutta-percha (Lantz and Persson, 1970; Stromberg et al., 1972), silver amalgam (Luebke and Down, 1964; Schommer and Marshall, 1971), cavit (Harris, 1976; Jew et al., 1982), calcium hydroxide (Ruchenstein, 1941; Frank and Weine, 1973; Bramante, 1980), zinc phosphate cement (Lantz and Persson, 1970) and zinc oxide-eugenol-based sealer (Nicholls, 1962; Seltzer et al., 1970). Of these materials, calcium hydroxide presents the best requirements to encourage perforation sealing. Apart from easy manipulation, it is quickly resorbed in case of possible extrusion through the periodontium, allowing periodontal tissue reorganization and consequent biologic sealing by mineralized material (Maisto and Capurro, 1964; Bramante, 1980).

Some authors have suggested calcium hydroxide renewal at short intervals in order to control the problem of inductive action loss of the material through its alkalinity exhaustion (Maisto and Capurro, 1964; Frank and Weine, 1973; Heithersay, 1975; Bramante, 1980). This statement, though, can be considered as only one hypothesis, since literature regarding calcium hydroxide use in root perforation correction is very scarce.
The purpose of this study is to evaluate the histologic response of perforations carried out in root canals of dogs after the use of calcium hydroxide iodoform paste renewed periodically.

Material and Methods

Seventy-two maxillary and mandibular premolars of 12 young adult mongrel dogs were used in this study. After venous anesthesia, a rubber dam was placed. The teeth were conventionally instrumented and obturated with gutta-percha and AH26. Perforations were then made at the cervical portion of the mesial root of each tooth, reaching the furca (Figure 1) with a bur of 0.7 mm in diameter and 2 mm long (D-74, Whaledent, New York City, NY). The perforation was carefully irrigated with saline solution, dried and filled with calcium hydroxide iodoform paste (P.A. calcium hydroxide and iodoform 2:1, v/v), using distilled water a vehicle). The paste was compressed with cotton pellets until the perforation was totally filled up. After the pulp cavity was cleaned and sealed with zinc oxide-eugenol sealer, the rubber dam was removed and a radiograph was taken.

The calcium hydroxide iodoform paste was removed from the perforations according to the time previously established for each case, that is, 7, 15, 30 and 60 days, individually or in combination, when new material was placed in the perforation (Table 1). For these changes, the animals were anesthetized and a rubber dam applied. After the temporary sealing material was removed, the calcium hydroxide iodoform was washed out using saline irrigation in order to clean the entire perforation. After drying, a fresh calcium hydroxide iodoform paste was introduced into the perforation by compressing with cotton pellets.

After the 90-day experimental period, the animals were killed by perfusion and the teeth and adjacent tissues were decalcified. Sections were then stained with hematoxylin and eosin and Masson's method. The sections were examined for inflammation, resorption

Figure 1 - Site of experimental perforation made by the D-74 bur.
Table 1 - Protocol followed for each experimental group using calcium hydroxide iodoform paste to treat root perforations.

<table>
<thead>
<tr>
<th>Group</th>
<th>Protocol</th>
<th>No. of teeth</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Without change</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Change at 7 days</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>Change at 15 days</td>
<td>12</td>
</tr>
<tr>
<td>D</td>
<td>Change at 30 days</td>
<td>11</td>
</tr>
<tr>
<td>E</td>
<td>Change at 60 days</td>
<td>12</td>
</tr>
<tr>
<td>F</td>
<td>Change at 7 and 15 days</td>
<td>10</td>
</tr>
<tr>
<td>G</td>
<td>Change at 7, 15 and 30 days</td>
<td>7</td>
</tr>
<tr>
<td>H</td>
<td>Change at 7, 15, 30 and 60 days</td>
<td>8</td>
</tr>
</tbody>
</table>

and apposition of bone and dental hard tissue at the perforation site. These features were recorded as being non-significant, mild, moderate or severe.

Results

In all experimental groups coagulation or liquefied necrotic areas in the bone and in the periodontal ligament were present. Irregular width was also seen (Figure 2.1). However, it was generally circumscribed and showing marked tendency to repair (Figure 2.2).

By forming spurs near the perforation, a cementum bridge was frequent in some of the experimental groups (Figure 3.1). In certain cases, it presented itself as a continuous area, in front of the empty perforation (Figures 3.2 and 3.3).

This resembled a true newly formed cementum bridge between the perforation and the newly formed periodontium. In some cases, the bridge was the contact point between the cementum and the alveolar bone, like a bridge separating the normal periodontium from a pathologic cavity frontal and continuous to the perforation. This, in turn, characterized an ankylosis (Figure 3.4).

Groups F and B representing calcium hydroxide iodoform paste changes at 7 and 15 days and at 7 days, respectively, exhibited markedly higher reparation indices with insignificant inflammatory reactions. Frequently, the bone destruction was limited to the periodontal ligament and the cementum bridge even formed real ankylosis.

Group E, in which calcium hydroxide iodoform paste was replaced at 60 days, showed a tendency to perforation sealing by mineralized material (Figures 3.2 and 3.3). However, in some cases, the inflammatory reactions still persisted possibly for the length of time (30 days) between the aggression caused by the paste change and the histologic evaluation.
Groups A, in which calcium hydroxide iodoform paste was used without change, and D (calcium hydroxide and iodoform replaced at 30 days) showed both reparative and inflammatory reactions of small magnitude which, on the whole, made the prognosis doubtful.

Groups H (calcium hydroxide and iodoform replaced at 7, 15, 30 and 60 days), G (calcium hydroxide and iodoform replaced at 7, 15 and 30 days) and C (calcium hydroxide and iodoform replaced at 15 days) showed less favorable prognoses. In these groups, discrete to moderate inflammatory reactions were still predominant compared to the reparative ones (Figures 2.1 and 2.2).

In groups A, C, D, G and H, cementum formation occurred by the formation of a spur which protruded towards the bone, although without formation of ankylosis. Except for group C, whose perforation sealing material change was carried out at 15 days, the other experimental groups exhibited empty cavities with bone exposure and basophilic line which was probably due to the calcium hydroxide contact with that tissue, causing a necrosed area.
Figure 3 - 3.1, Group G (calcium hydroxide iodoform change at 7, 15 and 30 days). Cementum forming a spur toward the bone (arrow). H.E. Original magnification X35. 3.2 and 3.3, Group E (calcium hydroxide iodoform change at 60 days). Cementum formation (arrow) like a mineralized bridge sealing the root perforation. H.E. Original magnification X35. 3.4, Cementum formation like a bridge over the periodontium causing ankylosis between cementum and bone (arrow), near the furca. Group B (calcium hydroxide iodoform change at 7 days). H.E. Original magnification X90.

Discussion

Joint analyses of inflammatory and reparative reactions allowed the classification of experimental conditions, starting with that of the most to the least favorable prognosis (see Table 2).
Table 2 - Classification of experimental groups in terms of the most to the least favorable prognosis.

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>Change at</th>
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<tbody>
<tr>
<td>1</td>
<td>Group F</td>
<td>7 and 15 days</td>
</tr>
<tr>
<td>2</td>
<td>Group B</td>
<td>7 days</td>
</tr>
<tr>
<td>3</td>
<td>Group E</td>
<td>60 days</td>
</tr>
<tr>
<td>4</td>
<td>Group A</td>
<td>Without change</td>
</tr>
<tr>
<td>5</td>
<td>Group D</td>
<td>30 days</td>
</tr>
<tr>
<td>6</td>
<td>Group H</td>
<td>7, 15, 30 and 60 days</td>
</tr>
<tr>
<td>7</td>
<td>Group G</td>
<td>7, 15 and 30 days</td>
</tr>
<tr>
<td>8</td>
<td>Group C</td>
<td>15 days</td>
</tr>
</tbody>
</table>

What could be expected as ideal in terms of root perforation repair, that is, sealing by mineralized material, could only be observed in group E (calcium hydroxide iodoform paste replaced at 60 days). This sealing occurred by means of mineralized tissue projected towards the bone facing the perforation (Figures 3.2 and 3.3). In one case, there was connective tissue proliferation originating from discontinuity of the same. They were located now very near the perforation, penetrating the connective tissue, as an apparent result of different pressures used during the application of the calcium hydroxide paste.

Our results justify the material change at 7 and 15 days. Calcium hydroxide immediately placed in the perforation probably comes in contact with the blood clot, which inhibits or diminishes its action. After being replaced and renewed, calcium hydroxide comes in contact with newly formed connective tissue which is adequate for repair, encouraging it more satisfactorily. It should be emphasized that, in this study, infection and severe mechanical or chemical trauma were avoided, which would obviously modify prognosis.

Conclusions

1. The teeth in which perforations were sealed with the aqueous calcium hydroxide iodoform paste presented common phenomena characterized by an area of necrosis facing the perforation with varied degrees of cementum formation.

2. The most favorable prognosis was observed in groups in which calcium hydroxide-iodoform was replaced at 7 and 15 days (group F), and at 7 days (group B).

3. The perforation sealing by mineralized tissue was detected in group E, where the material was changed at 60 days. However, in this group, some inflammatory cells still remained at 90 days.

References


Braz Dent J 5(1) 1994
Treatment of root perforations


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Accepted February 1, 1994