Microleakage through cervically exposed dentinal tubules in root canal filled teeth pretreated with desensitizing agent

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ABSTRACT

Background: Dentin permeability and microleakage are related together and provide a continuous, microscopic, bidirectional fluid filled route between the oral cavity and the pulp space. This study investigates the effect of pretreatment of inner canal wall with ferric-oxalate (desensitizing agent) on the salivary recontamination occurring between the root canal wall and sealer through cervically exposed dentinal tubules.

Material and Methods: Forty extracted mandibular premolar teeth were chemomechanically prepared then randomly divided into two main groups. The inner canal wall of each tooth in the second group was pretreated with ferric oxalate, and then all the teeth were obturated. A ring of 3 mm length at the cervical level of the teeth was subjected to root planning. All specimens were coated except for the ring area subjected to root planning, that was treated with citric acid. The specimens were exposed to natural saliva then pelikan ink. Then cleared and liner dye penetration was measured.

Results: Linear dye penetration was measured and the results were statistically analyzed using T-test.

Conclusion: The treatment of the inner canal wall with ferric-oxalate significantly reduced the microleakage through the cervically exposed dentinal tubules.

Keywords: Microleakage, dentinal tubule, desensitizing agent, ferric-oxalate

INTRODUCTION

Successful endodontic therapy appears to depend on complete sealing of the root canal and prevention of the micro leakage that may occur through cervically exposed dentinal tubules (1). The external sealing of the exposed dentinal tubules appear to be partial and short term cover; end with re-exposing of the dentinal tubules (2), so this study suggest the internal sealing of the dentinal tubules by the pretreatment of the inner canal walls with ferric-oxalate solution (desensitizing agent).

Dentin permeability and microleakage are related together and these processes provide a continuous, microscopic, bidirectional fluid filled route between the oral cavity and the pulp space. Dentin permeability has been defined as the movement of fluids or chemicals, such as microbial products, through dentin.

Dentin permeability is dependent up on the surface area of the exposed or cut dentin, remaining dentin thickness, and the degree of tubule occlusion (5).

It is fortunate that in most cases cementum act as a barrier against the penetration of toxic materials through the dentinal tubules (4), but the dentin may be exposed by gingival recession, dental caries, attrition, abrasion, acid erosion, trauma, cementation of crown, periodontal scaling, pocket elimination, surgical crown lengthening and external root resorption (8).

Wain Wright (6) showed that the diffusion of isotopes through enamel and dentin was more frequent near the gingival line and occlusal fissures without the necessity of following lamellae or cracks. It was also shown that cementum did not provide an impregnated barrier for the diffusion of fluids placed at the canal orifice which diffused through dentin and accumulated in the periodontal ligament (7). It has been hypothesized that cementum resorts after trauma and in 10% of teeth enamel and cementum don't meet and in such cases there's no cemento - enamel junction such kind of roots are devoid of cementum (9). Examination of the anatomy of the teeth shows that there are many paths to be taken by bacteria and their toxic products between the pulp and the periodontal ligament. Apart from the main apical foramen and lateral canals, the dentinal tubules provide path for passage of the noxious material (8).

The introduction of the oxalate salts as a dentin desensitizing agent has proved to be effective in decreasing the sensitivity of dentin due to the precipitation of crystals of insoluble calcium oxalate salt that closed the exposed dentinal tubules on the calcific surface (5,9,10). Oxalate salts such as potassium oxalate have been reported to show promise in reducing dentin permeability. Also they were reported to reduce micro leakage associated with dental amalgam and glass ionomer cement (3,5,11,12).

Ferric oxalate has been recently introduced to dentistry as a dentin desensitizing agent (13). Wang et al (14) evaluated the effectiveness of a 6% ferric oxalate solution applied during...
periodontal surgery to prevent post-operative root hypersensitivity. It was concluded that 6% ferric oxalate was effective in reducing post surgical cold sensitivity when applied during periodontal surgery procedures. The 6% ferric oxalate, when used as a liner under the bleaching paste, was found to be effective in reducing the microleakage of the bleaching agent. It was concluded that 6% ferric oxalate was effective in reducing post surgical cold sensitivity when applied during periodontal surgery procedures. The 6% ferric oxalate, when used as a liner under the bleaching paste, was found to be effective in reducing the microleakage of the bleaching agent. This study investigated the possibility of salivary microleakage through the cervically exposed dentinal tubules, and the effect of the treatment of the inner canal wall with ferric - oxalate on microleakage through the exposed dentinal tubules.

MATERIALS AND METHODS

Forty extracted human mandibular premolar teeth were used. The teeth were stored in 10 % formalin. In order to get flat reference point for measurements and to eliminate variables in access preparations, the crown portion of each tooth was removed to the level of the cervical line. Circular access opening for each tooth was prepared using carbide round bur No. 023 with conventional hand piece, then all the specimens conventionally instrumented to size 50, irrigated with 5% NaOCl. The specimens then randomly divided into two main groups (group I & group II); 20 specimens each. The inner canal wall of the roots in group II were treated with 6% ferric-oxalate solution (sensodyne sealant, Stafford – Miller Ltd, UK.). This was done with a piece of cotton rolled on a barbed broach and soaked in the solution; then painting the inner canal walls; waiting for 5 minutes; drying with absorbent paper points, and then repeating the procedure for the second layer. All the canals were obturated by lateral condensation of gutta-percha and AH- 26 Sealer (De- Tray Dentsply, USA) to within 2 mm of the coronal end. The remaining portion of the canal was obturated with Zinc- phosphate cement (Teret- Vivadent-Liechtenstein). The roots were then placed in 100 % Humidity at 37 for 48 h to allow the sealer to set.

A 3 mm high ring of tooth surface, 2 mm below the cemento - enamel junction of each tooth, was subjected to root planning with curettes, until the root cementum was completely removed. The external surface of each root was coated with two layers of nail varnish and two layers of sticky wax, except for the ring that had undergone root planning (figure 1). The ring subjected to root planning was then treated with a saturated solution of citric acid (pH 1) for 30 s and washed in water for 5 min. The teeth were placed in natural saliva for 10 days. The saliva was collected from the author only in order to maintain the same viscosity, with daily changes to prevent putrefaction. The teeth then placed in ink for 10 days at 37 C° to demonstrate microleakage.

RESULTS

The experimental teeth of group I (without ferric-oxalate treatment) showed more dye penetration than the experimental teeth of group II (without ferric-oxalate treatment), and that the mean value of group 1 is higher than that of group 2. Table 1 and figure 2. The comparison between the two groups by t-test showed too highly significant differences as in table 2.

<table>
<thead>
<tr>
<th>Comparison groups</th>
<th>Mean (mm)</th>
<th>SD</th>
<th>Min. (mm)</th>
<th>Max. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>6.525</td>
<td>0.986</td>
<td>5.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Group 2</td>
<td>5.45</td>
<td>0.732</td>
<td>3.9</td>
<td>6.6</td>
</tr>
</tbody>
</table>

Figure 1: The tested groups (1& 2)

Following dye exposure, the teeth were washed thoroughly under running tap water for 30 minutes, the nail varnish and the sticky wax was removed with a sharp wax knife. Then the teeth were decalcified with 5% nitric acid for a period of 5 days, renewing the acid daily. The teeth were then washed under running tap water for 30 minutes, and dehydrated with 99-100% ethyl alcohol for 3 days with daily changes of alcohol then all the teeth were made transparent by immersion in methyl salicylate for 24 hours. Linear dye penetration was measured using coordinate vernier microscope (Griffin and George, UK).
DISCUSSION

Microleakage has been considered as one of the most important factor affecting the successful endodontic treatment. After exposure of obturation materials to oral fluids, through loss temporary seal, marginal discrepancy, recurrent caries or exposed dentinal tubules; a salivary and bacterial contamination of the canal then occur re-establishing a pathway to the periapical tissues. There are a number of susceptible interfaces where microleakage may occur, between sealer and root canal wall and between sealer and gutta-percha. Microleakage has been shown to occur most frequently at these interfaces (1) Hovland and Dumsha (16) observed that most leakage occurred between the wall of the root canal and the sealer. It is possible that the space between the canal wall and the obturation materials become recontaminated because of microleakage through patent dentinal tubules in the cervical surface of root exposed to saliva. This leakage can continue in the apical direction, recontaminating the root canal (1).

When dentin is exposed after abrasion, grinding, scaling, caries, or cementation of a crown, a mat of mineralized material may form within two weeks occluding the dentinal tubule, but for many reasons such as excessively acidic food, alteration of the composition of saliva or traumatic tooth brushing, the exposed dentinal tubules remain uncovered and patent. The periodontal diseases and therapy are other important causes of exposure of cervical dentin and dentinal tubules particularly after treatment with citric-acid which would facilitate new attachment (17). So for the same reasons the application of the occluding agent at the external surface is subjected to removal which will end with re-exposure of the dentinal tubules (2). So in this study, the application of the occluding agent (desensitizing agent) done for the inner canal wall away from the removing factors before the obturation of the canals.

From the analysis of data of the group I and II, it was found that highly significant difference \( p < 0.001 \) between the two groups, this proved the occluding effect of the ferric oxalate. The present study demonstrated that the interface between the canal wall and the root filling material could be penetrated by the dye through patent dentinal tubules in the cervical surface represent the previous leakage of saliva. This finding is in agreement with the finding of Berrutti (1) in that the cervically expose dentin which was exposed to saliva for various periods showed dye penetration between the canal wall and the sealer. Also this result in agreement with other studies that shown that Oxalate salts (desensitizing agents) have a promising effect on reduction of the microleakage under the Amalgam, and glass ionomer final restoration; by replacing the soluble loosely attached smear layer by hardly attached insoluble acid resistance and non toxic crystalline artificial smear layer of calcium oxalate salts on the calcific surface and inside the dentinal tubules which occlude them.(5,11-15).

REFERENCES