The effect of root end etching on microleakage of gray mineral trioxide aggregate using light polarizing microscope

Rasha H. Jehad B.D.S., M.Sc. (1)  
Zainab M. Kamel B.D.S., M.Sc. (1)

ABSTRACT

Background: This in vitro study confirmed to compare the sealing ability of gray MTA in phosphoric acid etched and non-etched root surface, using light polarizing microscope.

Material and methods: Twenty freshly extracted single rooted teeth with mature apices were selected. Root end preparations were made using straight fissure carbide bur in a high speed turbine hand piece with a depth of 3mm. Their final diameter was determined by the radius of the bur. Ten root ends were filled with grey MTA after etching the root surface with phosphoric acid for 20 seconds and the other ten root ends were filled with grey MTA with no acid etching. Specimens were examined using light polarizing microscope to determine the interface between the tested material and tooth structure among the two groups. All teeth were coated with one layer of nail varnish and two layers of sticky wax and immersed in a plastic tube containing Pelikan ink for 48 hours. The leakage in all the roots was examined by means of stereomicroscope at X2 magnification.

Results: Root surfaces etched with phosphoric acid gel gave a statistically significant decrease in apical microleakage when compared to non-etched root surfaces filled with grey colored MTA.

Conclusions: Acid etching of root-end surfaces affect the apical microleakage differently. Examination with polarized light microscope showed that marginal gaps around the root-end filling were less in the etched group. Acid etching has an effect on marginal adaptation of MTA when used as a retrograde filling material.

Key words: MTA, polarized light microscope, microleakage. (J Bagh Coll Dentistry 2009; 21(4):12-14)

INTRODUCTION

During the last 20 years, endodontics has seen a dramatic shift in the application of periradicular surgery and the part it plays in the delivery of endodontic services. (1)

The aetiology of periapical (periradicular) periodontitis is microbial; the presence of microorganisms within the root canal system induces an inflammatory and immune response within the periradicular tissues resulting in discreet bone destruction. In addition, contamination of the periradicular tissues by microorganisms and root filling materials may initiate a foreign body reaction and healing cannot then take place. (2)

It has been reported that insufficient apical seal is a major cause of surgical endodontic failures. Surgical treatment usually involves the placement of a material designed to seal the root canal contents from the periradicular tissues and repair root defects. Understandably, this material should demonstrate the ability to form a seal with dental tissues while also exhibiting biocompatible behavior with the periodontal tissue. (3)

Numerous materials have been suggested for use as root-end fillings, including gutta-percha, amalgam, Cavit, intermediate restorative material (IRM), SuperEBA, glassionomers, composite resin, carboxylate cements, zinc phosphate cements, zinc oxide eugenol cements, and mineral trioxide aggregate (MTA). The suitability of these various materials has been tested by evaluating their microleakage (dye, radioisotope, bacterial penetration, fluid filtration), marginal adaptation, and cytotoxicity and clinically testing hem in experimental animals and humans. (1) MTA has been developed to seal communications between the tooth structures and external environment and has shown superior sealing properties to other root end filling materials.

This study was designed to assess the marginal adaptation of grey MTA in etched (phosphoric acid) vs. non-etched root surface using light polarizing microscope.

MATERIALS AND METHODS

Twenty freshly extracted single rooted teeth with mature apices and without cracks or fractures in the roots were selected. The teeth were placed in a glass vial containing normal saline solution changed daily.

The apical 3mm of each root was resected under copious water spray using straight fissure carbide bur, in a high speed turbine hand piece
perpendicular to the long axis of the tooth. A cavity was prepared in the resected root-ends to a depth of 3mm using a size 008 round steel bur in a slow speed hand piece.4

Teeth were randomly divided into two equal groups. Ten roots ends (group A) were filled with grey colored MTA after etching the root surface with phosphoric acid for 20 seconds and the other ten root ends (group B) were filled with grey colored MTA with no acid etch.

MTA cement was mixed on a clean dry glass slab and mixed according to the manufacturer's instructions. The cement was placed into the root-end cavity in small increments and packed until the cavity was full. The excess material was wiped off using a damp piece of gauze. All samples were stored at 37°C and 100% relative humidity for 48 hours to allow for complete setting of the root-end filling materials. Light polarized microscope with a special orthoplane camera with a magnification power of 50X was used to see if there are any gaps between the tested material and tooth structure in the two groups.

All teeth were coated with one layer of nail varnish and two layers of sticky wax except for the resected root-ends. Pelikan ink was used as a leakage indicator for all groups. Each sample was bound to the cap of a plastic tube and the apical 3-4 mm of the root was immersed in a plastic tube containing Pelikan ink for 48 hours. At the end of this period the samples were removed from the ink and washed under running water in a position opposite to the apical foramen for one minute.

RESULTS

The mean, standard deviation, minimum and maximum values in (mm) for all groups are illustrated in table 1.

Statistical analysis of data using student t-test showed that there was a highly significant difference between etched and non-etched groups when grey-colored MTA used as retrograde filling material (table 2).

<p>| Table 1: Descriptive statistics of apical microleakage in (mm) for all groups |
|-------------------------------|---------------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Depth of leakage in (mm)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (With acid)</td>
<td>10</td>
<td>Mean: 0.69</td>
<td>Min. value: Zero</td>
</tr>
<tr>
<td>B (without acid)</td>
<td>10</td>
<td>Mean: 1.96</td>
<td>Min. value: 1.3</td>
</tr>
</tbody>
</table>

<p>| Table 2: Student t-test between A &amp; B groups |
|---------------------------------------------|----------------|----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean difference</th>
<th>t-value</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;B</td>
<td>1.27</td>
<td>5.57</td>
<td>0.001</td>
<td>HS</td>
</tr>
</tbody>
</table>

DISCUSSION

The purpose of placing a root-end filling materials is to provide an apical seal which inhibits he leakage of irritants from the root canal system into the periradicular tissues.6

MTA has been shown to be a potential root-end filling material; MTA has been investigated as a material for sealing the communication between root canals and the external area of the teeth. Scheerer et al have shown the good sealing ability of this material, its biocompatibility and low cytotoxicity and also its effect on the induction of odontoblast and of a hard barrier.8

MTA showed better marginal adaptation to the root surface, this is due to the nature of the material .MTA powder consist of fine hydrophilic particles, the principle compounds of which are tricalcium silicate, dicalcium silicate, tetracalcium alumino-ferrite, calcium sulfate hydrate, and tricalcium aluminate's, moisture acts as an activator for the chemical reaction in this material, so MTA absorbed moisture and this could improve the flow and wetting characteristics of the material thus allowing better...
adaptation of the root-end cavity walls. Furthermore there is possibility of setting expansion of the colloidal gel that is formed after hydration of MTA powder which could be responsible also for it’s superior sealing ability.(10)

Acid etching may cause cleaning and freeing of uncleanable firmly adhered smear layer in dentine resulted in porous granulated surface, thus it may facilitate good adaptation of MTA with dentine.(11)

Figure 2: Polarized light microscope figure of etched grey-colored-MTA showing good adaptation

Figure 3: Polarized light microscope figure of non-etched grey-colored-MTA showing poor adaptation

Figure 4: Polarized light microscope figure of non-etched grey-colored-MTA showing microleakage

Figure 5: Polarized light microscope figure of etched grey-colored-MTA showing little or no microleakage

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