A comparative study of apical microleakage by using different preparation and obturation techniques.

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ABSTRACT

Background: When a tooth is treated endodontically, there are several objectives, which must be met for the root canal therapy to be successful. One of those objectives is the complete obturation of root canal system. The purpose of this study was to evaluate the apical sealing ability of root canals prepared by hand and rotary ProTaper system and obturated with Thermafil and ProTaper gutta percha points in comparison with conventional cold lateral condensation by using dye penetration method.

Materials and Methods: Sixty extracted human single straight canals (premolars) were collected and these teeth were randomly divided into two groups of 30 specimens each. (Group A-rotary ProTaper, Group B-hand ProTaper), and each group were divided into three subgroups of 10 specimens each. (Group A1, B1-Thermafil, Group A2, B2-ProTaper gutta percha points, Group A3, B3 cold lateral condensation). Dorifil root canal sealer was employed as the common sealant.

Results: The hand ProTaper was significantly better than rotary ProTaper at apical microleakage when Thermafil, ProTaper gutta-percha point and lateral condensation were used. In group A both the highest and lowest mean value for apical leakage were seen at lateral condensation technique (4.35) and Thermafil technique (1.35) while the protaper g.p points was (2.75). In group B both the highest and lowest mean value for apical leakage were seen at CLC (3.55) and Thermafil (1.1) while the protaper g.p points was (2.65). There was high statistically significant difference between Thermafil, protaper g.p points and CLC techniques (p<0.05)

Conclusion: The results of this study indicate that root canals prepared by hand protaper was significantly better than rotary protaper at apical microleakage. The roots treated by Thermafil leak the least than protaper g.p points and CLC techniques.

Key words: Apical seal, Thermafil, ProTaper gutta percha points, Lateral condensation.

INTRODUCTION

The extensive literature has shown that incomplete apical and coronal three-dimensional fluid tight seal is the main cause of endodontic treatment failure. The one of main objectives of root canal preparation is to shape and clean the root canal system effectively whilst maintaining the original configuration without creating any iatrogenic events such as instrument fracture, transportation, and ledge perforation. The ideal preparation for the root canal is funnel shaped form with smallest diameter at the apex and the widest width at the orifice. Nowadays, different root canal preparation techniques using NiTi instruments were developed (1). The ProTaper system which comprises of ProTaper rotary and a hand-operated instrument used in Balance force motion, that provide ideal shape in root canal instrumentation with least number of instruments in which the rotary P.T gives the speed while hand P.T provide tactile sensation. Obturation after cleaning and shaping provide a seal that prevent reinfection of canal and subsequent leakage into the periradicular tissues (2).

CLC of gutta-percha is one of the commonly used techniques in endodontics. However, it has poor adaptation to root canal walls, lack of homogeneity of gutta-percha mass and high percentage of sealer in the apical portion of canal. Recent advances in technology have lead to development of many gutta-percha obturating systems. Thermafil which have been introduced to make root canal filling easier and less time consuming and to produce a homogenous mass of gutta-percha in canal. Currently used carriers are made of stainless steal, Titanium or plastic (3). Nowadays, the ProTaper is a complete system comprising of both hand and rotary files and new ProTaper gutta-percha points and paper points allowing clinicians to produce better result than ever before. Hence, the objective of this study is to evaluate the apical sealing of root canals prepared by hand and rotary ProTaper system of three obturation techniques which are: Thermafil, ProTaper gutta-percha points and cold lateral condensation techniques.

MATERIAL AND METHODS

Sixty extracted single rooted teeth with straight canal (premolar) that extracted for orthodontic reasons were collected in formalin 10% for this study. The teeth were examined

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carefully by visible light curing unite to determine if there was any visible crack or fracture or external resorption. The tooth with these defects was excluded from the study. The crowns were removed at the cemento-dental junctions with diamond disc under water coolant to eliminate any variations associated with access opening procedure. Following pulp extirpation, a size 15 k-file was inserted into the canal until it was seen at the apical foramen. The working length was determined to be (11mm) short of that position its about (11mm). The NaOCl was 2.5% solution used for irrigation between each file size. The samples were randomly divided into 2 groups of 30 roots each.

Group A –Rotary PT, Group B-Hand PT, and each group were divided into 3 subgroups of 10 specimens each. After the completion of the preparation procedure, the canals were dried using ProTaper paper points. Dorifill root canal sealer was used as the sealer cement and the root canals were obturated as follows:

**Thermafil group**

The A1, B1 roots were obturated with the Thermafil plastic obturators. After completion of instrumentation with hand and rotary protaper system, a size# 30 Thermafil carrier reached the full length without being forced by rotation twisting. Once the fit is verified, a rubber stop marker is adjusted according to the working length on the shaft of the Thermafil obturators. Dorifill sealer mixed according to manufacturer’s instructions and canal wall painted with sealer by using size #25 file. Thermo prep oven was preheated before obturators are heated, then thermafil obturators was placed in thermaprep oven. According to manufacturer’s instructions a timer was used to ensure correct heating time. After removing the obturator from oven, firm apical pressure is used to insert Thermafil obturator into the canal to the previously marked working length with stop marker. After radiographic verification, the carrier shaft is removed with inverted cone bur at the canal orifice.

**ProTaper gutta-percha points group**

The A2, B2 roots were obturated with ProTaper gutta-percha points, sealer mixed according to manufacturer’s instruction. A master gutta-percha cone corresponding to last file size at working length, the F3 size #30 point was selected. The canal wall painted with sealer by using hand P.T file F2. A rubber stopper was positioned (1mm) shorter than the working length. The hand ProTaper was placed in the canal and turned counter-clockwise spinning the sealer into the canal. The ProTaper gutta-percha points are F1,F2,F3,F4,F5 used as single cone without auxiliary after Dorifill sealer cement insertion

**Cold lateral condensation group**

The A3,B3 roots were obturated with cold laterally condensed gutta-percha A standardized Iso No.30 master cone gutta-percha was trial fitted up to the working length, Dorifill sealer mixed according to manufacturer’s instructions and using size #25 file, the sealer was introduced into the entire length of the canal and turned counter clockwise spinning sealer into canal. The apical part of the master gutta-percha cone was coated with sealer and placed into the canal. The master cone was laterally condensed by inserting a finger spreader between it and the root canal wall. The spreader was inserted to the point 1mm short of working length. The spreader was rotated to 180 several times before disengaging it from the canal. The void created by the spreader was filled by condensing auxiliary gutta-percha points. The procedure was repeated until gutta-percha points could not be introduced more than 3mm into root canal. The excess gutta-percha was then removed with a hot plastic instrument and remainder was condensed vertically with a plugger.

**RESULTS**

Mean micro leakage measurements in mm and the standard deviation SD are shown in table 1. According to the result of this study, hand P.T was significantly better than rotary P.T at apical micro leakage when Thermafil, ProTaper gutta-percha points and cold lateral condensation techniques were used. CLC leaked the most in comparison with other test groups, which was followed by P.T gutta-percha points with moderate leakage and Thermafil with least leakage, so Thermafil obturation technique give the best apical seal.

**DISCUSSION**

In this in vitro study, different obturation techniques apical leakage was tested using dye penetration method which is very popular in literature, because of easy use and cheap laboratory processes. Hand ProTaper preparation provide minimum degree of apical leakage when compare with rotary ProTaper preparation for the obturation techniques (Thermafil, CLC) which made hand P.T better than rotary P.T, the present study was in agreement with Muhsen, they found that the hand P.T is better than rotary P.T with high significant difference in producing uniform taper with narrower diameter at apical region. This attributed to hand P.T showed less
canal transportation toward outer aspect of canal and greater transportation toward inner aspect also HPT remove significantly less material than RPT, this is may be due to tactile sense of HPT and low rotation, so hand PT was more efficient than RPT.

Table 1: Mean and standard deviations of apical leakage in experimental groups.(Liner leakage values in mm).

<table>
<thead>
<tr>
<th>Methods of obturation</th>
<th>Number of specimens</th>
<th>Mean leakage</th>
<th>Standard Deviation</th>
<th>Maximum leakage</th>
<th>Minimum leakage</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermafil A1</td>
<td>1</td>
<td>1.35</td>
<td>0.337</td>
<td>2</td>
<td>1</td>
<td>0.106</td>
</tr>
<tr>
<td>ProTaper G.P points</td>
<td>A2</td>
<td>2.75</td>
<td>0.425</td>
<td>3.5</td>
<td>2</td>
<td>0.134</td>
</tr>
<tr>
<td>Lateral Condensation</td>
<td>A3</td>
<td>4.35</td>
<td>0.709</td>
<td>5</td>
<td>3</td>
<td>0.224</td>
</tr>
<tr>
<td>Group B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermafil B1</td>
<td>1</td>
<td>1.1</td>
<td>0.211</td>
<td>1.5</td>
<td>1</td>
<td>0.067</td>
</tr>
<tr>
<td>ProTaper G.P points</td>
<td>B2</td>
<td>2.65</td>
<td>0.474</td>
<td>3.5</td>
<td>2</td>
<td>0.15</td>
</tr>
<tr>
<td>Lateral Condensation</td>
<td>B3</td>
<td>3.55</td>
<td>0.643</td>
<td>5</td>
<td>3</td>
<td>0.203</td>
</tr>
</tbody>
</table>

The results of the present study are in contrast to the results of Leonardo et al. The differences in result between them could be due to use of Profile system with Thermafil. 

Thermafil groups A1,B1

In this vitro study, for both preparation techniques HPT,RPT Thermafil show less leakage with high significant difference than ProTaper gutta percha and Lateral condensation groups that provide best apical sealing, this may be attributed to that alpha – phase gutta percha has low melting temperature and good adhesiveness and has flexible plastic carriers coated with alpha phase gutta percha and potential for shrinkage of thermoplastized gutta percha, and majority of canal space is filled with plastic core by reducing the volume of gutta percha undergoing setting contraction. This reduction in shrinkage could increase the seal at the gutta percha sealant-interface, thereby contributing to decrease leakage. The plastic carrier in Thermafil could act as plunger, which effectively forces the thermoplasticized gutta percha into lateral wall of canal. This condensation into the patent dentinal tubules leads to superior seal by Thermafil. Flowing characteristics of thermoplastized alpha phase gutta percha to replicate the canal wall, so Thermafil obturation technique can be advocated as an efficient obturation system for achieving optimal and predictable success in endodontic therapy. This finding is in agreement with the results of Rajiswari et al., Inan et al., Al-Shimmari and Al-Huwaizi. These results disagreed with Ravanshad etal, who state that the evaluation of apical seal ability of Thermafil obturation versus Lateral condensation. The disagreement may be attributed to that they used k-file at instrumentation of canal. The results of present study disagreed with Chu et al. The disagreement may be attributed to that their study was in vivo and periapical radiographic examination of teeth was done after three years.

ProTaper gutta-percha points A2,B2

ProTaper gutta percha points found to flow well when vertically compacted by using this technique, the points are stiff enough to easily placed into the canal to length without buckling up it gave good flow characteristics, they found to gave good tug back within a couple of millimeters of working length. According to this study for both obturation techniques the ProTaper gutta percha showed more leakage than Thermafil, but less leakage than cold lateral condensation, which mean it was better than CLC, that’s due to leakage of fusion between the multiple gutta percha cones in CLC technique used in obturation of the canal which lead to higher dye penetration or higher leakage, also attributed to its designed for use with ProTaper files and matched the shape of canals that prepared with PT files F1 F2 or F3 that provide optimal coronal fit and perfect apical fit. The ProTaper g.p placement includes vertical pressure while lateral condensation has lateral pressure and match less vertical pressure, as the objective of this study is to evaluate the apical microleakage, lateral condensation showed higher microleakage values. The points found to flow well when vertically compacted and visually adapting well to canal wall the post operative radiographic picture confirmed good adaptation of material. The results of present study were in agreement to the results of Carlos M.et al., the
results demonstrated that the ProTaper points were more efficient to promoting the apical sealing. The results of present study disagreed with Pommel and Champs. This may be attributed to differences in methods of preparation of canal (methodology) and different evaluation methods because they used fluid filtration microleakage system.

Cold Lateral condensation groups A3, B3
Cold Lateral condensation technique for both HPT, RPT preparation showed to be the most leakage group in comparison to the other test groups with the difference statistically significant. This may be attributed to the technique produce many irregularities in the final mass of gutta percha and it does not reproduce canal irregularities and there is inadequate dispersion of the sealer leading to the formation of voids in and around the gutta percha points therefore may have contributed to high leakage score. In this vitro study, the findings are in agreement with the results of Gencoglu et al, Al-Shimmary and Al-Huwaizi, while the results disagree with the findings of Ravanshad et al. The disagreement may be attributed to that they used k-files in preparation of canal and also disagree with Chu et al. and the disagreement may be attributed to the differences in methodology and evaluation.

REFERENCES