The comparison of effects of 3 methods of post space preparation on the apical seal invitro

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ABSTRACT

Purpose: The aim of this study was to compare the effects of A) a flame heated endo plugger, B) GatesGlidden drills and C) GPX drills on the apical seal for the purpose of post space preparation.

Materials & Methods: The crowns of sixty six extracted maxillary central teeth were removed from CEJ by a diamond disc and the root canals were prepared and obturated with gutta percha and sealer (Ah26) using lateral condensation technique. Six teeth were used as positive and negative control groups and the other sixty teeth were divided into 3 groups, each group containing 20 teeth. The post space in these 3 groups was made by either A/a hot plugger, B/# 3or# 4 Gates glidden drills and C/# 40 or # 50 GPX drills and apical dye leakage in each group was measured by stereomicroscope and the Anova test was used to compare the mean amount of dye leakage between groups.

Results: Between these 3 groups, the minimal mean dye leakage was related to the hot plugger group and the maximum mean leakage was observed in Gates glidden drill group. There was significant statistical difference between the groups (P=0.005).

Conclusion: The GPX drills for the purpose of post space preparation affect apical seal less than Gates glidden drills.

Keywords: Post Space, Methods, Apical seal.

INTRODUCTION

Endodontically treated teeth are commonly restored by a post and core followed by a crown. The required post space may be prepared either immediately after the completion of the endodontic procedure using hot pluggers or alternatively at a later stage after full setting of the sealer using rotary instruments.\(^{(1)}\)

Immediate removal of the coronal part of a root canal filling by hot plugger is often performed by the same operator who has just finished the root canal obturation, while late removal of coronal gutta percha is performed at a subsequent visit and frequently by a different operator - a Restorative dentist or Prosthodontist rather than an Endodontist.\(^{(2,3)}\) Although the length of the post within the root canal may vary, the apical 4 mm of the root canal filling material should not be disturbed.\(^{(1,2)}\) Previous studies have indicated that significant apical leakage may occur if less than 4 mm of apical gutta percha remains within the root canal. So the technique for gutta percha removal does not appear to be as clinically significant as the amount of remaining gutta percha. Schnell using heated endodontic pluggers for gutta percha removal, reported no significant difference in leakage of the apical seal after immediate or delayed post space preparation.\(^{(3)}\) Kwan and Harrington\(^{(4)}\) and Madison and Zakariasen\(^{(5)}\) found that post space preparation with Gates Glidden drills immediately after obturation actually decreased the amount of apical
leakage. Some studies reported no significant difference in the amount of apical leakage after post space preparation between heated endo pluggers, Peeso reamers and Gates Glidden burs. Gates Glidden drills and Peeso reamers remove dentin when they are used for the purpose of post space preparation.\(^6\)

Additionally an alternative instrument called gutta percha remover drill is introduced by J.T Mcspadden and manufactured by (Alpha seal. Co-Chattanoga Tn) which removes GP but does not remove dentin. The purpose of this study was to compare the effects of 3 methods of post space preparation on the apical seal. A-hot plugger, B-Gates Glididden drills and C Gutta percha remover drills.

**MATERIALS & METHODS**

This experimental study was performed on sixty six maxillary central teeth which were extracted due to nonrestorable caries, periodontal disease or full denture treatment planning.

The teeth were put in 10% formalin solution (Merck.co Germany) just after extraction. Soft debris and PDL remainings were removed by hand curettes and after final cleaning and rinsing with water the teeth were stored in 0.9% normal salin (Samen-Meshad). Crowns of teeth were removed at the cemento enamel junction by Diamond discs (D&Z Germany) A#10 K-Flex file (Kerr manufacturing Co. U.S.A) was placed into the root canals until it was just visible at the apical foramen. The working length was established by subtracting 1mm from this length. Then the high speed diamond disc (D & Z- Germany) was used to plane the coronal portion of the roots until the working length was standardized at 15mm for all of the specimens. The canals were cleaned and shaped using a standard stepback technique until a #50 K-Flex file was used to ensure patency of the apical foramen between each change in the file size. Saline 0.9% was used as the irrigating solution. The canals were then dried with paper points (Ariadent-Teh) and obturated using Lateral condensation of guttapercha (Ariadent-Teh) and Sealer (AH26-Densply U.S.A). Aradiograph of each specimen was exposed to confirm satisfactory obturation of the root canal. Approximately 3mm of coronal GP was removed with a flame heated endodontic plugger and the remainder was vertically condensed with room temperature endodontic pluggers. A temporary restoration dressing (Cavitec-Germany) was placed in the coronal access. The teeth were stored at 100% humidity at 37c for one week to allow the sealer to set. The roots were randomly divided into 1 of 3 experimental groups of 20 teeth each. Three teeth were used as positive controls and 3 as negative controls. The teeth were then dried and the temporary restorations were removed. A butane burner was used to heat one end of a #9-11 endodontic plugger (Maillefer Co-Swiss) cherry red. GP was removed with this instrument until 5 mm of GP remained in Group 1. A#4 or #3 Gates Glidden drill (Maillefer Co-Swiss) in a low speed hand piece was used to remove all but the apical 5 mm of GP in the second group and a #50 XGP drill (Alphaseal-Chattanooga U.S.A) was used to remove all but the last 5 mm of GP in the third group. A rubber stop was placed on the spreader to verify depth of the instrument within the canal and ensure that 5mm of intact GP remained in the apical portion of the root canal. A radiograph of each specimen was exposed to confirm that 5mm of GP remained. The 3 positive control teeth were not obturated after preparation and the 3 negative control teeth were obturated but the post space was not prepared inside them. The positive and negative control group were coronally sealed by dressing material (Cavitec-Germany) and dry cotton pellet finally. Following post space preparation, amalgam (Sinalux-Shaheed faghihi, Iran) was condensed into all experimental post space perparations to simulate a post. The roots were then covered with 2 layers of nail polish except for the apical 1.5mm. The entire root of negative controls was completely coated with nail polish. The roots of 3 experimental groups and positive and negative controls were put in separate dishes of 2% methylene blue (Merk-Germany) at
37c for 48 hours. The teeth were then washed and rinsed with water the nail polish was removed and longitudinal sections were made by diamond discs (D&Z Germany) in all specimens and the linear dye leakage was measured and recorded by 4X stereomicroscopy (Olympus Japan) and statistical analysis was performed by one way analysis of variance.\(^{6,7,8}\)

**RESULTS**

The linear apical microleakage for the three groups are listed in table 1 and 2.

The specimens in which the post space was prepared by hot endo pluggers showed the minimum apical dye leakage (Mean=1.825mm, SD=0.775) and the maximum dye leakage was seen in Group 3 in which the post space was made by Gates Glidden drills (Mean = 4.896mm, SD = 0.972). The average apical dye leakage in GPX Group was 3.725mm with SD=1.251.

The 3 negative controls demonstrated no apical leakage(0) and the 3 positive controls showed leakage throughout the length of the canals.

There was significant statistical difference between the groups using one way Anova test \(P=0.05\) (table2).

**Table 1. Linear apical microleakage(mm).**

<table>
<thead>
<tr>
<th>Group</th>
<th>No</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>1.825</td>
<td>0.775</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>8.896</td>
<td>0.972</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>3.725</td>
<td>1.251</td>
</tr>
</tbody>
</table>

Group 1- Hot plugger  
Group 2- Gates glidden drills  
Group 3- GPX drills

**Table 2. Statistical analysis of variance**

<table>
<thead>
<tr>
<th>Source variance</th>
<th>d.f</th>
<th>Sum of squares</th>
<th>Mean squares</th>
<th>Fratis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>2</td>
<td>74.241</td>
<td>34.312</td>
<td>36.02</td>
</tr>
<tr>
<td>Within groups</td>
<td>56</td>
<td>52.93</td>
<td>0.0887</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>130.724</td>
<td></td>
<td></td>
</tr>
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Tukey-SHD procedures ranges for the 0.05 level for variance analysis.

One way Anova test: Significant statistical difference between the groups.

**DISCUSSION**

It is commonly recommended that post space preparation should allow a remaining root canal filling of 5mm to avoid compromising the apical seal.\(^9\) Protell et al reported that 3mm showed statistically increased leakage \(P<0.01\) over 7 mm, if post space preparation was delayed for 2 weeks.\(^10\) Dickey et al reported significant apical leakage if the sealer was not allowed to set when 3mm of GP remained at the apex.\(^11\) However, their results may have been due to an insufficient amount of remaining GP rather than the time of post space preparation. Lateral condensation of GP with sealer Ah26 (Densply. Co) was used to obturate all of the specimens since this has been the most popular root canal filling technique. Camp and todd, Neagly, Suchina and Ludington showed that there was no statistical difference in apical leakage provided from alternate obturation techniques when 4 to 5mm of Gp remained at the apex.\(^12\) More over the methodology of GP removal for post space preparation is another causative factor that may affect the quality of apical seal. Matisson et al reported that the mechanical removal of GP with a Gates Glidden drill was the most desirable method of post space preparation compared with chemical solvent or heated instrument. Flame heated endo pluggers are a fast and inexpensive means of GP removal and they don't cause canal shape alterations. A disadvantage of this technique is the burn potential for the dentist, dental assistant or the patient. Damage to the PDL by flame heated pluggers does not appear to be a problem. Hand et al found that flame heated endo pluggers did not cause any permanent damage to the periodontium when used for vertical compaction of warm gutta percha. Advantages and disadvantages exist for each of the GP removal techniques.\(^13\) Peeso
reamers are not expensive and remove the GP very fast. The rotary motion of these instruments creates parallel walls which provide optimal retention form for the post. Disadvantages of pesso reamers include the possibility of creating root perforation, canal transportation, overenlargement of the canal resulting in weakened remaining root structure and instrument separation. Pesso reamers should be used only in straight canals or short of an apical curvature. The gates glidden drills are more conservative instruments compared with pesso reamer drills and cut and remove dentin slower than pesso reamer drills and because of these properties their disadvantages are less than pesso reamers. GP burs are tapered rotary instruments that match Standardized endodontic file sizes #25/#50. When used for GP removal on a low speed turbine they cause slight frictional heat which softens the GP before removal. Although developed for complete GP removal in retreatment cases, the GPX was also fast and effective in post space preparation. The bur does not engage the dentin so canal shape remains unaltered and the frictional heat generated is minimal. These burs are relatively inexpensive and the disadvantage of the GPX could be instrument separation. This could occur if the instrument bound in a canal integrity or was used to past a canal curvature although we had no GPX separation in our study that the canals were straight.

CONCLUSION

Minimal Apical dye leakage after post space preparation by GPX supports and advices this instrument for post space preparation.

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REFERENCES
