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A Comparison between immediate and delayed post space preparation on the apical seal prepared by hand protaper instruments

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Abstract

Forty single-rooted human mandibular premolar were instrumented with hand ProTaper instruments and obturated with gutta-percha and Zinc oxide eugenol sealer. Then all teeth were divided to two group the first group received immediate post space preparation half teeth with hot plugger and other half with peeso reamer, the roots were coated with nail varnish and were immersed in methylene blue 2% for 72 hours in an incubator. After one week the other group received delayed post space preparation same as the first group and coated with nail varnish and were immersed in methylene blue 2% for 72 hours in an incubator. All roots splitted longitudinally and the apical leakage measured and compared for each group. The minimal leakage value and the lowest mean of leakage were observed in subgroup one, while the maximum leakage value and the highest mean of leakage was obvious in subgroup four. A significant difference was found in the group of roots that received delayed post space preparation using peeso reamers, which showed more apical leakage than other subgroups.

Keywords: Post space, Hand protaper, Micro leakage

Introduction

In recent years, nickel-titanium (NiTi) alloy manual and rotary endodontic instruments have revolutionized endodontics. Thanks to the extraordinary super elasticity and strength of these alloys, rotary instruments with as much as 4-fold the taper of traditional manual instruments are now available. Consistent and efficient canal shaping is now possible with relatively few instruments [(1)]. The NiTi rotary instrument rotates continually within the root canal system and is subject to structural fatigue and ultimately failure because of two principal types of stress: bending stress and torsional stress. The durability of a NiTi rotary instrument is directly proportional to the working stress it undergoes, and this is closely related to the number of cycles performed [(2)]. Most rotary NiTi instruments have tip designs that confer poor cutting capability. If the tip encounters a portion of canal smaller than its diameter, the instrument tends to lock, and torque rises rapidly. If torque reaches a critical level, the instrument undergoes structural failure. Based on these considerations, manual

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preflaring would reduce instrument failure by reducing frictional forces applied to the file. Similarly, a reduction in the applied torque would also reduce instrument failure [1].

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 a full setting of the sealer [3]. This procedure calls for partial removal of the root canal filling to prepare a post space, the depth of which is dictated by biomechanical considerations. Post-space preparation is frequently done by a restorative dentist. The assumption is that, once the cement in the root canal filling is fully set, the apical part of the filling remaining after post-space preparation will provide a seal that is equivalent to that of the intact filling [4].

Immediate removal of the coronal part of a root canal filling by hot pluggers soften requires a modification of the canal preparation to allow the insertion of the desired plugger to the predetermined length. An additional advantage of this protocol is that the condensation of the remaining gutta-percha filling can be assessed and improved if necessary, the familiarity of the operator with the root canal system minimizes the risk of perforation or stripping [3]. Yet the common procedure is late removal of the coronal part of the root canal filling performed at a subsequent visit and frequently by a different operator (a restorative dentist rather than an endodontist). The procedure is usually done using rotatory instruments such as Gates Glidden drills, with or without a gutta-percha solvent. It is rather uncommon to perform this procedure using a rubber dam, and it is usually performed in conditions similar to those used in general restorative dentistry [5]. The length of the post preparation is dictated by the mechanical retention requirements on one hand and by the need to leave sufficient length of the root canal filling to maintain its apical seal; furthermore it is assumed that the seal provided by that minimal remaining root canal filling of 5 mm does not differ from that of the intact root canal filling [6]. In some studies no difference could be demonstrated between the leakage of an intact root canal filling and that of a remaining filling of 4 to 5 mm [7]; in others no such comparison is reported [8]. Abramovitz et al. [9] have demonstrated that a remaining filling of 5 mm is clearly inferior to the intact filling, providing that the assay used is sensitive enough to pick up the difference. They have demonstrated that, in passive conditions, even 14 days of exposure to the marker were not sufficient to demonstrate differences in leakage that were clearly demonstrated in a pressure-driven system within few days.

The aim of this present study was to compare the apical microleakage after immediate and delayed post space preparation after preparation the teeth by hand ProTaper instruments.

Materials and Method

Forty single-rooted human mandibular premolar were selected and stored in normal saline solution at room temperature. All teeth were carefully debrided of soft tissue with periodontal curette. To eliminate any variables in access preparation, the crown portion of each tooth were removed at cemento-enamel junction to provide a reproducible reference point.

Each canal was prepared by hand ProTaper instruments (Dentsply-Maillefer, Ballaigues, Switzerland),

which consist of six individual files (Shaping file SX, S1, and S2. Finishing files F1, and F2, and F3). The sequence of preparation was performed as follows:

- Apical patency was verified in each root with #10 K-type file and working length was established 1mm shorter of canal length, the point at which the #10 file was first visible at the apical foramen.
- Shaping file S1 was introduced with a pecking motion into the canal, 3 mm short of the supposed working length.
- SX was fed into the canal for 2⁄3 of its blade length
- S1 was used to the working length.
- S2 was used to the working length.
- F1 was used to the working length, and the canal was then gauged with a #20 file. If it fit closely at the apex, the preparation was concluded.
- When the #20 file did not fit correctly at the apex, instrumentation was continued with the F2 and the canal gauged with a #25 file. Once again, if it fit closely at the apex, instrumentation was concluded; otherwise, it was continued with the F3. For standardization all roots were prepared to file F3.

Sodium hypochlorite solution (5%) was used as an irrigates during preparation, and apical patency was verified with a #10 file after completion of instrumentation. The canals were then dried with paper points and obturated with ProTaper gutta-percha points size F3 (Dentsply-Maillefer, Ballaigues, Switzerland) and ZOE (Dorifil-Dorident) sealer, the canals in all roots obturated with laterally condensed. A thin layer sealer was applied to the preparation walls with a paper point, then the master cone was coated with sealer and inserted in the canal; finger spreader (Dentsply-Maillefer, Ballaigues, Switzerland) was used for lateral condensation. The spreader was remaining in the canal until accessory gutta-percha cone was ready to put in place. Accessory cones were added until the spreader reached the coronal third of the canal. Excess gutta-percha was then removed with heated endodontic plugger, and then vertically condensed. Radiographs were taken for each root to visually evaluate the obturation. Then the roots were randomly divided into two experimental groups of 20 roots each to evaluate the amount of apical microleakage:

1- **Immediate group:** twenty roots divided in to two subgroup ten for each:

   a- Subgroup one (1HP): ten roots have dowel space prepared immediately after obturation, leaving 5mm of apical filling material. Worm endodontic pluggers were used to remove the gutta-percha and moderate pressure was applied to remaining apical fills, and then sealed coronally with temporary filling, stored in physiologic saline solution at $37C^0$ for two weeks.

   b- Subgroup two (2Peeso): ten roots have dowel space prepared immediately after obturation, leaving 5mm of apical filling material, using peeso reamers to remove the gutta-percha and then they were coronally sealed and incubated in same manner as in subgroup one.

2- **Delayed group:** twenty roots divided into two subgroup ten for each:

   a- Subgroup three (3HP): after one week storage in physiologic saline solution at $37C^0$, the obturated roots received dowel space preparation, using hot endodontic pluggers, and coronally

sealed in same manner as in subgroup one.

b- Subgroup four (4Peeso): after one week storage in physiologic saline solution at $37C^0$, the obturated roots received dowel space preparation using peeso reamers, and coronally sealed in same manner as in subgroup one.

In this study, two methods of gutta-percha removal were utilized. In subgroup one and three, the gutta-percha was removed using hot pluggers. In subgroup two and four, the gutta-percha was removed using peeso reamers No. 2-4.

The obturated roots were dried and coated on their external surfaces with nail varnish; except for the apical 2mm, the roots of each group were held in a vertical direction with the apices directed downwards. Then the specimens were immersed in methylene blue 2% and placed in an incubator at 37^0C for 72 hours. They were then thoroughly washed with water, the varnish was carefully removed with lacron, and the roots were dried. Using a diamond disk, two grooves were made longitudinally on the roots were then splitted in half by applying a gentle pressure. Liner apical dye penetration was measured for each specimen using stereomicroscope at X10 magnification. The resulting measurements of dye leakage were subjected to statistical analysis.

Results

The minimum and maximum values of mean and standard deviation values for each group are represented in table (1). The minimal leakage value and the lowest mean of leakage were observed in subgroup one, while the maximum leakage value and the highest mean of leakage was obvious in subgroup four. Figure (1) shows the bar chart that represents the mean leakage values in millimeters for the four subgroups.

Using the raw data, a further t-test was preformed to test the differences between four means of leakage of each pair of subgroups (table 2). A statistically significant differences ($P<0.05$) was found when subgroup one was compared with subgroup three and between subgroup one and subgroup four and between subgroup two and subgroup four and between subgroup three and subgroup four. While there was no significant differences when subgroup one was compared with subgroup two and between subgroup two and subgroup three.

Discussion

Three dimensional sealing of the root canal is one of the main goals of endodontic treatment and is essential for preventing apical and coronal leakage in the root canal system [(10)].

Creating a dowel space for the dowel or post is a very critical phase for the fixed prosthetic treatment because it necessitates removal of a portion of the root canal filling material. During preparation of a dowel space with rotary instruments for removing the gutta-percha, the possibility exists of twisting the entire filling or creating vibrations and breaking the seal. Additional hazard of using rotary instruments are root perforation and over preparation of the tooth [(11)].

Various studies demonstrated in vitro that the seal of the remaining obturating material was not compromised when rotary instruments were used because the heat from the action of the rotary instrument thermoplastically softened the gutta-percha, producing improvement in the endodontic seal. In contrast, other

authors claimed that the apical seal was worse after preparation with rotary instruments compared to the seal of completely obturated root canals [12].

The hot plugger method has benefits in terms of efficiency and safety. Preparing the post space by this method takes less time and is preformed without rotary instruments it also reduces the risk of a perforation with this particular root canal [9]. The widely accepted notion that, a remaining root canal filling of 5mm maintains a seal similar to that of an intact root canal filling [4]. Many tracer (dye or radioisotope) studies have indicated that after post space preparation the remaining apical portion of the root canal filling, 3-5 mm in length, provided the same seal as full length root canal filling [13].

The detaching of the root canal sealer from the dentin or gutta-percha caused by setting shrinkage may result in many voids along the filling. In short filling, the voids may be more easily connected with one another than in long filling and can permit leakage over the full length [14]. Abramovitz et al. [9] report that partial removal of a root canal filling should be followed by immediate preparation of post space and if not possible $Ca(OH)_2$ should be used as dressing to prevent contamination of post space between visits.

The use of the new ProTaper file for hand use offers all the benefits associated with nickel titanium instruments and seem the perfect alternative to the more traditional stainless steel files because protaper files are multi-tapered, fewer files are needed to create a tapered shape, this offers hugs advantages for the dentist and increases efficiency during root canal treatment. Also, as nickel titanium has excellent memory retention the hand protaper files is better to keep its shape. This gives the file system extreme flexibility which is very useful in severely curved canals.

In hand Protaper group instrumentation methods leave a good tactile feed back and having the control of a stainless steel hand file, and may aid removal of acute apical curvature or ledges and provides access to apical canal areas for irrigants. The other reassuring thing about ProTaper hand files it gets back to the basic Roan Balance Force Concept [15], however, general agreement exists that Balance Force approach provides excellent canal centering ability, superior to other techniques with hand instruments [16].

In this study delayed post space preparation resulted in more leakage than immediate preparation this is in agreement with the finding of Fan et al. [17] they measure the apical root fillings after immediate and delayed post preparation using different types of sealer. Also the result of this study are in agreement with the result of Fernando et al. [18] they report that when using vertical condensation and AH Plus sealer, there was significantly less leakage when the post space was prepared at the time of obturation compared to post space prepared one week after obturation.

When hot pluggers were used to remove gutta-percha, the results of this study showed that immediate and delayed dowel space preparation had no significant effect on the apical seal. Also there was no difference in the quality of apical seal between roots that prepared immediately or those prepared after one week this finding come in agreement with Abramovitz (2000) [9] and with finding of Hikmet (1999) [19]. But came in contrast with results of the study of Portell et al. [20] who found that delayed preparation using hot pluggers significantly increased leakage but in teeth when only 3mm of apical gutta-percha

remained. But when using peeso reamer, the roots that received delayed preparation showed significantly more leakage than those received immediate preparation this result agree with Karapanou et al [21].

This study showed that all subgroup with immediate and delayed removal of gutta-percha exhibited some apical leakage of the dye, but the degree of the leakage is inferior to the apical leakage in other studies [4,6-9,13,19-21]. They used traditional stainless steel files for shaping and cleaning of the root canal, while in this study hand ProTaper have been used. This may due to that traditional stainless steel files create narrow canal shape which makes effective access for irrigants and obturation material more difficult, while with hand ProTaper files the root canal preparation result more taper and achieve a correct canal shape with more centric canal lumen since Balance Force technique is used, which provide enough or suitable space for irrigant and placement of an effective root filling.

In most situation, it is better to have the clinician that prepare the root canal therapy prepare the post space because that person has become intimately familiar with root canal system

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Figure (1): Bar chart graph to shows the mean leakage for the four subgroups.

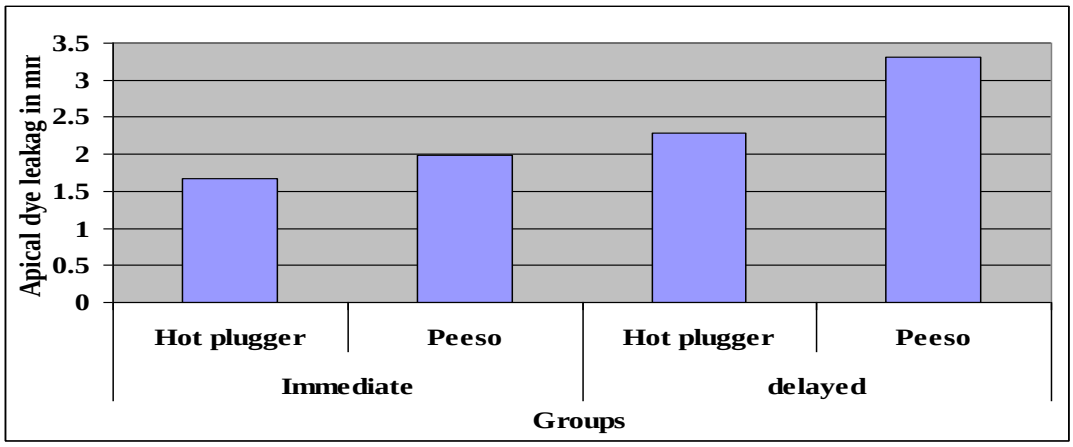

Table (1): Descriptive statistics for the experimental subgroups.

Groups		No. of teeth	Mean	S.D	Min. value (mm)	Max. value (mm)
Immediate	1HP	10	1.67	0.368	1.1	2.3
	2Peeso	10	1.99	0.593	1.1	2.8
delayed	3HP	10	2.29	0.435	1.7	3.1
	4Peeso	10	3.31	1.139	1.9	5.5

Table (2): t-test between each pair of subgroup.

Comparison	t-test	*P*-value	Sign.
1HP – 2Pesso	1.166	0.273	NS
1HP – 3HP	3.192	0.011	S
1HP – 4Pesso	4.393	0.002	S
2Peeso – 3HP	1.218	0.254	NS
2Peeso – 4Peeso	3.245	0.01	S
3HP – 4Peeso	2.502	0.034	S