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Influence of the ProTaper™ Gutta-percha master point diameter in the apical sealing

ABSTRACT

Aim: evaluate the influence of ProTaper™ gutta-percha master point diameter to seal root canals prepared using the ProTaper rotary system.

Methodology: forty mesiobuccal roots from maxillary first molars were randomly divided into four experimental groups containing 10 teeth. The group 1 was instrumented with ProTaper™ rotary files F1 and was obturated using a ProTaper™ gutta-percha master point F1 and AH Plus sealer; group 2 was instrumented with F2 and was obturated using a ProTaper™ gutta-percha master point F2 and AH Plus sealer; group 3 was the positive control group and the group 4 was the negative control group. The apical leakage was evaluated by dye penetration. Each specimen was suspended vertically in a clamp stretched over a reservoir container filled with India ink and stored in 100% humidity at 37±1°C for seven days. The samples were removed from the dye and the roots were sectioned longitudinally in a bucco-lingual direction. The maximum linear dye penetration was measured by two independent evaluators using a stereoscopic magnifier with 10X magnification and a ruler with a 1.0 mm graduation.

Results: Kruskal-Wallis test revealed that the differences between the experimental groups were not statistically sig-

nificant. A level of significance of 0.05 was adopted.

Conclusions: the group 2 showed the least dye penetration.

Key words:

Epoxy resins, Gutta-percha, infiltration, sealants.

INTRODUCTION

Rotary instruments made from nickel-titanium alloy are the result of recent advances in endodontics (1) and they permit a very high degree of automation in the biomechanical preparation of root canals (2). Those with a triangular section cut the dentine more efficiently and are thus able to produce more deviations in the trajectory of the root canal (3).

Root canal sealing has played an important role in dental therapy and the biomechanical preparation by itself is not capable of disinfecting root canals (4). A complete and hermetically sealed root canal is very important for achieving success in endodontic therapy (5). Although, there are a large number of filling materials and obturation techniques, the combination of gutta-percha and a sealer is the most widely used in clinical practice (6).

The aim of the present study was therefore to evaluate, *in vitro*, the influence of

ProTaper™ gutta-percha master point diameter to seal root canals prepared using the ProTaper™ rotary system.

MATERIALS AND METHODS

Forty mesiobuccal roots with mature apices from extracted human maxillary first molars obtained from the Tooth Bank of the Department of Prosthetics and Oral and Facial Surgery of Federal University of Pernambuco (UFPE) were used in this study. These molars had a curvature angle ranging from 30 to 46 degrees (7). Previous approval for this study was obtained from the Ethics in Research Committee of the Center of Health Science of the UFPE (080/2005 - CEP/ CCS). The teeth were stored in 1% sodium chlorite until needed. All roots were radiographed mesio-distally to ensure the presence of a single root canal. Coronal access was achieved using a diamond #1016 bur (KG Sorensen, São Paulo, Brazil), followed by straight-line access to the mesial wall with an Endo-Z bur (Maillefer, Ballaigues, Switzerland) in a high-speed handpiece under water refrigeration. After confirming the presence of a single root canal, a #08 K-File (Maillefer, Ballaigues, Switzerland) was introduced into the mesiobuccal canal for the purpose of detecting the presence of obstructions and/or

calcification. The canal was then filled with a 1% sodium hypochlorite solution (Farmácia Escola Carlos Dumont de Andrade-UFPE, Brazil). The working length was determined visually by advancing a size 10 K-file into the root canal until the tip was just visible and then subtracting 1.0 mm from the measured length of the file. The roots were randomly divided into four groups: Group 1 consisted of 10 specimens prepared by the ProTaper™ system (Maillefer, Ballaigues, Switzerland) up to instrument F1 and filled using the warm vertical condensation technique with the gutta-percha master point F1 (Maillefer, Ballaigues, Switzerland) and AH Plus™ sealer (De Trey, Germany); Group 2 consisted of 10 specimens prepared with the ProTaper™ system (Maillefer, Ballaigues, Switzerland) up to instrument F2 and filled using the warm vertical condensation technique with the gutta-percha master point F2 (Maillefer, Ballaigues, Switzerland) and AH Plus™ sealer (De Trey, Germany); Group 3 consisted of 10 specimens that were used as positive control group and did not have the canal filled, but the root was rendered impermeable by coating it with epoxi resin (Araldite, Brascola, São Bernardo do Campo, Brazil) throughout its length, except for the final 3 mm and the Group 4 that was the negative control group and did not have the canal filled but was rendered impermeable by coating it with epoxi resin along its entire length.

During the instrumentation, root canals were irrigated with copious amounts of 1% sodium hypochlorite (Roval, Recife, Brazil) that was used in conjunction with EDTA (Biodinâmica, Paraná, Brazil) as a chelating agent for irrigating the root canals, and then dried with size F1 or F2 absorbent paper point (Dentsply, Petropolis, Brazil). All samples were stored for ten days in a humid chamber at $37\pm1^{\circ}\text{C}$ to allow the complete setting of the sealer. In the experimental groups, the access was sealed with wax. The entire root surface, except for the apical 3.0 mm, was covered with an epoxy resin (Araldite, Brascola, São Bernardo do Campo, Brazil). After drying at room temperature, each

specimen was suspended vertically in a clamp stretched over a reservoir container filled with India ink (8) and stored in 100% humidity at $37\pm1^{\circ}\text{C}$ for seven days. The samples were then removed from the dye and rinsed with tap water for 15 minutes. The roots were sectioned longitudinally in a bucco-lingual direction using a double-faced diamond disk (Wilcos, Rio de Janeiro, Brazil) in a straight handpiece, after which a chisel was used to separate the two halves. The maximum linear dye penetration was measured by two independent evaluators using a stereoscopic magnifier with 10X magnification and a ruler with a 1.0 mm graduation. The average of the two scores was recorded. The Kappa test was used for determination of the evaluators' degree of agreement, and the Kruskal-Wallis test was used to determine the statistically significant differences between the groups. The level of significance was set at 0.05.

RESULTS

The positive control teeth showed complete dye penetration, whereas the negative control group showed no dye penetration. The Kappa test revealed a high degree of agreement (97.5%) between the examiners (0.949; $p < 0.001$).

Table 1 presents the principal statistical results of the values of leakage using to the ProTaper gutta-percha master point. Data were analyzed statistically using

the Kruskal-Wallis test. The results showed no statistically significant differences among the experimental groups.

In Figure 1 the root canal of group 2 can be seen with apical infiltration and Figure 2 the root canal is without infiltration.

In Figure 3 the root canal of group 1 can be seen without apical infiltration and Figure 4 the root canal is showing infiltration.

DISCUSSION

This study evaluated the influence of the ProTaper™ gutta-percha master point diameter to seal root canals prepared using the ProTaper™ rotary system. Although the biomechanical preparation is essential for reducing the microorganisms, it is not possible to completely disinfect the root canal system (4, 5, 9). Because of this, the authors emphasize the importance of filling the root canal, which must be completely filled along its entire length and width and hermetically sealed according to Orucoglu; Sengun; Yilmaz (10). The results of this study confirm that the ProTaper™ gutta-percha master point used with AH Plus™ sealer meet these requirements. A more ample transverse preparation is also recommended, as demonstrated in this study, even though the differences are not statistically significant, the F2 Pro-

Statistical values of the infiltration values							
Sealer	Gutta-Percha Point	N	Median	SD	Mean	Minimum	Maximum
AH Plus	F1	10	1.70	1.49	2,50	0	3
	F2	10	1.60	1.50	2	0	3
	Total	20	1.65	1.46	2.5	0	3

N = Number of specimens; SD = Standard deviation

Table 1 - Principal statistical results of the infiltration values according to the type of gutta-percha point used (Kruskal-Wallis test).

Principali risultati statistici dei valori d'infiltrazione in base al tipo di cono di guttaperca usato (Kruskal-Wallis test).



Fig. 1 - Root canal filling with F2 gutta-percha point and AH Plus™ sealer showing infiltration (blue).

Otturazione canalare (eseguita con cono di guttaperca F2 e sealer AH Plus™) in cui si evidenzia infiltrazione di colorante (blu).



Fig. 3 - Root canal filling with F1 gutta-percha point and AH Plus™ sealer not showing infiltration.

Otturazione canalare eseguita con cono di guttaperca F1 e sealer AH Plus™ in cui non si evidenzia infiltrazione di colorante.



Fig. 2 - Root canal filling with F2 gutta-percha point and AH Plus™ sealer not showing infiltration.

Otturazione canalare eseguita con cono di guttaperca F2 e sealer AH Plus™ in cui non si evidenzia infiltrazione di colorante.



Fig. 4 - Root canal filling with F1 gutta-percha point and AH Plus™ sealer showing infiltration (blue).

Otturazione canalare eseguita con cono di guttaperca F1 e sealer AH Plus™ in cui si evidenzia infiltrazione di colorante (blu).

Taper™ gutta-percha points had a better effect.

Yücel & Çiftçi (11) compared the bacterial penetration (*Enterococcus faecalis*) following obturation with System B, Lateral Compaction, Thermafil, Single ProTaper™ Gutta-Percha and Laterally Compacted ProTaper™ Gutta-Percha with AH Plus™ sealer. The evaluation was carried out for 60 days. At 30 day

the slowest penetration was observed in the groups of System B and Laterally Compacted ProTaper™ Gutta-Percha. The fastest penetration was observed in the groups of Thermafil and Single ProTaper™ Gutta-Percha. At 60 day there was no statistically significance difference among all groups.

The NiTi rotary instruments have advantages such as ease at use and effi-

ciency compared with hand preparation, fewer instrumentation errors and a better preparation of curved canals (1). However, the rotary instruments with a triangular cross-section, such as those used in the ProTaper™ rotary system, have greater cutting efficiency and, as a result, with this a greater risk of morphological alterations in the root canal (3).

The great taper master gutta-percha point allows a better apical seal in canals prepared with rotary systems (12), which is in agreement with Al-Hadlaq; Al-Rabiah (2) and with the results of this study. In addition to the angle of taper, the results of this study indicate that the prepared diameter was an important factor in the apical seal. The specimens where the canals were filled with master gutta-percha point ProTaper™ F2 produced better results than F1. On the basis of the results of the present research, the use of the ProTaper™ gutta-percha point in filling the root canal system may be strongly recom-

mended since it permits a larger and more uniform gutta-percha. In this study the worst result was from the F1 ProTaper™ point, in relation to the dye leakage, which could be explained as being due to the transverse thickness of the gutta-percha points and the need for a thicker sealer layer. The use of a chelate solution facilitates the removal of the smear layer, which, in its turn, facilitates the penetration of the sealer into the base of the epoxy resin in the dentine canals, producing a better adhesion of the sealer to the dentine by means of a mechanical aggregation (13). AH Plus™ is an epoxyamine-based resin

and was chosen in this case as the root-end filling material for its favorable properties, such as an excellent sealing capacity, lower leakage, bond strength, good radiopacity and bonding (14-17). Based on the results of the present experiment, it could be concluded that the group obturated with ProTaper™ gutta-percha master point F2 showed the least dye penetration. However, the difference was not statistically significant.

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