Post Space Cleaning Using a New Nickel Titanium Endodontic Drill Combined with Different Cleaning Regimens

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Abstract

This study compared the effect of two drills and five cleaning regimens on post space debridement. One hundred extracted premolars were instrumented and obturated with warm vertical compaction of gutta percha. The teeth were divided into two groups according to the drill used to remove gutta percha/sealer and for post space preparation: a Largo drill (Largo; Dentsply, St Quentin en Yvelines, France) or a MTwo-PF drill (Sweden&Martina, Due Carrare, Padova, Italy). The following cleaning regimens were used: EDTA, ultrasonics, ultrasonics + EDTA, phosphoric acid, and distilled water. Scanning electron microscopic images of the post spaces were taken, and the presence of debris and of open dentin tubules were evaluated. The ultrasonics + EDTA, phosphoric acid, and EDTA groups were comparable in open tubules scores for both drills and in debris scores after the use of MTwo-PF ($p > 0.05$). The ultrasonics and control groups performed significantly worse ($p < 0.05$). The MTwo-PF drill resulted as effective as the Largo drill in obtaining a good post space cleaning, especially when followed by ultrasonics + EDTA irrigant regimen. *(J Endod 2008;34:83–86)*

Key Words

Debridement, gutta percha removal, irrigant regimens, post space

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The removal of gutta percha and sealer from root-filled teeth is required for endodontic retreatment and post space preparation (1, 2). This procedure produces debris on canal walls, leading to increase in leakage (3) and occlusion of dentin tubules (4, 5), thus impairing the adhesive luting of fiber posts (6). Therefore, an optimal removal of smear layer is required. Many factors affect the amount of debris on post space walls, such as the type of instrument and the cleaning system used. Several hand and rotary instruments used for gutta percha/sealer removal have been investigated, and rotary instruments were more effective and time-saving (7–19). Although various methods for cleaning endodontically treated canals have been proposed, including different irrigant regimens with or without ultrasonic devices (20–27) or with gutta percha solvents (16, 28), few studies investigated how to clean a post space (29, 30).

To prepare the post space, either preformed drills made by the posts' manufacturers or Largo (also known as Peeso Reamer) (Largo; Dentsply, St Quentin en Yvelines, France) drills have been commonly used. However, these drills might remove an excessive amount of root canal dentin, reducing the strength of the root (31). Recently, a nickel titanium (NiTi) drill (MTwo Post-File; Sweden&Martina, Due Carrare, Padova, Italy) with a noncutting tip and noncutting lateral surface has been proposed for removing gutta percha and preparing the post space without enlarging the canal diameter.

The aim of this study was to evaluate the effect of the NiTi drill compared with a Largo drill in combination with different cleaning regimens on the removal of gutta percha/sealer from the post space surface. The null hypothesis tested is that there is no morphologic difference in smear layer removal from post space walls after the use of a new NiTi drill or a Largo drill with different cleaning regimens.

Materials and Methods

One hundred extracted caries-free human premolars, with one canal with a curvature smaller than 20°, were cleaned and stored in 1% T-chloramine solution at 4°C for no more than 1 month. The canal morphology was checked radiographically. All the endodontic treatments were performed by the same operator. After the coronal access, a K-file #10 (Dentsply Maillefer, Ballaigues, Switzerland) was placed into the canals until it was visible at the apical foramen. The working length was set 1 mm shorter than this length. The teeth were cut to make all the canals 16 mm long. The canals were instrumented with NiTi rotary instruments (MTwo files) mounted in a 16:1 gear reduction handpiece (Tecnika Vision, ATRsrl, Pistoia, Italy). The sequence of instrumentation was up to a 25.06# file while irrigating with 5.25% NaOCl (Niclor 5; Dentale-Ogna, Milan, Italy), and, finally, the canals were dried with paper points (Mynol; Curaden Healthcare, Saronno, Milano, Italy). Each set of MTwo files was used for 10 teeth.

The canals were obturated according to the continuous wave technique by using nonstandardized gutta percha cones (Dentsply, France) warmed with a heat source (System B; SybronEndo, Orange, CA) and compacted with pluggers up to 4 to 5 mm from the apex. The sealer (CRCS; Coltène/Whaledent Inc, Cuyahoga Falls, OH) was spread onto the main cone. Backfilling was performed by using thermoplastic gutta percha and an Obtura II unit (Obtura Corp, Fenton, MO) at 185°C. Each treatment was checked radiographically. The teeth were then coronally sealed with glass-ionomer cement (Fuji II, GC, Tokyo, Japan) and stored in saline solution for 24 hours at 37°C.

Afterward, the teeth were randomly divided into two groups (n = 50) according to the drill used to remove gutta percha/sealer and for post space preparation: group A, in which a Largo #3 drill was used, and group B, in which a MTwo-PF drill was used. The coronal seal was removed, and the drills were used in the canals up to 4 mm from the canal apex to obtain 12-mm deep post spaces. The removal of gutta percha and the post space morphology were checked radiographically. Each drill was used 5 times.

The teeth were randomly divided into five subgroups (n = 10) according to the cleaning regimen used for debridement: (1) 17% EDTA (E.D.T.A.17%; Dentale-Ogna, Milan, Italy): the canals were treated with 3 mL of 17% EDTA for 1 minute and then rinsed with 10 mL of distilled water and dried; (2) ultrasonic irrigation: the canals were treated with an ultrasonics file (KaVo endodontic file n°68; KaVo, Biberach, Germany) for 1 minute, irrigated with water, and dried; (3) ultrasonic irrigation and 17% EDTA: the canals were treated with the ultrasonics file while irrigating with 3 mL of 17% EDTA for 1 minute, rinsed with water, and dried; (4) 36% phosphoric acid (Conditioner 36, Dentsply): the canals were treated with phosphoric acid gel applied for 30 seconds, irrigated with water, and dried; and (5) distilled water (control group): the canals were rinsed with 10 mL of distilled water and dried. Each regimen was used once in each group.

The teeth were then cut in a mesiodistal direction with a low-speed diamond saw (Isomet; Buehler, Lake Bluff, NY). The halves were immersed in 90% alcohol, air dried, mounted on metallic stubs, gold sputtered (Emitech K550, Asthford, England), and observed under scanning electron microscope (SEM; Philips, Amsterdam, Netherlands).

One half of each tooth was randomly chosen and evaluated at 10 mm (apical third), 6 mm (middle third), and 2 mm (coronal third) from the coronal cut. Two SEM images (one at 150× magnification and one at 600× magnification) were taken for each third of each specimen, resulting in 6 images per tooth. The 150× image was used for evaluating the presence of debris and gutta percha/sealer remnants on post space walls, and the 600× image was used for assessing the amount of opened dentin tubules visible on the post space walls. The serial images were numbered with a coding system to allow blind evaluation by the two independent evaluators, according to the following three-step scale (29):

1. Debris score:
   0: no debris (Fig. 1*A*),
   1: few particles with a diameter smaller than 20 μm (Fig. 1*B*);
   2: large quantities of debris (Fig. 1*C*).

2. Open tubules score:
   0: all dentinal tubules open and no smear layer visible (Fig. 1*D*);
   1: some tubules open and a thin smear layer covered tubules openings (Fig. 1*E*);
   2: all dentinal tubules covered (Fig. 1*F*).

Therefore, three debris scores and three open tubules scores were registered for each tooth. In case of different readings between the two evaluators, the worst score was registered.

Two separate Kruskal-Wallis analyses of variance on ranks were applied to assess the significance of differences in debris and open tubules scores between the groups. In each analysis, a Dunn's multiple range test was used for pairwise comparisons. In all the tests, the level of significance was set at $p < 0.05$. The data were analyzed with SPSS 14.0 software for Windows (SPSS Inc, Chicago, IL).

Results

Mean and median values of scores in each group are reported in Table 1. A multiple comparison test revealed that the type of drill did not influence the cleaning effectiveness of investigated regimens. The ultrasonics + EDTA, phosphoric acid, and EDTA groups were comparable in open tubules scores for both drills and in debris scores after the use of the MTwo-PF. In the ultrasonics and control groups, significantly higher scores compared with other groups were recorded.

Discussion

When luting fiber posts, the complete elimination of gutta percha remnants and smear layer from post space is a requirement in order to create ideal conditions for optimal adhesion to root canal dentin. Few studies have been performed on canal wall debridement after post space preparation (29, 30). The procedures for post space cleaning foresee the use of a drill for removing the filling materials and the use of a cleaning regimen to eliminate the smear layer created. The drills used for post space preparation produce sealer and gutta percha residues plasticized by bur friction heat and inorganic components (30). The design of their cutting blade affects the amount of debris and remnants created in the canal (32).

Both the Largo and the MTwo-PF drills produced smear layer and debris in the post space as a result of their action in gutta percha/sealer removal from canal walls. The Largo drill is widely accepted in clinical practice because it is able to effectively remove the filling materials. Nevertheless, some concern was raised regarding the Largo drill, assuming that it does not respect the conical shape of canals, which may result in excessive dentin stripping on canal walls (Fig. 1*G*) with subsequent root weakening (31).

The MTwo-PF drill was as effective as the Largo drill in gutta percha removal. Additionally, the Mtwo-PF appeared to be more respectful of canal shaping and less aggressive on dentin walls, reducing the dentin stripping (Fig. 1*H*). The canal shaping obtained with the MTwo-PF drill is currently under investigation in our laboratory. Its use could allow luting of small-sized posts with a conicity similar to that obtained in the root canal at the end of endodontic instrumentation. However, both drills achieved an effective post space debridement only when combined with an adequate cleaning regimen, which was the discriminative factor for post space debridement.

According to a previous SEM analysis, the etching treatment with 35% phosphoric acid followed by water rinsing was not able to clean dentin optimally; large areas covered by smear layer and sealer/gutta percha remnants were evident on post space walls after etching (30). Likewise, in the present study, the etching treatment alone resulted in an incomplete debris removal. A relatively good ability to expose dentin tubules was observed, and this is in agreement with the previously reported ability of phosphoric acid to demineralize intertubular dentine and to enlarge tubule openings when used for canal debridement (27). A similar effect on dentin tubules was described for EDTA (27), which is also widely used because of its chelating action, which enables the removal of the inorganic component of smear layer (33).

A recent study (26) reported that the combination between 17% EDTA and ultrasonics could significantly improve the smear layer removal after endodontic instrumentation. The present study analyzed the effect on post space cleaning of EDTA and ultrasonics both separately and combined. EDTA alone resulted in an incomplete debris removal. When EDTA was combined with the MTwo-PF drill, it was more effective in opening tubules. The incomplete ability of EDTA to remove debris, especially when it was not combined with 5.25% NaOCl irrigation, has been previously reported (33). The EDTA irrigation for 1 minute performed in the present study was reported to be sufficient to produce

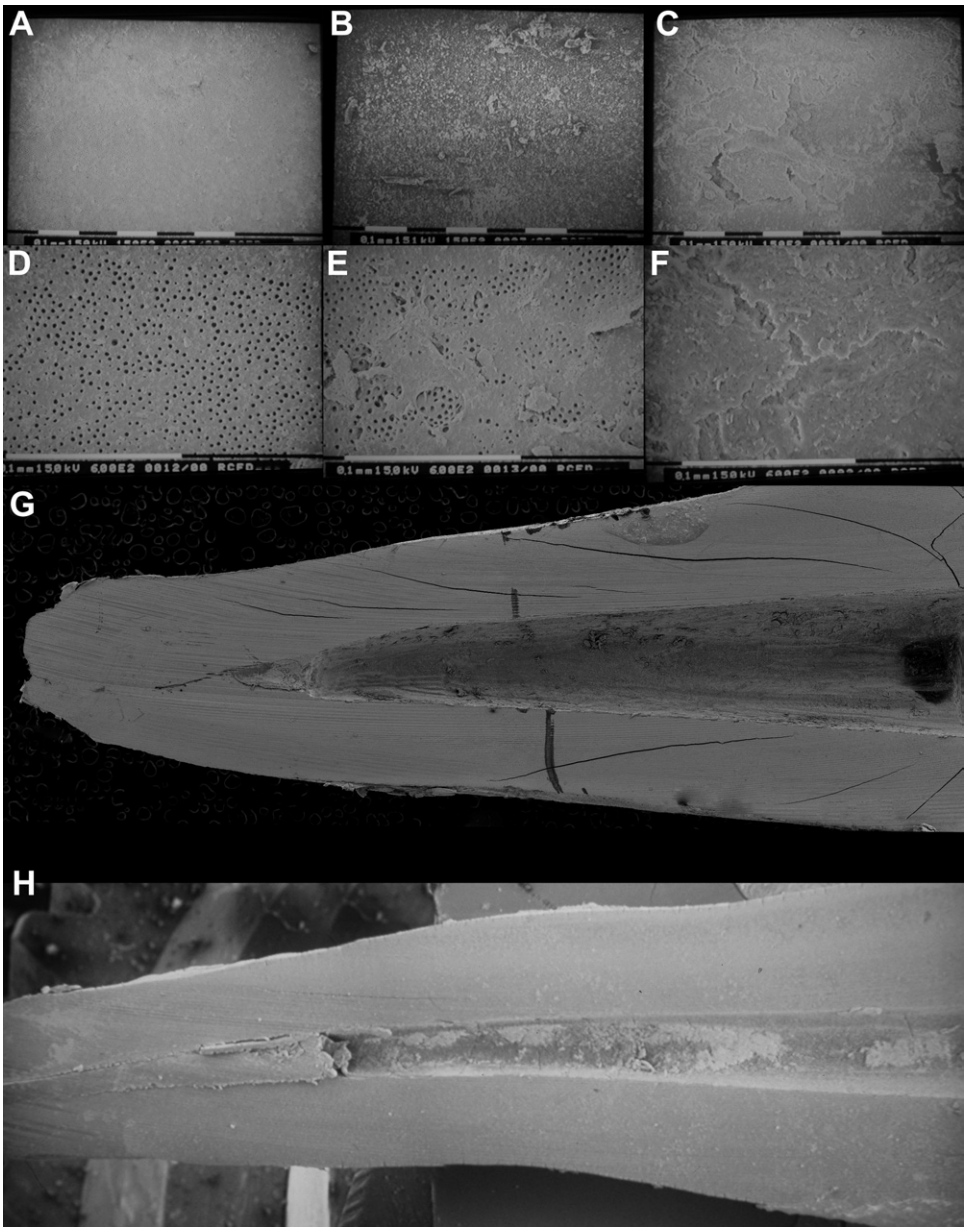

Figure 1. SEM micrographs showing: (*A*) debris score 0, no debris particles are present (150×); (*B*) debris score 1, few particles with a diameter smaller than 20 μm (150×); (*C*) debris score 2, large quantities of debris (150×); (*D*) open tubules score 0, all dentinal tubules open and no smear layer visible (600×); (*E*) open tubules score 1, some tubules open and a thin smear layer covered tubules openings (600×); (*F*) open tubules score 2, all dentinal tubules covered (600×); (*G*) post space shape created into the root canal using a Largo drill; and (*H*) post space shape created into the root canal using a MTwo-PF drill.

clean canals (20). Ultrasonics resulted in a poor smear layer removal, which was comparable with control groups. It may be speculated that ultrasonics contribute to pack debris into dentinal tubules, thus making the removal more difficult.

The combination of ultrasonics and EDTA showed promising results in canal debridement and tubule opening. This finding is in agreement with Plotino et al (20) who reported that the ultrasonic vibration increases the effectiveness of the irrigation solutions in root canal de-

TABLE 1. Numbers Are Means; Values in Brackets Are Medians

	EDTA	Ultrasonics	Ultrasonics + EDTA	Phosphoric acid	Water
Debris score					
Largo	1.0 [1] B	1.8 [2] C	0.6 [1] AB	0.9 [1] B	1.9 [2] C
MTwo-PF	0.8 [1] B	1.7 [2] C	0.3 [0] A	0.7 [1] AB	2 [2] C
Open tubules score					
Largo	1.0 [1] B	1.5 [2] C	0.6 [1] AB	0.9 [1] B	1.8 [2] C
MTwo-PF	0.8 [1] AB	1.6 [2] C	0.4 [0] A	0.6 [1] AB	1.8 [2] C

Two separate analyses were performed for debris and open tubules scores. Different letters indicate statistically significant differences according to the multiple comparisons test ($p < 0.05$).

bridement. For irrigant solutions to be effective, they have to be in direct contact with dentin surface (20, 21); it may be speculated that the continuous movement of the irrigant generated by ultrasonics vibration could allow for a better interaction between EDTA and root dentin. Because morphologic differences were detected among the investigated methods in the smear layer removal and in the ability to expose dentinal tubules, the tested null hypothesis was rejected.

Conclusions

Within the limits of this study, the MTwo-PF drill resulted as effective as the Largo drill in removing the filling materials and in obtaining a good post-space cleaning, especially when followed by an ultrasonics + 17% EDTA irrigant regimen.

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