Debris Remaining in the Apical Third of Root Canals after Chemomechanical Preparation by Using Sodium Hypochlorite and Glyde: An *In Vivo* Study

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Abstract

Introduction: During chemomechanical instrumentation, several liquid or paste substances are used to ease the action of the files and to eliminate debris and the smear layer. The aim of this study was to evaluate whether the use of a paste containing EDTA during cleaning and shaping of the root canal helps to eliminate debris. **Methods:** Twenty root canals in dog teeth were instrumented by a crown-down technique by using nickel-titanium rotary files. In 10 root canals (group A), sodium hypochlorite was used during instrumentation, followed by a final irrigation with 17% liquid EDTA. In another 10 canals (group B), sodium hypochlorite was again used as the irrigating solution, but Glyde File Prep paste was used with every instrument, and a final irrigation with EDTA was also carried out. Two additional teeth were used as positive and 2 as negative controls. The jaws were prepared for histologic evaluation. **Results:** In group A where Glyde was not used during cleaning and shaping, little or no debris was found in the apical third of the instrumented root canals; however; in group B in which Glyde File Prep paste was used during chemomechanical instrumentation, moderate to high accumulation of debris was observed in the apical third. **Conclusions:** The use of Glyde File Prep paste during rotary mechanical instrumentation favors the accumulation of debris in the apical third of the root canals. Irrigation with NaOCl and a final flush with EDTA by means of a small-gauge needle with simultaneous aspiration led to less accumulation of debris than in the Glyde File Prep group ($P < .05$). *(J Endod 2014;40:1419–1423)*

Key Words

Chelating agents, chemomechanical instrumentation, EDTA, Glyde, NaOCl

Root canal treatment success is closely related to appropriate cleaning and shaping of the root canal (1). The persistence of organic material (pulp, predentin, bacteria, and their by-products) or inorganic (dentinal debris) in the root canal, especially in the apical third, can lead to unsuitable biological conditions for periapical healing (2, 3). One of the key factors affecting appropriate debridement of the root canal is the chemomechanical instrumentation technique used, which includes the use of rotary and hand files and auxiliary substances such as irrigation solutions and pastes (1).

Some substances with a creamy consistency have been proposed as auxiliaries during chemomechanical instrumentation (4, 5). The use of these substances has various objectives; they serve as lubricants to ease movement of instruments within the root canals (6), promote better cleaning of the dentin, and eliminate the smear layer from the dentinal walls (7, 8).

However, various disadvantages have been pointed out in relation to such pastes (9–11), mainly the persistence of paste residues inside the root canal (12, 13). *In vitro*, EDTA paste residues remained in 96% of canals after manual root canal preparation even after irrigation (12), probably because it was mixed with dentinal or organic debris (14). The presence of dentinal and pulpal debris inside the root canal after rotary instrumentation by using an EDTA paste has not been evaluated *in vivo*.

The aim of this study was to compare the accumulation of debris after cleaning and shaping by using 2 different methods. In one group, sodium hypochlorite was used during instrumentation, and a final irrigation was performed with 17% liquid EDTA. In the second group, sodium hypochlorite was also used as the irrigating solution, but Glyde File Prep paste was used with every instrument; also a final irrigation was performed with 17% liquid EDTA.

Materials and Methods

This study was conducted with the approval of the university ethical committee. Twenty root canals were used, which were selected from premolars and upper and lower incisors from a male mongrel dog approximately 2 years old. The animal was sedated with Zoletil (Virbac, 5 mg/kg) and atropine (0.5 mL/kg). After appropriate isolation by using a rubber dam, the teeth were disinfected with iodine. Access to the cavity was created with a high-speed handpiece and a number 3 carbide bur and rinsed with sodium hypochlorite (5.25%). The pulp was removed with a sterile medium barbed broach (Dentsply-Maillefer, Ballaigues, Switzerland). Five upper and 5 lower teeth were assigned randomly to each of the 2 treatment groups by use of a coin toss.

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Group A (n = 10)

With the pulp chamber filled with 5.25% sodium hypochlorite, chemomechanical preparation was performed with sterile K3 instruments (Sybron Endo, Orange, CA) by using a Tecnika electric motor (A.T.R., Pistoia, Italy) at 350 rpm by a crown-down technique following a strict aseptic chain. Two K3 files (25/12 and 25/10) were used to flare the coronal third of the root canals; then 40/06, 35/06, and 25/06 K3 instruments were used to flare the middle and apical thirds of the root canals. The canal length was determined with a #20 K-file at 0.5 mm from the radiographic apex by taking a radiograph by using the digital Schick system (Schick Technologies, Sirona, Long Island, NY).

Next, the apical third was further flared up to a 45/02 K3 (Sybron Endo) instrument, and a final taper was obtained by use of a 40/06 K3 (Sybron Endo) instrument to length. Between every instrument, the root canal was irrigated with 3 mL 5.25% NaOCl by using a 30-gauge needle (Monoject, Mansfield, MA) with gentle in-and-out movement of the needle to reach the apical 1–2 mm of the root canal; the NaOCl was then aspirated with a 12-gauge needle. When the preparation of each canal was finished, it was irrigated with 5 mL 5.25% NaOCl, followed by a final irrigation with 3 mL liquid EDTA (Smear Clear; Sybron Endo). All canals were aspirated and dried with sterile coarse paper points.

Group B (n = 10)

This group was treated with the same instrumentation and irrigation protocol as group A by using NaOCl between all instruments, but a layer (average of 0.86 mg) of Glyde File Prep (Dentsply-Maillefer) was applied to the cutting flutes of each instrument before introducing it into the root canal. After the root canals were flared, a final irrigation was performed with 5 mL 5.25% NaOCl and then with 3 mL liquid EDTA. The root canals were dried with sterile coarse paper points.

Two teeth were used as positive controls in which instrumentation with K hand files without irrigation was performed up to a 40-K instrument. Two teeth in the same dog were used as negative controls in which after pulp extirpation with a barbed broach and without instrumentation, the roots were thoroughly irrigated with 5.25% NaOCl for 20 minutes with a 30-gauge needle positioned at full working length as determined by a radiograph.

After these procedures, the dog was killed with an overdose of 3% pentobarbital sodium. The jaw blocks were fixed in 10% formaldehyde and prepared for histologic evaluation. Semi-serial cuts 5 μm in width were stained with hematoxylin-eosin. By using an Axio Scope microscope (Zeiss, Jena Germany), 3 representative sections with the most debris of each root were selected to evaluate its presence or absence in the apical third of each canal. If present, debris was quantified as low (less than 10% of the apical third), medium (from 10%–33% of the apical third), or high (more than 33%); scores of 0, 1, 2, and 3, respectively, were assigned by a blinded assessor. For statistical analysis, differences in frequencies between groups were compared by using the χ^2 or Fisher exact test as appropriate, considering $P < .05$ as the minimum level of significance.

Results

No roots were lost during the experimental procedure. Both positive controls showed the presence of abundant debris in all thirds of the instrumented root canals, whereas negative controls showed the absence of debris in all thirds of the root canal.

The Glyde File Prep group (B) showed a higher incidence ($P < .005$) of debris than the NaOCl and final flush with Smear Clear group (A) (Table 1 and Figs. 1–6).

TABLE 1. Remaining Debris in the Apical Third after Preparation

Group	Preparation	Absent	Present			*P* value
			Low	Medium	High	
A (10 canals)	NaOCl	8	2	—	—	.0005
B (10 canals)	NaOCl and Glyde File Prep	—	2	6	2	

Discussion

Complete elimination of organic and inorganic debris from the apical third of root canals is ideal to improve the prognosis of root canal therapy (1, 2); however; this task has proven difficult (15). The results of this study show that in dog teeth, chemomechanical preparation by using rotary instruments, irrigation with NaOCl, and a final flush with liquid EDTA results in clean and properly debrided root canals. In only 2 of 10 cases, a small quantity of debris was observed at the apical level.

On the other hand, using the same cleaning and shaping technique but adding an EDTA paste applied to every instrument favored the accumulation of debris at the apical level in every case. These data are similar to those obtained by Holland et al (14) from a study in which chemomechanical instrumentation was performed with hand files and a different EDTA paste. An *in vitro* study that used scanning electron microscopy evaluation after chemomechanical preparation with rotary instruments, NaOCl, and Glyde as the lubricant found that cleaning of the apical third was poor and that Glyde did not help to remove the smear layer produced during rotary instrumentation (11). The accumulation of a chelating paste in the curved aspect of root canal walls may also be

Figure 1. Group A: NaOCl and final flush with liquid EDTA. Apical area shows a small quantity of debris (*arrow*). Original magnification, ×40.