Efficacy of SmearClear and Ethylenediaminetetraacetic Acid for Smear Layer Removal in Primary Teeth

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ABSTRACT

Purpose: The purpose of this study was to compare the efficacy of SmearClear and ethylenediaminetetraacetic acid (**EDTA**) for removal of the smear layer from the root canals of primary teeth after instrumentation.
Methods: Thirty extracted, single-rooted, primary incisors and canines were instrumented and randomly assigned to the 3 groups (N=10): group 1=14% EDTA; group 2=SmearClear; and group 3=no smear layer removal procedure (control). The specimens were submitted to standard processing for scanning electron microscopic analysis to evaluate cleaning according to a 3-point scoring system that indicated best to worst cleaning. Data were analyzed statistically by the Mann-Whitney U test at a 5% significance level.
Results: There was no statistically significant difference ($P>.05$) between groups 1 (EDTA) and 2 (SmearClear).
Conclusion: SmearClear was able to remove the smear layer from the root canals of primary teeth as effectively as ethylenediaminetetraacetic acid, suggesting that both solutions may be indicated for such purpose.
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The smear layer formed after biomechanical preparation of the root canal system must be removed because it may prevent or considerably delay the penetration of antimicrobial agents, such as endodontic irrigants and intracanal medications, into the dental tubules.[1] In teeth with pulp necrosis, the success of the endodontic treatment depends on the elimination of bacteria and their byproducts from the root canal system.[2] Hence, the removal of the smear layer is of paramount importance.[3]

Sodium hypochlorite (**NaOCl**) is the most widely employed chemical solution in the biomechanical preparation of the root canal system. It has been systematically used in endodontics in concentrations ranging from 0.5% to 5.25%. In spite of its excellent antimicrobial action and capacity to dissolve organic materials, however, this solution alone does not effectively remove the smear layer.[3-5] Several authors[3,5-10] have evaluated NaOCl's association with different concentrations of ethylenediaminetetraacetic acid (**EDTA**) for smear layer removal. The association of these products is currently well accepted and has been proved to

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effectively eliminate the smear layer from the root canal system of permanent[11,12] and primary teeth.[13]

Recently, a new product containing 17% EDTA solution along with cetrimide and additional proprietary surfactants has been launched by SybronEndo (Orange, Calif) under the brand name SmearClear. This endodontic irrigant is advertised as being specifically designed for smear layer removal and root canal cleansing, and little published data is available about its performance.[14] The development of newer smear removal agents for use in biomechanically prepared root canals suggests evaluating these products at different research levels to prove their efficacy on the basis of research-supported outcomes.

Due to lack of published works in the primary dentition, the purpose of this scanning electron microscopic (**SEM**) study was to evaluate the efficacy of SmearClear for removal of the smear layer from the root canals of primary single-rooted teeth prior to obturation, in comparison to ethylenediaminetetraacetic acid.

METHODS

This research project was reviewed by the local Ethics in Research Committee of the School of Dentistry of Ribeirão Preto, University of São Paulo, Brazil and the study design was approved (process no. 2007.1.74.58.4).

Thirty extracted human primary incisors and canines with a single straight root (either fully developed or with one third of physiological resorption) were obtained from the tooth bank of the School of Dentistry of Ribeirão Preto, University of São Paulo, Brazil. The teeth had their root surfaces carefully rinsed with sterile saline and were stored in 10% formalin solution at a 1:4 ratio until use.

The teeth were radiographed to observe the pulp chamber and root canal system morphology. After coronal opening and manual exploration of the canals, teeth with any obstruction, excessive root curvature, a length less than 10 mm, or a working length diameter less than a size 25 K-file were discarded. Warm wax was used to seal the apical foramen. The teeth were hand-prepared by a single operator using K-files (Dentsply Maillefer, Ballaigues, Switzerland), according to a crown-down, pressureless technique up to the tooth's real length. At each instrument change, the canals were irrigated with 3.6 mL of 2.5% NaOCl, followed by aspiration with endodontic needles of a size compatible with the root canal diameter.

After instrumentation and drying of the root canals with absorbent paper points, the teeth were randomly assigned to 3 groups (N=10).

Group 1, EDTA (14.3% buffered EDTA solution at a pH of 7.4, Odahcan Herpo Produtos Dentários Ltda, Rio de Janeiro, Brazil), was delivered to the root canals with a long endodontic needle coupled to a Carpule syringe, left for 3 minutes after stirring with a K-file, and neutralized with 2.5% NaOCl.

Group 2, SmearClear (SybronEndo, Orange, Calif), was delivered to the root canals with a long endodontic needle coupled to a Carpule syringe, left for 60 seconds according to the manufacturer's instructions, and neutralized with 2.5% NaOCl. The root canals of groups 1 and 2 had the irrigants aspirated and were dried with sterile absorbent paper points.

In group 3 (control), the root canals were not submitted to any smear layer removal procedure.

Thereafter, groves were prepared with a water-cooled diamond bur on the buccal and lingual surfaces and the teeth were split along their long axis in a buccolingual direction using a surgical chisel. The obtained specimens were split and fixed in modified Karnovski's solution (2.5% glutaraldehyde, 4% paraformaldehyde, in 0.1 M sodium cacodylate, pH=7.2-7.4). To prepare for SEM analysis, the specimens were critical-point dried with CO_2 and sputter-coated with a 20-nm layer of gold. Magnifications of X200 and X750 were used to evaluate cleaning at the apical, middle, and cervical root canal thirds according to a 3-point scoring system indicating best to worst cleaning: 0=surface free of debris and totally exposed dentinal tubule openings; 1=root surface partially covered with debris; 2=root surface totally covered with debris, with no visible dentinal tubule openings. In each root canal third, 4 areas were demarcated and analyzed and scores were given. The mean of the 4 scores was calculated, and a single score was attributed to each third.

Data were analyzed statistically by the Mann-Whitney U test at a 5% significance level.

RESULTS

During laboratorial processing, 2 group 1 specimens, 2 group 2 specimens, and 1 group 3 specimen were lost.

In all group 1 specimens (N=8), the 3 root canal thirds were scored as 0. On the other hand, score 2 was attributed to the 3 root canal thirds of all group 3 specimens (N=9). In group 2 (N=8), the cervical third was scored 0 in 4 cases and 1 in 4 cases. In the middle third, score 0 was attributed to 6 cases and score 1 was assigned to 2 cases. The apical third was scored 0 in 6 cases and 1 in 2 cases. No score 2 was given in this group.

There was no statistically significant difference ($P>.05$) among the analyzed root canal thirds (cervical, middle and apical) in either of the groups. Groups 1 and 2 differed significantly from group 3 ($P<.01$). There was no statistically significant difference ($P>.05$), however, between groups 1 and 2.

A panel of SEM micrographs representative of smear layer removal in the 3 root canal thirds of the teeth in groups 1, 2, and 3 is shown in Figure 1.

DISCUSSION

Applying EDTA in the root canals has been advised for smear layer removal[10] and cleaning of the canal walls prior to obturation.[8,12,15] Smear layer removal is also important when the placement of an interappointment intracanal dressing is

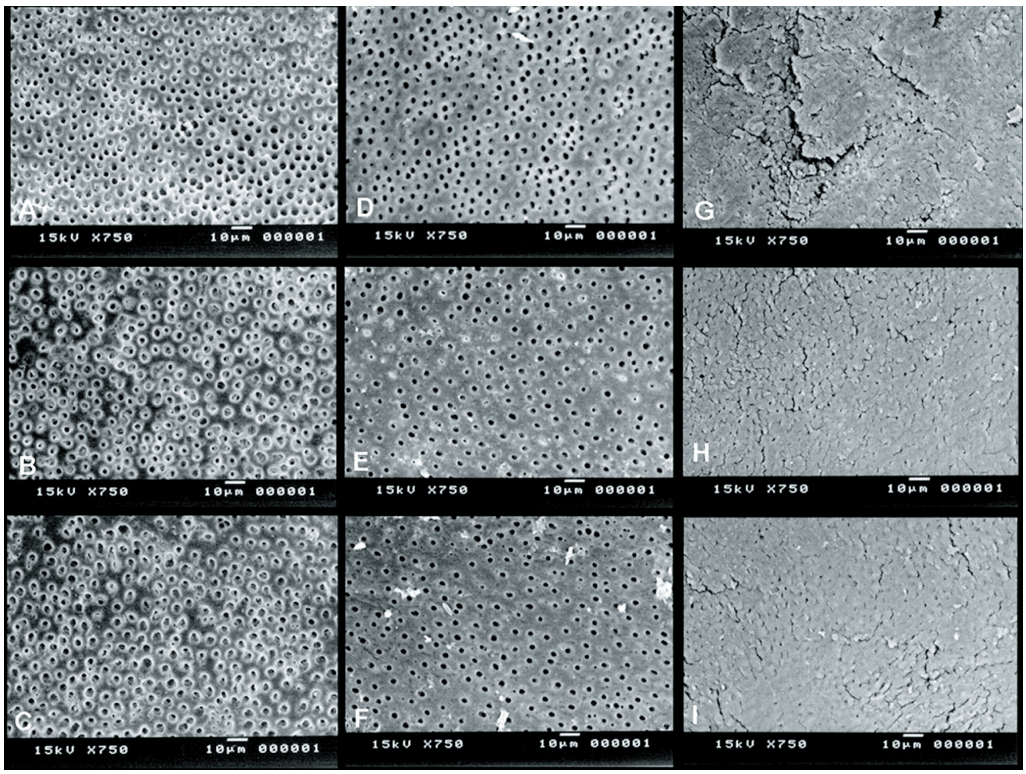

Figure 1. Scanning electron microscopic micrographs representative of group 1 (A=cervical third; B=middle third; C=apical third I), group 2 (D=cervical third; E=middle third; F=apical third), and group 3 (G=cervical third; H=middle third; I=apical third).

required. According to Foster et al,[16] eliminating the smear layer from the root canals facilitates calcium hydroxide diffusion through the radicular dentin to the external root surface.

Several authors[3,5-12] have investigated the use of different EDTA concentrations associated with NaOCl for smear layer removal. The findings of studies in permanent teeth have demonstrated that the most effective smear layer removal method is root canal irrigation with 15% to 17% EDTA followed by 2.5% to 5.25% NaOCl.

The outcomes of this SEM study in primary teeth showed effective removal of the smear layer from the root canal thirds in group 1, in which 2.5% NaOCl was associated with a chelating solution (14.3% EDTA). The root canal walls were free of debris, and the dentinal tubule entrances were visible. This cleaning effectiveness has been attributed to the physicochemical action of NaOCl on the dissolution of organic matter and tissue remnants, and the action of EDTA has been attributed mainly to inorganic debris.[7,8,12,17]

EDTA's results in the present study agree with those of Alacam,[18] who also used this chelating solution in the root canals of primary teeth and observed that, in addition to its efficacy in removing the smear layer, the teeth irrigated with EDTA exhibited better penetration of the filling material into the dentinal tubules.

The present study's results showed that irrigation with 2.5% NaOCl alone as an endodontic irrigation during mechanical preparation was not able to effectively remove the smear layer from the analyzed canal thirds. These findings are consistent with those of previous studies,[13] which, in spite of using different application times and concentrations, also found that the use of NaOCl as an endodontic irrigant in primary teeth did not optimally remove the smear layer, providing the association with another solution that can have this capacity .

Newer smear removal agents for use after biomechanical preparation of root canals are constantly introduced to the market. Thus, it is necessary to investigate the efficacy of the products to increase the clinical success rate of the endodontic treatment in primary and permanent teeth. SmearClear has been recently launched as a 17% EDTA-based endodontic irrigant containing cetrimide and additional proprietary surfactants. This product is known to have been evaluated in only one in vitro study with permanent teeth,[14] which compared the efficacy of different root canal irrigants against *Enterococcus faecalis* biofilms. These authors found that SmearClear had greater efficacy than almost of them. These results may be attributed to the fact that SmearClear contains cetrimide, which is a quaternary ammonium compound and a cationic detergent that is effective against gram-positive and gram-negative micro-organisms.[19]

The present study's results showed that SmearClear and EDTA had a similar performance in smear layer removal from the root canal system of single-rooted primary teeth.

There is no advantage to using SmearClear when a simple and likely cheaper solution (17% EDTA) can remove the smear layer as effectively. The lack of studies addressing the use of SmearClear in the primary dentition hinders comparing these findings to those published elsewhere. Further in vitro studies and clinical trials should be undertaken to confirm the efficacy and safety of this product's use in root canal therapy in pediatric patients.

CONCLUSIONS

Under the tested conditions, SmearClear was able to remove the smear layer from the root canals of primary teeth as effectively as 14.3% ethylenediaminetetraacetic acid, suggesting that both solutions may be indicated for this purpose.

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