Introduction

Removal of filling material and cleaning of root canals are considered important procedures for a successful endodontic retreatment.[1,2] In order to remove the filling material from the root canals, different techniques have been proposed by the literature. These techniques include the use of rotary or manual instruments in association or not with solvents.[3]

Different solvents have been proposed for aiding in the removal of filling material from root canals, among them one can cite chloroform, eucalyptol and xylol.[3,4] Although effective, most endodontists do not use solvents because of the toxic action of such substances on periapical tissues.[5,6]

According to Oliveira,[7] chlorhexidine gel can be an alternative to the use of solvents. In fact, this substance has low toxicity[8] and allows the root canal walls to be mechanically cleaned due to its viscosity, thus compensating the action of solvents.[8] In addition, chlorhexidine has a wide-spectrum antibacterial activity.[9,10,11] According to Gomes et al,[10] 2% chlorhexidine gel has shown to be highly effective against Enterococcus faecalis, which is a relevant fact as Sundqvist et al,[12] Molander et al[13] and Pinheiro et al[14] reported that this microorganism is associated with cases of endodontic failure.

The objective of the present study was to compare the action of 2% chlorhexidine gel to two solvents largely used in endodontic retreatment, xylol and eucalyptol, regarding the cleaning of the root canal walls.

Material and Methods

The Human Research Ethics Committee of the Federal University of Pelotas, Dentistry School (process number 012/2006) has approved this study. A total of 45 human single-rooted teeth (incisors and canines) with complete apices were used for study, all being stored in saline solution (Basa – Indústria Farmacêutica Basa Ltda, Caxias do Sul, RS, Brazil) and kept at constant temperature of 37°C in an oven. By using a digital calliper, the roots had their length standardised to 15 mm. Double-faced diamond discs (KG Sorensen, São Paulo, SP, Brazil) mounted on a micro-motor and straight handpiece (Kavo Extra –Torque 605C, Brazil) were used for this standardization.

The foramens were standardised by using a Flexofile #15 file (Dentsply Maillefer, Petrópolis, RJ, Brazil) and the working length was set at 1 mm short of the apex.

The root canals were instrumented according to the step-back technique, which consisted in preparing the coronal third with Gates-Glidden burs #2 and #3 (Dentsply Maillefer, Petrópolis, RJ, Brazil). For apical preparation, the apical stop was standardised to calliper #35 and step back performed in 1 mm increments until #55 file. During instrumentation, the root canals were irrigated with 2.5% sodium hypochlorite solution (Vida Nova Farmácias de Manipulação). After instrumentation, EDTA (Iodontosul Indústria Odontológica do Sul) was used for 3 minutes for removal of the smear layer and then a final irrigation with saline solution was applied.

Root canals were dried with paper tips (Endopoints) and filled according to the lateral condensation technique by using gutta-percha cones and Endofill sealer (Dentsply). The teeth were radiographed in the mesial-distal and buccal-lingual orientations for analysis of the quality of the obturation.

Next, the root canal entry was temporarily restored with intermediate restorative material (Dentsply) and the teeth were stored in an oven at 37°C during 60 days to allow the sealer to set.

After 60 days, the restorative material was removed, including a coronal 5 mm of filling material (gutta-percha + sealer) by using Gates-Glidden burs #2 and #3 in order create a reservoir for the auxiliary chemical agent being used.

The teeth were divided into 3 groups (n = 15) depending on the auxiliary chemical agent used during the preparation:

- Group 1: Manual instrumentation with #15 to #45 K-files (Dentsply Maillefer) followed by #15 to #45 Hedströem files (Dentsply Maillefer) in association with the use of 0.5 mL of 2% chlorhexidine gel at each instrumentation and abundant irrigation with 3 ml of saline solution (Basa).
- Group 2: Manual instrumentation with #15 to #45 K-files (Dentsply Maillefer,) in association with #15 to #45 Hedströem files (Dentsply Maillefer), adding 0.5 mL of xylol (Merck at each instrumentation and final irrigation with 3 ml of saline solution (Basa).
- Group 3: Manual instrumentation with #15 to #45 K-files (Dentsply Maillefer) in association with #15 to #45 Hedströem files (Dentsply Maillefer), adding 0.5 mL of eucalyptol (Biodinâmica) at each instrumentation and final irrigation with 3 ml of saline solution (Basa).

The maximum time for removing the filling material from each root canal was defined in 30 minutes. Removal of the filling material was considered complete when remnants of gutta-percha or filling material recovering the instruments were no longer observed, with these criteria already being proposed by Hulsmann, Stotz[15] and Imura et al.[16]

After removing the filling material, the teeth were radiographed (Spectro 70X-Dabi-Atlante) at a focal distance of 200 mm with an X-ray unit operating at 70 KVp, 8mA, and exposure time of 0.5 seconds. The radiographs taken were in the mesial-distal and buccal-lingual directions.

The radiographs were evaluated by three double-blinded examiners for the presence of remnants of gutta-percha, attributing scores described by Ferreira et al[17] (Table 1) for the different thirds (coronal, middle and apical) regarding the amount of radiopaque debris.

After the radiographic analysis, the teeth were longitudinally sectioned in the buccal-lingual direction by using double-faced diamond discs (KG Sorensen) and surgery chisel (Neumar). Image of the segments were taken in pairs (semi-parts) by digitalizing the image with a scanner device HP Deskjet F300 All-In-One Series (HP-Brasil) operating at a 1200 dpi resolution and presence of a stainless steel ruler for image standardization. Next, the software Image Tool was used to analyze the images and helped calculate the sum of all areas (regions) where remnants of the filling material were present. For this analysis, the measurements were in mm^2.

Kruskall-Wallis' test was used ($p < 0.05$) for statistical analysis of the amount of radiopaque debris (radiographic analysis of the scores), whereas ANOVA ($p < 0.05$) and Tukey's tests ($p < 0.05$) were used to analyze the sum of the areas containing remnants of filling material.

Results

With regard to the radiographic analysis of the scores, no statistically significant difference was observed between the three groups studied, that is, chlorhexidine, xylol, and eucalyptol (Table 2). However, when the total area of remaining filling material was assessed with the Image Tools software, one could observe a statistically significant difference between the chlorhexidine and xylol groups, with the latter being more efficient than 2% chlorhexidine gel for cleaning the root canals. No statistically significant difference was found regarding the use of eucalyptol and 2% chlorhexidine gel.

With regard to the analysis of the thirds, Figure 1 shows the scores obtained from each of them. It was observed a higher degree of cleaning efficiency in the coronal third, followed by middle and apical thirds.

Discussion

According to Wilcox and Swift,[18] a successful endodontic retreatment is strongly associated with the cleaning of the root canal walls. The present study has evaluated the root canal cleaning with different substances by means of radiographic analysis and digital imaging.

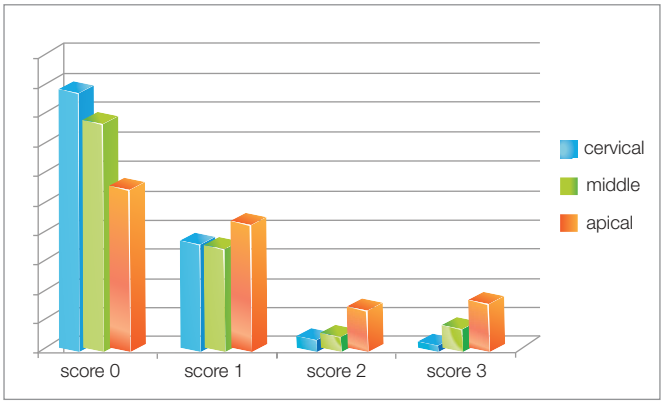

Figure 1. Scores attributed to the different thirds.

Table 1. System of scores attributed to radiographic analysis according to the amount of radiographic debris.

Scores	Significant
0	Absence of radiopaque debris
1	*Less than 25% of debris*
2	*Between 25% and 50% of debris*
3	*More than 50% of debris*

Table 2. Values of the sum of remaining filling material present in the root canals in the three groups.

Groups	Radiographic analysis (scores)	Image analysis (Area of remaining material)
Chlorhexidine	0.8 ± 1.1^a	6.1 ± 4.2^b
Xilol	0.3 ± 0.5^a	2.5 ± 3.0^a
Eucalyptol	0.8 ± 0.9^a	5.4 ± 4.9^b

Notes: Letters a and b mean statistically significant differences.

In the present work, the root length was standardised to 15 mm with the removal of the coronal portion of the teeth. This procedure was performed according to Al-Omari and Dummer,[19] who state that such a removal allows the root canal to be better viewed morphologically and possible interferences eliminated during the retreatment procedures.

Although several previous studies had shown that the time required for removing the filling material is around 20 minutes, regardless of the technique used,[2,16] we have opted to define a time of 30 minutes.

With regard to the different analyses used in the present study, the radiographic one was used because it is a methodology already established in the literature. According to Tanomaru Filho et al,[20] the conventional radiographic technique using periapical films in two radiographic orientations provides good conditions for analysis. However, according to Ferreira et al,[17] it is not possible to assess the amount of remaining filling material existing on the root canal walls by using periapical films.

In the present study, according to such a technique, it was observed a better cleaning of the coronal third compared to the middle and apical ones. This finding may be associated to the use of Gates-Glidden burs for this third, enabling better cleaning compared to the middle and apical thirds as these were cleaned with manual instruments only.[7] Despite also being described by Wilcox[21] and Ferreira et al,[17] these burs were used here to prepare a reservoir for storing the chemical substances used.

With regard to the analysis of the root canal cleaning using digital imaging, this technique was shown to be efficient for quantifying the amount of remaining filling material, which was also reported by Bramante and Betti.[22]

In the present work, when this technique was employed it was observed a better cleaning of the dentinal walls in association with the use of xylol compared to 2% chlorhexidine gel and eucalyptol. In addition, in the case of the former substance, it was difficult to reach the entire working length in some of the teeth, as higher pressure was applied to the files in order o remove the filling material from the root canals. This happened because chlorhexidine does not act directly on the filling material, that is, it does not alter the properties of this material by causing its dissolution. In fact, because of its viscosity, this substance only allows the filling material to be removed in fragments, which are dislocated from the inside of the root canals. Also, due to the need to exert higher pressure to the instrument, the use of manual files in association to 2% chlorhexidine gel might cause a deviation of the root canal, which did not occurred in the present study as the teeth being used already had wide and straight root canals.

The findings reported in the present study are in accordance with Oyama et al,[23] who evaluated the properties of several solvents by assessing the weight loss of gutta-percha cones following the action of the substances at different times, concluding that xylol was the most effective. Additionally, Bueno and Valdrighi[24] reported better results with the use of xylol compared to eucalyptol. However, our findings differ from those found by Oliveira,[7] who reported that chlorhexidine was better than the other solvents studied. This discrepancy may be associated to the type of instrumentation, since Oliveira[7] had used rotary instruments that soften the gutta-percha by heating it, whereas in the present study manual files were used instead.

Conclusion

According to the methodology used and the results found in the present work, one can conclude that the use of xylol has favoured the removal of filling material as well as the cleaning of dentinal walls compared to the use of eucalyptol and 2% chlorhexidine gel.

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In vitro evaluation of dentin marginal adaptation of three root-end filling materials inserted with and without surgical microscope

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ABSTRACT

Objective: Periradicular surgery is the procedure of choice when one aims to solve problems or complications which conventional endodontic therapeutics has not been able to solve. Surgical therapy comprises a number of procedures, among which retrofilling. The aim of this study was evaluating the degree of dentin marginal adaptation of root-end filling materials, as well as ascertaining the effectiveness of optical microscopic usage in the insertion of these materials. **Methods:** Sixty upper canine teeth were selected, apicectomized and then rood-end cavities were prepared with the help of ultrasonic tips. The specimens were divided according to the material used: White MTA Angelus®, Super-EBA® and Sealapex® + White MTA Angelus®, it being that optical microscope was used in half of the samples of each group. All samples were processed and evaluated by scanning electronic microscopy (SEM). **Results:** The three materials tested presented satisfactory marginal adaptation. The use, or not, of the optical microscope, did not change the degree of adaptation of root-end filling materials evaluated in the present study. **Conclusion**: All materials tested (White MTA Angelus®, Super-EBA®, and Sealapex® cement added to White MTA Angelus®) proved efficient regarding the issue evaluated, dentin marginal adaptation. The use of the optical facilitated insertion of root-end filling materials, due to better illumination and magnification. However, it did not promote any difference in the materials marginal adaptation to root-end cavities, when compared with its non-utilization.

Keywords: Retrograde obturation. Scanning electron microscopy (SEM). Endodontics. Oral surgery.

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