

EFFECT OF DIFFERENT ROTARY INSTRUMENTATION TECHNIQUES AND THERMOPLASTIC FILLING ON APICAL SEALING

EFEITO DE DIFERENTES TÉCNICAS DE INSTRUMENTAÇÃO ROTATÓRIA E OBTURAÇÃO TERMOPLÁSTICA NO SELAMENTO APICAL

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The aim of this study was to evaluate apical sealing after root canal treatment using two different rotary instrumentation techniques and two thermoplastic root canal filling techniques. The study was performed in 115 human extracted mandibular premolars. After coronary access the apical foramen was opened with a # 15 K file 1 mm beyond the apex. Cleaning and shaping was subsequently carried out at the working length, 1 mm from the apex, with ProFile .04/.06 system (Dentsply/Maillefer), Quantec (Analytic Endodontics/Kerr) or by the step-back technique with 1% sodium hypochlorite solution as irrigating solution. The root canals were filled with Thermafil (Dentsply/Maillefer) or Microseal (Analytic Endodontics/Kerr) or by lateral condensation technique using AH Plus sealer (epoxy type). The teeth were immersed in 2% methylene blue under vacuum. Then, they were longitudinally sectioned. The results showed that the association of Profile and Thermafil Plus provide the best results ($p < 0.05$). In conclusion, the association of different rotary instrumentation techniques and different filling systems influenced the apical sealing.

UNITERMS: Root canal therapy; Root canal instrumentation; Cleaning and shaping; Rotary instrumentation; Obturation techniques.

INTRODUCTION

Extensive literature has shown that incomplete apical and coronal tridimensional fluid-tight seal is the main cause endodontic treatment failure^{5,12,16}. Many authors have evaluated the quality of the apical seal after different root canal filling techniques^{2,7,9}. Among these techniques, lateral condensation with gutta-percha points provides adequate apical sealing, however this also depends on the sealer used^{11,18}.

Nowadays, different root canal preparation techniques using rotary Nickel-Titanium instruments and thermoplastic root canal filling methods are indicated^{8,15,18}. AH Plus sealer,

which is based on epoxy resin, has been reported to have the best apical sealing when compared to sealers based on zinc oxide or glass ionomer¹.

The aim of this study was to evaluate apical microleakage after instrumentation using the Quantec and Profile .04/.06 system followed by Microseal and Thermafil Plus sealing using AH Plus sealer compared to active lateral condensation of gutta-percha points *in vitro*.

MATERIAL AND METHODS

One hundred and fifteen extracted mandibular, straight, single rooted pre-molars with only one root canal were selected for this study. All teeth were obtained from the tooth bank at the School of Dentistry of Araraquara-SP, maintained for 24 h in 4-6% sodium hypochlorite solution and stored in saline solution. The Ethics Committee approved this study.

After coronal access, the apical foramen was opened by a #15 K file inserted into the root canal 1 mm beyond the apical foramen. Eighty root canals were divided into 5 groups of 16 teeth each and were submitted to the following procedures: group I: instrumented with ProFile .04/.06 (Dentsply Maillefer, Ballaigues, Switzerland) and filled with Thermafil (Dentsply Maillefer, Ballaigues, Switzerland); group II: instrumented with Quantec (Analytic Endodontics, Glendora, CA, USA) and filled with Thermafil; group III: instrumented with ProFile .04/.06 and filled with MicroSeal (Analytic Endodontics); group IV: instrumented with Quantec and filled with MicroSeal; group V (control): instrumented with the step-back technique¹³ and filled with active lateral condensation of gutta-percha points.

AH Plus sealer (Dentsply/Detrey, Konstanz, Germany) was used to seal the root canals in all groups. As a negative control, 5 root canals were filled without sealer. As a positive control, after instrumentation and filling 2 teeth of each group were completely impermeabilized previous to ink immersion.

Root canal instrumentation with Quantec system

The apical foramen was standardized with a # 15 manual K file 1 mm beyond the apex. Root canal preparation was performed according to the manufacturer's technique. All Quantec LX instruments were used 1 mm from the apical foramen and 1.8 ml of 1% sodium hypochlorite solution was used between instruments.

Cleaning and shaping started with the Flare series instruments (Analytic Endodontics), which were used in decreasing order from the cervical to the apical third of the root canal. The following Quantec LX instruments were then used: # 4 (25/.02) as the first apical instrument followed by 30/.02, 35/.02, 9 (40/.02) and 10 (45/.02) at the working length. An electric handpiece (Nouvag AG, Goldach, Switzerland) with a 16:1 reduction of speed was used at 500 rpm for the Flare series instruments and 340 rpm for the LX instruments (14). Apical preparation was complemented with a #45 K file. EDTA (Odahcam, Herpo Produtos Dentários Ltda., Rio de Janeiro, RJ, Brazil) was applied for 3 min and the root canals were dried with absorbable paper points.

Root canal instrumentation with ProFile .04/.06 system

Root canal entrances were dilated with Orifice Shapers (Dentsply Maillefer, Ballaigues, Switzerland), numbered from 1 to 6 and used in decreasing order until the root canal

middle third. After that, the apical foramen was standardized with a # 15 manual K file 1 mm beyond the apex. Crown/Down preparation was performed with ProFile .04/.06 system instruments¹⁴. The first apical instrument was ProFile 25/.04 and the apical preparation was enlarged to a ProFile 45/.04 instrument 1 mm from the apical foramen and 1.8 ml of 1% sodium hypochlorite solution was used between instruments. Apical preparation was complemented with a K file number 45. EDTA solution was applied for 3 minutes and the root canals were dried with paper points. An electric handpiece (Nouvag AG, Goldach, Switzerland) was used with a 16:1 reduction of speed at 500 rpm for the Orifice Shapers and 250 rpm for Profile .04/.06 tapers.

Manual Instrumentation Technique

The apical foramen was standardized with #15 K file 1 mm beyond the apex and the working length was established 1 mm from the apex. The manual instrumentation technique was performed with K files and the step-back technique.¹³ The apical preparation was dilated to a #45 file and 3 instruments were used for the step-back technique. The root canal was irrigated with 1.8 ml of 1% sodium hypochlorite solution after each instrument.

Root impermeabilization

The tooth surfaces were impermeabilized with two layers of epoxy adhesive (Araldite, Brascola, São Bernardo do Campo, SP, Brazil), and the root canals were filled with the epoxy resin-based sealer AH Plus, using the Microseal, Thermafil or lateral condensation technique.

Evaluation of Microleakage

After root canal filling, the teeth were immersed in 2% methylene blue under vacuum for 24 h. The teeth were then washed in running water, dried and cut longitudinally according to De Moor and De Boever.⁸

Apical microleakage was analyzed with a Nikon ProFile Projector (Model 6 C, Nippon Kogatu, Tokyo, Japan), magnification 20X from the apical preparation (1 mm from the apical foramen) to the greater dye penetration on the dentin walls. Three different examiners, who were previously calibrated, did the measurements. The data was submitted to statistical analysis using ANOVA and Tukey test.

RESULTS

The mean apical leakage values are reported in figure 1. The specimens from the negative control group did not present leakage while the positive control group presented leakage throughout the root canal. ANOVA showed significant statistical differences between groups at the level of 5%. The difference between the groups was evaluated by the Tukey test. Less apical leakage occurred in group 1 (ProFile, Thermafil, $p < 0.05$). The other groups: 3 (ProFile,

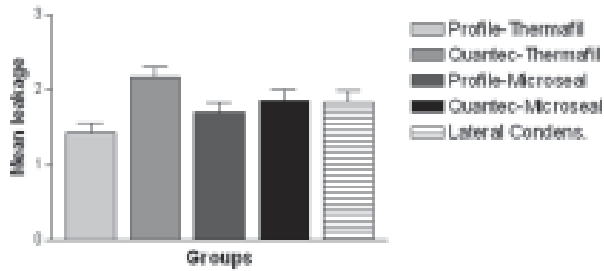


FIGURE 1- Mean apical microleakage (mm) in the groups

Microseal), group 5 (step-back, lateral condensation), group 4 (Quantec, Microseal) and group 2 (Quantec, Thermafil) were similar ($p>0.05$).

DISCUSSION

Many methodologies have been used to evaluate the apical sealing capacity of root canal sealers. Ink infiltration is the most common^{2,5,6,7,9}. In our study, we used ink penetration under vacuum condition. Spangberg, et al.¹⁷ suggested the use of vacuum in dye leakage studies to avoid the influence of entrapped air in the results.

Rapisarda et al.¹⁵ evaluated ProFile .04/.06 instrumentation of molar root canals followed by thermafil filling and reported good adaptation of the root canal sealer on the cervical walls and unsatisfactory adaptation in the apical third where the plastic carrier frequently was in contact with the root canal walls.

In the present study using pre-molar root canals, the best sealing was obtained with ProFile .04/.06 instrumentation and the Thermafil system. These results are similar to those reported by Chiacchio, et al.⁴

Our results also show that there was no statistical difference between the thermoplastic filling techniques and lateral condensation, in agreement with several studies^{6,7,10}. However, less apical leakage occurred with the association of ProFile and Thermafil techniques. Other studies comparing Thermafil and the lateral condensation technique have shown more favorable sealing results for the Thermafil root canal filling technique^{2,5,9,18}.

CONCLUSION

The use of rotary instrumentation techniques and filling systems leads to different degrees of apical sealing, with less leakage found with Profile .04/.06 system and filling with Thermafil. Nevertheless, one should take into consideration that this experiment was conducted *in vitro*, with its inherent limitations and therefore clinical extrapolation should be avoided.

RESUMO

O objetivo deste estudo foi avaliar o selamento apical após obturação de canal radicular usando duas diferentes técnicas de instrumentação rotatória e duas técnicas termoplásticas de obturação de canal radicular. O estudo foi realizado em 115 pré-molares extraídos de humanos. Após abertura coronária, o forame apical foi dilatado com lima tipo K 15, 1 mm além do ápice. Em seguida, o preparo biomecânico foi conduzido no comprimento de trabalho, 1 mm aquém do ápice, utilizando o Sistema ProFile 0,04/0,06 (Dentsply/Maillefer), Quantec (Analytic Endodontics/Kerr) ou técnica escalonada com hipoclorito de sódio como solução irrigadora. Os canais radiculares foram obturados com Thermafil (Dentsply/Maillefer) ou Microseal (Analytic Endodontics/Kerr) ou condensação lateral ativa usando o cimento AH Plus. Os dentes foram imersos em solução de azul de metileno a 2% em ambiente de vácuo. Depois, eles foram seccionados longitudinalmente. Os resultados demonstraram que a associação do Profile e Thermafil promoveu os melhores resultados ($p<0.05$). Conclui-se que a associação de diferentes sistemas rotatórios de instrumentação e diferentes sistemas de obturação influenciaram no selamento apical.

UNITERMOS: Tratamento de canal radicular, instrumentação de canal radicular, preparo biomecânico, instrumentação rotatória, técnicas de obturação de canal radicular.

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Recebido para publicação em: 06/10/2003

Encaminhado para reformulações em: 24/10/2003

Pronto para publicação em: 21/11/2003

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