

Graziele Silva^{1*}, Emmanuel João Nogueira Leal da Silva², Juliana Melo da Silva³, Carlos Vieira Andrade-Júnior¹, Caio César Randi Ferraz²

Sealing Ability Promoted by Three Different Endodontic Sealers

1. State University of Southwest Bahia, Bahia, Brazil.

2. Piracicaba Dental School, State University of Campinas, Campinas, Brazil.

3. Federal University of Pará, Pará, Brazil

INTRODUCTION: The aim of this study was to evaluate the apical and coronal seal of endodontic filling promoted by the combined use of Sealer 26/gutta-percha, Endofill/gutta-percha and Resilon/ Epiphany.

MATERIALS AND METHODS: A total of 38 extracted human canine teeth were selected; 10 teeth for each test group and 4 for each control group. After conducting conventional endodontic treatment, the teeth were immersed in saline solution for thirty days, and subsequently sealed and stored in India ink for seven days. They were then cleaned and evaluated for infiltration by stereoscopic microscope. The data were statistically analyzed by ANOVA and Bonferroni tests.

RESULTS: The results showed no significant differences between the three groups of filling materials used.

CONCLUSION: Within the limitations of this *in vitro* study, no material showed superiority in their apical and coronal seal.

KEYWORDS: Clearing, Endodontics, Microleakage, Root Canal Filling, Resilon, Sealer

Received: 25 Dec 2010; **Revised:** 13 Jan 2011; **Accepted:** 18 Feb 2011

***corresponding Author at:** Graziele Silva, State University of Southwest Bahia, Bahia, Brazil, E-mail: grazieless@hotmail.com

INTRODUCTION

The root canal obturation is the final stage of the endodontic treatment (1). Though all the stages of endodontic therapy have equal importance; more emphasis is given to obturation as its quality can determine the success or failure of therapy (2). Moreover, the quality of the filling is used as parameter for assessing the quality of endodontic treatment.

A good root canal filling should be able to prevent fluids, residues of necrotic tissue, bacteria and other irritants that were not removed during the biomechanical preparation to be disseminate to the periapical region (2,3).

Different techniques and materials have been developed to obtain a hermetic sealing (2), however an ideal material has not been discovered yet (1,4,5). Among the materials

currently used, gutta-percha is known to have good physical and biological properties, however it also have unfavorable characteristics such as low flow and low adhesion (4,6). Therefore, the use of sealers alongside gutta-percha produces a more homogeneous filling and prevents micro-leakage of periapical exudates, preventing reinfection (1,4). This material is critical for hermetic seal since the infiltration of fluids into the filling may occur at the interfaces of the sealer with dentin surface, sealer with gutta-percha, inside the sealer or by the dissolution of the sealer (1,4,7).

Many investigations were carried out into sealers with physicochemical properties that can eliminate the possibility of recontamination and micro-leakage, and thus new materials were developed. These materials are classified according to their constituents, such as zinc

oxide and eugenol, calcium hydroxide, resins, glass ionomer or silicones (1).

The aim of this study was to analyze the quality of apical and coronal seal promoted by the use of Sealer 26/gutta-percha, Endofill/gutta-percha and Resilon/Epiphany.

MATERIALS AND METHODS

A total of 38 canines were selected from a teeth bank. After removal of the coronal portion, #10 K files (Dentsply, Maillefer, Ballaigues, Switzerland) were introduced into the canal until it was just visible at the apical foramen. From this length, 1 mm was subtracted to establish the working length (WL).

The root canals were prepared with K-Flexofile (Maillefer, Ballaigues, Switzerland), with the crown-down technique until WL was reached. Instruments were adjusted to the walls of the canal, followed by instruments in ascending order of diameter, to achieve an apical flare equal to that provided by #45 file. During the biomechanical preparation, patency was maintained with a size #10 K file and irrigation with 2.5% sodium hypochlorite was carried out. After preparation, the canals were instrumented with #10 and #15 files 2mm beyond the foramen, to standardize the foramina diameter. After using the last file, the roots were irrigated with physiologic saline solution and dried with absorbent paper cones (Tanari, Amazonas-Brazil).

To remove the smear layer, 17% EDTA (Biodynamic Quim, Paraná, Brazil), was mixed within the canal for 0.5 minutes with a lentulo spiral (Maillefer, Ballaigues, Switzerland), and then left for another 2.5 minutes in the canal. Sodium hypochlorite (2.5%) was subsequently applied under the same conditions as EDTA; however, this material remained for 4.5 minutes within the canal. The canal was irrigated with physiologic saline solution and dried with absorbent paper cones.

Samples were divided into three experimental groups (n=10) and two control groups (n=4). The canals of group 1, 2 and 3 were filled with Sealer 26/gutta-percha, Endofill/gutta-percha and Resilon/Epiphany system, respectively. The tooth roots in group 4 were not filled and the coronal third was filled with Coltosol

(Vigodent, Rio de Janeiro, Brazil) to facilitate sealing; the roots' surfaces were then thoroughly coated with two layers of nail varnish (Colorama, São Paulo, Brazil). The root canals in group 5 were not filled, but received two coats of nail varnish except the apical 1mm and the cervical portion. The same protocol of coating was also used for the groups 1, 2 and 3.

Tagger's hybrid technique was performed for root canal obturation in which gutta-percha was used with Endofill (Dentsply, Rio de Janeiro, Brazil) or Sealer 26 (Dentsply, Rio de Janeiro, Brazil). In the Resilon/Epiphany system (Pentron Clinical Technologies, Wallingford, CT, USA) obturation was performed according to the manufacturer using Tagger's hybrid technique. A halogen light curing unit (Gnatus, São Paulo, Brazil) was used for 40 seconds to cure the coronal portion of Resilon/Epiphany group. Finally, the teeth were immersed in physiologic saline solution for 30 days. The solution was renewed each week. Later, the roots were covered with two coats of nail varnish as described above and were stored in India ink (Acrilex, São Paulo, Brazil) for seven days.

The teeth in groups 4 and 5 were also placed in the India ink for the same period. Specimens were washed with water and immersed in water for two hours. Once cleaning was performed, the apical and coronal leakage was analyzed through a stereomicroscope (Leica, Germany) with $\times 20$ magnification. All teeth were observed by one calibrated evaluator and data were analyzed with ANOVA and Bonferroni tests ($P < 0.05$) using the Biostat software.

RESULTS

Apical leakage (Table 1) and coronal leakage (Table 2) showed no statistically significant differences between the three groups of materials. However, Sealer 26/Gutta-percha showed significantly higher apical leakage than the negative controls ($P < 0.05$). All test groups showed significantly greater coronal microleakage than the negative controls ($P < 0.05$).

DISCUSSION

The quality of obturation seal has been a hot debate; especially the sealers used (1-4,8,9). Conflicting results have been presented when

Table 1. Apical microleakage of filling materials (mm)

Filling Material	Mean \pm SD
Sealer 26/gutta-percha	2.67 \pm 2.50
Endofill/gutta-percha	1.10 \pm 0.66
Resilon/Epiphany	1.44 \pm 1.07
Negative Control	0.00 \pm 0.00
Positive Control	12.13 \pm 5.12

different materials and methodologies were used. We used the dye penetration method to compare the quality of apical and coronal seal between the different filling systems. Various types of dyes and techniques such as India ink, methylene blue, bacterial penetration and filtration of fluids are used to evaluate the sealing ability of filling materials, however, as the dyes have smaller molecules than the pathogens that they intend to simulate, dyes application may have questionable validity (10). In contrast to this finding, a review of a large number of publications on fluid filtration showed that the penetration of particles or solutions between the filling material and root canal walls are adequate measures to assess whether the root canal filling has adequate seal (11).

The chosen method for the evaluation of the filling was provided by the clearing technique. This has the advantage of easy implementation, economics, possibility of three-dimensional visualization of the teeth, reproducibility and reliability in the search results (6,7,12,13).

No statistical difference in microleakage was observed between the study groups; however, Sealer 26/gutta-percha showed statistical difference compared with the mean of negative controls; this could suggest the poorest seal for this filling system. Sealer 26 is an epoxy resin sealer with calcium hydroxide content (14). This sealer has more biocompatibility and sealing than zinc oxide and eugenol sealers. However a study claimed that calcium hydroxide sealers present similar values of infiltration to other commonly used sealers; corroborating the findings of this study (15). Using calcium hydroxide sealers is due to antimicrobial effects and stimulating periapical tissues to maintain or promote health. The sealing ability can be changed by the solubility of sealers. A desirable property of sealers is insolubility and constancy against action of tissue fluids. This is

Table 2. Coronal microleakage of filling materials (mm)

Filling Material	Mean \pm SD
Sealer 26/guta-percha	3.94 \pm 3.57
Endofill/gutta-percha	4.20 \pm 3.91
Resilon/Epiphany	2.44 \pm 1.48
Negative Control	0.00 \pm 0.00
Positive Control	13.50 \pm 2.41

a major concern with calcium hydroxide sealer and its therapeutic effects (16).

In relation to coronal leakage, there were no significant differences between the various fillings, except the Resilon/Epiphany system which did not significantly differ from negative controls. The formation of a monobloc between the Resilon cones, Epiphany Sealer and the root canal walls, according to several studies (3,17-19), was not demonstrated in this study.

Endofill is a widely known and clinically used endodontic sealer. It is zinc-oxide and eugenol based and was used as a control in several studies that compare sealers *in vitro* (3). There are conflicting results regarding the sealing ability of fillings with gutta-percha and zinc oxide and eugenol sealer (3,5). It has been claimed that sealers containing eugenol can generate cause the volume expansion of gutta-percha and improved sealing (20). No superior sealing was observed by Endofill in this study. Zinc oxide and eugenol based cements are highly disintegrable and soluble when kept in aqueous medium and are highly permeable, with poor adhesion to the dental structures (3,21); this fact could not be seen in this study. Storing specimens in saline solution for 30 days may have increased the penetration of India ink, similar to Brandão *et al.*'s study (13).

The difficulty of linking the *in vitro* results to the clinical conditions and using variable methods may create the inconsistency of this study with other surveys. *In vitro* studies provide constant conditions for comparing materials and techniques (1,2,14,21-22). This study showed that all sealers allowed apical and coronal leakage; but this will not necessarily cause endodontic failure (23).

CONCLUSION

None of the tested materials showed superiority

in promoting apical and coronal sealing. Finding materials that promote optimal seal to the root canal system are still needed.

Conflict of Interest: 'None declared'.

REFERENCES

1. Andrade Júnior CV, Colombo SNG, Dantas JCP, Souza RA. Avaliação em momentos diferentes do selamento apical de dois cimentos endodônticos: Endofill e Sealer 26. UFES Rev Odontol 2005;7:41-6.
2. Souza RA. Comportamento de um cimento endodôntico à base de óxido de zinco e eugenol no selamento apical. J Bras Endod 2003;4:242-5.
3. Dultra F, Barroso JM, Carrasco LD, Capelli A, Guerisoli DMZ, Pécora JD. Evaluation of apical microleakage of teeth sealed with four different root canal sealers. J Appl Oral Sci 2006;5:341-5.
4. Valois CRA, Castro AJR. Comparação do selamento apical promovido por quatro cimentos endodônticos. J Bras Endod 2002;3:317-22.
5. Yunes JRM. Avaliação in vitro da infiltração marginal em retrobturações utilizando diferentes materiais obturadores (dissertação). Ribeirão Preto: Faculdade de Odontologia de Ribeirão Preto,1999.
6. Camargo CHR, Valera MC, Gomes ADM, Kajiura AP, Barreto JV. Capacidade seladora apical dos cimentos N-Rickert, Sealer 26e um cimento experimental, em canais obturadores pela técnica híbrida modificada. Rev ABO Nac 2006;3:148-51.
7. Valois CRA, Costa Júnior ED. Efetividade do selamento apical promovido por três materiais retrobturadores. J Bras Endod 2003;4:219-22.
8. Barbosa HG, Holland R, Souza V. Infiltração marginal coronária em canais radiculares após preparo para pino: influência do tipo de cimento obturador e de um plug de cimento temporário. J Bras Endod 2003;4:208-12.
9. Cunha RM, Kuga MC, Duarte MAH, Yamashita JC, Simões JR de B, Oliveira ECG de. Capacidade seladora de três materiais endodônticos associados à gutta-percha em perfurações radiculares. J Bras Endod 2002; 3:217-20
10. Higa K, Torabinejad M, Mckendendry DJ, Mcmillan PJ. The effect of storage time on the degree of dye leakage of root-end filling materials. Int Endod J 1994; 27:252-6.
11. Wu MK, De Gee AJ, Wesselink PR, Moorer WR . Fluid transport and bacterial penetration along root canal fillings. Int Endod J 1993;26:203-8.
12. Camões ICG, Loretti FV, Gomes CC, Freitas LF, Pinto SS. Estudo Comparativo entre duas técnicas obturadoras: Condensação lateral X híbrida de Tagger. Pesq Bras Odontoped Clin Integr 2007;7:217-22.
13. Brandão CG, de Moraes IG, Bramante CM. Capacidade Seladora Apical de Cimentos endodônticos ionoméricos. Rev FOB 2001; 9:29-34.
14. Barbosa HG, Holland R, Souza V, Dezan Júnior E, Bernabé PFE, Otoboni Filho JA et al. Healing process of dog teeth after post space preparation and exposition of the filling material to the oral environment. Braz Dent J 2003; 14:103-8.
15. Chailertvanitkul P, Saunders WP, Mackenzie D. An assessment of microbial coronal leakage in teeth root filled with gutta-percha and three different sealers. Int Endod J 1996;29:387-92.
16. Desai S, Chandler N. Calcium hydroxide-based root canal sealers: a review. J Endod 2009;35:475-80. Epub 2009 Feb 26.
17. Shipper G, Orstavik D, Trope M. An evaluation of microbial leakage in roots filled with a thermoplastic synthetic polymer-based root canal filling material (Resilon). J Endod. 2004; 30:342-7.
18. Teixeira FB, Teixeira EC, Thompson J, Leinfelder KF, Trope M. Dentinal bonding reaches the root canal system. Esthet Restor Dent 2004;16:348-54.
19. Teixeira FB, Teixeira EC, Thompson JY, Trope M. Fracture resistance of roots endodontically treated with a new resin filling material. J Am Dent Assoc 2004;135:646-52.
20. Michaud RA, Burgess J, Barfield RD, Cakir D, McNeal SF, Eleazer PD. Volumetric expansion of gutta-percha in contact with eugenol. J Endod 2008;34:1528-32.
21. Carvalho Junior JR, Souza Neto MD, Correr Sobrinho L, Arruda MP, Ferraz JAB. Estudo in vitro da infiltração marginal apical em canais obturados pela técnica termomecânica híbrida. Cienc odontol Bras 2005;8:61-6.
22. De Almeida YMEM, Pécora JD. Estudo in vitro da infiltração marginal coronária em canais radiculares obturados. [dissertação]. Ribeirão Preto: Faculdade de Odontologia de Ribeirão Preto,2005,2007.
23. Villela AM, Fidel RAS. Análise comparativa da infiltração marginal apical de três cimentos endodônticos através de um processo de diafanização. [dissertação]. Duque de Caxias: Universidade do Grande Rio “Prof. José de Souza Herdy”,2007.