Introduction

Surgical therapy is the procedure of choice when one aims at the resolution of endodontic problems with repercussion on adjacent periapical tissues. Thus, it should be seen as an extension of the endodontic treatment, not as an independent entity. All principles of conventional endodontics, such as cleaning, modeling, disinfecting, filling and canal sealing should be followed, it being that such procedures are carried out via root apex rather than by access cavities in surgical treatment.[1]

Materials used in root-end fillings are, among others, determining factors for the success of periradicular surgery.[3] It should be emphasized that the ideal root-end filling material to be used should provide adherence, promote tridimensional sealing of the root canal system, be biologically tolerated by the periradicular tissues, non-absorbable, easy to handle and radio-opaque, in addition to allowing for a conducive environment to tissue regeneration.[2,3,4]

The most-used materials include amalgam, gutta-percha, zinc oxide and eugenol cement, IRM® (Intermediate Restoration Material), Super-EBA®, glass ionomer cement, composite resin, consistent Sealapex® and MTA (Mineral Trioxide Aggregate).[5]

Use of optical microscopy for performing surgical procedures involving the periapex has rendered prognosis more predictable. A great number of failures stems from poor visualization of root apex anatomical structures.[6,7]

The degree of adaptation and the quality of apex sealing provided by the filling materials used in root-end cavities have been evaluated by the use of dies, radioisotopes, bacterial penetration measures, scanning electron microscopy, electrochemical means and fluid filtering techniques.[8]

Continuous search for an ideal root-end filling material, which remains unknown, may be materialized as from the use of a surgical protocol, with or without the use of an optical microscope.

The present study aims to evaluate the degree of dentin marginal adaptation for three root-end filling materials: White MTA Angelus® (Mineral Trioxide Aggregate), Sealapex® added to White MTA and Super-EBA®.

Concomitantly, the study shall ascertain the efficacy of the use of optical microscopy in periradicular surgery, more precisely in the adaptation of the root-end filling material to root-end cavities.

Material and Methods

Sixty upper and lower canine teeth extracted from humans, with fully-formed apexes, single rooted and straight, conditions which have been proven by visual and radiographic examination. The present study had its research project approved by the Committee of Ethics in Research of the Estácio de Sá University.

The sample was preserved for 24 hours in a sodium hypochlorite solution at 2.5% for disinfecting and dissolving organic matter, being later washed in running water for 15 minutes and then sterilized.

Access to cavities was performed under constant refrigeration, with spherical bur #1013 (KG Sorensen, São Paulo, Brazil), burs #3083 (KG Sorensen) and Endo-Z (Dentsply-Maillefer, Ballaiguess, Switzerland). Apical foramen for each canal was ascertained with a Kerr # 10-type file (Dentsply-Maillefer), by visual method, apical limit being considered 1 mm beyond apex for keeping the instrumentation standard. Instrumentation was carried out up to Kerr # 40 (Dentsply-Maillefer) file, by the MRA (alternate rotation movement) technique. Irrigation was done at every file change with 2 ml of a sodium hypochlorite solution at 2.5%.

Instrumentation being completed, the canals received irrigation with 5 ml of EDTA 17% in solution, which remained in the canal for 5 minutes, followed by new irrigation with sodium hypochlorite 2.5%. Canals were dried with cones of absorbent paper 0.40 mm caliber (Dentsply-Maillefer, Petrópolis, RJ, Brazil) and then filled with calibrated gutta-percha cones (Dentsply-Maillefer, Petrópolis, RJ, Brazil) by the lateral condensation technique using Sealer 26 epoxy cement (Dentsply-Maillefer, Petrópolis, RJ, Brazil).

Apical resection of the teeth was performed in the apical 3 mm roots, following marking off with an overhead projector, in a 90° angle, with the long axis of the root, using a Zecrya bur (Dentsply-Maillefer, Ballaiguess, Switzerland) under high rotation with constant cooling. The teeth were fixed in acrylic tubes with wax 7 and acrylic resin leaving only 10 mm of its most apical position outward. Upon resection, the assembly was attached to a lathe, thereby avoiding unforeseen movements during this procedure.

The samples were randomly divided into three groups according to the root end filling material: Group I – White MTA (Angelus, Paraná, Brazil), Group II – Super-EBA® (Bosworth, Illinois, USA), and

Group III – Sealapex® (SybronEndo, California, USA) + White MTA. Later, groups I, II, and III were divided into subgroups: with the help of a surgical microscope and without a surgical microscope.

In experimental groups, root-end cavities were made with diamond burs, model TU21 (Trinity, São Paulo - Brazil), coupled to an ultrasonic unit ENAC model OE3 (Osada, Japan), adjusted to level 5 (average). This stage was carried to a total time of 90 seconds, with the 15 first seconds without cooling so that removal occurs, by plasticization, of the gutta-percha present therein and the last 75 seconds under cooling with distilled water spray. The root-end cavities were made to a depth of 3 mm, and immediately afterwards, were irrigated with saline, and dried with paper cones. Twelve points were used for the making of root-end cavities, with 1 point for every 5 teeth of groups I, II, and III.

After completion of root-end cavities, the teeth were submitted to retrofilling, manufacturers' recommendations being used regarding the proportion and form of mixing. Each group with its respective material and each subgroup either using, or not, a surgical microscope (M-900 DF Vasconcelos) to a magnification of 25 times. The root-end filling material was taken to the operating field with the help of a child's amalgam carrier and condensed with the help of Bernabé instrumenting #2, #4, and #6.

The retrofilling, the 10 mm portion of the teeth was cut from the acrylic tubes by means of a diamond-coated cutting disc inserted in the precision cutter (Labcut 1010 – Extec Corp, Enfield, USA), an average speed of 150 rpm under constant irrigation with distilled water.

The specimens were fixed on a wax 7 so that surface with retrofilling be turned to the wax. The same were separated according to their pertinent subgroups and captured with an epoxy resin which was contained up to its total holding with 10 mm-high PVC cylinders.

The finishing of epoxy resin cylinders was performed on a Universal APL – 4 Sander and Polisher (Arotec, Rio de Janeiro, Brazil). Fine sandpaper with increasing granulation of 600, 1200, 1500, and 2000, at a low speed and under constant cooling. Alumina suspension (Arotec, Rio de Janeiro, Brazil) #4, #3, and #2 with a felt disk was used for polishing.

Following final polishing, samples were immersed in distilled water and placed in an ultrasonic basin (Cristófoli Equipamentos de Biossegurança, Paraná, Brazil) for 10 minutes for removal of debris. The demineralization procedure was started for removal of the dental inorganic matrix for later observation in SEM. A phosphoric acid solution at 37% (Condac – FGM, Santa Catarina, Brazil) was applied, for 3 minutes, for demineralization. Later, the samples were dehydrated in absolute ethylic alcohol in growing concentrations (25%, 50%, 75%, and 100%) for 15 minutes in each concentration.

Specimens were mounted on steel plates, of 45 mm diameter, with double face adhesive tape, to be submitted to metal-coating. Sample coating was done in gold and the latter stored in the desiccators until processing in SEM.

Processing was performed under variable-pressure (self-vacuum), scanning electron microscope, LEO model VP1450 (Carl Zeiss do Brasil, São Paulo, Brazil), under EHT conditions: 15.00 kV, chamber pressure: 1.2 ± 0.04mBar, detector: QBSE and WD 12/15 mm. All samples were analyzed and photographed with a magnification of 70x and then divided into four quadrants. Each quadrant was amplified by 500x and analyzed by two examiners who did not know the root-end filling material used, and the form of insertion of the latter, with or without the help of a surgical microscope.

Results

In the analysis of dentin marginal adaptation, with the aid of SEM, it was ascertained that there are no points of failure of adaptation at any of the three groups evaluated; thus, a statistical analysis is unnecessary at this stage of the experiment. Groups I, II, and III displayed total adaptation to the surface of the root-end cavities, there being no presence of cracks between dentin walls and the filling material, indicating that the MTA Angelus®, Super-EBA®, and the combination of the Sealapex® + MTA Angelus®, displayed a similar behavior in the marginal adaptation item (Fig 1).

It is important to point out that all specimens were submitted to previous procedures, related to the methodology of the present study, so that they would be appropriate for SEM evaluation. The presence of cracks, stemming from apical resection or ultrasonic root-end cavities, is evident in some images. In other images, we can ascertain dark regions under the retrofilling, which are the burns occurring during test sample metal-coating. Both the cracks and the burns are deemed technical artifacts for preparing specimens.

In analyzing optical microscope effectiveness during root-end filling material insertion, it was determined that the use of the latter rendered control of the retrofilling phase easier, due to the excellent illumination and the magnification provided. However, this did not change adaptation of material to root-end cavities. Independently of optical microscopic use, all specimens referring to Groups I, II, and III presented perfect adaptation to root-end cavity surface. Thus, there is no need either of statistical evaluation at this stage of the research (Fig 2).

Discussion

The specific objective of this study consisted in comparing the dentin margin adaptation capacity of three root-end filling materials: White MTA Angelus®, Sealapex® added to White MTA Angelus®, and Super-EBA®. Additionally, performance of the optical microscope as surgical material, in helping the performing of root-end filling material insertion.

Proven techniques, such as apicectomy at 45°, root-end cavities with burs and retrofilling with amalgam, have been gradually replaced by new procedures such as using ultrasounds in root-end cavities and the employment of new odontological materials for retrofilling, for example. These important innovations increase surgical benefits and provide for better clinical prognosis in cases deemed as of difficult therapeutical solution.[9,10]

Apical resection may be performed with different types of burs and different angles. In this research, option was made for apical resection at 90°, at 3 mm of the

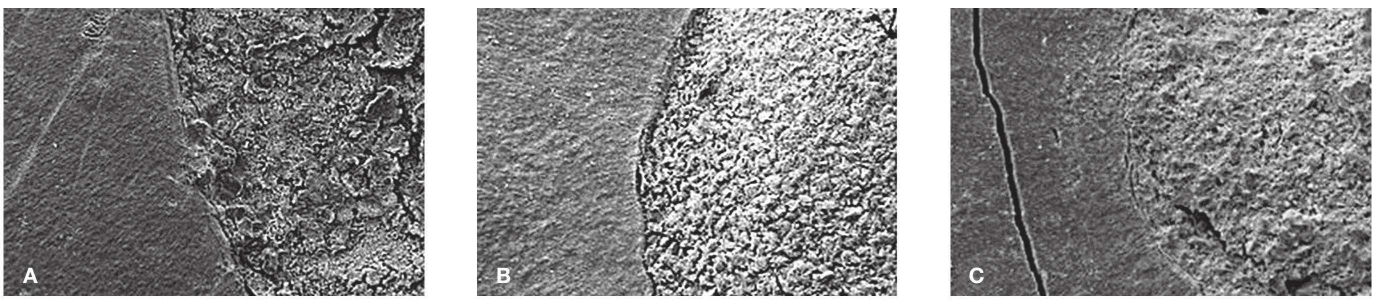

Figure 1. Evaluation of marginal adaptation to dentin of retrograde obturation materials. (**A**) MTA 500x; (**B**) Super-EBA 500x; (**C**) Sealapex + MTA 500x.

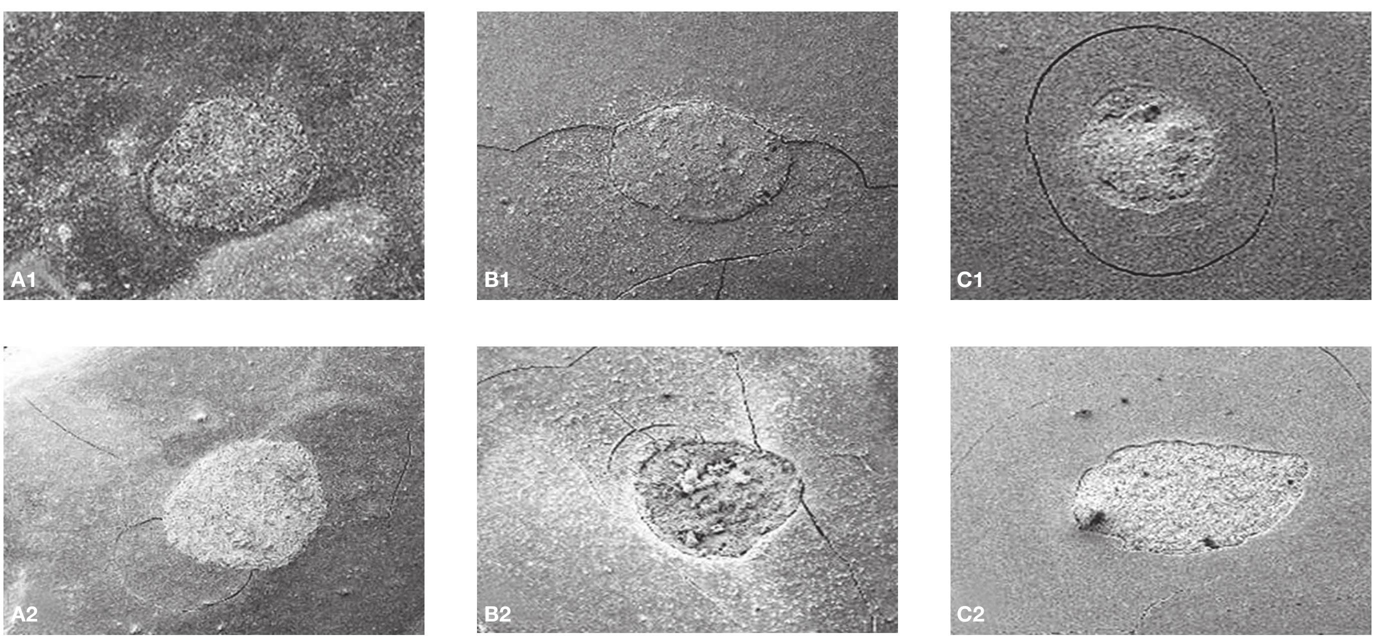

Figure 2. Evaluation of surgical microscope use in the insertion of retrograde obturation materials: **A1**) MTA with microscope 70x; **A2**) MTA without microscope 70x; **B1**) Super-EBA with microscope 70x; **B2**) Super-EBA without microscope 70x; **C1**) Sealapex + MTA with microscope 70x; **C2**) Sealapex + MTA without microscope 70x.

root apex, as these are the apicectomy techniques most recommended in literature.[9,10,11]

In the cases in which apicectomy at 90° is performed, more security is found in removing root canal ramifications. Thus, one of the causes of failure in periradicular surgery, the possibility of the passage of bacteria and irritating agents via root apexes, is prevented.[12,13]

Option was made in the present research for using the diamond-covered ultrasonic point was based on three main criteria: preserving dental structure, capacity of performing duper and more appropriate preparation for inserting the root-end filling material and its capacity of providing cleaner and smoother root-end cavities.[14,15,16]

However, studies warn on the possibility of occurring microcracks and microfractures when ultrasonic points are used in making root-end cavities. It was possible, in this study, it was possible to ascertain the presence of these injuries following the use of ultrasonic points in a number of specimens.[17,18]

The presence of cracks was also ascertained in the SEM of apex surfaces of specimens following placement of root-end filling materials. In these authors' view, the occurrence of cracks may be associated to the preparation of samples for SEM observation, this hypothesis being the one with which our study agrees.[19]

The capacity of marginal adaptation and the apical scaling of the main materials in retrofillings are approached by countless works in the literature.[5,11,19-28]

In selecting the materials tested in the present study, it was attempted to comparatively evaluate those which were object of biological experiments and those which displayed more favorable results.

It was ascertained, upon comparing the capacity of dentin marginal adaptation of MTA Angelus®, Super-EBA®, and Sealapex® + MTA Angelus® in this research, which bore scanning electron microscopy as tool, it was found out that all materials displayed similar behaviors from the point of view of adaptation, which differs from the work of Torabinejad et al,[19] in which the authors report that the MTA displayed better adaptation when compared with Super-EBA® and amalgam.

The present research was made according to the findings of Bernabé et al,[5] when the authors compared four root-end filling materials: MTA Angelus®, Pro-Root® MTA, Portland cement and consistent Sealapex®. No statistical difference was found regarding seepage by dye on the interface between the filling material and exposed dentin surface on the cavity wall, which justifies a satisfactory material adaptation.

In another studio, the authors evaluated the marginal sealing capacity of a combination proposed by them, in which MTA Angelus® (powder) was added in the mixing of the Sealapex cement. The authors compared this combination with the MTA Angelus® cement and with the consistent Sealapex® cement.[27]

The aim of investigation by the present study whether such combination would provide a better marginal adaptation, as the other authors have reported better consistency and consequently a better insertion of this material when compared with the other groups. The authors did not find statistically significant differences between the groups studied.

As from this finding, we have compared the combination proposed with two already-known materials, previously tested: MTA Angelus® and Super-EBA. No difference was found in marginal adaptation between the materials; it was not ascertained that the combination between Sealapex® and MTA Angelus® promotes a better insertion of the material or a better consistency. The materials displayed themselves in a similar fashion, in the item consistency, insertion and adaptation.

It is important to point out that the present study evaluated only the dentin marginal adaptation of this combination; new studies need to be developed. However, one can say that all materials tested displayed potential to be indicated as root-end filling materials.

The use of optical microscopy for the performing of surgical procedures involving the periapex has been emphasized by other authors, which justifies the protocol adopted in this work.[7,29]

We are able to confirm, with the results of the present research, that the surgical microscope provides better lighting and magnification of the operating field, thereby rendering the surgical phase easier. However, we have determined that it is also possible to perform satisfactory retrofilling without the use of the microscope, as results were similar in the groups aided by the microscope and not aided by the optical microscope. Thus, the presence of the optical microscope in the endodontic surgical protocol is not a mandatory factor.

References

1. Kuga MC. Avaliação clínica e radiográfica de cirurgias perirradiculares, em função de modalidades cirúrgicas, tempo de controle e método de classificação [dissertação]. Araçatuba (SP): Universidade do Estado de São Paulo;1995.
2. Lloyd A, Jaunberzins A, Dummer PM, Bryant S. Root-end cavity preparation using the MicroMega Sonic Retro-prep Tip. SEM analysis. Int Endod J. 1996;29(5):295-301.
3. Torabinejad M, Pitt Ford TR. Root end filling materials: a review. Endod Dent Traumatol . 1996;12(4):161-78.
4. Shipper G, Trope M. In vitro microbial leakage of endodontically treated teeth using new and standard obturation techniques. J Endod. 2004;30(3):154-8.
5. Bernabé PFE, Cintra LTA, Bernabé DG, Almeida JFA, Gomes Filho JE, Holland R, et al. Avaliação in vitro da capacidade seladora marginal e da infiltração na massa de agregados de trióxidos minerais. J Bras Endod. 2004;5(19):322-8.
6. Lopes HP, Siqueira JF Jr. Endodontia: biologia e técnica. 2ª ed. Rio de Janeiro: Medsi; 2004.
7. Pecora G, Andreana S. Use of dental operating microscope in endodontic surgery. Oral Surg Oral Med Oral Pathol. 1993;75(6):751-8.
8. Torabinejad M, Lee SJ, Hong CU. Apical marginal adaptation of orthograde and retrograde root end fillings: a dye leakage and scanning microscopic study. J Endod. 1994;20(8):402-7.
9. Gagliani M, Taschieri S, Molinari R. Ultrasonic root-end preparation: influence of cutting angle on the apical seal. J Endod. 1998;24(11):726-30.
10. Tsesis I, Rosen E, Schwartz-Arad D, Fuss ZVI. Retrospective evaluation of surgical endodontic treatment: traditional versus modern technique. J Endod. 2006;32(5):412-6.
11. Xavier CB, Weismann R, Oliveira MG, Demarco FF, Pozza DH. Root-end filling materials: apical microleakage and marginal adaptation. J Endod. 2005;31(7):539-42.
12. Morrier JJ, Suchett KG, Nguyen D, Rocca JP, Blanc-Benon J, Barsotti O. Antimicrobial activity of amalgams, alloys and their elements and phases. Dent Mater. 1998;14(2):150-7.
13. Eldeniz AU, Hadimli HH, Ataoglu H, Orstavik D. Antibacterial effect of selected root-end filling materials. J Endod. 2006;32(4):345-9.
14. Gorman MC, Steiman R, Gartner AH. Scanning electron microscopic evaluation of root-end preparation. J Endod. 1995;21(3):113-7.
15. Kuga MC, Conti KPD, Duarte MAH, Fraga SC, Yamashita JC. Infiltração marginal em obturações retrógradas em função dos métodos de preparo da cavidade. Rev Bras Odontol. 1998;55(6):322-6.
16. Abad EC. Avaliação in vitro do aumento da área foraminal, e diminuição da área mineralizada apical após confecção de retropreparos com aparelhos de ultra-som [tese]. Rio de Janeiro (RJ): Universidade Federal do Rio de Janeiro; 2002.
17. Abedi HR, Van Mierlo BL, Wilder-Smith P, Torabinejad M. Effects of ultrasonic root-end cavity preparation on the root apex. Oral Surg Oral Med Oral Pathol. 1995;80(2):207-13.
18. Rainwater A, Jeansonne BG, Sarkar N. Effects of ultrasonic root-end preparation on microcrack and leakage. J Endod. 2000;26(2):72-5.
19. Torabinejad M, Smith PW, Kettering JD, Pitt Ford TR. Comparative investigation of marginal adaptation of Mineral Trioxide Aggregate and other commonly used root-end filling materials. J Endod. 1995;21(6):295-9.
20. Torabinejad M, Watson TF, Pitt Ford TR. Sealing ability of a mineral trioxide aggregate when used as a root end filling material. J Endod. 1993;19(12):591-5.
21. Torabinejad M, Higa RK, McKendry DJ, Pitt Ford TR. Dye leakage of four root end filling materials: effects of blood contamination. J Endod. 1994;20(4):159-63.
22. Fischer EJ, Arens DE, Miller CH. Bacterial leakage of mineral trioxide aggregate as compared with zinc-free amalgam, intermediate restorative material, and Super-EBA as a root-end filling material. J Endod. 1998;24(3):176-9.
23. Chong BS, Pitt Ford TR, Hudson MB. A prospective clinical study of MTA and IRM when used as root-end filling material in endodontic surgery. Int Endod J. 2003;36(8):520-6.
24. Gondin Junior E, Zaia AA, Gomes BPFA, Ferraz CCR, Teixeira FB, Souza Filho FJ. Investigation of the marginal adaptation of root-end filling materials in root-end cavities prepared with ultrasonic tips. Int Endod J. 2003;36(7):491-9.
25. Taschieri S, Del Fabbro M, Francetti L, Testori T. Effect of root-end resection and root-end filling on apical leakage in the presence of core-carrier root canal obturation. Int Endod J. 2004;37(7):477-82.
26. Theodosopoulou JN, Niederman R. A systematic review of in vitro retrograde obturation materials. J Endod. 2005;31(5):341-9.
27. Bernabé PFE, Cintra LTA, Gomes Filho JE, Saito CTMH, Bernabé DG, Otoboni Filho JA, et al. Evaluación in vitro de la capacidad selladora marginal de materiales retroobturadores: estudio del cemento Sealapex adicionado com MTA. Med Oral. 2006;8(2):61-7.
28. Valera MC, Camargo CHR, Carvalho AS, Gama ERP. In vitro evaluation of apical microleakage using different root-end filling materials. J Appl Oral Science. 2006;14(1):49-52.
29. O'Connor RP, Hutter JW, Roahen JO. Leakage of amalgam and Super-EBA root-end fillings using two preparation techniques and surgical microscopy. J Endod. 1995;21(2):74-8.

Eugenol influence on the bond strength of intracanal metallic cast posts bonded with resinous cement

Valdemir Junior da Silva **SANTOS**[1]
Heloísa Helena Pinho **VELOSO**[2]
Felipe Cavalcanti **SAMPAIO**[3]
Tulio Pessoa de **ARAÚJO**[4]
Rodivan Braz da **SILVA**[5]

ABSTRACT

Objective: To verify the influence of the eugenol on the bond strength of cast intracanal posts using resinous cement. **Methods:** Root canal shaping of 33 human maxillary central incisors with 15 mm was performed standardizing the apical shaping at #55 file, 1 mm below de apical foramen. The teeth were divided in 3 experimental groups and 1 control. Group I (Control group) was composed by 3 teeth with root canal filling. The experimental groups were composed by 10 teeth each, filled by gutta-percha associated to 3 types of root canal sealers, used according to the group: Group II – epoxy resin based root canal sealer (AH Plus); Group III – calcium hydroxide based root canal sealer (Sealapex); Group IV – zinc oxide and eugenol based root canal sealer (Endofill). After the root canal preparation, 10 mm for the intracanal post, and the cast posts were adjusted and cemented with resinous cement (RelyX ARC). Every specimens were submitted to the mechanical test in the Universal Testing Machine Kratos 5002, at 0,5 mm/min speed and the values of the higher strength needed to dislocate the posts were registered and submitted to statistical analysis by the tests ANOVA and Tukey with 5% significance level. **Results:** The control group presented mean of 598.05 kgf/cm^2, AH Plus 475,43 kgf/cm^2, Sealapex 358,03 kgf/cm^2 and Endofill 213,70 kgf/cm^2. **Conclusion:** The eugenol influenced the bond strength of intracanal cast posts using resinous cement decreasing tensile resistance.

Keywords: Dental materials. Endodontics. Intracanal posts. Cementation and bond strength.

How to cite this article: Santos VJS, Veloso HHP, Sampaio FC, Araújo TP, Silva RB. Eugenol influence on the bond strength of intracanal metallic cast posts bonded with resinous cement. Dental Press Endod. 2012 Oct-Dec;2(4):26-31.

[1]Graduated in Dentistry, Federal University of Paraíba.
[2]Professor of the Department of Restorative Dentistry, Federal University of Paraíba.
[3]MSc in Dentistry, Federal University of Goiás.
[4]Professor of the Department of Fixed Prosthesis, Federal University of Paraíba.
[5]Professor of the Department of Esthetic Dentistry, Pernambuco University.

» The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.

Received: September 25, 2012. Accepted: October 15, 2012.

Contact address: Felipe Cavalcanti Sampaio
Décima Primeira Avenida, 334, Qd. 103, Lt. 15, apto. 208, Setor Leste Universitário, CEP: 74605-060, Goiânia / GO – Brazil
E-mail: felipecavalcantisampaio@yahoo.com