

Current trends in endodontic treatment by dental surgeons in Brazil

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• **Conflicts of interest:** none declared.

ABSTRACT

Objective: to be aware of the main practices currently adopted by general dentists and endodontists when performing endodontic treatments. **Material and methods:** a questionnaire containing 21 multiple-choice questions was sent to professionals in the five regions of Brazil. These questions covered experience time, techniques, materials and auxiliary resources. **Results:** most participants are from the Southeast and South regions of Brazil and have been specialized in endodontic for less than 10 years. They perform up to 20 treatments per month, use apex locator, manual instrumentation with stainless steel files associated with gates-glidden or largo burs, magnifying loupes and absolute isolation. Sodium hypochlorite (2.5 to 5.0%) and EDTA are the most used substances for irrigation associated with ultrasound. The treatment is done in a single visit, but pulp diagnosis might alter the number of visits. When intracanal medication is required, calcium hydroxide associated with other formulations is the first choice. For root canal filling, lateral condensation technique, zinc oxide and eugenol based sealers are used. Coronal sealing between sessions is done with Coltosol® and glass ionomer cement at the end of treatment, when patients are referred to another professional for final restoration. These professionals update their knowledge with scientific articles and show availability to test new products. **Conclusion:** most participants have been adhering to current practices (new technologies) during treatment and has kept updated by reading scientific articles.

Keywords: Instrumentation; Root canal obturation; Dental restoration temporary; Dental restoration permanent; Root canal irrigation.

Introduction

Changes in the understanding of biological concepts and the introduction of new technologies in endodontic intervention have caused substantial changes in clinical practice in recent years.¹ In order to achieve excellence in endodontic treatment (ET), new materials, instruments and techniques have been studied and used, both in the academic and in the clinical setting.

For the success of the ET, perfect cleaning, shaping and disinfection of the root canal is essential, and the instrumentation stage of the root canal system (RCS) has undergone major changes in recent years.² Initially, the instrumentation of the root canals was performed only with manual files made of stainless steel. However, due to its low flexibility, tendency to rectify curved canals and create deformations, perforations and deviations, a search for new alloys began, with greater flexibility and resistance.³ The development of nickel-titanium (NiTi) files was a revolutionary event in Endodontics, incorporating a series of conceptual changes in the preparation of the RCS.^{4,5} NiTi instruments were used initially in manual technique and in mechanized movement of continuous rotation. Subsequently, the reciprocating mechanized movement was proposed.⁶ With the proposal of obtaining the best of the two kinematics, rotational and reciprocating, files with a hybrid system have recently appeared on the market.⁷

Different chemical substances have been proposed for irrigation of the RCS, with sodium hypochlorite (NaOCl) being the most widely used irrigant.⁸ In addition to the

different irrigants, irrigation systems have been proposed and can be divided into two categories: techniques manual irrigation (positive pressure, manual agitation using gutta-percha cones or brushes) and machine-assisted irrigation techniques (sonic, ultrasonic, negative pressure, rotating brushes and continuous irrigation during rotary instrumentation).⁹

When filling the RCS, a three-dimensional and compact filling of the space formerly occupied by pulp tissue is intended, offering regeneration conditions to the periapical tissues.¹⁰ Endodontic sealers associated with gutta-percha, has the function of filling this system, and facilitating its adaptation to the dentin surface, thus being the filling materials of choice.¹¹

As auxiliary resources to ET, operative microscopy (OM) brought great technological advancement, expanding up to 20 times all internal and deep aspects of RCS. Called magnification, it assists in locating calcified canals, detecting microfractures, identifying isthmus, among other advantages.¹² Another innovative feature is cone beam computed tomography that uses cone-shaped X-ray beams and captures all bone structures of the skull, mandible and maxilla.¹³ This technology allows the visualization of the dental element in three dimensions, aiding in the diagnosis of the case.¹⁴

In view of the technological advances achieved in the last decades in ET, the objective of this work was to know the main practices currently adopted by dentists, general practitioners and endodontists, during endodontic treatment in Brazil.

Material and Methods

This study was approved by the Human Research Ethics Committee at Veiga de Almeida University under protocol number 2.899.006. An invitation to participate in the research was sent by email, via social media, in specialty forums and communities related to regional dentistry councils, for dental surgeons, general practitioners and specialists in Endodontics.

The research used a questionnaire with 21 multiple choice and multiple selections questions (Table 1).

Dentists, general practitioners, who considered themselves qualified to perform ET and specialists in Endodontics, from the South, Southeast, North, Northeast and Midwest regions of Brazil were included in the research.

Table 1. Questionnaire

<p>1- In which region of Brazil do you perform your clinical activity?</p> <ol style="list-style-type: none"> 1. South 2. Southeast 3. North 4. Northeast 5. Midwest 	<p>2- If you are not a specialist in endodontics, how many years have you completed a degree in dentistry and performed endodontic treatments?</p> <ol style="list-style-type: none"> 1. >30 2. 20-30 3. 11-20 4. 5-10 5. <5 6. Not applicable 	<p>3- How many years ago did you complete the post-graduate course in Endodontics?</p> <ol style="list-style-type: none"> 1. >30 2. 20-30 3. 11-20 4. 5-10 5. <5 6. Not applicable
<p>4. On average, how many endodontic treatments do you perform per month?</p> <ol style="list-style-type: none"> 1. >20 2. 11-20 3. 1-10 	<p>5. Do you use apex locator?</p> <ol style="list-style-type: none"> 1. Always 2. Never 3. Sometimes 	<p>6. What type of instrumentation do you perform?</p> <ol style="list-style-type: none"> 1. Manual, only with stainless steel files. 2. Manual, only with NiTi files. 3. Manual, associating stainless steel files with gates-glidden or largo burs 4. Manual, associating NiTi files with gates-glidden or largo burs 5. Mechanical rotary system 6. Mechanical reciprocating 7. Mechanical oscillation 8. Other
<p>7. Do you use magnification?</p> <ol style="list-style-type: none"> 1. Microscope 2. Magnifying loupes 3. No 	<p>8. Do you use absolut isolation?</p> <ol style="list-style-type: none"> 1. Always 2. Never 3. Sometimes 	<p>9. If you never use it or only use it sometimes, what is the reason?</p> <ol style="list-style-type: none"> 1. Difficulty 2. Cost 3. Requires long time to perform
<p>10. Which irrigant solution do you use?</p> <ol style="list-style-type: none"> 1. Sodium hypochlorite above 5% 2. Sodium hypochlorite between 2.5% e 5% 3. Sodium hypochlorite between 1% e 2.5% 4. Sodium hypochlorite below 1% 5. Chlorhexidine 2% gel 6. Chlorhexidine 2% solution 7. Chlorhexidine 0.2% solution 8. EDTA 9. Citric acid 10. Hydrogen peroxide 11. Saline 12. Distilled water 13. Others 	<p>11. Do you use any device to assist in agitating the irrigant?</p> <ol style="list-style-type: none"> 1. Ultrasound 2. Sonic device 3. Gutta-percha cone 4. Hand file 5. Plastic file 6. Others 	<p>12. In how many visits do you perform endodontic treatment?</p> <ol style="list-style-type: none"> 1. Always in a single visit 2. Always in multiple visits 3. Mostly in single visit 4. Mostly in multiple visits 5. In case of vital pulp in a single visit and pulp necrosis in multiple visits 6. The pulp diagnosis does not influence the choice.
<p>13. Which intracanal medication do you use?</p> <ol style="list-style-type: none"> 1. Cotton ball with camphorated para-monochlorophenol (CMCP) 2. Cotton ball with sodium hypochlorite 3. Cotton ball with tricresol formalin 4. Chlorhexidine 2% gel 5. Calcium hydroxide associated with saline 6. Calcium hydroxide associated with CMCP 7. Calcium hydroxide/CPMC/glycerin paste 8. Other formulations associated with calcium hydroxide 9. Other medicines 10. I never use intracanal medication 	<p>14. What material do you use for coronary sealing between consultations during endodontic treatment?</p> <ol style="list-style-type: none"> 1. Zinc oxide and eugenol cement 2. Temporary restorative material (Coltosol®) 3. Glass ionomer cement 4. Composite resin 5. Others 6. I only perform treatment in a single visit. 	<p>15. Which filling technique (s) do you use?</p> <ol style="list-style-type: none"> 1. Lateral condensation 2. Schilder technique 3. Continuous condensation wave (Buchanan) 4. Mc Spadden technique 5. Tagger hybrid technique 6. Other
<p>16. Which endodontic sealer do you use?</p> <ol style="list-style-type: none"> 1. Zinc oxide and eugenol based sealer 2. Resin sealer 3. Sealer containing calcium hydroxide 4. Bioceramic sealer 5. MTA-based sealer 6. Other 	<p>17. What material do you use for coronary sealing after the endodontic treatment is concluded?</p> <ol style="list-style-type: none"> 1. Zinc oxide and eugenol based sealer 2. Temporary restorative material (Coltosol®) 3. Glass ionomer cement 4. Composite resin 5. Others 	<p>18. Upon conclusion of endodontic treatment, you often:</p> <ol style="list-style-type: none"> 1. Refer the patient to perform the direct permanent restorative treatment (direct restoration) 2. Refer the patient to carry out the indirect permanent restorative treatment (onlay, full crown) 3. Refer the patient to perform the definitive restorative treatment (to prepare and post cementation) 4. Performs direct permanent restorative treatment (direct restoration) 5. Performs the indirect permanent restorative treatment (onlay, full crown) 6. Performs the definitive restorative treatment (to prepare and post cementation)
<p>19. Do you routinely use cone beam computed tomography to assist in endodontic diagnosis?</p> <ol style="list-style-type: none"> 1. Yes 2. No 	<p>20. How do you keep up to date in this area?</p> <ol style="list-style-type: none"> 1. I read scientific papers 2. Through refresher courses 3. Th ough the internet / Social media 4. I participate in a discussion group 5. Others 	<p>21. Do you feel willing to testing new products for endodontic treatment?</p> <ol style="list-style-type: none"> 1. Yes 2. No 3. Sometimes

Results

A total of 189 questionnaires were fully answered. Regarding the region of Brazil, 59.3% of the professionals in the sample were from the Southeast region; 21.2% from the South region; 10.0% from the Northeast region; 5.8% from the Midwest; and 3.7% from the North.

Among the professionals who answered the questionnaire, 71% were specialists in Endodontics and 29% were not specialists. For endodontists, 30.9% completed graduate degree less than 5 years ago; 26.3% between 5 and 10 years; 21.7% between 11 and 19 years; 15.8% between 20 and 30 years and 5.3% more than 30 years. For general practitioners, the time of experience performing ET was: 45.5% less than 5 years; 10.9% from 5 to 10 years; 20% from 11 to 20 years; 18.2% from 20 to 30 years; and 5.5% more than 30 years of experience.

Regarding the technologies used during the treatment, as shown in Figure 1A, the apex locator is always used by 79.4% of the participants; sometimes used by 13.2% and never used by 7.4% of professionals. In concern to the use of magnification, 57.1% responded using it (29.6% the magnifying loupe and 27.5% the microscope); 42.9% answered not to use this assistant. As for the use of cone beam computed tomography, 57.1% of the professionals answered not to use it and 42.9% answered yes for its use.

When asked about the average number of endodontic treatments performed monthly, 31.2% perform more than 20 treatments; 38.1% perform between 11 and 20 and 30.7% perform between 1 and 10 treatments.

Regarding the type of instrumentation, 68.8% responded using the manual technique; 29.1% use mechanized and 2.1% answered the use of other techniques. Among the manual technique, 23.8% answered to use only stainless steel files and 10.6% only NiTi files; 39.7% responded using stainless steel files associated with gates-glidden or largo burs and 23.3% NiTi files associated with gates-glidden or largo burs. Among those who use the mechanized technique, 72% responded using a rotary system; 55.6% reciprocating and 17.5% oscillatory, as seen in Figure 1B.

Asked about the use of absolute isolation, 90.5% of professionals answered yes; 9% answered sometimes, from which 44.4% of them is due to the difficulty; 22.2% because of the delay in the procedure; 5.6% for high cost and 27.8% for other reasons. Only 0.5% answered not to use absolute isolation.

Considering RCS irrigation, as seen in Figure 1C, sodium hypochlorite (97.4%) and EDTA (74.6%) were the most used irrigants, followed by chlorhexidine (46.6%), saline (31.2%), distilled water (18.5%), citric acid (4.8%), others (3.2%) and hydrogen peroxide (2.6%).

With respect to the use of different concentrations of NaOCl, it was classified as: 2.5% to 5% by 58.2% of professionals; 1% to 2.5% by 24.9% of professionals; above 5% for 12.2% of professionals and below 1% for 2.1% of professionals.

About the different concentrations and presentations of chlorhexidine, it was classified as: 2% gel by 36% of professionals; 2% solution by 9.5% of professionals and 0.2%

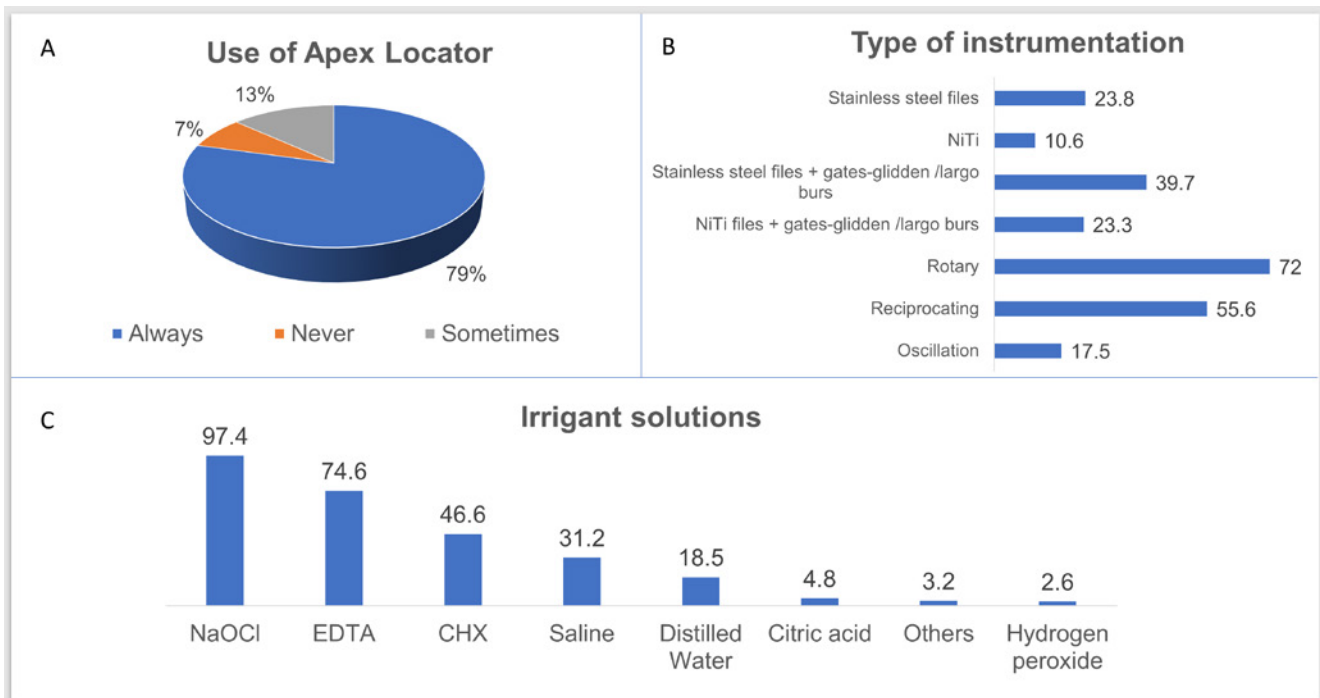


Figure 1. (A) Percentage of professionals who use the apex locator as an auxiliary instrument in performing endodontic treatment; (B) choice of instrumentation technique used during endodontic treatment*; (C) use of irrigants in any part of the irrigation protocol during endodontic treatment*. *Multiple answers were accepted.

Note: CMCP - camphorated paramonochlorophenol

solution by 1.1% of professionals.

As shown in Figure 2A, 49.2% of the professionals responded using the ultrasound as an auxiliary device in the agitation of the irrigant solution, followed by a plastic file with 36.5%; manual file with 35.4%; gutta-percha cone with 13.2%; other devices with 12.7% and sonic device with 5.8%.

When asked in how many visits the ET is performed (Figure 2B), only 5.8% of the professionals answered to carry out the treatment exclusively in multiple visits and 3.2% exclusively in a single visit. The other professionals make their choices according to each case, with 43.9% performing the treatment most of the time in a single visit and 24.9% most of the time in multiple visits. Considering the pulp diagnosis, 28% of the professionals perform the treatment in a single visit when there is vital pulp, and in case of pulp necrosis, the treatment is performed in multiple visits, even though 9.5% answered that the diagnosis does not influence the choice of the number of visits of the ET.

The most used intracanal medication by professionals is calcium hydroxide, and calcium hydroxide associated with saline obtained 35.4% of responses; calcium hydroxide associated with camphorated paramonochlorophenol (CMCP), 28.6%; calcium hydroxide/CPMC/glycerin paste, 20.6%; and calcium hydroxide associated with other formulations, 42.3%. Other medications used include cotton ball with tricresol formalin, 31.7%; cotton ball with CMCP, 24.9%; chlorhexidine 2% gel, 13.8%; cotton ball with sodium hypochlorite, 10.1%; and others not specified, 16.4%. Only 3.7% of the professionals answered that they did not use any

type of intracanal medication in the ET (Figure 2C).

As seen in Figure 3A, different results were obtained when the type of coronary seal used was questioned. The same option material is not always used between sessions and after the endodontic treatment is completed. Between sessions Coltisol® was the material of choice with 66.7% of responses, followed by glass ionomer cement with 58.2%; 26.5% composite resin; zinc oxide and eugenol based cement with 13.8% and other materials with 4.8%. For sealing after endodontic treatment, the material of choice is the glass ionomer cement with 65.1% of responses, followed by composite resin with 53.4%; Coltisol® with 42.3%; other materials with 9.5% and zinc oxide and eugenol based cement with 5.8%.

Lateral condensation was the filling technique of choice of most professionals with 61.4% of the answers, the second option was divided between the Mc Spadden and Tagger hybrid techniques, both with 36% of the answers, followed by the Schilder's technique with 25.4%; other techniques with 13.2% and continuous condensation wave (Buchanan) with 12.2% of the responses (Figure 3B).

In relation to the sealer used for RCS filling, Figure 3C, more than half of the professionals responded using zinc oxide and eugenol based sealers (52.4%), the second option was with resin based sealers (39.7%), followed by sealers containing calcium hydroxide (28.6%); bioceramic sealer (25.9%); MTA-based root canal sealer (16.9%) and other (5.3%).

Figure 4A shows that after the conclusion of the ET, most professionals responded to refer the patient to perform the

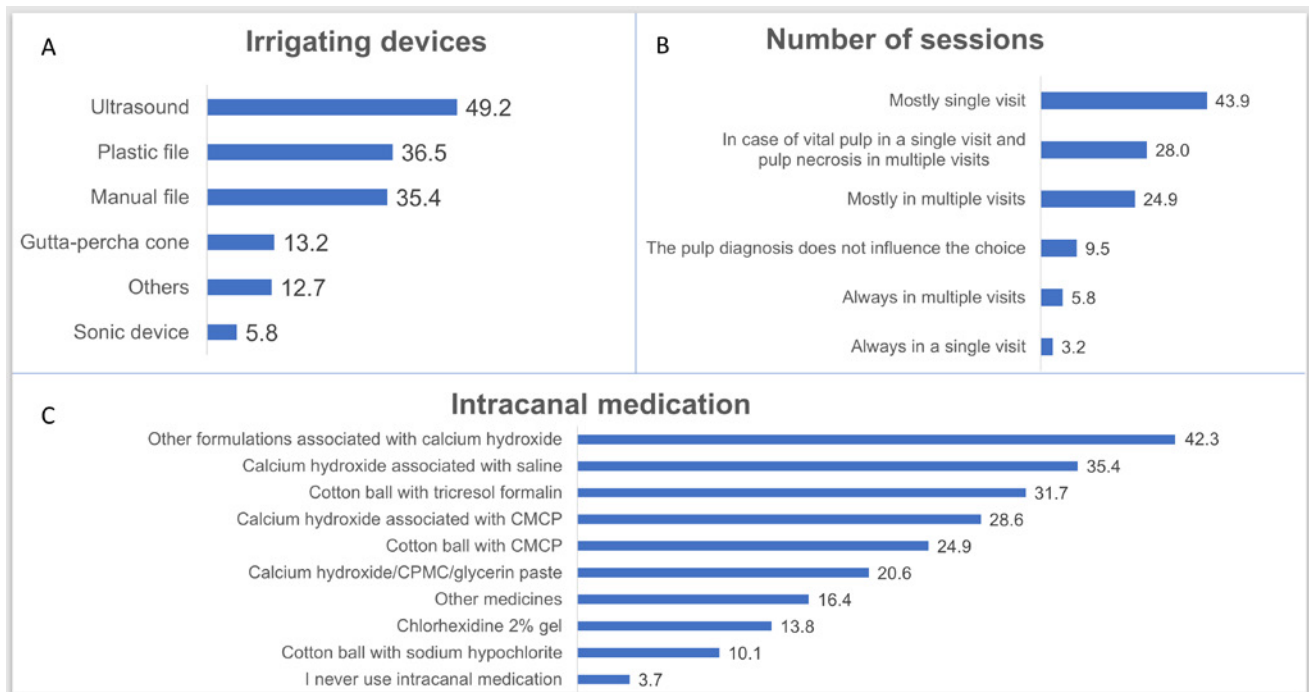


Figure 2. (A) Professional responses (%) regarding the use of a device to assist in the agitation of the irrigant solution during endodontic treatment; (B) regarding the number of visits to perform endodontic treatment; (C) intracanal medication of choice during endodontic treatment. (Multiple answers were accepted in the questions).

restorative treatment with another professional, with 67.2% recommending performing direct restoration; 59.3% indirect restoration (onlay, fixed prosthesis); 51.3% for confection of intracanal posts. The other professionals declare also perform the restorative treatment, with 46% performing direct restoration; 41.8% making and sealing posts and 29.6% the

indirect restorative treatment.

To keep themselves updated in the area of Endodontics, professionals responded by reading scientific articles (72%), participating in discussion groups (67.2%), taking refresher courses (55.6%), through the internet/social media (54%) and

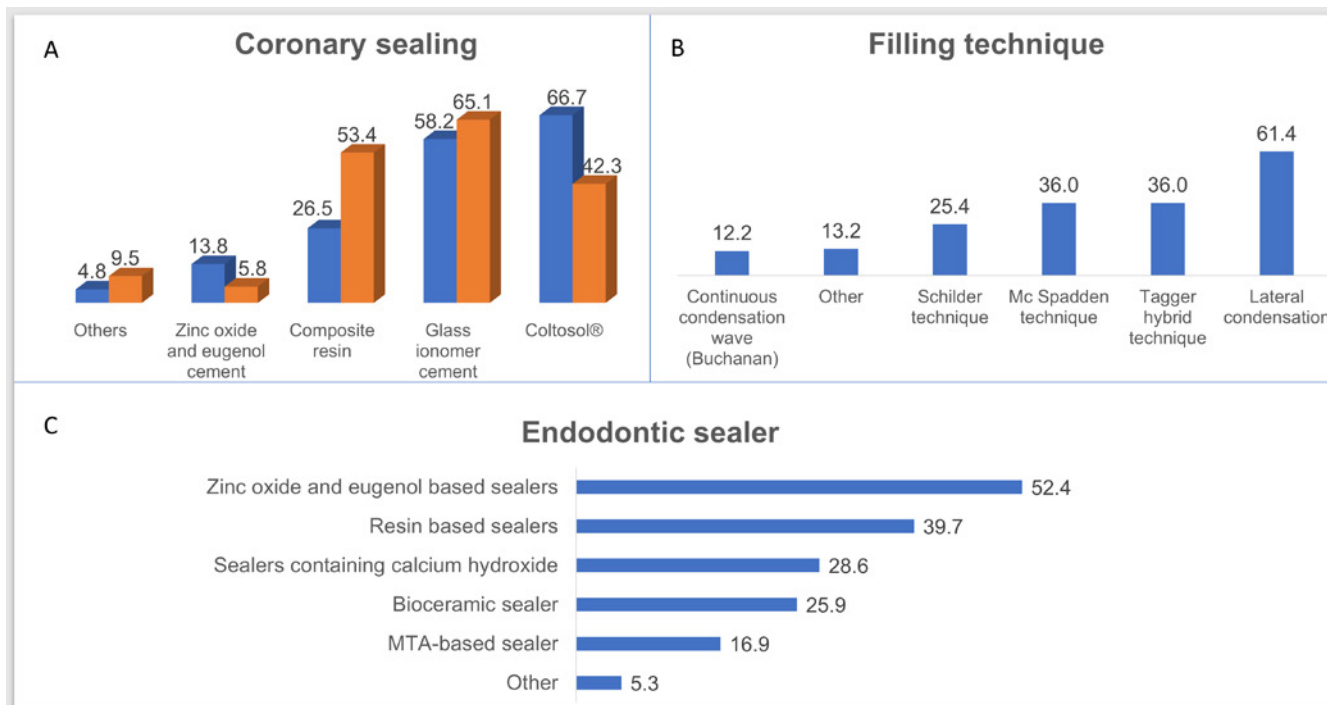


Figure 3. (A) Different choices of coronary sealing material (%) between sessions (blue) and after the endodontic treatment is completed (orange) (multiple responses were accepted);(B) percentage filling technique after chemomechanical preparation*; (C) answers regarding the professionals' choice about the use of endodontic sealer for root canal filling*. *Multiple answers were accepted.

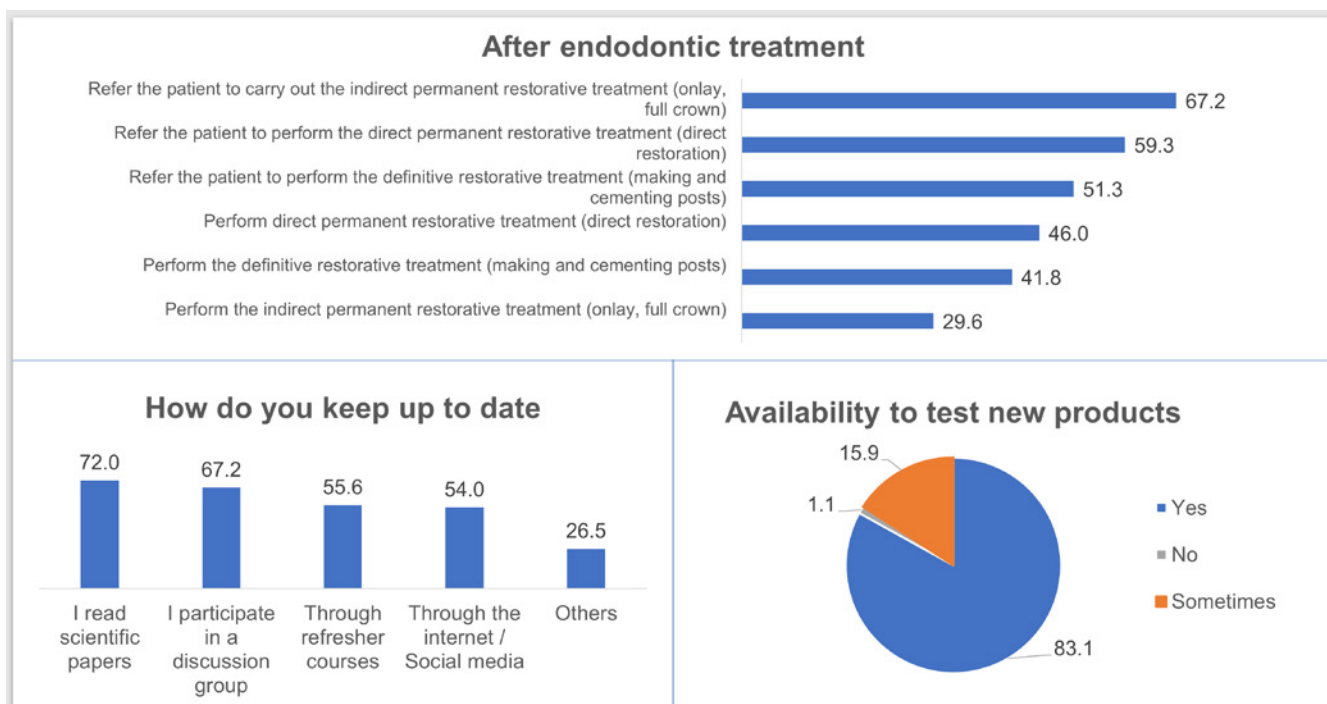


Figure 4. (A) Professional responses (%) about the option of restorative treatment after the endodontic treatment conclusion; (B) How professionals keep up to date in their area of expertise; (C) positioning of professionals about willingness to test new products for endodontic treatment.

other resources (26.5%) (Figure 4B).

Considering the constant emergence of new products, professionals were asked about the willingness to test them and the vast majority (83.1%) answered 'yes', 15.9% answered they test sometimes and only 1.1% of professionals responded that they were not open to testing new products (Figure 4C).

Discussion

In view of the technological advances and materials incorporated in the endodontic arsenal in recent years, it is of great importance to know how the professionals who perform the endodontic practice are acting. Thus, the present research used a questionnaire to assess the profile of Brazilian dental surgeons, general practitioners and specialists, in relation to the performance of the proper ET, addressing techniques, materials and technologies.

As for the methodology, a questionnaire with multiple choice and multiple selections questions was used. This method was previously used by Prado *et al.*¹⁴ who evaluated the current trends in irrigation among Brazilian endodontists, and Ferreira *et al.*⁸ who evaluated the current trends in technological and treatment instruments among Brazilian endodontists.

All regions of Brazil were included in the present research as well as in the study by Prado *et al.*¹⁴ In both surveys, there was a low return in the Midwest and North regions. Ferreira *et al.*⁸ excluded the Midwest region, and justified the exclusion due to the fact that according to the Brazilian Federal Council of Dentistry, in this area there is not a significant concentration of endodontists.

During the instrumentation phase, root canal length measurement is an important step in the chemical-mechanical preparation, as it delimits the working extension of the root canal. In the present study, most professionals (79.4%) responded using the apex locator as an auxiliary instrument in this step, in accordance with the research by Savani *et al.*¹ The use of this technology leads to the reduction of the patient's exposure to radiation, decreased treatment time and success in determining the working length.^{15,16}

Another feature used is magnification, mainly in order to identify the root canals and to minimize the obscurity of the operative field, among other applications. More than half of the professionals (57.1%) answered to make use of this resource, being 29.6% through magnifying loupes and 27.5% with microscope. The investment and learning time for using the microscope may justify the choice to use the magnifying loupes, as seen in the study by Feix.¹² In addition, the fact that the loupes are portable facilitates their use in different locations, without causing transportation problems, as well as it requires less investment when compared to microscope.¹⁷

Following the trend of the digital age, the use of cone beam computed tomography was questioned, and it was found that

most professionals (57.1%) do not use this technology to make the diagnosis in ET. According to the research by Setzer *et al.*,¹⁸ the frequency of use of this technology is higher among professionals who are graduating in endodontics than those who are already specialists, and the use is "frequently" or "always" in cases of internal or external root resorption, in the preoperative period for surgical retreatment or intentional reimplantation, absent canals, preoperative period for non-surgical retreatments, diagnostic differentials, identification of periapical lesions, calcified cases, immature teeth and assessment of healing. Absence of use was justified by cost impacts and lack of space for installing the equipment at the office.¹⁸

As for the number of endodontic treatments performed monthly, the present research showed that most professionals perform 11 to 20 or more treatments per month. A similar result was obtained by Ferreira *et al.*,⁸ who asked the same question in a survey involving only professionals specialized in Endodontics. The similarity of results may have occurred because most of the participants in this study were specialists.

Another step of extreme importance in ET is the type of instrumentation. In the present study, more than half of the professionals opted for the use of manual instrumentation (68.8%), with stainless steel files or NiTi files associated with gates-glidden or largo burs. In research with a similar subject, it was found that mechanized instrumentation was well received and used by professionals from different countries, including Brazil, and that the disadvantages of this type of instrumentation were the risk of fracture, reduced durability and useful life of the instruments, in addition to the high cost of files.¹⁹ Such disadvantages may justify the result of this research.

Almost all professionals responded using absolute isolation to perform the ET, the same result obtained by Ferreira *et al.*⁸ in which only 1% answered not to use this resource either because of the time spent or cost. The rubber dam is considered gold standard for ET because it is a barrier to contamination of the root canal by oral pathogens and possible accidents, either with the irrigant solution or with the swallowing of the files.²⁰

Used as an aid to mechanical preparation, in this research, the irrigant solution of first choice was sodium hypochlorite in its different concentrations (1%, 2.5% or 5%); this same result was obtained in surveys in Brazil^{13,14} and in the United States²¹ (91%). The most used agitation device was ultrasonic activation, as also observed in the study by Prado *et al.*¹⁴

The number of visits used to conclude an ET is still widely discussed in the scientific literature. There is a tendency to finish in a single visit. This was the option of 43.9% of the answers in the present research, in accordance with the results obtained in other studies^{1,8,22} and with the trend of the last decades, with more than 70% of schools from different

geographical areas and researchers defending treatment in a single visit and the pulp condition often being a prerequisite for choosing a single or multiple visits.²³

The calcium hydroxide associated with a vehicle was the first choice of intracanal medication by the professionals surveyed. This result can be justified by the properties of this material, such as its mineralizing and antimicrobial effect. This effect is due to ionic dissociation into calcium and hydroxyl ions, favoring biological properties.²²

After disinfecting the RCS, whether in single or multiple visits, a seal must be applied in order to prevent the penetration of oral fluids and their contaminants into the root canal.²⁴ For sealing between sessions, 66.7% of the professionals responded using Coltosol®. Regarding the use of this material, Grillo *et al.*²⁵ observed a higher average of microbial growth inhibition halos when this material was evaluated, showing a better antimicrobial property *in vitro*. For sealing after ET, the choice of sealing material was 65.1% glass ionomer cement (GIC). The GIC-based materials used as sealers, during or after endodontic therapy, have a good ability to decrease or cancel the penetration of bacteria inside the RCS, in addition to presenting adequate sealing at the cement-tooth interface.²⁵ Ferreira *et al.*⁸ showed that endodontists also preferred GIC for coronary sealing, due to its adhesive properties.

After the mechanical chemical preparation is finished, the RCS must be filled three-dimensionally to prevent the entry of new microorganisms in the root canal or the growth of those that survived the preparation. In the present study, the lateral condensation technique and zinc oxide and eugenol-based sealer were the materials of choice by most professionals consulted. A similar study carried out in Saudi Arabia²⁶ revealed that lateral condensation was also the technique most used by professionals in the field. However, Ferreira *et al.*⁸ reported that 53% of the professionals responded using the thermoplastic filling technique. The association of gutta-percha with endodontic sealer based on zinc oxide and eugenol is the form most used by clinicians.²⁷

When asked about the treatment performed after the RCS filling conclusion, more than half of the professionals responded to refer the patient to perform the restorative procedure with another professional, with 67.2% direct restorations, 59.3% indirect restorations and 51.3% for confection of intracanal posts. The restorative treatment prevents the penetration of fluids and microorganisms from the oral cavity, and the endodontically treated tooth should be restored as soon as possible.²⁸ Thus, the endodontic treatment can only be considered complete after the restoration, returning the function and aesthetics aspects to the tooth.²⁸

Most of the consulted professionals responded that they were willing to test new products in their daily practices. Constant updating is necessary in the area of Endodontics for the knowledge and practice of new techniques and technologies that appear every day. In this study, 72% of professionals responded to reading scientific articles for updates on new content. Currently, Brazil is showing a favorable environment for updating professionals, as the production of research and scientific articles has significantly grown. According to a study by Gonçalves *et al.*,²⁹ regarding the citation rates of articles co-authored by Brazil with or without other countries, from 2,155 articles published between 2015 and 2017, 6,596 gathered citations in the period, with Endodontics being the theme with the greatest absolute number of citations (17.3%).

Conclusion

In view of the answers obtained in the questionnaires, it is concluded that most of the participants have been adhering to the current and modern practices, with the use of new technologies during the ET, and declare to keep updated by reading scientific articles.

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References

1. Savani GM, Sabbah W, Sedgley CM, Whitten B. Current trends in endodontic treatment by general dental practitioners: Report of a United States national survey. *J Endod.* 2014;40(5):618-24.
2. Semaan FS, Fagundes FS, Haragushiku G, Leonardi DP, Filho FB. Mechanized endodontic: the Evolution of continuous Rotary systems. *Rev Sul-bras odontol.* 2009;6(3):297-309.
3. Pereira HSC, Silva EJNL, Coutinho Filho TS. Reciprocating movement in endodontics: literature review. *Rev Bras Odontol.* 2012;69(2):246-9.
4. Satappan, B, Nervo GJ, Palamara JEA, Messer HH. Defects in rotary Nickel-titanium files after clinical use. *J Endod.* 2000;26(3):161-5.
5. Gavini G, Santos M, Caldeira CL, Machado MEL, Freire LG, Iglecias EF, *et al.* Nickel-titanium instruments in endodontics: a concise review of the state of the art. *Braz oral res.* 2018;32(suppl 1):e67.
6. Machado MEL, Nabeshima CK, Leonardo MFP, Cardenas JEV. Analysis of working time of the reciprocating single file instrumentation: WaveOne and Reciproc. *Rev Assoc Paul Cir Dent.* 2012;66(2):120-4.
7. Cavalli D. Estudo Comparativo de Sistemas Rotatório, Reciprocante e Híbrido no Preparo de Canais Radiculares em Dentes com Infecção Endodôntica Primária: perfil microbiano e quantificação de endotoxinas [Tese]. São José dos Campos: Universidade Estadual Paulista, Faculdade de Odontologia, Programa de Pós-graduação em Odontologia Restauradora, 2016.
8. Ferreira ACG, Frozoni M, Prado M, Gomes B, Signoretti F, Soares AJ. Current trends in technological armamentarium and treatment among Brazilian endodontists. *Braz J Oral Sci.* 2017;16.
9. Basrani B. Endodontic Irrigation: Chemical disinfection of the root canal system. Toronto: Springer International Publishing; 2015.
10. Gil AC, Nakamura VC, Lopes RP, Lemos EM, Calil E, Amaral KF. Contemporary Review of the termo plasticized obturation, using the termo mechanical compacting technique. *Revista Saúde UNG-Ser.* 2009;3(3):20-9.
11. Estrela C, Chaves R, Alencar AHG, Guedes AO, Silva JA. Effectiveness of the

- Lateral Condensation of Gutta-Percha in Endodontic Sealing. *Rev Odontol Bras Central*. 2008;17(43):56-64.
12. Feix LM, Boijink D, Ferreira R, Wagner MH, Barletta FB. Operating microscope in endodontics: visual magnification and luminosity. *Rev Sul-bras Odontol*. 2010;7(3):340-8.
 13. Garib DG, Raymundo Jr R, Raymundo MV, Raymundo DV, Ferreira SN. Cone beam computed tomography (CBCT): understanding this new imaging diagnostic method with promising application in Orthodontics. *Rev Dent Press Ortodon Ortop Facial*. 2007;12(2):139-56.
 14. Prado M, Alencastro F, Athias L, Lima CO, Marion JJ, Simão RA *et al*. Current trends in irrigation among Brazilian endodontists. *Dental Press Endod*. 2018;8(3):34-40.
 15. Gonçalves MCW, Fontana CE, Stringheta CP, Bueno CES, Rocha DGP, Pinheiro SL, *et al*. Evaluate the accuracy of four electronic Apex locators during endodontic retreatment. *Rev Assoc Paul Cir Dent*. 2017;71(1):36-40.
 16. Guimarães BM, Marciano MA, Silva PAA, Alcalde MP, Bramante CM, Duarte MAH. The use of Apex locator in endodontics: a literature review. *Rev Odontol Bras Central*. 2014;23(64):2-7.
 17. Resende CA, Almeida JFA, Campos PEGA, Filho FJS, Dekon SFC. THE APPLICATION OF CLINICAL MICROSCOPE IN DENTISTRY. *Rev Odontol Arac*. 2008;29(1):09-12.
 18. Setzer FC, Hinckley N, Kohli MR, Kohli, Karabucak B. A Survey of Cone-beam Computed Tomographic Use among Endodontic Practitioners in the United States. *J Endod*. 2017;43(5):699-704.
 19. Sidney GB, Santos IM, Batista A, Kowalczyk A, Deonizio MD. The implementation of rotary systems in endodontics. *Rev. Odontol. Bras Central* 2014;23(65).
 20. Benevides AAA, Venâncio AEF, Feitosa VP. The Influence of absolute Insulation on the Success of Direct Restorations and Endodontical Treatment: A Literature Review. *Rev Odontol Arac*. 2019;40(1):35-40.
 21. Dutner J, Mines P, Anderson A. Irrigation trends among American Association of Endodontists members: a web-based survey. *J Endod*. 2012; 38(1):37-40.
 22. Freitas EGS, Santos GN. Perfil de tratamento endodôntico dos cirurgiões-dentistas na cidade de Aracajú SE [tese]. Aracaju: Universidade Tiradentes, Faculdade de Odontologia. Programa de Graduação em Odontologia, 2016.
 23. Endo MS, Santos ACL, Pavan AJ, Queiroz AF, Pavan NNO. Endodontics in single or multiple visits: literature review. *RFO UPF*. 2015;20(3):408-13.
 24. Parron LF, Panerari ALS, Cimardi ACBS, Victorino FR. Marginal microbial infiltration in coronary double sealing. *Rev Odontol UNESP*. 2014;43(6):409-413.
 25. Grillo JPF, Uzeda M, Alves FRF, Gonçalves LS. Temporary coronary dental sealers: determination of in vitro antimicrobial activity. *Rev Assoc Paul Cir Dent*. 2013;67(2):136-40.
 26. Iqbal A, Akbar I, Qureshi B, Sghaireen MG, AL-Omiri MK. A survey of standard protocols for endodontic treatment in north of KSA. *ISRN Dent*. 2014;2014:865780.
 27. Ferreira CM, Gomes FA, Guimarães NLSL, Ximenes TA, Canuto NSCP, Vitoriano MM. Analysis of gutta-percha's root canal filling capacity through three different obturation techniques. *Rev Sul-bras odontol*. 2011;8(1):19-26.
 28. Almeida GA, Veloso HHP, Sampaio FC, Oliveira HF, Freire AM. Restoration Quality and Endodontic Failure. *Rev Odontol Bras Central*. 2011;20(52):74-78.
 29. Gonçalves AP, Porto BL, Rodolfo B, Júnior CMF, Agostini BA, Neto MDS, Moraes RR. Brazilian Articles in Top-Tier Dental Journals and Influence of International Collaboration on Citation Rates *Braz Dent J*. 2019; 30(4):307-316.

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