BJOS
Brazilian Journal of Oral Sciences

Volume 16
2017
e17045

Original Article

# Current trends in technological armamentarium and treatment among Brazilian endodontists

Ana Cristina Garcia Ferreira[1] Marcos Frozoni[2], Maíra Prado[3], Brenda Gomes[4], Fernanda Signoretti[5], Adriana De-Jesus-Soares[6].

[1] Post graduate Student, São Leopoldo Mandic Dental Research Center, Campinas, São Paulo, Brazil.

[2] PhD, Professor, São Leopoldo Mandic Dental Research Center, Campinas, São Paulo, Brazil.

[3] PhD, Professor, Department of Restorative Dentistry, Veiga de Almeida University, Rio de Janeiro, RJ, Brazil.

[4] PhD, Professor, Department of Restorative Dentistry, Piracicaba Dental School, State University of Campinas-UNICAMP, Piracicaba, SP, Brazil.

[5] PhD, Professor, São Leopoldo Mandic Dental Research Center, Campinas, São Paulo, Brazil.

[6] PhD, Professor, Department of Restorative Dentistry, Piracicaba Dental School, State University of Campinas-UNICAMP, Piracicaba, SP, Brazil.

**Correspondence**:
Dr Maira do Prado
Praça da Bandeira, 149 - Praça da Bandeira, Rio de Janeiro - RJ, postal code 20270-150– Brazi
Phone/ Fax: (0055) (21) 2502-3238
E-mail: maira.prado@uva.br

**Received**: May 6, 2017
**Accepted**: August 09, 2017

**Aim:** To determine the current trends in technological armamentarium and endodontic treatment among Brazilian endodontists. **Methods:** A total of 279 endodontists answered a web-based survey questionnaire about their region of activity in Brazil and years as a specialist, average number of endodontic cases treated per month, number of visits to complete the treatment, use of rubber dam for isolation, type of irrigant, obturation technique and device used for this purpose, temporary filling materials, and greater difficulty encountered during treatment and technological armamentarium. A descriptive analysis, expressed in terms of frequency and percentage, was performed and the data were correlated using the chi-square test ($p<0.05$). **Results:** Most of the respondents had up to 10 years as specialists. More than 50% of endodontists preferred to complete the endodontic treatment in a single visit. Ninety-nine percent of endodontists used rubber dam for isolation. NaOCl was the most widely used irrigant. Most of the respondents associated different techniques for root canal filling. Lateral condensation and Continuous wave of condensation were the isolated technique most reported. Filling devices (thermocompactors) were used by 53% of endodontists. Glass ionomer was the preferred temporary filling material. The answers for the use of technological armamentarium revealing that 94% of endodontists used an apex locator; 67.38% utilized magnification (loupe: 23.66%; microscope: 35.48%; microscope and loupe: 8.24%); 58% reported to digital radiography; and 47.31% used computed tomography as a complementary tool. About mechanized instrumentation, 44.44% endodontists employed rotary and reciprocating files. The difficulties encountered during endodontic treatment were classified as preparation > access > obturation > anesthesia > isolation. **Conclusions:** Most endodontists have implemented new technologies, such as mechanical instrumentation, apex locators, magnification, digital radiography, computed tomography, ultrasound, and obturation tools, in their clinical practice.

**Keywords**: Endodontics. Root Canal Irrigants. Root Canal Obturation. Root canal therapy. Trends.

## Introduction

In the last decades, new trends and technologies in dentistry, specifically in endodontics, have been introduced in the clinical practice of specialists and general practitioners, providing benefits to the quality, efficiency, and safety of endodontic treatment[1,2].

Technological innovations such as apex locator, electric motor with controlled speed and torque, nickel titanium files, irrigation systems, ultrasound, clinical microscope, thermoplastic filling devices, digital radiography, and computed tomography have brought about a revolution in endodontic treatment[1-4].

These new technologies and materials have allowed obtaining a more accurate working length and root canal patency, with consequently better preparation and filling, contributing to better predictability of endodontic treatment[5,6]. Additionally, the length of treatment was reduced. According to Bjørndal and Reit[7], in the past, conventional endodontic treatments were performed in five, six, or up to seven sessions. With technological advancements, the number of sessions declined and endodontic treatment is usually performed in a single session.

Questionnaires to assess trends in endodontic treatment and new technologies are commonly applied in other countries[8-18]. In Brazil, in 1999, Gurgel-Filho et al.[19] conducted a study on the philosophy of single-session endodontic treatment in Brazilian and North American universities. Afterwards, in 2001, Santos et al.[20] evaluated the conception of endodontists regarding new technologies and teaching in the area. The most recent study found in the literature dates back to 2011, when Pedrosa et al.[21] evaluated the panorama of tooth isolation in dental clinics in Belo Horizonte.

In view of the new technologies incorporated into the endodontic arsenal in recent years and the limited knowledge about endodontic treatment trends in Brazil, the present study aimed to determine the current trends in technological armamentarium and endodontic treatment among Brazilian endodontists.

## Material and MethodS

This study was approved by the local Research Ethics Committee (Protocol no. 47780415.2.0000.5374).

An invitation to participate in a web-based survey was sent to members of the Brazilian Forum on Endodontics (http://www.forumdeendodontia.com.br), an online group of clinical specialists and researchers in endodontics. A total of 2,000 endodontists from the southeast, south, and northeast regions of Brazil were invited to participate. These regions were selected because, according to the Brazilian Federal Dental Council, they concentrate the largest number of endodontists.

The survey consists of a questionnaire with 17 multiple-choice questions with multiple selections about region of activity in Brazil and years as a specialist, average number of endodontic cases treated per month, number of visits to complete the treatment, use of rubber dam for isolation, type of irrigant, obturation technique and device used for this purpose, temporary filling materials, and greater difficulty encountered during treatment and technological armamentarium (use of apex locator, mechanized instrumentation,

magnification, digital radiography, cone beam computed tomography (CBCT), and ultrasonic system). The questionnaire (translated into English) is shown in Table 1.

**Table 1.** Questionnaire

| 1. Region of activity | 2. Years of activity as a specialist | 3. On how many teeth do you perform endodontic treatment on a monthly basis? |
|---|---|---|
| ( ) Northeast | ( ) 1-5 years | ( ) 1-10 |
| ( ) Southeast | ( ) 6-10 years | ( ) 11-20 |
| ( ) South | ( ) 11-15 years | ( ) > 20 |
| | ( ) 16-20 years | |
| | ( ) 21-25 years | |
| | ( ) 26-30 years | |
| | ( ) > 30 years | |
| **4. In how many sessions do you perform endodontic treatment?** | **5. Do you use rubber dam for tooth isolation?** | **6. Why do you not use rubber dam for tooth isolation?** |
| ( ) One visit | ( ) Yes | ( ) Difficulty |
| ( ) Multiple visits | ( ) No | ( ) Cost |
| ( ) Mostly in one visit | | ( ) Delay |
| ( ) Mostly in multiple visits | | |
| **7. Which irrigant(s) do you use?** | **8. Which obturation technique(s) do you use?** | **9. Do you use any filling device (thermocompactor)?** |
| ( ) Sodium hypochlorite | ( ) Lateral Condensation | ( ) Yes |
| ( ) Saline | ( ) Schilder technique | ( ) No |
| ( ) Distilled water | ( ) Continuous wave of condensation (Buchanan) | |
| ( ) Anesthetic | ( ) Mcspadden technique | |
| ( ) Hydrogen peroxide | ( ) Tagger's hybrid technique | |
| ( ) EDTA | ( ) Other | |
| ( ) 2% chlorhexidine gel | | |
| ( ) Combination of two irrigants | | |
| ( ) Other | | |
| **10. What material(s) do you use for temporary sealing after endodontic treatment?** | **11. Do you use an apex locator?** | **12. Do you use ultrasound?** |
| ( ) IRM | ( ) Yes | ( ) Yes |
| ( ) Zinc oxide/eugenol | ( ) No | ( ) No |
| ( ) Glass ionomer | | |
| ( ) Composite resin | | |
| ( ) Temporary restorative material (Coltosol) | | |
| **13. Do you use magnification?** | **14. Do you use digital radiography?** | **15. Do you use routine exams such as cone beam computed tomography to aid in the diagnosis?** |
| ( ) Microscope | ( ) Yes | ( ) Yes |
| ( ) Loupe | ( ) No | ( ) No |
| ( ) No | | |
| **16. Do you use mechanized instrumentation?** | **17. Which step(s) is(are) most difficult during endodontic treatment?** | |
| ( ) Rotary techniques | ( ) Anesthesia | |
| ( ) Reciprocating techniques | ( ) Access | |
| ( ) Oscillating techniques | ( ) Isolation | |
| ( ) No | ( ) Preparation | |
| | ( ) Obturation | |

The survey was closed 3 months after the questionnaire was sent. Data were collected, exported to Excel (Microsoft, Seattle, USA), and analyzed by the IBM SPSS 2.1 software. A descriptive analysis, expressed in terms of frequency and percentage, was performed and the data were compared using the chi-square test ($p<0.05$).

## RESULTS

A total of 279 complete questionnaires were received (response rate of 13.95%).

Figure 1 showed the region of activity and years of activity as specialist of the respondents. The most of respondents work in the southeast region. With respect to years of activity as a specialist, it was ranked as: 1-5 years > 6-10 years > 11-15 years > 16-20 years > 21-25 years > 26-30 years = >30 years. Most respondents (61.75%) had up to 10 years' experience as endodontists.

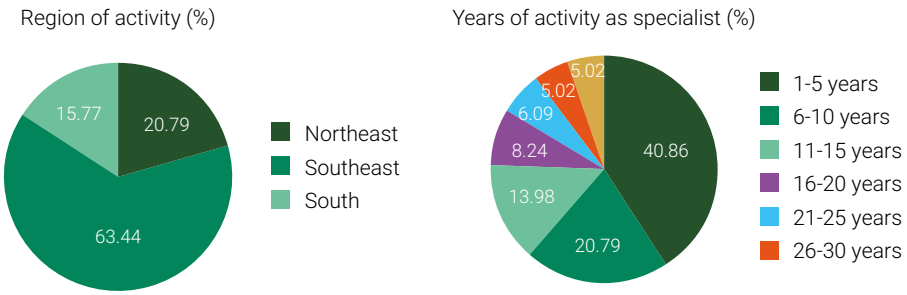


**Figure 1.** Percentage of respondents according to their region of activity and years as a specialist.

Regarding the number of monthly endodontic treatments, most specialists (82%) treated more than 11 teeth. As to the number of visits to conclude the treatment, it was ranked as: mostly in one visit > mostly in multiple visits > only in single visit > only in multiple sessions (Figure 2).

Regarding rubber dam for tooth isolation, 99% of respondents said they used it. The remaining 1% who did not use it reported it was either due to the cost or time required for isolation (treatment delay).

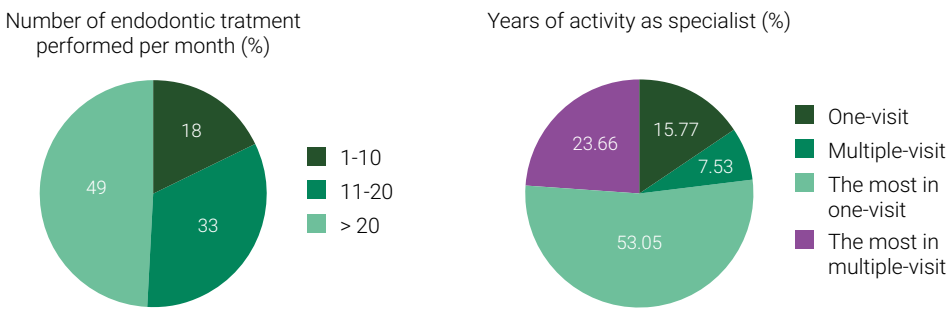


**Figure 2.** Number of monthly endodontic treatments and number of visits to conclude the treatment (%).

Concerning irrigants (Table 2), they were ranked as: NaOCl/EDTA > others > only NaOCl > NaOCl/ EDTA/ 2% CHX gel/ saline solution > NaOCl/ EDTA/ 2% CHX gel = NaOCl/ EDTA/saline solution > saline solution/ EDTA/ 2% CHX gel > saline solution/2% CHX gel = only 2% CHX gel > saline solution.

**Table 2.** Irrigants used in isolation or combined.

| Irrigants used isolated and in association. | Number of respondents (%) |
|---|---|
| 2% CHX gel | 12 (4.30%) |
| NaOCl | 55 (19.71%) |
| NaOCl/ EDTA | 69 (24.73%) |
| NaOCl/ EDTA/ 2% CHX gel | 17 (6.09%) |
| NaOCl/ EDTA/ saline solution | 15 (5.38%) |
| NaOCl/ EDTA/ 2% CHX gel/ saline solution | 26 (9.32%) |
| saline solution | 1 (0.36%) |
| saline solution/2% CHX gel | 12 (4.30%) |
| saline solution/ EDTA/ 2% CHX gel | 15 (5.38%) |
| Others | 57(20.43%) |
| Total | 279 (100%) |

The techniques for root canal filling, used either in isolation or combined, are displayed in Table 3. The most of participants associated different techniques. Lateral condensation and continuous wave of condensation (Buchanan) were the techniques most cited in isolation. Filling devices (thermocompactors) were used by 53% of endodontists.

**Table 3.** Root canal filling techniques used either in isolation or combined.

| Root canal filling techinique | Number of respondents (%) |
|---|---|
| Lateral condensation | 34 (12.19%) |
| Tagger's hybrid technique | 23 (8.24%) |
| Mc Spadden | 19 (6.81%) |
| Continuous wave of condensation (Buchanan) | 34 (12.19%) |
| Schilder | 24 (8.60%) |
| Other | 57 (20.43%) |
| Associations | 88 (31.54%) |
| Total | 279 (100%) |

Regarding temporary sealing materials after endodontic treatment, 20.07% of the respondents used only glass ionomer, 17.56% used only provisional restorative material (Coltosol®), 17.20% participants answered others, 16.13% used composite resin only; 10.75% used glass ionomer and Coltosol®; 8.24% used glass ionomer and composite resin; 6.09% used composite resin and Coltosol®; 2.87% used IRM and 1.08% Zinc oxide/eugenol.

The answers for the use of technological armamentarium revealing that 94% of endodontists used an apex locator; 67.38% utilized magnification (loupe: 23.66%; microscope: 35.48%; microscope and loupe: 8.24%); 58% resorted to digital radiography; and 52.69% did not use computed tomography as a complementary tool.

About mechanized instrumentation, 44.44% employed rotary and reciprocating files; 3.94% associated rotary and oscillating tools; 14.7% associated rotary, reciprocating, and oscillating tools; 28.32% used only rotary instruments; 5.73% used only reciprocating instruments; 1.43% utilized only oscillating files; and 1.43% did not use mechanized instrumentation at all.

The difficulties encountered during endodontic treatment were classified as preparation (44.8%) > access (22.94%) > obturation (13.98%) > anesthesia (9.32%) > isolation (2.15%). More than one item was reported as a difficulty by 6.81%.

There was statistical difference in mechanical instrumentation across different regions ($p = 0.009$). All respondents from the south of Brazil reported using some type of mechanical instrumentation compared with the southeast and northeast where a small percentage (1.7%) did not use any mechanical instrumentation. In the south, there was a higher percentage (29.5%) of professionals who combined rotating, oscillating, and reciprocating instruments compared to 15.5% in the northeast and only 10.7% in the southeast. On the other hand, in the association of rotary and reciprocating tools, there was a lower percentage in the south (29.5%) than in the southeast (48%) and northeast (44.8%) regions.

A statistical difference was observed between the use of digital radiography and time of activity as a specialist ($p = 0.000$). Among endodontists with 1 to 5 years' experience, 74.5% did not use digital radiography, and among those with 11 to 15 years of practice, 61.5% used it. However, among endodontists with over 21 years of experience, the use of digital radiography was greater than 50%.

Years as a specialist significantly influenced ($p = 0.007$) the use of CBCT. With up to 10 years of practice, most endodontists did not use CBCT as a complementary tool, but there was a predominance of CBCT use between 16 and 30 years of practice. Among endodontists who used digital radiography, 60.5% utilized CBCT as a complementary tool – which was statistically significant (0.000).

The number of years as a specialist influenced the use of magnification *($p = 0.021$)* and ultrasound *($p = 0.021$)*. As time as a specialist increases, endodontists use more magnification and ultrasound.

When comparing mechanical instrumentation and magnification, four endodontists did not use mechanical instrumentation and also did not adopt any type of magnification. Among those who used rotary tools, 24.1% used a microscope, 10.1% microscope and loupe, 13.9% loupe, and 51.9% did not use any magnification.

## Discussion

A questionnaire was employed in the present study to identify the materials and techniques most widely used in endodontics as well as the new technologies and trends incorporated into the daily practice of Brazilian endodontists.

Most respondents had 1 to 5 years' experience whereas quite a small number had 26 to 30 years or more of practice. This finding is consistent with that of other studies conducted elsewhere[1,10,22]. However, Lee et al.[4], in the United States, and Slaus and Bottenberg[18], in Belgium, observed the highest number of professionals with 11 years or more of clinical practice, while Whitten et al.[23] showed similar percentages for all groups.

Regarding the number of monthly endodontic treatments, almost half of the endodontists treated 20 teeth or more. Locke et al.[15], after evaluating general practitioners in Wales, observed that 83% of them performed endodontic treatment on 1 to 5 teeth every week, totaling 5 to 20 teeth per month. Savani et al.[17] showed that most general practitioners (58%) treated 1 to 5 teeth and that only 2% treated more than 20 teeth per month. The difference in the results may be due to the professionals evaluated. In the present study, only endodontists answered the questionnaire while in other studies, general practitioners were also evaluated. The present study indicates that the monthly number of teeth treated by endodontists exceeds the number of teeth treated by general practitioners.

Concerning the number of sessions required to complete endodontic treatment, the most of respondents said they performed most of the treatments in a single visit in accordance with Savani et al.[17] who observed that most interviewees preferred to perform the treatment in a single session (63%) and only 21% in multiple sessions. Preference is related to the shorter length of treatment after the advent of nickel titanium files. However, other authors[7,12,18,22] found that most of the surveyed dentists preferred multiple endodontic treatment sessions. Whitten et al.[23] argue that specialists opted for a single session while general practitioners preferred multiple sessions.

With respect to tooth isolation, in the present study, 99% of endodontists used a rubber dam, a superior incidence than found by Zou et al.[1] and Whitten et al. [23]. Also, these studies[1,23] observed that the percentage of specialists who used a rubber dam during endodontic practice was higher than that obtained for general practitioners. Additionally, other previous studies[7,10,11-13,18,22] that evaluated general practitioners observed that the most of them did not use rubber dam routinely during root canal treatment. The reasons why some participants did not to use a rubber dam included treatment delay and costs, as described in the present study.

As to the types of irrigants, most professionals used NaOCl and a combination of sodium hypochlorite and EDTA. Compared with other studies, sodium hypochlorite is, in fact, the most widely used irrigant in most countries[9,11,23]. Gurgel Filho et al.[19] observed that EDTA was employed in 67% of Brazilian dental schools universities against only 8% in the United States. However, sodium hypochlorite at higher concentrations (2.5% to 5.25%) was more widely used in the United States (94%) than in Brazil (43%). In countries such as India[10] and Saudi Arabia[12], saline solution is far more common than sodium hypochlorite. In Nigeria[22], the use of saline solution (28.8%) is similar to that of sodium hypochlorite (32.5%).

Regarding root canal filling, a great variation was observed in the combination of techniques, revealing the use of heterogeneous protocols by Brazilian specialists. Lateral condensation and continuous wave of condensation were the most frequently adopted techniques isolated, in accordance with Lee et al. [4] findings in the United States. Other studies, in Denmark[7] and in north of Saudi Arabia[12] revealed that lateral condensation was the most commonly used technique.

In the present study, endodontists preferred glass ionomer, followed by temporary restorative material (Coltosol®) and composite resin as temporary sealing materials. Other professionals employed more than one material. Slaus and Bottenberg[18] and Lee et al.[4] showed that provisional restorative material Cavit® was the material of choice, followed

by IRM® and zinc oxide eugenol cements. Gupta and Rai[10] also described extensive use of Cavit® and eugenol zinc oxide cement. Kaptan et al.[13] also found that Cavit® was the preferred, followed by zinc phosphate cement, and zinc oxide eugenol and IRM® cements. Composite resin was not cited as a temporary restorative material.

Among technological innovations, an apex locator was widely employed by the respondents. This percentage was significantly higher than that reported in previous studies[1,4,11,22]. This can be explained because the present study evaluated endodontists participating in a forum that discusses innovations and exchanges of experiences in endodontic practice. Also, the difference can be associated with the culture, the academic formation (in the graduation), the socioeconomic condition found among the dentists of different countries. Additionally, according to scientific evidence, previous studies report increasing use of this tool, as it provides greater accuracy in the determination of working length and a decrease of operative time[5,6].

Regarding magnification, 23.66% of the endodontists used a loupe, 35.48% adopted the clinical microscope, 8.24% associated the microscope with a loupe, and 32.62% did not use any magnification instrument. Kersten et al.[14] showed that the use of magnification accounted for 90% while in 1999 it was only 52%. When compared with the present study, their rate was higher than that obtained here. By evaluating different groups, the use of the clinical microscope as a function of years of activity was 22.8% in the group with 1-5 years' experience and 43.6% among those with 11-15 years of practice. Endodontists with 16-20 years of activity were those who used magnification most frequently (65.2%). The findings also show that the adoption of new technologies by the professionals requires a certain time of activity, continuing education and training, with a long learning curve[10,12].

Digital radiography is a faster, non-polluting method that provides less radiation exposure[5]. In this study, it was employed by 42% of the endodontists. Gupta and Rai[10], in India, observed that digital radiography was used by 17% of the respondents and a significantly higher proportion of respondents had postgraduate qualifications as compared to respondents who did not have postgraduate qualifications. Savani et al.[17], in USA, found that 72% of general dentists used this technological innovation. The difference in the results can be associated with the culture, the academic formation (in the graduation) and the socioeconomic condition found among the dentists of different countries

In the present study, most specialists used mechanical instrumentation, choosing more than one system. In most recent surveys, the results vary across countries. In Nigeria[22] and in Saudi Arabia[12], the use of mechanical instrumentation is low (2.5% and 17.5%, respectively). In India[10] and in Turkey[13], the utilization of nickel titanium files accounts for 61% and 43.9%, respectively. In the United States[17] and in Wales[15], the rate is higher (74% and 71%, respectively), even among general practitioners.

The use of rotary instrumentation associated with some other type (oscillating, reciprocating, or both) demonstrated a significant increase in the number of teeth treated per month. In the present study, endodontists who used manual instrumentation answered to treat a maximum of 10 teeth per month while those who employed mechanical instrumentation treated, on average, 11 teeth or more. Those who combined different types of instrumentation treated 20 teeth or more. Our study consolidates the literature findings about the efficiency and speed of mechanical systems[5,24,25].

A positive correlation was observed between mechanical instrumentation and magnification. These findings indicate that professionals working with varied instrumentation systems are more prone to implement technological innovations in their clinical practice.

Regarding the greatest difficulties encountered during endodontic treatment, preparation was mentioned by 44.8%, access by 22.94%, obturation by 13.98%, and anesthesia by 9.32%. These findings are consistent with those of other studies, such as the one conducted by Udoye et al.[22], who detected difficulties in access and preparation among Nigerian dentists, leading to a high rate of perforations. Gupta and Rai[10] and Hommez et al.[11] suggested continuing education and training as ways to solve these problems.

In conclusion, most endodontists affiliated with the Brazilian Forum on Endodontics from the southeast, south, and northeast regions of Brazil have implemented new technologies, such as mechanical instrumentation, apex locators, magnification, digital radiography, computed tomography, ultrasound, and obturation tools, in their clinical practice. More than 50% of endodontists preferred to complete the endodontic treatment in a single visit. Ninety-nine percent of endodontists used rubber dam for isolation. NaOCl was the most widely used irrigant. Most of the respondents associated different techniques for root canal filling. Lateral condensation and Continuous wave of condensation were the isolated technique most reported. Glass ionomer was the preferred temporary filling material. The most of endodontists used an apex locator; 67.38% utilized magnification (loupe: 23.66%; microscope: 35.48%; microscope and loupe: 8.24%); 58% reported to digital radiography; and 47.31% used computed tomography as a complementary tool. The difficulties encountered during endodontic treatment were classified as preparation > access > obturation > anesthesia > isolation.

## References


1. Zou H, Li Y, Lian X, Yan Y, Dai X, Wang G. Frequency and Influencing Factors of Rubber Dam Usage in Tianjin: A Questionnaire Survey. Int J Dent. 2016;2016:7383212. doi: 10.1155/2016/7383212.
2. Lababidi EA. Discuss the impact technological advances in equipment and materials have made on the delivery and outcome of endodontic treatment. Aust Endod J. 2013 Dec;39(3):92-7. doi: 10.1111/aej.12040.
3. Mortman RE. Technologic advances in endodontics. Dent Clin North Am. 2011 Jul;55(3):461-80 , vii-viii. doi: 10.1016/j.cden.2011.02.006.
4. Lee M, Winkler J, Hartwell G, Stewart J, Caine R. Current trends in endodontic practice: emergency treatments and technological armamentarium. J Endod. 2009 Jan;35(1):35-9. doi: 10.1016/j.joen.2008.10.007.
5. Glickman GN, Koch KA. 21st-century endodontics. J Am Dent Assoc. 2000 Jun;131 Suppl:39S-46S.
6. Bahcall J. Today's endodontic therapy driven by advances in technology, changes in thinking. Compend Contin Educ Dent. 2015 May;36(5):378-9.
7. Bjørndal L, Reit C. The adoption of new endodontic technology amongst Danish general dental practitioners. Int Dent J. 2005 Jan;38(1):52-8.
8. Clarkson RM, Podlich HM, Savage NW, Moule AJ. A survey of sodium hypochlorite use by general dental practitioners and endodontists in Australia. Aust Dent J. 2003 Mar;48(1):20-6.

9. Dutner J, Mines P, Anderson A. Irrigation trends among American Association of endodontists members: A web-based survey. J Endod. 2012 Jan;38(1):37-40. doi: 10.1016/j.joen.2011.08.013.

10. Gupta R, Rai R. The adoption of new endodontic technology by Indian dental practitioners: A questionnaire survey. J Clin Diagn Res. 2013 nov; 7(11):2610-4. doi: 10.7860/JCDR/2013/5817.3628.

11. Hommez GMG, Braem M, de Moor RJG. Root canal treatment performed by Flemish dentists. Part 1. Cleaning and shaping. Int Dent J. 2003 Mar;36(3):166-73.

12. 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 May 4;2014:865780. doi: 10.1155/2014/865780.

13. Kaptan RF, Haznedaroglu F, Kayahan MB, Basturk FB. An investigation of current endodontic practice in Turkey. ScientificWorldJournal. 2012;2012:565413. doi: 10.1100/2012/565413.

14. Kersten DD, Mines P, Sweet M. Use of the microscope in endodontics: Results of a questionnaire. J Endod. 2008 Jul;34(7) 804-7. doi: 10.1016/j.joen.2008.04.002.

15. Locke M, Thomas MB, Dummer PMH. A survey of adoption of endodontic nickel-titanium rotary instrumentation part 1: general dental practitioners in Wales. Br Dent J. 2013 Feb;214(3):E6. doi: 10.1038/sj.bdj.2013.108.

16. Lynch CD, McConnell RJ. Attitudes and use of rubber dam by Irish general dental practitioners. Int Endod J. 2007 Jun;40(6):427-32.

17. 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 May;40(5):618-24. doi: 10.1016/j.joen.2014.01.029.

18. Slaus G, Bottenberg P. A survey of endodontic practice amongst Flemish dentists. Int Endod J. 2002 Sep;35(9):759-67.

19. Gurgel Filho ED, Coutinho Filho T, de Deus G, Krebs RL. [Critical study of the philosophy of endodontic treatment in a single session in Brazilian and North American universities]. Rev Bras Odontol. 1999;56(4):148-52. Portuguese.

20. Santos KS, Oliveira MRNS, Moraes VR. [Conception of endodontists regarding new technologies and teaching in the area]. Rev Bras Odontol. 2001;58(6):368-72. Portuguese.

21. Pedrosa FAS, Silveira RR, Yamauti M, Castro CDL, Freitas ABDA. [Isolation of the Operative Field: panorama of use in private clinics and clinics of Belo Horizonte. MG, Brazil]. Pesq Bras Odontoped Clin Integr. 2011;11(3):443-9. Portuguese.

22. Udoye CI, Sede MA, Jafarzadeh H, Abbott PV. A survey of endodontic practices among dentists in Nigeria. J Contemp Dent Pract. 2013 Mar;14(2):293-8 .

23. Whitten BH, Gardiner DL, Jeansonne BG, Lemon RR. Current trends in endodontic treatment: report of a national survey. J Am Dent Assoc. 1996 Sep;127(9):1333-41.

24. Gutmann JL. Revisting the scope of contemporary endodontics. Dent Today. 2015 May;34(5):14-5.

25. Kishen A, Peters OA, Zehnder M, Diogenes AR, Nair MK. Advances in endodontics: Potential applications in clinical practice. J Conserv Dent. 2016 May-Jun;19(3):199-206. doi: 10.4103/0972-0707.181925.