

Current trends in irrigation among Brazilian endodontists

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ABSTRACT

Introduction: Different irrigants have been studied, proposed and used during endodontic therapy. The aim of this study was to determine current trends in irrigation among Brazilian endodontists. **Methods:** A total of 398 Brazilian endodontists answered a web-based survey questionnaire with 15 multiple-choice questions, multiple selections and numeric rankings about their irrigant selection, concentration, smear layer removal, and use of adjuncts to irrigation. **Results:** Sodium hypochlorite was the irrigant most primarily used at a concentration lower than 5.0%. Chlorhexidine (CHX) was the second primarily irrigant used, and 2% CHX

gel was the most prevalent. Regarding smear layer removal, 88.4% of respondents declared to remove it, while EDTA was the irrigant most used (93.7%). More than 70% of endodontists use an adjunct to irrigation, with 39.9% using ultrasonic activation, 24.4% using plastic file, and 1.0% using sonic activation. The use of EndoVac was not reported. **Conclusions:** Most respondents used sodium hypochlorite and routinely remove smear layer during endodontic treatment using EDTA. Brazilian endodontists are using an adjunct to aid irrigation technique.

Keywords: Endodontics. Therapeutic irrigation. Dental pulp cavity.

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Introduction

Cleaning and shaping is an important stage of root canal treatment.¹ The procedures include removal of vital and necrotic tissue, and reduction of root canal infection.^{1,2} An important aspect is that due to complex anatomy of the root canal system, all instruments, including conventional hand files, nickel-titanium rotary instruments and self-adjusting file instruments, are not able to touch all dentin surface, thus leaving parts of the root canal surface unprepared.³⁻⁵ To reach these uninstrumented surfaces, the use of irrigants is indispensable.⁵

According to Zehnder,⁶ an ideal irrigant should be nontoxic, noncaustic to periodontal tissues, have a broad antimicrobial spectrum, act on endodontic biofilm, inactivate endotoxins, be capable of dissolving vital and necrotic pulp tissue, have little potential to cause anaphylactic reaction and either prevent formation of smear layer or dissolve it when formed. However, no irrigant combines all these properties. Therefore, during root canal treatment, different irrigants are used.

During preparation, sodium hypochlorite (NaOCl) is used due to its ability to dissolve organic tissue in association with effective antimicrobial properties.^{6,7} Chlorhexidine (CHX) has been used because it is an effective antimicrobial agent with substantivity. Nevertheless, CHX lacks tissue-dissolving capabilities. Thus, it has been suggested as final irrigant and intracanal medication.^{6,8}

During instrumentation, an amorphous irregular layer known as smear layer is formed. This layer forms a barrier between filling material and sound dentin, which inhibits the penetration of irrigants into dentinal tubules, increases microleakage of commonly used sealers, and decreases bond strength of resin-based materials.⁹ The use of agents, such as EDTA (ethylenediaminetetraacetic acid), citric acid, phosphoric acid, MTAD (a mixture of doxycycline, citric acid, and Tween 80 detergent) and QMix (a mixture of a bisbiguanide antimicrobial agent, a polyamino-carboxylic acid, calcium-chelating agent, saline, and a surfactant) are suggested to remove smear layer.⁹⁻¹¹

Different adjuncts have been developed to improve delivery and effectiveness of irrigants. Plastic file, sonic and ultrasonic agitation allow safe activation of intracanal solutions and could produce vigorous

intracanal fluid agitation. Systems, such as EndoVac (Discus Dental, Culver City, CA, USA) use negative pressure to safely bring irrigants into contact with all surfaces of the root canal.^{12,13,14} These adjuncts may allow irrigants to have access to root canal irregularities.¹⁴

Different irrigants have been studied, proposed and used; however, there is no research conducted to determine the widespread practice among Brazilian endodontists. Thus, the aim of this study was to ascertain the current trends in irrigation among Brazilian endodontists.

Material and Methods

An invitation to participate in a web-based survey was e-mailed to members of the Brazilian Forum on Endodontics, an online group of clinical specialists and researchers in Endodontics. The survey has as instrument a questionnaire with 15 multiple-choice questions, numeric rankings and multiple selections, based on survey design proposed by Dutner et al¹⁴ with modifications. The questions were about region of activity in Brazil and years as a specialist, type of irrigant used, the irrigant primarily used, concentration of sodium hypochlorite, concentration and presentation of chlorhexidine, phase of treatment that chlorhexidine is used, reasons for primary irrigant selection, if the choice of irrigant(s) differ based on pulpal or periapical diagnosis, irrigants used in cases of retreatment, if the participant removes smear layer, the irrigant used for this purpose, and if any adjuncts to irrigation are used. The questionnaire (translated from Brazilian Portuguese into English) is seen in Table 1. A total of two reminders were issued until the survey was closed after eight weeks. Data were collected and analyzed by IBM SPSS 15.0 software.

Statistical analyses were performed using Spearman test, so as to verify if there was correlation among questions.

Results

A total of 398 complete questionnaires were received (a response rate of 9.7%).

Among the respondents, 5% of endodontists completed their postgraduate endodontic training more than 30 years ago; 7% between 21-30 years; 19.1% between 11-20 years; 24.1% between 5-10 years and

Table 1. Questionnaire.

1- How many years ago did you complete your postgraduate endodontic training? 1) > 30 2) 21–30 3) 11–20 4) 5–10 5) < 5	6- What concentration and presentation form of chlorhexidine do you use? 1. 0.12% gel 2. 0.12% solution 3. 0.2% gel 4. 0.2% solution 5. 2% gel 6. 2% solution 7. I do not use chlorhexidine	11- Which of the following irrigants would you primarily utilize when treating a tooth with a necrotic pulp? 1. Sodium hypochlorite 2. Chlorhexidine 3. EDTA 4. Citric acid 5. Hydrogen peroxide 6. Saline 7. Sterile water 8. Others
2- In which region of Brazil do you practice your clinical activity? 1. South 2. Southeast 3. North 4. Northeast 5. Midwest	7- Which phase of treatment do you use chlorhexidine? 1. During preparation 2. As intracanal medication 3. As final flush 4. I do not use chlorhexidine	12- Which of the following irrigants would you primarily utilize when treating a previously treated tooth? 1. Sodium hypochlorite 2. Chlorhexidine 3. EDTA 4. Citric acid 5. Hydrogen peroxide 6. Saline 7. Sterile water 8. Others
3- Which irrigants do you use? 1. Sodium hypochlorite 2. Chlorhexidine 3. EDTA 4. Citric acid 5. Hydrogen peroxide 6. Saline 7. Sterile water 8. Others	8- Rank the reasons for your primary irrigant selection from (5- most important 1- less important) 1. Antibacterial capability ____ 2. Biocompatibility____ 3. Tissue dissolution____ 4. Substantivity____ 5. Expense____	13- Do you remove the smear layer? 1. Yes 2. No 3. Sometimes
4- Which irrigant do you primarily use? 1. Sodium hypochlorite 2. Chlorhexidine 3. EDTA 4. Citric acid 5. Hydrogen peroxide 6. Saline 7. Sterile water 8. Others	9- Does your choice of irrigant(s) differ based on the pulpal or periapical diagnosis? 1. Yes 2. No	14- Which agent do you use to remove the smear layer? 1. EDTA 2. Citric acid 3. Phosphoric acid 4. MTAD 5. QMix 6. Maleic acid 7. Outro 8. I do not remove smear layer
5- Which concentration of sodium hypochlorite do you primarily use? 1. <0.5% 2. 0.5%–1.5% 3. 1.6%–2.5% 4. 2.6%–4.0% 5. 4.1%–5.0% 6. >5.0% 7. I do not use sodium hypochlorite	10- Which of the following irrigants would you primarily utilize when treating a tooth with a vital pulp? 1. Sodium hypochlorite 2. Chlorhexidine 3. EDTA 4. Citric acid 5. Hydrogen peroxide 6. Saline 7. Sterile water 8. Others	15- Which, if any, adjuncts to irrigation do you utilize? 1. Ultrasonic activation 2. Sonic activation (Smart sonic, Endoactivator, etc) 3. Plastic file (Easyclean) 4. EndoVac 5. I do not utilize adjuncts to irrigation

44.7% below 5 years. Regarding the region of Brazil where endodontists exert their clinical activity, 59.5% are in the Southeast; 21.9% in the South; 8.3% in the Northeast; 7% in the Midwest; and 3.3% in the North.

As observed in Figure 1, sodium hypochlorite (88.2%) and EDTA (85.4%) were the most prevalent irrigants used. Followed by chlorhexidine (44.7%), saline solution (42%), sterile water (12.1%), citric acid (5.3%), hydrogen peroxide (4.4%), and others (2.3%).

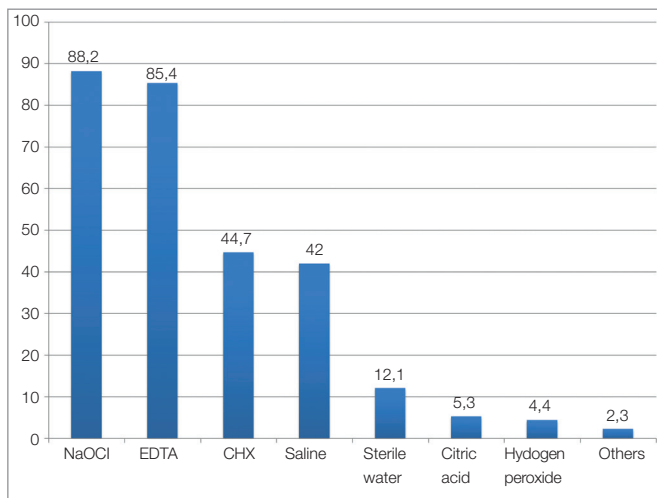


Figure 1. Percentage of endodontists who include each irrigant as any part of their irrigation protocol (Multiple responses were accepted).

Sodium hypochlorite was the irrigant primarily used in 83.4% of cases, followed by chlorhexidine in 12.3% of cases. Saline solution (3%), EDTA (0.8%), sterile water (0.3%), and others (0.2%) were also reported as primary irrigants (Fig 2).

Regarding the use of different NaOCl concentrations, it was ranked as: 1.6%-2.5% (54.7% of endodontists) > 2.6% - 4.0% (15.4% of endodontists) > greater than 5% (15.1% of endodontists) > 0.5% - 1.5% (10.8% of endodontists) > 4.1% - 5.0% (3.5% of endodontists) > lower than 0.5% (0.6% of endodontists) (Fig 2).

In respect to the use of chlorhexidine during different phases of treatment (Fig 3), 51.3% declared to use it. Out of these respondents, 76% of endodontists declared they use CHX during preparation; 45% as intracanal medication, and 22% as final irrigant. Regarding its presentation form and concentration, 53.2% of endodontists use 2% CHX gel; 22.6% of endodontists use 2% CHX solution; 8.1% of endodontists use 0.2% CHX gel; 4.7% of endodontists use 0.2% CHX solution; 6.7% of endodontists use 0.12% CHX gel, and 4.7% of endodontists use 0.12% CHX solution.

When asked to rank the reasons for their primary irrigant selection, antibacterial capability was the most important, followed by tissue dissolution, biocompatibility, substantivity, and costs.

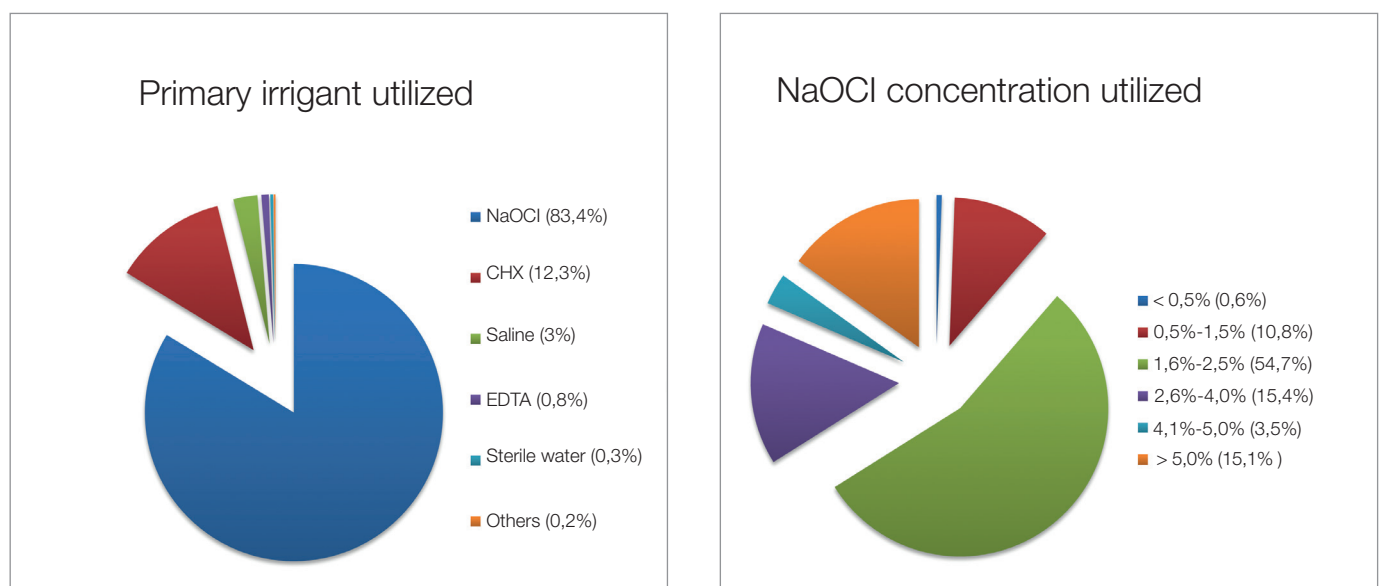


Figure 2. Responses of the irrigant primarily used and NaOCl concentration.

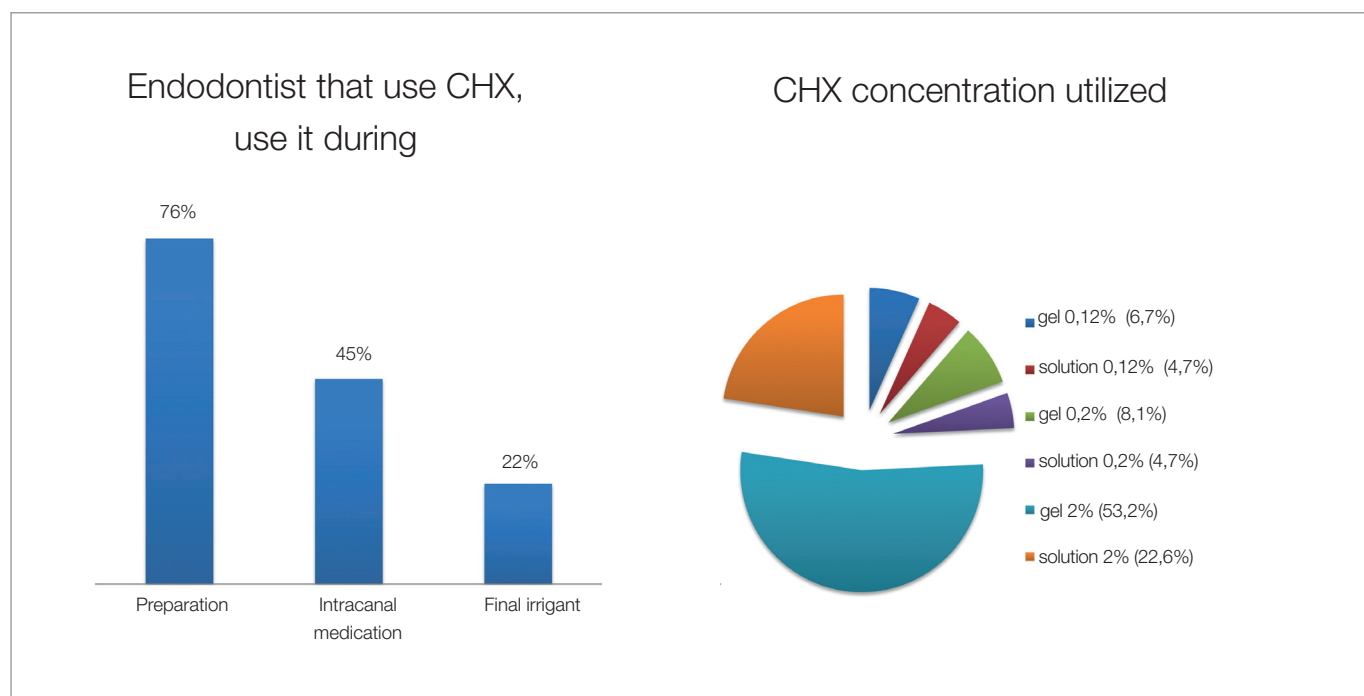


Figure 3. Responses of endodontists that use chlorhexidine (CHX).

Most endodontists (62.1%) will not change their irrigant selection on the basis of pulpal or periapical diagnoses. Sodium hypochlorite was the most used irrigant regardless of vital (79.6%) or necrotic pulp (80.7%) and in cases of retreatment (74.9%). The use of CHX was superior in cases of retreatment (16.3%), followed by 14.6% for necrotic pulp and 13.6% for vital pulp.

Regarding smear layer removal, 88.4% of respondents remove it during endodontic treatment and 93.7% of endodontists use EDTA for this purpose. Citric acid (2.3%), phosphoric acid (0.8%), MTAD (0.3%) and others (0.5%) were also used.

More than 70% of endodontists use an adjunct to irrigation, (72.1%). Out of those endodontists, 55% of them use ultrasonic activation, 34% plastic file, 1% sonic activation and 9% use other methods. The use of EndoVac was not reported. No correlation was observed among questions.

Discussion

The present study evaluated the current trends in irrigation among Brazilian endodontists. This study has provided knowledge about the irrigants profile used in Brazilian population.

Sodium hypochlorite was the most common irrigant used (88.2% of respondents). It can be associated with the fact that this is the only irrigant able to dissolve organic tissue and to exert effective antimicrobial activity.^{6,7} Additionally, when asked to rank the reasons for their primary irrigant selection, antibacterial capability and tissue dissolution were the most important reasons.

In the present study, the rate of NaOCl use as primary irrigant was 83.4%. Dutner et al¹⁴ found that the overwhelming majority of American endodontists (91%) use sodium hypochlorite as their primary irrigant. Clarkson et al,¹⁵ in a survey conducted in Australia, reported that 94% of endodontists used sodium hypochlorite. In a United Kingdom survey among 643 general dentists, irrigant choice was strongly linked to rubber dam use and 71% of rubber dam users irrigated with sodium hypochlorite.¹⁶ However, in a survey conducted in North Jordan among general dentists, only 32.9% of respondents used sodium hypochlorite.¹⁷ In a survey conducted in Iran, 42.9% of general dentist respondents used sodium hypochlorite and 61.8% used saline solution.¹⁸ The use of NaOCl as primary irrigant is commonly observed among endodontists; nevertheless, this rate decreases

es when general dentists were the respondents.

In the present study, NaOCl concentration most used was between 1.6% and 2.5%, and only 15.1% of Brazilian endodontists use concentration greater to 5%. Among members of the American Association of Endodontics (AAE), 57% of endodontists use concentration of 5% or greater.¹⁴ Among Australian endodontists, 80% used 1% NaOCl solution.¹⁵

Due to effective antimicrobial activity with substantivity, CHX has been suggested as chemical adjunct substance during preparation, as intracanal medication and as final irrigant.^{6,8} In the present study, 44.7% of endodontists responded that they use chlorhexidine during endodontic treatment and 12.3% claimed they use CHX as primary irrigant. The percentage of American endodontists using CHX during any phase of endodontic treatment¹⁴ was superior (56%) to that observed in the present study (44.7%). However, as primary irrigant, 12.1% of Brazilian endodontist used CHX in comparison with only 1.1% of American endodontists.

Most endodontists using CHX during preparation opted for 2% CHX gel. In this case, saline solution or sterile water need to be used as irrigant.^{8,19} The high values in the use of saline solution and sterile water as irrigants can be associated with the use of CHX gel,⁸ as well as the use of an inert irrigant to remove traces of active irrigants.^{8,19}

When asked if the choice of irrigant differ based on pulpal or periapical diagnosis, most endodontists (62.1%) will not change their irrigant selection on the basis of pulpal or periapical diagnoses and their primary irrigant was sodium hypochlorite, in accordance with Dutner et al.¹⁴ The use of CHX in cases of

vital pulp was lower than necrotic pulp. An explanation is that CHX lacks tissue-dissolving capabilities.⁸ In cases of retreatment, the use of CHX as primary irrigant was greater than in cases of vital and necrotic pulp. These answers should be interpreted with caution because the questions were not open-ended and did not allow protocols with multiple irrigants to be considered.

In the present study, 88.4% of endodontists declare they remove smear layer. A previous survey among members of AAE revealed that 51% of practicing endodontists removed smear layer in 2001,²⁰ and in 2012¹⁴ this rate improved to 77% of endodontists. EDTA was the most common irrigant used in the present study (93.7%) and among AAE members (80%).^{14,20}

More than 70% of endodontists use an adjunct to irrigation (72.1%). Out of those respondents, 55% use ultrasonic activation, 34% plastic file, 1% use sonic activation and 9% use other methods. The use of EndoVac was not reported. The use of adjuncts can improve the activity of an irrigant, favoring its capacity of tissue dissolution, antimicrobial activity and smear layer removal activity.^{13,21-24}

Conclusions

Most respondents used sodium hypochlorite and routinely remove smear layer during endodontic treatment using EDTA. Brazilian endodontists are using an adjunct to aid irrigation technique.

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References

- Schilder H. Cleaning and shaping the root canal. *Dent Clin North Am.* 1974 Apr;18(2):269-96.
- Yu DC, Schilder H. Cleaning and shaping the apical third of a root canal system. *Gen Dent.* 2001 May-June;49(3):266-70.
- Peters OA. Current challenges and concepts in the preparation of root canal systems: a review. *J Endod.* 2004 Aug;30(8):559-67.
- Topcu KM, Karatas E, Ozsu D, Ersoy I. Efficiency of the Self Adjusting File, WaveOne, Reciproc, ProTaper and hand files in root canal debridement. *Eur J Dent.* 2014 July;8(3):326-9.
- Ahmetoglu F, Keles A, Simsek N, Ocak MS, Yologlu S. Comparative evaluation of root canal preparations of maxillary first molars with Self-Adjusting File, Reciproc Single File, and Revo-S rotary file: A micro-computed tomography study. *Scanning.* 2015 May-June;37(3):218-25.
- Zehnder M. Root canal irrigants. *J Endod.* 2006 May;32(5):389-98.
- Zehnder M, Kosicki D, Luder H, Sener B, Waltimo T. Tissue-dissolving capacity and antibacterial effect of buffered and unbuffered hypochlorite solutions. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002 Dec;94(6):756-62.
- Gomes BP, Vianna ME, Zaia AA, Almeida JF, Souza-Filho FJ, Ferraz CC. Chlorhexidine in endodontics. *Braz Dent J.* 2013;24(2):89-102.
- Leal F, Simão RA, Fidel SR, Fidel RA, Prado M. Effect of final irrigation protocols on push-out bond strength of an epoxy resin root canal sealer to dentin. *Aust Endod J.* 2015 Dec;41(3):135-9.
- Prado M, Gusman H, Gomes BP, Simão RA. Scanning electron microscopic investigation of the effectiveness of phosphoric acid in smear layer removal when compared with EDTA and citric acid. *J Endod.* 2011 Feb;37(2):255-8.
- Adigüzel O, Yiğit-Özer S, Kaya S, Uysal İ, Ganidağlı-Ayaz S, Akkuş Z. Effectiveness of ethylenediaminetetraacetic acid (EDTA) and MTAD on debris and smear layer removal using a self-adjusting file. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2011 Dec;112(6):803-8.
- Gu LS, Kim JR, Ling J, Choi KK, Pashley DH, Tay FR. Review of contemporary irrigant agitation techniques and devices. *J Endod.* 2009 June;35(6):791-804.
- Kato AS, Cunha RS, ES, Pelegrine RA, Fontana CE, Martin AS. Investigation of the efficacy of passive ultrasonic irrigation versus irrigation with reciprocating activation: an environmental scanning electron microscopic study. *J Endod.* 2016 Apr;42(4):659-63.
- 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.
- 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.
- Whitworth JM, Seccombe GV, Shoker K, Steele JG. Use of rubber dam and irrigant selection in UK general dental practice. *Int Endod J.* 2000 Sept;33(5):435-41.
- Al-Omari WM. Survey of attitudes, materials, and methods employed in endodontic treatment by general dental practitioners in North Jordan. *BMC Oral Health.* 2004;4:1-6.
- Raouf M, Zeini N, Haghani J, Sadr S, Mohammadalizadeh S. Preferred materials and methods employed for endodontic treatment by Iranian general practitioners. *Iran Endod J.* 2015;10(2):112-6.
- Prado M, Simão RA, Gomes BP. Effect of different irrigation protocols on resin sealer bond strength to dentin. *J Endod.* 2013 May;39(5):689-92.
- Moss HD, Allemang JD, Johnson JD. Philosophies and practices regarding the management of the endodontic smear layer: results from two surveys. *J Endod.* 2001 Aug;27(8):537-9.
- Paragliola R, Franco V, Fabiani C, Mazzoni A, Nato F, Tay FR, et al. Final rinse optimization: influence of different agitation protocols. *J Endod.* 2010 Feb;36(2):282-5.
- Jiang LM, Lak B, Eijssvogels LM, Wesselink P, van der Sluis LW. Comparison of the cleaning efficacy of different final irrigation techniques. *J Endod.* 2012 June;38(6):838-41.
- Niu LN, Luo XJ, Li GH, Bortoluzzi EA, Mao J, Chen JH, et al. Effects of different sonic activation protocols on debridement efficacy in teeth with single-rooted canals. *J Dent.* 2014 Aug;42(8):1001-9.
- Plotino G, Pameijer CH, Grande NM, Somma F. Ultrasonics in endodontics: a review of the literature. *J Endod.* 2007 Feb;33(2):81-95.