Assessment of Knowledge about the Effects of Root Canal Irrigants among Dental Students

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Abstract

Root canal procedure includes access opening, cleaning and shaping and a proper obturation with adequate seal of the root canal. Complete debridement of the smear layer and the infective microorganisms is an important step in the procedure. Root canal irrigants is necessary to flush out the debris, dissolving tissue and for disinfecting the root canal.

Aim: To assess the knowledge about the various effects of the root canal irrigants in the root canal treatment among dental students.

Objective: The objective of this survey would be to understand the awareness of the various root canal irrigants among dental students.

Materials and methods: A closed ended questionnaire containing 15 questions were given to 300 dental students of third year, final year and interns.

Results: The results of the survey showed that sodium hypochlorite was the most popular irrigant and chlorhexidine was the second most popular irrigant if the patient was allergic to chlorine.

Keywords: Root canal irrigant, dental, sodium hypochlorite, chlorhexidine, saline

Introduction

The aim of endodontic treatment is to reduce the infection of the root canal system in order to allow the host response to favor the healing of the periapical tissues. [1] Irrigation of the root canal is necessary as it performs certain mechanical functions like removing particulate debris, wetting of the root canal and removing the smear layer. Irrigation also possesses certain biologic functions which pertain to the irrigants bacteriostatic or bactericidal properties. [2]
Zehnder has described an ideal root canal irrigant as systemically nontoxic, non-irritant and biocompatible to the oral hard and soft tissues, possessing broad antimicrobial qualities, capable of dissolving necrotic pulp tissue, and either preventing the formation of a smear layer or dissolving it once it has formed. [3] Many irrigating solutions have been studied extensively to determine the irrigant with ideal properties, but the ideal irrigant has not yet been identified. [4]
The main goals of a root canal treatment are three-dimensional cleaning and shaping, and a proper obturation with adequate seal of the root canal. Complete debridement, with the smear layer removal is an important step in the treatment. [5]

Removal of microorganisms from infected root canals is a complicated task. The outcome of the treatment is higher if the infection is eradicated effectively before the root canal system is obturated. However, there is always a high risk of treatment failure if microorganisms persist at the time of obturation, or if they penetrate into the canal after obturation. [6, 7]

The success of the root canal therapy depends on the chemo mechanical debridement of dentin debris pulpal tissue, and infective microorganisms. Irrigants have the capacity to augment mechanical debridement by flushing out debris, dissolving tissue, and disinfecting the root canal system. Chemical debridement is needed for teeth with complex internal anatomy such as fins or other irregularities that might be missed by instrumentation. [8]

Ideal requirements of a root canal irrigant are: [3]

1. High efficacy against anaerobic and facultative microorganisms organized in biofilms
2. Ability to dissolve necrotic pulp tissue remnants and inactivate endotoxin
3. Prevent the formation of a smear layer during instrumentation or to dissolve the latter once it has formed.
4. Broad antimicrobial spectrum
5. As the endodontic irrigants come in contact with vital tissues they should be systematically nontoxic, non caustic to periodontal tissues, and with little potential to cause an anaphylactic reaction.

A successful endodontic treatment depends primarily on the obliteration of the root canal which results in the elimination of microorganisms from the root-canal system and prevention of their re infection. This can be achieved by constant irrigation to remove the inflamed and necrotic tissue, microbes/ biofilms, and other debris from the root-canal space. [9]

The complex anatomy of root canal system demands the use of various adjuncts during cleaning and shaping before the final obturation. Cleaning and shaping is done with hand and rotary instruments under constant irrigation to remove the inflamed and necrotic tissue, microbes/biofilms, and other debris from the root canal space. Even though many irrigants have been identified, none of them is identified as the ideal irrigant with the above mentioned properties. [9]

The root canal treatment involves a chemo-mechanical preparation of the root canal system to achieve a 3 dimensional cleaning. It is nearly impossible to mechanically clean the canal system, hence the need to use an irrigant solution. The functions of the irrigant would be to debride the root canal system and provide lubrication for the files.[9] There are several irrigants available in the market and the clinician has to make a decision to choose an ideal irrigant.
The aim of this study was to assess the knowledge about the different root canal irrigants among the dental students. The study also aimed in creating awareness about the different aspects of irrigation during the root canal treatment.

Endodontic Microbiology

Kakehashi et al. showed the importance of the oral microorganisms causing infection of pulp and periapical lesion formation. [10] The micro flora of the untreated teeth with necrotic pulps is found to be mixed, consisting of Gram-positive and Gram-negative organisms, with a predominance of anaerobic bacteria. [11]The microorganisms which are found in the endodontic treatment failure comprises of one or two species, mostly Gram-positive bacteria with Enterococcus faecalis as the most prevalent organism.[12]Fungi, Candida albicans can also be found at a significantly higher rate than what is seen in the primary infection.[13]

It is well established that bacteria are the main causative factors in the development of dentinal caries and its progression to pulpal and periapical disease.[14] E. faecalis is the bacterial species most commonly recovered from root-filled teeth. Studies have shown that the E. faecalis is able to withstand a high alkaline environment such as the one generated by calcium hydroxide.[15]The resistance appears to be related to a cell proton-pump that is necessary for the survival of the bacterium at high pH.[16]Therefore, E. faecalis is able to form biofilms in the calcium-hydroxide-medicated root canals. [17]

Current methods available for bacterial reduction in endodontic therapies include mechanical instrumentation to clean and widen the root canal space, and chemical disinfection by irrigation and intracanal medication, known as the antimicrobial dressing. [18] The use of irrigants in conjunction with mechanical instrumentation is essential for loosening and aids in removing debris and bacteria. It is important that the irrigating solution should also provide antibacterial effects which may include the killing of bacteria in the root canal system and provide disinfection in areas of the canal that are inaccessible to the mechanical instrumentation. Numerous irrigating solutions are recommended for clinical endodontic use. [19]

The primary root canal infections are polymicrobial, typically dominated by obligatory anaerobic bacteria[20]. The most frequently isolated microorganisms before root canal treatment are Gram-negative anaerobic rods, Gram-positive anaerobic cocci ,Gram-positive anaerobic and facultative rods, Lactobacillus species, and Gram-positive facultative Streptococcus species. [3]The obligate anaerobes are rather easily eradicated during the root canal treatment. On the other hand, facultative bacteria like non mutans Streptococci, Enterococci, and Lactobacilli, once established, are more likely to survive chemomechanical instrumentation and root canal medication. [21] In particular Enterococcus faecalis has gained more attention in the endodontic literature, as it can frequently be isolated from root canals in cases of failed root canal treatments [22]. In addition, yeasts can also be found in root canals associated with therapy-resistant apical periodontitis. [23] The aim of this study is to assess the knowledge about the various effects of the root canal irrigants in the root canal treatment among dental students.

Materials and Methods

This is a questionnaire based study on the assessment of knowledge about the root canal irrigants. A total number of 300 students undertook the survey. The questionnaire was distributed among the dental students of three different dental colleges in Chennai. A total of 15 questions were asked to the students and was manually filled by them.(fig 1 and fig2) Individuality was assured when the students filled the survey. After the data collection, statistical analysis was done.

Assessment of knowledge about the effects of root canal irrigants among dental students

Quesstionaire

1. Do you use rubber dam isolation while doing root canal treatment?
A) Yes
B) No

2.Which of the following irrigants do you primarily use for cleaning ad shaping?
A) Normal saline
B) EDTA
C) Hydrogen peroxide
D) Sodium hypochlorite
E) Chlorhexidine
F) Combination of irrigants

3. Which method of irrigant agitation technique do you commonly use?
A) Syringe with needle
B) Manual dynamic agitation
C) Rotary brushes
D) Sonic/ultrasonic
E) Other

4. How much volume of irrigant do you employ in the canal?
A) 0.5
B) 2.5 ml
C) 5-10 ml
D) >10 ml
E) I don't know

5. Rank the reasons for your primary irrigant selection from the most important to least important?

1	Antibacterial capability		4	Substantivity	
2	Biocompatibility		5	Expense	
3	Tissue dissolution				

6. Which concentration of sodium hypochlorite do you primarily use?
A) <0.5%
B) 0.5-1.5%
C) 1.5-2.5%
D) >2.5%
E) I do not know the concentration used
F) I do not use sodium hypochlorite

7. If sodium hypochlorite is the irrigant that you primarily use, what other irrigant would you use if the patient reports allergy to chlorine ?
A) Chlorhexidine
B) Distilled water
C) saline
D) sodium hypochlorite is not my first choice of irrigant
E) other

Figure 1: Questionnaire

8.Which concentration of chlorhexidine do you use?
A) 0.17% B) 0.18-0.19%
C) 2.0% D) >2%
E) I do not know the concentration used
F) I do not use chlorhexidine

9. Does the choice of irrigant differ based on the pulp (vital or necrotic pulp)?
A) Yes B) No

10. Which of the following irrigant would you use when treating a tooth with a vital pulp? (specify the order)

1	Sodium hypochlorite		4	Distilled water	
2	Chlorhexidine		5	Others	
3	Saline				

11. Does your choice of irrigant differ based upon the periapical diagnosis?
A) Yes B) No

12. Which of the following irrigant would you primarily use when treating a tooth with radiographic evidence of a periapical lesion?
A) Sodium hypochlorite D) Sterile water
B) Chlorhexidine E) Others
C) Saline

13. Do you routinely aim in removing the smear layer
A) Yes B) No

14. Which of the following irrigant would you primarily utilise for smear layer removal?
A) Sodium hypochlorite B) Chlorhexidine
C) Saline D) Distilled water
E) EDTA F) MTAD
G) other

15. What is the length of the time that you use for smear layer removal?
A) <15 sec B) 15 sec
C) 30 sec D) 45sec
E) 60 sec F) >60 sec

Figure 2: Questionnaire

Results

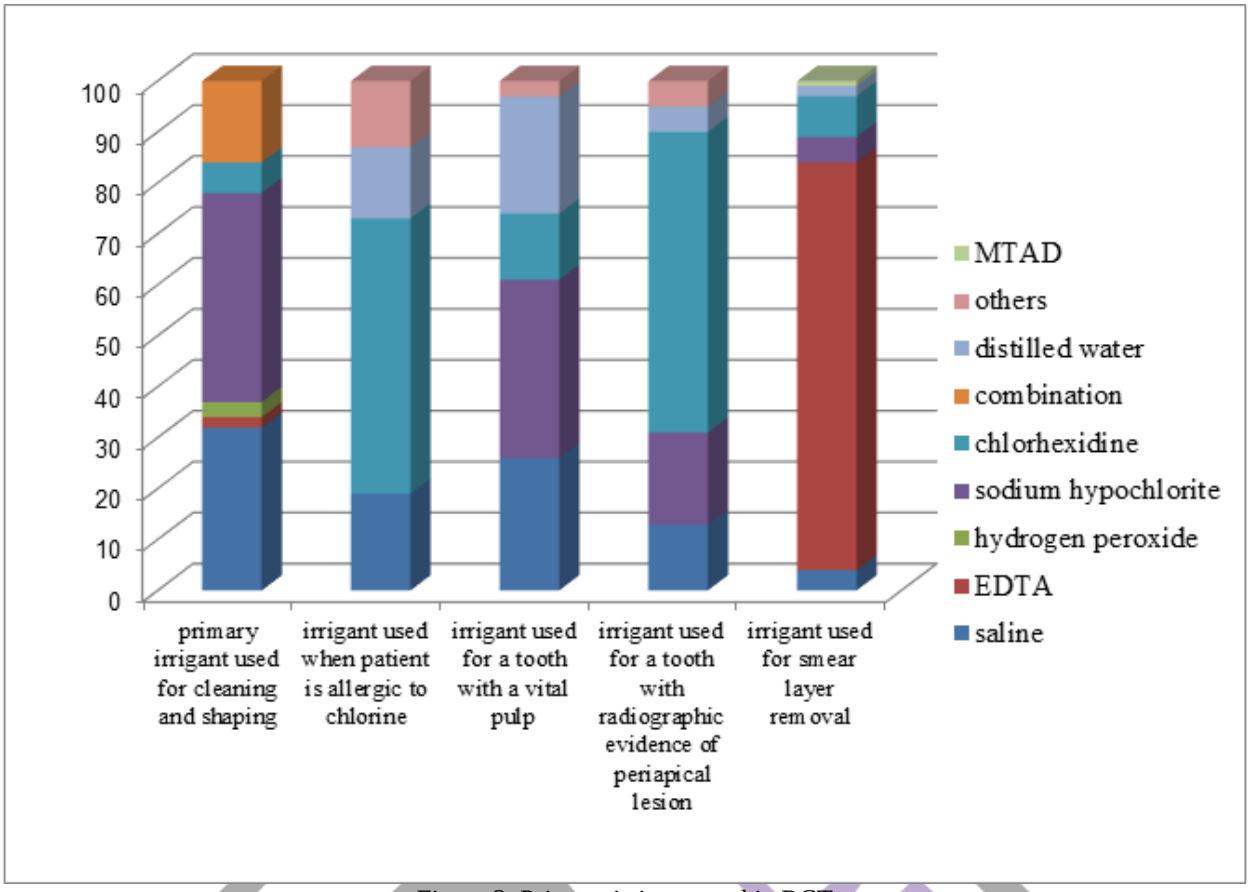

Figure 3: Primary irrigant used in RCT

The graph depicts the different irrigants which are used for various purposes during the cleaning and shaping of a root canal. From the graph (fig 3) it is understandable that sodium hypochlorite is the most commonly used irrigant and chlorhexidine is the irrigant used when the patient is allergic to chlorine. Sodium hypochlorite is used for a tooth with a vital pulp chlorhexidine is the choice of irrigant for a tooth with radiographic evidence of periapical lesion. EDTA is mainly used for smear layer removal. Further the study revealed that 100% of respondents used rubber dam isolation. 98% of the respondents used syringe with needle for irrigation. A minor portion of the respondents (25%) were not aware of the concentration of chlorhexidine used. The majority of the respondents (58%) felt that the choice of irrigant is based on the status of the pulp.

Discussion

In this study, the response rate was very high. Among the data collected it was found that 100% of students use rubber dam isolation while performing the root canal treatment. This was in contrast with the other studies conducted. The use of rubber dam by Belgian dental practitioners was low. Only 7% of the practitioners used rubber dam in all cases, even though the use of rubber dam is taught in every dental school in Flanders. [24]

Sodium hypochlorite was the most popular choice as a primary irrigant with 41% of students using it during their treatment, followed by saline (32%), combination of irrigants (16%), chlorhexidine (6%), hydrogen peroxide (3%), EDTA (2%). These results were similar to the other studies conducted. Sodium hypochlorite was the most common irrigant used by the Flemish dentists with 82.4% [6], dental practitioners in Himachal Pradesh also used sodium hypochlorite as their primary choice of irrigant. [25]
Siqueira et al. evaluated the effectiveness of 4% NaOCl against Enterococcus faecalis in vitro and reported that it was significantly more effective than saline solution (control group) in disinfecting the root canal. [27]

In another study, Siqueira et al. compared the antibacterial activity of various irrigants against four black-pigmented anaerobic bacteria and four facultative bacteria through an agar diffusion test. Their findings showed that the antibacterial effectiveness of 4% NaOCl and 2.5% NaOCl was significantly greater than other tested agents. [27]

Gomes et al. evaluated the effectiveness of five concentrations of NaOCl (0.5%, 1%, 2.5%, 4% and 5.25%) and two forms of chlorhexidine gluconate (CHX) (gel and liquid) in three concentrations (0.2%, 1% and 2%) in the elimination of E. faecalis. They found that all the irrigants were effective in killing E. faecalis, but at different times. CHX in the liquid form at all concentrations tested (0.2%, 1% and 2%) and NaOCI (5.25%) were the most effective irrigants. However, the time required by 0.2% chlorhexidine liquid and 2% chlorhexidine gel for promoting negative cultures was only 30s and 1min, respectively. [28]
Vianna et al. investigated the antimicrobial activity of five concentrations of NaOCl (0.5%, 1%, 2.5%, 4%, and 5.25%) and compared the results with those achieved by 0.2%, 1%, and 2% CHX. All tested irrigants eliminated Porphyromonas endodontalis,

Porphyromonas gingivalis, and Prevotellaintermedia in 15s. The timing required for 1.0% and 2.0% CHX liquid to eliminate all the microorganisms was the same required for 5.25% NaOCl. [29]

Okino et al. evaluated the tissue dissolving ability of 0.5, 1.0 and 2.5% sodium hypochlorite; 2% aqueous solution of CHX; 2% CHX gel (Natrosol™); and distilled water as control. Bovine pulp fragments were weighed and placed in contact with 20mL of each tested substance in a centrifuge at 150rpm until total dissolution. Dissolution speed was calculated by dividing the pulp weight by dissolution time. Distilled water and both solutions of CHX did not dissolve the pulp tissue within 6h. Mean dissolution speeds for 0.5, 1.0 and 2.5% sodium hypochlorite solutions were 0.31, 0.43 and 0.55mg/min, respectively. [30]

When asked about the irrigant agitation technique used, majority 98% of students used syringe with needle technique. This was in accordance with another study in chennai where syringe with needle was most common technique. [31] 44% of students use 5-10 ml of irrigant per canal during the cleaning and shaping procedure and 40% of students use more than 10 ml.
In our study the highest ranked reasons for irrigant selection was biocompatibility, followed by antibacterial capability, tissue dissolution, substantivity and expense. In another survey the highest ranked reasons for irrigant selection was antibacterial capability followed by tissue-dissolving capability. [31]

30% of students use 1.5-2.5% of sodium hypochlorite, 27% use >2.5%, 11% use 0.5-1.5%,7% use <0.5% and 8% of people are not aware of the percentage of sodium hypochlorite which they use. In previous studies, 49.3% of respondents claim to use 2.6-4.0% NaOCl [31]. In another study conducted the most popular concentration of sodium hypochlorite was 2.5%. [24] 54% of students reported that they use chlorhexidine as a replacement for sodium hypochlorite if the patients are allergic to chlorine. 52% of the respondents reported that they use 2% of chlorhexidine irrigant, and 25% of the students are unaware of the percentage of the chlorhexidine used.
58% of the students agreed that the choice of irrigant differs based on the pulp, whereas 42% of people disagreed with it. 68% of the students agreed that the choice of irrigant differs based on periapical diagnosis and the remaining disagreed with it. The primary irrigant employed for treating a tooth with radiographic evidence of a periapical lesion was chlorhexidine with 59%.
Only 72% of students aim in removing the smear layer .Recent methods to remove the smear layer involves the use of a chelating agent during irrigation or as a final rinse in combination with other irrigants. Ethylene di amine tetra acetic acid (EDTA) helps in removing the in organic component of the smear layer. [32]
In previous studies, MTAD was reported to be efficient is removing the smear layer. MTAD is effective in removing the smear layer along the whole length of the root canal and also in removing organic and inorganic debris and does produce any signs of erosion or physical changes in dentine, whereas a mixture of 5.25% sodium hypochlorite and 17% EDTA does. [33-35]

MTAD mixture is very effective against E. faecalis, and it is also less cytotoxic than a range of endodontic medicaments, including eugenol, hydrogen peroxide (3%), EDTA, and calcium hydroxide paste. [36-41]

Torabinejad et al. showed that the effectiveness of the MTAD was enhanced when low concentration of the NaOCl is used as an intracanal irrigant before the use of MTAD as a f inal rinse. MTAD does not seem to change the structure of the dentinal tubules. [40]

Newberry et al. determined the antimicrobial effect of MTAD as the final irrigant on eight strains of Enterococcus faecalis. After irrigating with 1.3% NaOCl, the root canal and the external surfaces were exposed to MTAD for 5 minutes. Roots or dentin shavings were cultured to find the growth of E. faecalis. The results showed that this treatment regimen was effective and useful in completely eliminating growth in seven of eight strains of E. faecalis. [41]

Mancini et al. compared the efficacy of Bio-Pure MTAD, 17% EDTA, and 42% citric acid in endodontic smear layer removal and the degree of erosion in the apical third of endodontic canals. [42]

None of the agents were found to be as efficient in the apical one third of the root canal. This finding is in contrast with the results of Torabinejad et al. showing an effective cleaning action with BioPure MTAD in the apical third. [40,43]

The American survey I (2001) revealed that 51% of practicing Endodontists removed the smear layer before obturation of the root canal system, [44]while the American survey II (2012) revealed that 77% of Endodontists removed the smear layer [45]. 24% of the respondents use 60 seconds to remove the smear layer.
Sodium Hypochlorite is the primary endodontic irrigant used by many of the clinicians [46] and there is also an increasing use of newer irrigants like MTAD and herbal irrigants. [47]
Further researches are recommended with increased sample size to get a correct idea about the root canal irrigants.

Conclusion

The study investigated the knowledge and the status of endodontic irrigants among the dental students. All the students in this survey used rubber dam isolation for the procedures. Chlorhexidine was the irrigant of choice as an alternative to sodium hypochlorite for patients who were allergic to chlorine. Syringe with needle was the most common irrigant agitation technique used by the students. Students did not seem to keep up with recently introduced techniques, but use more conventional methods. Sodium

hypochlorite is the primary endodontic irrigant and there is an increasing use of newer irrigants like MTAD used by the students for removing the smear layer which is essential for a successful root canal treatment.

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