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Prevalence Of Different Root Canal Irrigants Used During Endodontic Therapy - An Institution Based Retrospective Study

Research Article

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Abstract

A successful root canal treatment can only be achieved by effective removal of microorganisms and necrotic pulp tissue. The root canal space with necrotic pulp provides space for bacterial colonization and causes root canal space to provide a suitable environment for microbial growth. The primary endodontic treatment goal must thus be to optimize root canal disinfection and to prevent re-infection. Infection of the root canal space occurs most frequently as a sequela to a profound carious lesion. The aim of this study is to analyse the prevalence of different root canal irrigants used during endodontic therapy. This retrospective cross-sectional study was conducted using the patient records from the Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Chennai from June 2019-April 2020, and patients who underwent root canal treatment and the root canal irrigants used during the procedure were analyzed. The patients were assessed based on the type of root canal irrigant used. Data was collected and then subjected to statistical analysis. Out of total 4785 patients, 2194 patients were female and 2591 patients were male. Saline was the most common irrigant, followed by a combination of Sodium Hypochlorite+EDTA+Saline and then by Sodium Hypochlorite 3% .On statistical evaluation it was noticed that there was a positive correlation regarding the irrigant used, with a statistically significant result, $p<0.05$.It has become increasingly clear that the largest proportion of endodontic diseases of both pulp and periradicular tissues is due to the presence of microorganisms. Therefore, the success of treatment depends upon the ability to remove these microorganisms and prevent reinfection. A successful root canal treatment can be achieved only by the effective removal of microorganisms and necrotic pulpal tissue. This is ensured by the use of root canal irrigants.

Keywords: Root Canal Irrigant; Saline; Chlorhexidine; Sodium Hypochlorite; Root Canal Therapy.

Introduction

There can be no doubt today that microorganisms, either remaining in the root canal space after treatment or re-colonizing the filled canal system, are the main cause of endodontic failure [34]. The primary endodontic treatment goal must thus be to optimize root canal disinfection and to prevent re-infection. Infection of the root canal space occurs most frequently as a sequela to a profound carious lesion [19]. Pulpitis is the host reaction to opportunistic pathogens from the oral environment entering the endodontium. Vital pulp tissue can defend against microorganisms and is thus largely non infected until it gradually becomes necrotic [26]. In contrast, the pulp space of nonvital teeth with radiographic signs of periapical rarefaction always harbors cultivable microorganisms [27].

A successful root canal treatment can be achieved only by the effective removal of microorganisms and necrotic pulpal tissue. This is ensured by the use of root canal irrigants [29].The main steps of endodontic treatment involved with control of the infection are represented by chemomechanical preparation and intracanal medication [13, 24] Chemomechanical preparation is of

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paramount importance for root canal disinfection because instruments and irrigants act primarily on the main canal, which is the most voluminous area of the system and, consequently, harbors the largest number of bacterial cells. Bacterial elimination from the root canal is performed by means of the mechanical action of instruments and irrigation as well as the antibacterial effects of the irrigants [10].

Historically, countless compounds in aqueous solution have been suggested as root canal irrigants, including inert substances such as sodium chloride (saline) or highly toxic and allergenic biocides such as formaldehyde [9]. From prior knowledge, it appears evident that root canal irrigants ideally should:

- Have a broad antimicrobial spectrum and high efficacy against anaerobic and facultative microorganisms organized in biofilms.
- Dissolve necrotic pulp tissue remnants.
- Inactivate endotoxin.
- Prevent the formation of a smear layer during instrumentation or dissolve the latter once it has formed [32].

Furthermore, as endodontic irrigants come in contact with vital tissues, they should be systemically nontoxic, non caustic to periodontal tissues and have little potential to cause an anaphylactic reaction [18].

Root canal therapy is considered to be successful when there is proper debridement of canals with efficient biomechanical preparation, thereby preventing inflammation and pain and further aiding in the prosthetic and restorative management of the affected tooth [1, 3-7, 12, 14, 16, 20, 23, 25, 27, 28]. Therefore, efficient root canal therapy forms the foundation for effective treatment of an affected tooth.

Various root canal irrigants have been found, each classified on the basis of their activity and their effect against oral pathogens. From previous studies it has been noticed that Sodium Hypochlorite a tissue dissolving agent, a reducing agent which is clear, straw coloured solution containing 5% available chlorine, is the most widely used irrigant solution followed by 2% chlorhexidine [30].

In the vast availability of root canal irrigants, this study aims to analyze the prevalence of usage of these root canal irrigants and analyse whether these irrigants reach their optimum potential when used alone or as a mixture with other irrigants.

Materials And Methods

The study is done under a university setting. The similar characteristics of the study is that it is done with the available data and under similar ethnicity of the population. The disadvantage of the study can be that the geographic location is similar. The study was approved by the institutional ethics board. Two reviewers are involved in the study. The samples were taken from patients who had checked in the clinic from June 2019 to April 2020. Total number of sample sizes includes 4785 individuals who were subjected to root canal treatments and were identified as systemically healthy. The case sheets were verified with the help of photographs and interim procedure notes.

To minimise the sampling bias, we included all the data available and there was no sorting of data done. Internal validity of the study included all those undergoing root canal treatment. The external validity of the study is to find the prevalence pattern. Data collection was done from the dental archives of the patient management software system patented by Saveetha Dental College. The data was obtained from the category of Multi visit and Single visit Root canal treatment, Root canal Irrigants used, and the data was tabulated. If the root canal irrigant used was not mentioned, those samples were excluded for the study.

Data was verified by one external reviewer. The data was imported to SPSS and the variables were verified. Chi-square test was done on the data obtained using SPSS software by IBM. The students level of study and year of study were considered as independent variables. Type of irrigation, Quantity of irrigant used, Method of administration and Gender of the patient were considered as dependent variables. Type of analysis which was done was correlation and association.

Results And Discussion

The data collected from the patient management software were tabulated in SPSS and the descriptive statistics were obtained. Out of total 4785 patients, 2194 patients were female and 2591 patients were male. On analyzing the data it was observed that Saline was the most commonly used root canal irrigant (1503 patients) followed by Sodium Hypochlorite + EDTA + Saline (1142 patients). (Table 1 and Graph 1)

Chi-square test was done to analyse the type of irrigant used by undergraduate and postgraduate students so as to determine the most commonly used root canal irrigant. It was observed that, Saline was the most common irrigant (1222 UG students), followed by a combination of Sodium Hypochlorite+EDTA+Saline (539 UG students) and then by EDTA (520 UG students), among undergraduates. Among the postgraduate students, the combination of Sodium hypochlorite + EDTA + Saline is the most commonly used one followed by the other irrigants. (Table 2 and Graph 2) There was a significant difference between the undergraduates and postgraduates with respect to the choice and usage of irrigants (Chi Square =641.22; $p < 0.05$).

The shaping and cleaning of the root canal constitutes one of the most important phases of endodontic therapy. Instrumentation of the canal reduces the microbial content of the root canal to a great extent. However, the root canal anatomy provides areas in which bacteria can persist and thrive. Individual microorganisms proliferate to form populations which occur as microcolonies [31].

It has become increasingly clear that the largest proportion of endodontic diseases of both pulp and periradicular tissues is due to the absence of proper root canal debridement thereby causing increased microbial cultivation. Therefore, the success of treatment depends upon the ability to remove these microorganisms and prevent reinfection [8].

One of the neglected phases of endodontic treatment is the eradication of microorganisms and the complete removal of minute fragments of organic debris, necrotic tissue, pulp remnants, and dentinal shavings from the root canal.

Table 1. This table depicts the frequency of the different types of root canal irrigants used. It is observed that Saline is the most common irrigant (1503 patients), followed by a combination of Sodium Hypochlorite+EDTA+Saline (1142 patients) and then by Sodium Hypochlorite 3% (630 patients).

		GENDER		Total
		Female	Male	
IRRIGANT	chlorhexidine	21	30	51
	chlorhexidine+EDTA+Saline	40	45	85
	EDTA	273	294	567
	Saline	715	788	1503
	Sodium Hypochlorite	315	315	630
	Sodium Hypochlorite+Chlorhexidine+EDTA+Saline	134	197	331
	Sodium Hypochlorite+Chlorhexidine+Saline	81	92	173
	Sodium Hypochlorite+EDTA+Saline	500	642	1142
	Sodium Hypochlorite+Saline	115	188	303
Total		2194	2591	4785

Graph 1. Bar graph depicting the frequencies of the different types of irrigants used. X axis represents the Frequency of irrigant used and Y axis represents the type of irrigants. Saline is the most common root canal irrigant, followed by a combination of Sodium Hypochlorite+EDTA+Saline.

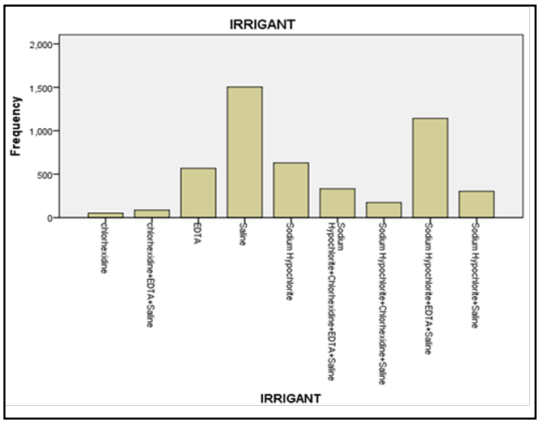


Table 2. This table depicts the frequency distribution of the type of irrigant used among undergraduate and postgraduate students. It is observed that Saline was the most commonly used irrigant among undergraduates (1222 UG students) and Sodium Hypochlorite+EDTA+Saline (603 PG students) was used by the postgraduates.

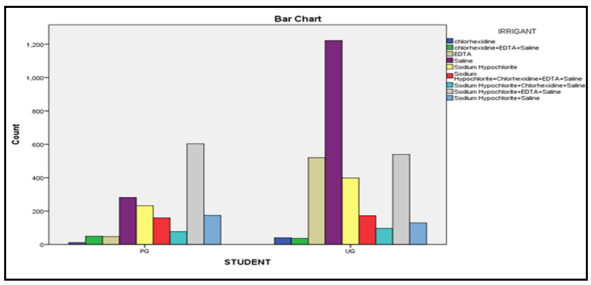
		IRRIGANT									Total
		CHX	CHX + EDTA + Saline	EDTA	Saline	Sodium Hypochlorite	Sodium Hypochlorite + CHX + EDTA + Saline	Sodium Hypochlorite+ CHX+Saline	Sodium Hypochlorite + EDTA + Saline	Sodium Hypochlorite + Saline	
STUDENT	PG	11	49	47	281	232	159	77	603	174	1633
	UG	40	36	520	1222	398	172	96	539	129	3152
Total		51	85	567	1503	630	331	173	1142	303	4785

Through the years, different irrigating solutions have been recommended. A stream of hot water discharged from an insulated syringe, physiologic saline solution, a 30% solution of urea, urea peroxide solution in glycerin, a solution of chloramine, sodium hypochlorite, and sodium hypochlorite in conjunction with ethylenediaminetetraacetic acid (EDTA) [11]. An ideal irrigant should have most of the ideal requirements listed in:

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

However, none of the currently available irrigating solutions has all the properties needed. A combined use of separate irrigants is

Graph 2. Bar graph depicting the frequencies of the different types of irrigants used among undergraduate and postgraduate students. X axis represents the Student cluster and Y axis frequency of the root canal irrigant used. There is a significant difference between the frequencies of the different types of irrigants used among undergraduate and postgraduate students. (Pearson Chi-square test, p value =0.000; (p<0.05). Hence, it is significant. Saline is the most commonly used root canal irrigant among undergraduates.



the clinical protocol recommended to ensure successful outcome of endodontic treatment [22].

The irrigants used to disinfect the canals should be administered in such a manner that they can unleash their full potential on their targets in the root canal rather than act on each other, or cause any damage to underlying tissues. Hence, a hypochlorite solution should be employed throughout instrumentation, without altering it with EDTA or citric acid. Canals should always be filled with sodium hypochlorite. This will increase the working time of the irrigant [2].

In a previous study by Sarbinoff et.al, it was noticed that Sodium Hypochlorite was the most effective irrigant used due to its tissue dissolving property. This property is attributed to its mechanism of action after coming in contact with the bacterial protoplasm. Sodium Hypochlorite causes a series of reactions like, Saponification, Amino Acid Neutralization and Chloramination, finally resulting in destruction of bacterial cell and DNA Lysis [21].

EDTA, is a chelating agent which when used in a concentration of 17%, (introduced by Nygaard and Osby), it is relatively non-toxic and not irritating. A combination of Sodium Hypochlorite with Chlorhexidine, EDTA or Citric Acid, dissolved in Saline will increase the efficacy of the irrigants. Which is in conjunction with this study, where it was noticed that Sodium Hypochlorite + EDTA + Chlorhexidine served as a highly efficacious irrigant (1142 patients).

Chlorhexidine appears to be the most promising agent to be used as a final irrigant as it has an affinity to dental hard tissues , and once bound to a surface, has prolonged antimicrobial activity, due to a phenomenon called substantivity. Substantivity is not observed with sodium hypochlorite.

In a randomized clinical trial by Zamany et.al, a 2% chlorhexidine solution, used as a final irrigant, significantly decreased bacterial loads in root canals that had been irrigated with sodium hypochlorite during canal preparation [33]. One of the neglected phases of endodontic treatment is the eradication of microorganisms and the complete removal of minute fragments of organic debris, necrotic tissue, pulp remnants, and dentinal shavings from the root canal.It has become increasingly clear that the largest proportion of endodontic diseases of both pulp and periradicular tissues is due to the absence of proper root canal debridement.

Therefore, the success of treatment depends upon the ability to remove these microorganisms and prevent reinfection, which requires proper understanding of the different irrigants and their properties. Therefore, further studies are of paramount importance to analyze the prevalence pattern of irrigants to identify a gold standard irrigant which is incorporated during endodontic therapy.

Conclusion

The use of Root canal irrigants is to ensure proper debridement of the root canal space with no potential for microbial colonization. From this study it is noted that Saline is an efficacious irrigant followed by a combination of Sodium Hypochlorite + EDTA + Saline, thereby ensuring efficient debridement of the canal.

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