



KAP Survey on Endodontic Irrigants and Its Deleterious Effects

R. Preety¹ and S. Delphine Priscilla Antony^{2*}

¹Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.

²Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author RP carried out the study, collection and analysis of data and drafted the manuscript. Author SDPA designed the study and participated in data analysis verification and drafting the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

The aim is to assess how aware the dental students are about endodontic irrigants and the deleterious effect. Successful root canal therapy relies on the combination of proper instrumentation, irrigation, and obturation of the root canal. Of these three essential steps of root canal therapy, irrigation protocol is very important as it determines the healing of the periapical tissues. The primary endodontic treatment goal must thus be to optimize root canal disinfection and to prevent reinfection. Cytotoxicity of root canal irrigants is essential due to their close contact with host tissues. The study aimed to assess how aware the dental students are about the deleterious effects of endodontic irrigants. A cross-sectional study was conducted among dental students in January 2020. The survey was made on the app survey planet and a questionnaire was administered to 100 dental students about their awareness of cytotoxicity of irrigants in endodontics. The data was collected and put into bar charts in SPSS version 20 by IBM for statistical results. It is observed 38% were interns, 33% were final years and 29% were third years.

*Corresponding author: E-mail: delphine.sdc@saveetha.com;

90% were aware of what irrigants are, 86% were aware of the types of irrigants, 76% were aware of the cytotoxicity of irrigants, 49% used sodium hypochlorite, 21% used chlorhexidine, 10% used MTAD, 8% used citric acid and 12% have used all of the above. 65% are aware of the duration of irrigants in canals. 59% think irrigants can be used in a previously treated tooth, 20% disagree and 21% are not sure. A p-value of 0.000 was obtained which is statistically significant as $p < 0.05$. In vitro cytotoxicity tests are usually carried out for new materials before applying them clinically. These irrigating solutions should be used at lower concentrations to enhance cell viability and protect the tissues from toxicity damage, irrespective of their increased efficacy at higher concentrations. Through this study, it was evident that students are not fully aware of the deleterious effects of endodontic irrigants though they are used daily. The awareness of the concentration and type of irrigant to be used should be more emphasized during theory classes so that the same can be followed during clinical procedures.

Keywords: Irrigants; deleterious effect; obturation; sodium hypochlorite.

1. INTRODUCTION

Endodontic therapy is primarily based on the removal of potential stimuli from the root canal system [1]. Irrigants flush debris from canals and assist in reducing microbial flora of infected canals and help to dissolve necrotic tissues. The persistence of residual pulp tissue and infected dentine or bacteria in the root canal system may be responsible for treatment failure [2]. The endodontic irrigants should possess 4 major properties: antimicrobial activity, dissolution of organic tissues, debridement of the canal, and non-toxicity to periapical tissue [3]. As in both vital and nonvital cases, extrusion of irrigants occurs even in teeth with fully formed mature intact apices and improper techniques can also allow the solution to flow into surrounding tissues. Tissue cytotoxicity is therefore of great concern in choosing endodontic irrigants [4].

Sodium hypochlorite has been widely used as an irrigant due to its antimicrobial activity and solvent activity for both necrotic and vital tissues [5]. Extrusion of any root canal irrigating agent beyond the tooth apex may lead to tissue reaction and pain. Therefore any irrigant should have minimal toxicity. A study by Hegger et al showed that wound healing in vitro and in vivo concluded that 0.25% sodium hypochlorite was the safest concentration to be used as it was nontoxic and bactericidal [6]. Another irrigant with less potential for adverse effects is desirable.

2% chlorhexidine digluconate, when used as an irrigant, has an antibacterial effect and long-acting nature due to the ability to bind to hydroxyapatite [1]. A study revealed Ultrasonic agitation increase the effectiveness of the final rinse procedure in the apical third of the canal walls [7]. 1% NaOCl solution at 45°C dissolved pulp tissues as effectively as the 5.25% solution

at 20°C [8] Studies by Larz Spangberg showed that Betadine scrub eliminated 90 % of *Enterococcus faecalis* in the sample in 15 minutes [9].

Numerous highly cited publications on well designed clinical trials and lab studies [10–26]. This has provided the right platforms for us to pursue the current study. Our aim is to assess the knowledge and awareness of the use and deleterious effect of irrigants.

2. MATERIALS AND METHODS

The design of the study is a cross-sectional study which was conducted in January 2020 among dental students. An online questionnaire was administered to the students to assess their knowledge and awareness on the use and deleterious effect of irrigants. 100 students participated in this questionnaire. The data collection was done on the survey planet website. A structured questionnaire comprising 10 questions was distributed among second years, third years, final years and interns. The goal of this questionnaire was to assess the awareness of the students working in clinics about irrigants and its deleterious effect. The data collected was exported to SPSS version 20 by IBM, where statistical results were obtained.

3. RESULTS AND DISCUSSION

Bar graphs were obtained from SPSS software to show the statistical results. Fig. 1 shows the year of students where 38% were interns, 33% were interns and 29% were third years. Fig. 2 shows that 90% were aware of what irrigants are, Fig. 3. shows that 86% were aware of the types of irrigants, Fig. 4 shows that 76% were aware of the deleterious effect of irrigants, Fig. 5 shows that 49% used sodium hypochlorite, 21% used

chlorhexidine, 10% used MTAD, 8% used citric acid and 12% have used all of the above. Fig. 6 represents the selection of irrigants where 29% responded to antibacterial property, 21% responded biocompatibility, 6% responded tissue dissolution, and 44% responded all of the above. 61% of the students think that sodium hypochlorite is the commonly used irrigant, 24% think its chlorhexidine, and 19% think its MTAD, represented in Fig. 7. Fig. 8 shows the responses of students for how long the canal should be rinsed with an irrigant and 50% responded 1 minute, 40% responded 3 minutes and 10% responded 5 minutes. Fig. 9 represents awareness of the mechanical properties of irrigants and 65% are aware of it. In Fig. 10, 59% think irrigants can be used in a previously treated tooth, 20% disagree and 21% are not sure. Correlation between the year of study and irrigants used on a previously treated tooth is represented in Fig. 11, Fig. 12 shows a correlation between year of study and duration of irrigant in the canal, and Fig. 13 represents a correlation between year of study and irrigants used in the clinic. The data from the

questionnaire were tabulated on an excel sheet and the Chi-square test was done using SPSS software and a p-value of 0.000 was obtained where $p < 0.05$ and is statistically significant.

The use of root canal irrigant solutions is essential in endodontic treatment because they help to disinfect and lubricate the root canal, flush out debris from the canal system, and dissolve organic and inorganic tissues [27]. Sodium hypochlorite (NaOCl) and chlorhexidine gluconate (Chx) are commonly used for these purposes in endodontic treatment. NaOCl is widely recommended as a root canal irrigant for its antibacterial effects and its capacity to dissolve organic tissues [28]. Concentrations ranging from 0.5–5.25% have been reported in the literature, with higher concentrations having better antibacterial efficacy but also higher toxicity Chx is used extensively in periodontal therapy because of its substantive and broad-spectrum antimicrobial effects. For these same reasons, it is also used as a root canal irrigant and intracanal medication in endodontics [29].

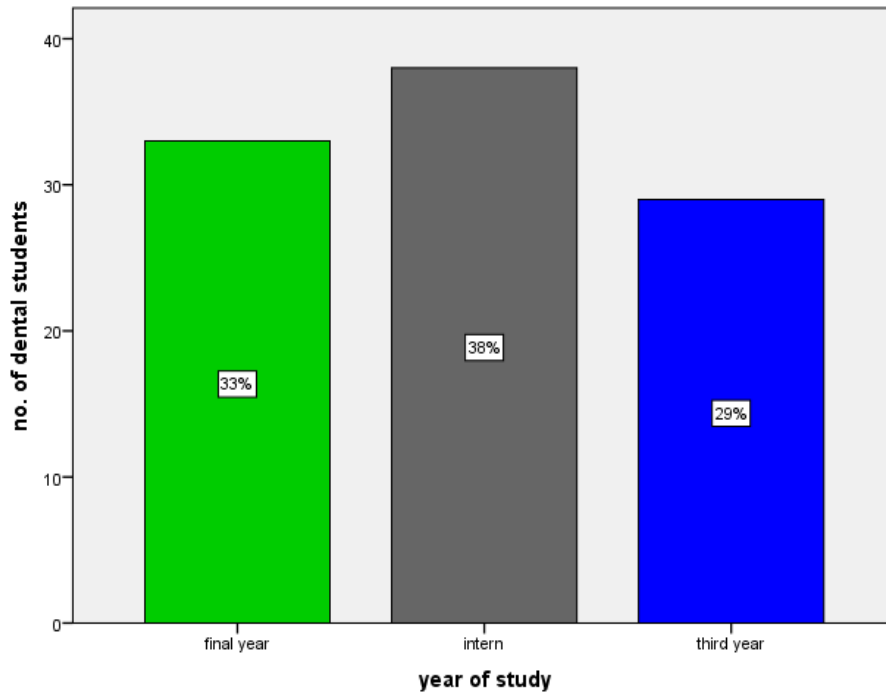


Fig. 1. Bar diagram showing the frequency distribution of year of study of the students. The X-axis represents year of study and Y-axis represents the number of dental students. 33% are final years, 38% are interns and 29% are third years. N = 100

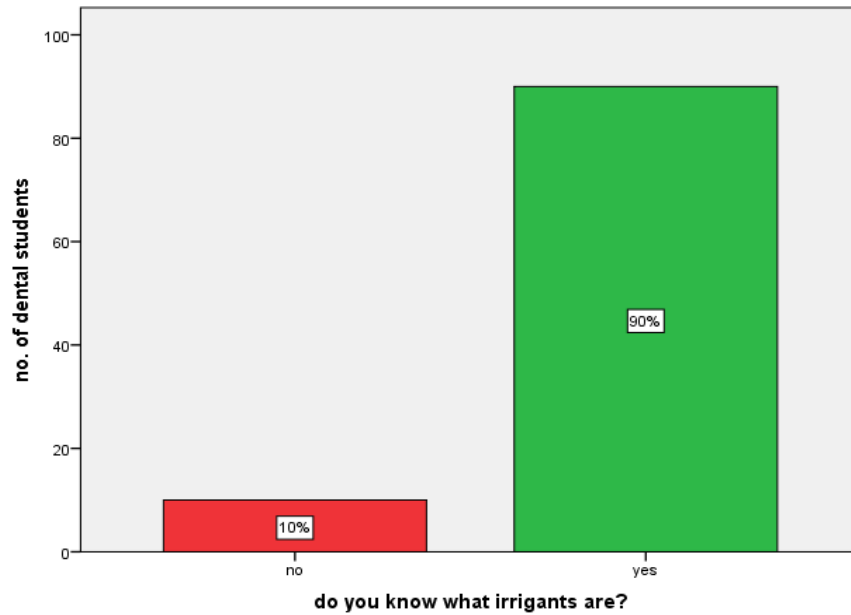


Fig. 2. Bar diagram showing the frequency distribution of awareness of irrigants. The X-axis represents awareness of what irrigants are and Y-axis represents no. of dental students. 90% responded 'yes' and 10% responded 'no'. N = 100

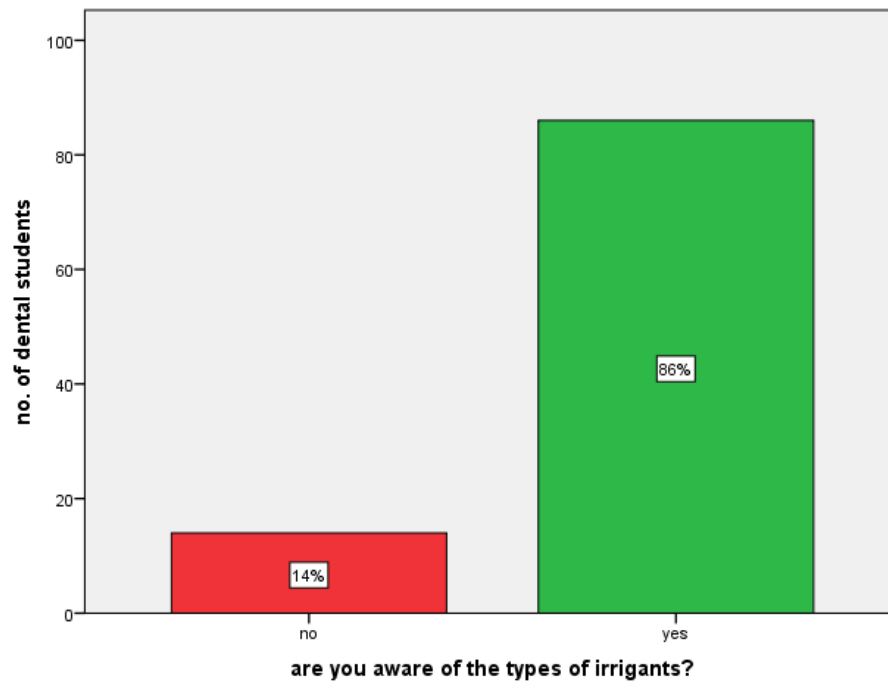


Fig. 3. Bar diagram showing the frequency distribution of awareness on types of irrigants. The X-axis represents responses to types of irrigants and the Y-axis represents the no. of dental students. 86% responded 'yes' and 14% responded 'no'. N = 100

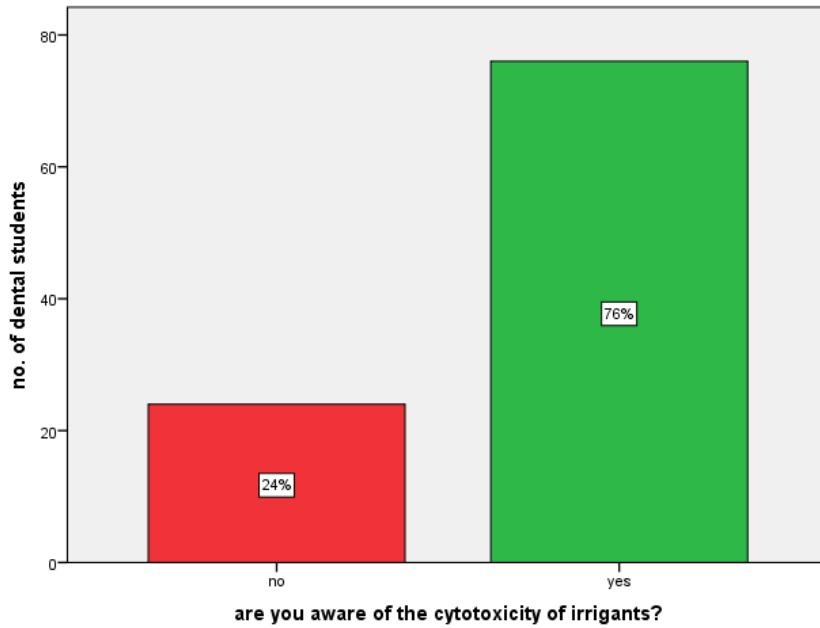


Fig. 4. Bar diagram showing the frequency distribution of awareness of cytotoxicity of irrigants. The X-axis represents the responses to awareness of cytotoxicity of irrigants and the Y-axis represents no. of dental students. 76% responded 'yes' and 24% responded 'no'. N = 100

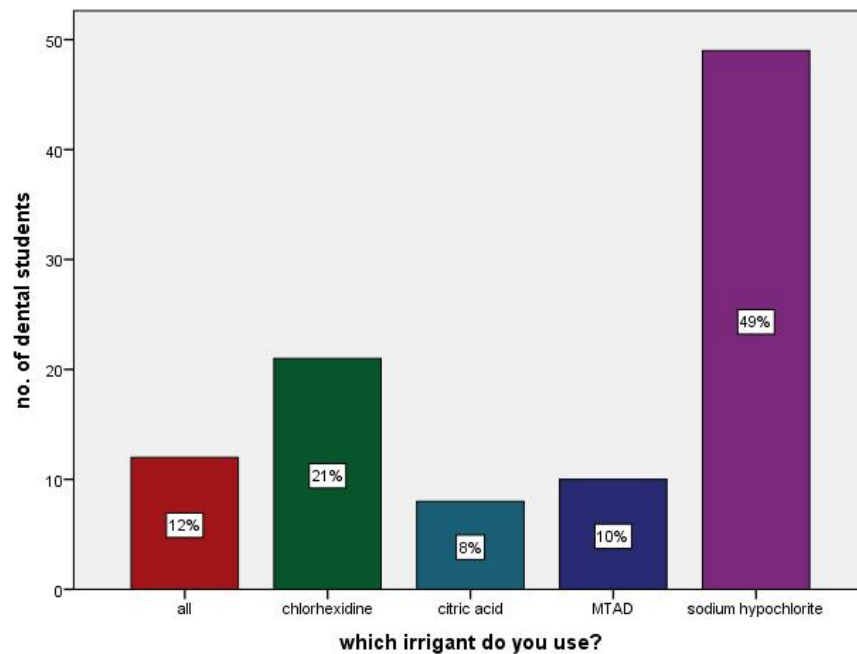


Fig. 5. Bar diagram showing the frequency distribution of the type of irrigants used. The X-axis represents the types of irrigants used by the student and the Y-axis represents the no. of dental students. 49% answered sodium hypochlorite, 10% answered MTAD, 8% answered citric acid, 21% answered chlorhexidine and 12% answered all of the mentioned. N = 100

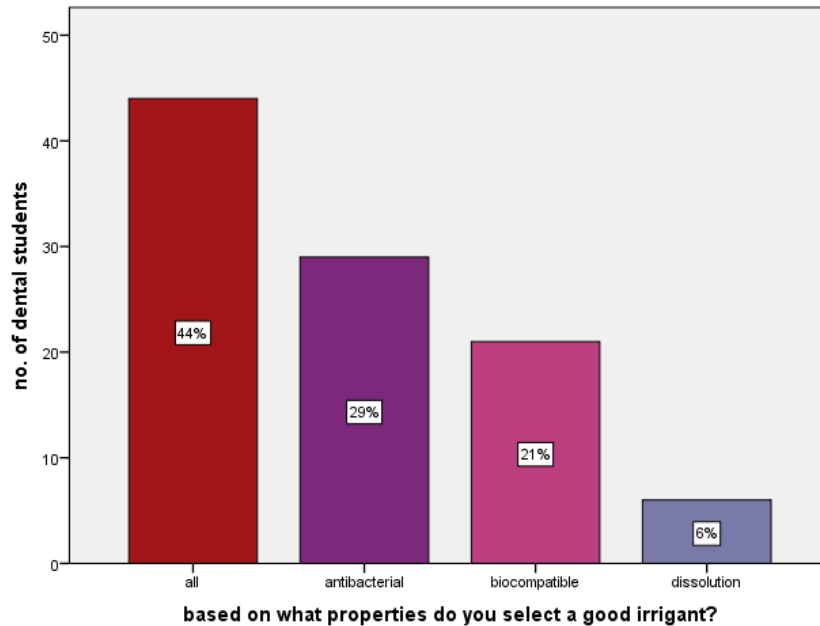


Fig. 6. Bar diagram showing the frequency distribution of properties of irrigants. The X-axis represents on what basis a good irrigant is selected and Y-axis represents the no. of students. 29% answered antibacterial, 21% answered biocompatibility, 6% answered dissolution and 44% answered all of the mentioned. N = 100

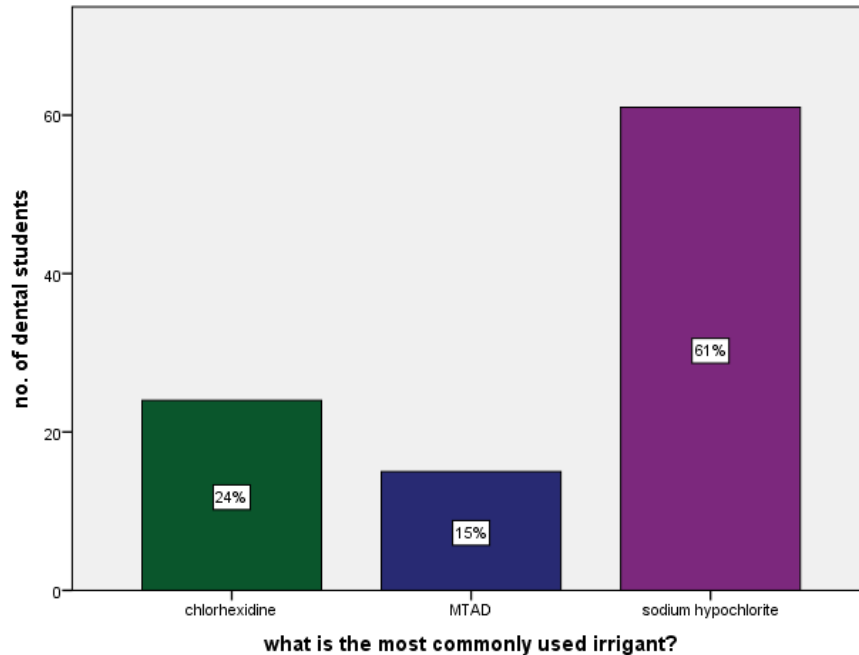


Fig. 7. Bar diagram showing the commonly used irrigant. X-axis represents the responses to the most commonly used irrigant and Y-axis represents the no. of students. 61% answered sodium hypochlorite, 15% answered MTAD and 24% answered chlorhexidine. N = 100

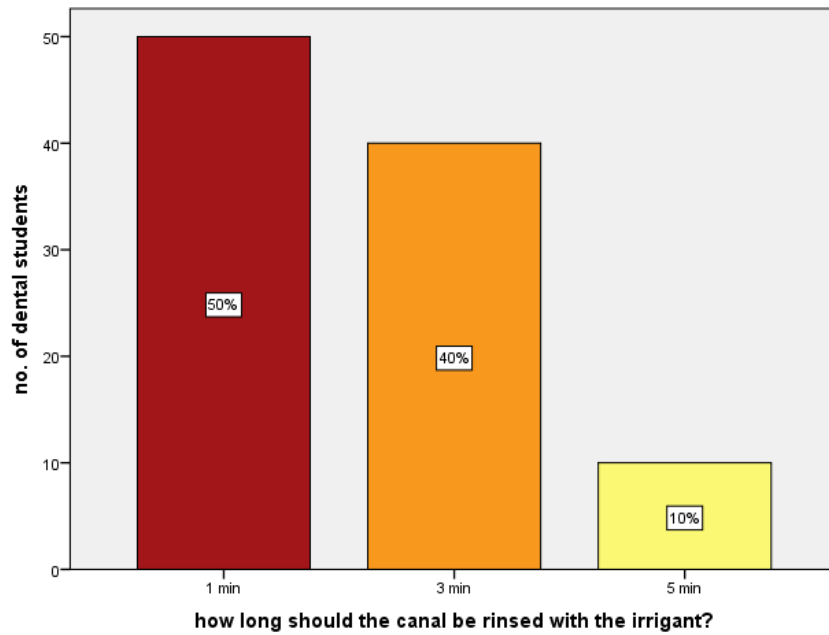


Fig. 8. Bar diagram showing the frequency distribution of duration of irrigant in the canal. The X-axis represents the responses to how long the irrigant should be rinsed in the canal and Y-axis represents the no. of students. 50% answered 1 minute, 40% answered 3 minutes and 10% answered 5 minutes. N = 100

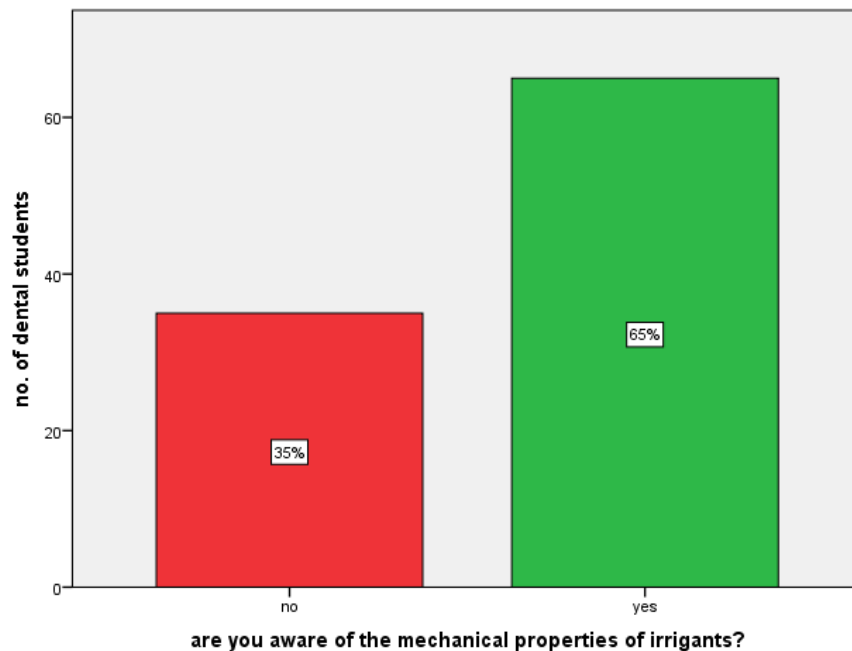


Fig. 9. Bar diagram showing frequency distribution of awareness on the mechanical properties of irrigants. The X-axis represents the responses to awareness on the mechanical properties of irrigants and the Y-axis represents the no. of dental students. 65% responded 'yes' and 35% responded 'no'. N = 100

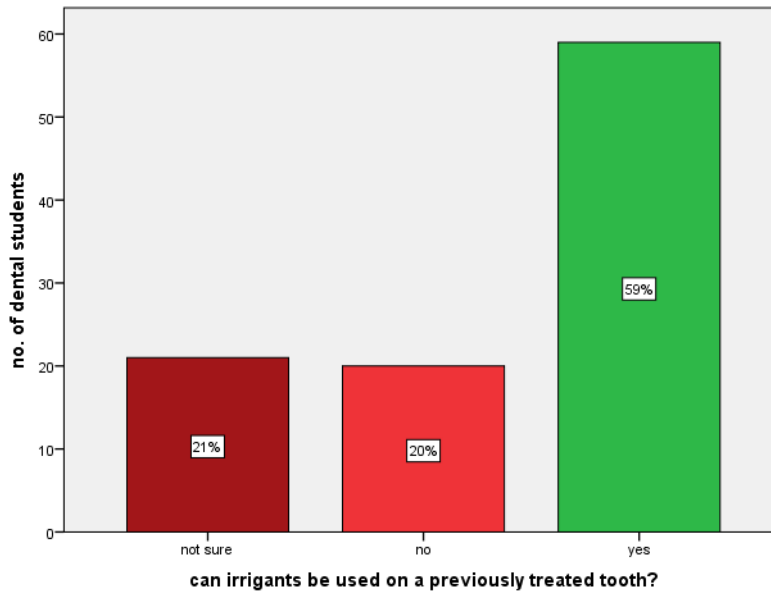


Fig. 10. Bar diagram showing the frequency distribution of irrigants use on a previously treated tooth. The X-axis represents the responses if irrigants can be used on a previously treated tooth and Y-axis represents the no. of dental students. 59% answered 'yes', 20% answered 'no' and 21% answered 'not sure'. N = 100

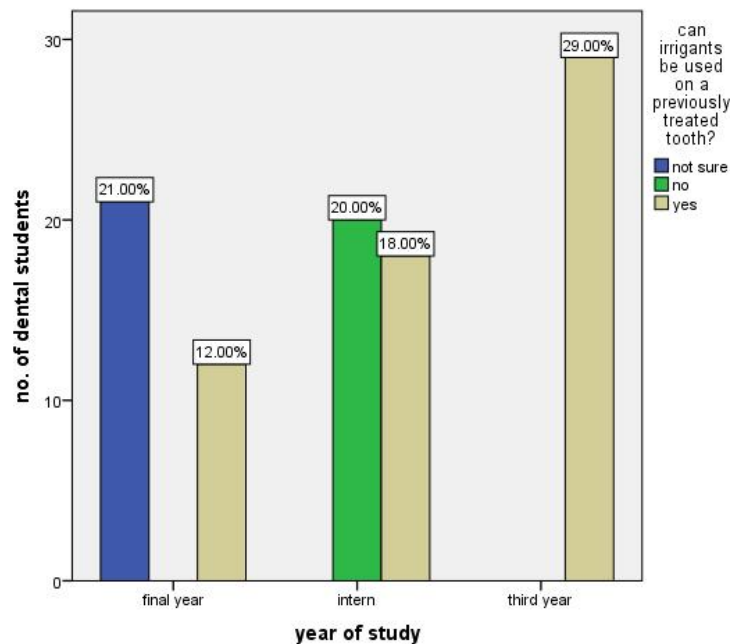


Fig. 11. Bar graph showing an association between the year of study and responses on 'can irrigants be used on a previously treated tooth?'. The X-axis represents the year of study and Y-axis represents responses to the question. Blue denotes 'not sure', green denotes 'yes' and grey denotes 'no'. Among final years, 21% answered not sure and 12% answered yes, among interns 20% answered no and 18% answered yes and among third years 29% answered yes. Chi-square test was done and a p-value of 0.000 ($p < 0.05$) was obtained which is statistically significant

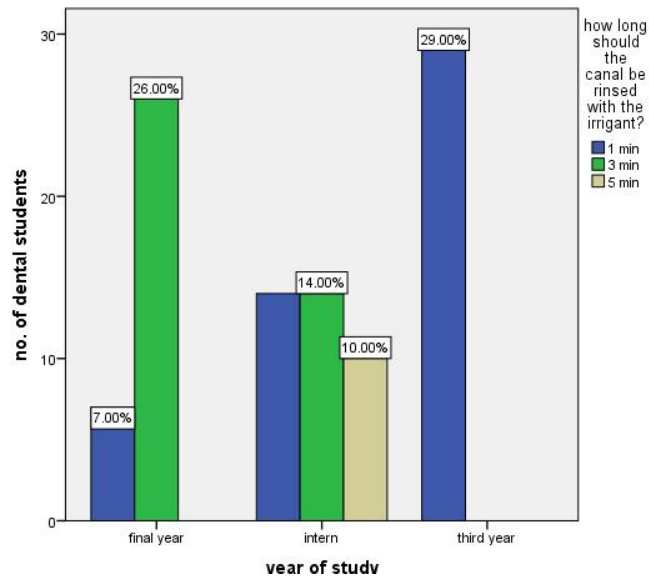


Fig. 12. Bar graph showing an association between the year of study and responses on 'how long should canal be rinsed with irrigant?'. The X-axis represents the year of study and Y-axis represents responses to the question. Blue denotes '1 minute', green denotes '3 minutes' and grey denotes '5 minutes'. Among final years, 7% answered 1 minute and 26% answered 3 minutes, among interns 14% answered 1 minute and 3 minutes, and 10% answered 5 minutes. Among the third years, 29% answered 1 minute. Chi-square test was done and a p-value of 0.000 ($p < 0.05$) was obtained which is statistically significant

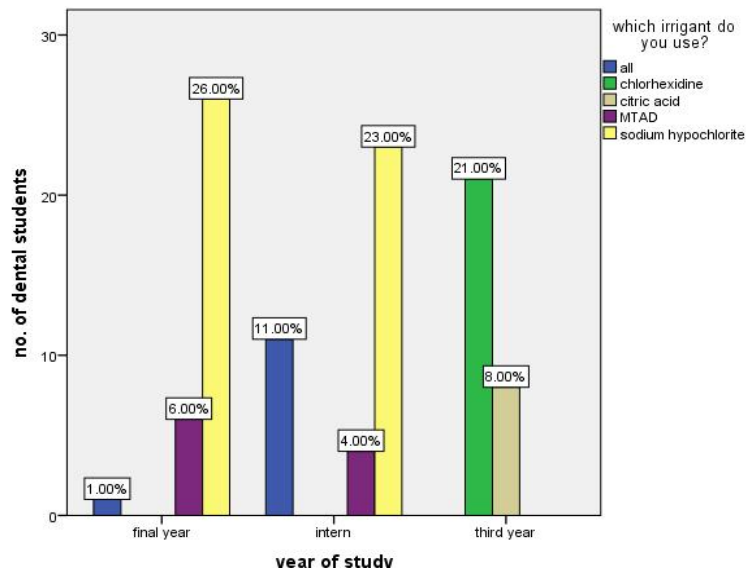


Fig. 13. Bar graph showing association between the year of study and responses on 'which irrigants do you use?'. The X-axis represents the year of study and Y-axis represents responses to the question. Blue denotes all, green denotes chlorhexidine, grey denotes citric acid, purple denotes MTAD and yellow denotes sodium hypochlorite. Among final years, 1% answered all of the mentioned, 6% answered MTAD and 26% answered sodium hypochlorite. Among interns, 4% answered chlorhexidine and 8% answered MTAD and 23% answered sodium hypochlorite. Among third years 21% answered chlorhexidine and 8% answered citric acid. Chi-square test was done and a p-value of 0.000 ($p < 0.05$) was obtained which is statistically significant

A new root canal irrigant, known as MTAD, has been introduced for use as a final irrigation solution, comprising a tetracycline isomer, an acid, and a detergent. This eliminates microorganisms that are resistant to the conventional root canal irrigants [30]. An ideal root canal irrigant should be biocompatible, because of its close contact with the periodontal tissues during endodontic treatment. The biocompatibility of dental materials has frequently been analyzed using the WST-1 test, in which the conversion of tetrazolium dye into formazan crystals in the mitochondria of living cells is proportional to their viability [31]. In vitro cytotoxicity tests are usually carried out for new materials before applying them clinically. In vitro model assays enable experimental factors and variables to be controlled, which often is an important complication of performing experiments in vivo. MTT (3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyl tetrazolium bromide) is well established for cytotoxicity analysis of dental materials, being used initially for cell viability analysis in the 1980s [32]. Although the MTT assay is sensitive, it requires more time to be completed, but recent developments of other metabolic activity-based tests such as the WST-1. The WST-1 reagent produces a water-soluble formazan, in contrast to the product of the MTT assay, which is water-insoluble. Thus, the WST-1 analysis is easier and faster than the MTT test and is considered to be a more sensitive index for evaluating the cytotoxicity of dental materials [33]. Ideally, an endodontic irrigant should be systemically non-toxic when they come in contact with vital tissues, to periodontal tissues with little potential to cause an anaphylactic reaction and act as an antimicrobial agent. Root canals have complex anatomy because of which approximately 50 % of canal walls remain uninstrumented during preparation which results in insufficient debridement of necrotic tissue remnants. Hence necessitating the use of irrigants and acting as an antimicrobial agent is necessary.

Controversy exists regarding the toxic and irritating potential of sodium hypochlorite. Sodium hypochlorite is a very caustic, non-specific agent whose action is not limited to necrotic tissue but is cytotoxic to all except heavily keratinized epithelium [34].

One of the most serious complications of sodium hypochlorite is the passage of some solutions through the foramina which sometimes occurs when the needle is wedged tightly into the canal,

perforations and in case of improper techniques. Pashley et al evaluated the cytotoxicity of various dilutions of sodium hypochlorite on Red blood cells and found that 5.25% sodium hypochlorite in 1:1000 dilution caused complete hemolysis of Red blood cells in vitro [34]. Studies reported the irritating effect of Sodium hypochlorite at high concentrations. He recommended 0.5% to be an acceptable noncytotoxic solution. However, studies have shown sodium hypochlorite to possess the property to dissolve pulp which chlorhexidine lacks. Hence this makes Sodium Hypochlorite the irrigant of choice [35]. Chlorhexidine has been recommended as an alternative in patients allergic to sodium hypochlorite or in teeth with incomplete root formation and crestal perforations to prevent inflammatory response in proximity to the epithelial attachment [1].

4. CONCLUSION

Awareness was created among students and their knowledge of the use and deleterious effect of irrigants was assessed. In this study, the students use sodium hypochlorite in clinics as the primary irrigant for obturation. The clinical situation, the concentration used, exposure time to the agent, and exposed surface area are important factors, all of which must be considered while select before the irrigant. From the current study it was evident that interns were more aware about the deleterious effects of irrigants compared to third years and final year students.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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