



## **Knowledge and Awareness towards Herbs Substitutes for Root Canal Disinfectants among Dental Students**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author KAHS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CSC and DG managed the analyses of the study. Author DG managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

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 of the root canal is the most important determinant in the healing of the periapical tissues. The primary endodontic treatment goal must thus be to optimize root canal disinfection and to prevent reinfection. This study aims to assess the knowledge and awareness of herbal substitutes for root canal disinfectants among dental students. This study was a cross-sectional study, which was conducted among the clinical students of Saveetha Dental College. The questionnaire consisted of 14 multiple choice questions. Once the students have answered the questionnaire, the data obtained from the survey were analyzed using statistical sciences (SPSS) version and results were

obtained. A total of 100 students which comprised 3rd year, 4<sup>th</sup> year, and Final year students had actively participated and taken up the survey and completed the survey successfully. The results of this survey show that the students who attempted the questionnaire had a fair knowledge about herbal substitutes in root canal disinfection. From this survey, we can see that the dental students have fair knowledge and awareness about the herbal substitutes for root canal disinfection and It is very important to educate and create awareness and increase the knowledge of our traditional folk medicine where herbs are used to treat and cure individuals among the health care members.

*Keywords: Irrigants; phytomedicines; reinfection; disinfection.*

## 1. INTRODUCTION

It is well known that root canals are most often, not straight cones from orifice to apex but can consist of ribbons, fins, lateral canals, and multiple ramifications. The success of endodontic treatment depends on the eradication of microbes from the root canal system and the prevention of reinfection. The root canal is shaped with and rotary instruments under constant irrigation to remove the inflamed and necrotic tissue, microbes/biofilms, and other debris from the root canal space [1]. Irrigants have traditionally been delivered into the root canal space using syringes and metal needles of different sizes and tip designs.

Successful root canal therapy relies on the combination of proper instrumentation, irrigation, and obturation of the root canal [2]. Of these three essential steps of root canal therapy, irrigation of the root canal is the most important determinant in the healing of the periapical tissues. The primary endodontic treatment goal must thus be to optimize root canal disinfection and to prevent reinfection.

Several chemicals and therapeutic agents are used to disinfect the root canal. The most effective among them is Sodium Hypochlorite (NaOCl), 2% solution of CHX and Ca(OH)<sub>2</sub>, which possess varying degrees of antibacterial activity [3]. Sodium Hypochlorite has been the most widely used root canal irrigating solution for several decades due to its excellent properties of tissue dissolution and antimicrobial activity. But it has several adverse characteristics such as tissue toxicity, risk of emphysema when overfilling, allergic potential, and inability to remove the smear layer.

Owing to the potential side effects, safety concerns, and ineffectiveness of conventional chemicals, consumption of preparations from

medicinal plants has increased over the last few decades [4,5]. Herbal or natural products have been used in dental and medical practice for thousands of years and have become even more popular today due to their high antimicrobial activity, biocompatibility, anti-inflammatory, and antioxidant properties [6]. According to WHO herbal medicine is defined as plant-derived material or preparation which contains raw or processed ingredients from one or more plants with therapeutic capacities.

Herbal products have been used since ancient times in folk medicine, involving both eastern and western medicinal traditions. Many plants with biological and antimicrobial properties have been studied since there has been a relevant increase in the incidence of antibiotic overuse and misuse [7]. In dentistry, Phytomedicines have been used as anti-inflammatory, antibiotic, analgesic, and sedative agents. In endodontics because of the cytotoxic reactions of most of the commercial intracanal medicaments used and their inability to eliminate bacteria from dentinal tubules, the trend of recent medicine attends to use biologic medication extracted from natural plants [8].

Therefore it is the irrigants that we rely on to clean and disinfect these anatomic complexities. Needless to say, the choice of irrigants, their protocol, and method of use can greatly influence the outcome of endodontic therapy.

An irrigant is expected to perform the following functions [9]. They should have a broad antimicrobial spectrum and high efficacy against anaerobic and facultative microorganisms organized in biofilms, dissolve pulp tissue, and organic debris, inactivate endotoxin, be a good lubricant, remove the smear layer, be systemically non-toxic, non-caustic to periodontal tissues, and have little potential to cause an anaphylactic reaction.

Previously our department has conducted extensive research on various aspects of prosthetic dentistry, like in vitro studies, surveys, clinical trials, and review [10–24]. Hence this study aims to assess the knowledge and awareness of herbal substitutes towards root canal disinfectants among dental students.

## 2. MATERIALS AND METHODS

This study was a cross-sectional study, which was conducted among the clinical students of Saveetha Dental College. The questionnaire consisted of 13 multiple-choice questions. The questionnaire was structured as general information of the student i.e, name phone number, and email. The next set of questions was based to assess the knowledge of the students on chemical disinfectants followed by questions regarding the herbal irrigants. Once the students had answered the questionnaire, the data obtained from the survey were analyzed using statistical sciences (SPSS) and results were obtained.

## 3. RESULTS AND DISCUSSION

A questionnaire consisting of 13 questions were prepared and distributed to 100 dental students to assess their knowledge, awareness, and practice towards herbal substitutes for root canal disinfectants among dental students. The questionnaire was prepared online using a survey planet and the link was distributed to the dental practitioners to fill the survey. The questionnaire contained questions about basic knowledge of root canal disinfectants and awareness regarding its herbal substitutes. The data were tabulated using Microsoft excel and were imported into SPSS software for statistical analysis. The results were expressed as percentages.

The aim of root canal irrigation is the complete removal of microorganisms from the root canal system and to produce an impermeable seal between oral environment and periradicular space. Instrumentation of the root canal leads to the formation of a smear layer which contains remnants of tissues and bacteria. Several studies have reported that with currently available instrumentation systems and protocols, large areas of the root canal remain untouched by the instruments due to complex canal anatomy [25]. The presence of root canal debris which left even after instrumentation prevents the penetration of irrigants and medicaments into the dentinal

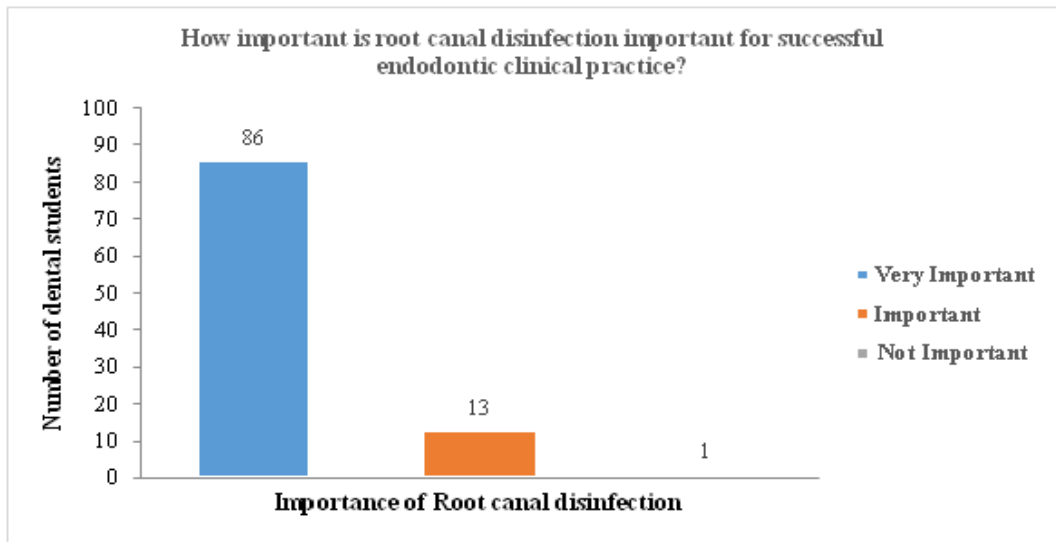
tubules and prevents proper adaptation of obturating material into the canal wall. The mechanical debridement of the root canal system fails to completely remove the debris from the root canal walls. This emphasizes the importance of irrigation for the removal of debris, bacteria, toxic products, and substrates necessary for bacterial growth from the inaccessible, uninstrumented surfaces [26]. This survey shows that out of the 100 participants who had taken up the survey, 86% feel that the root canal disinfection is very important in the root canal treatment in endodontics and feel the need of proper irrigation to completely remove the microorganisms from the root canal systems which will lead to a successful root canal therapy.

The participants were questioned which is the most commonly used root canal disinfectant in root canal therapy with options having, sodium hypochlorite, chlorhexidine, saline, hydrogen peroxide. To which the results of this question from this survey being sodium hypochlorite(64%) then saline (18%) then hydrogen peroxide (12%) followed by chlorhexidine (6%). Sodium hypochlorite is the root canal irrigation fluid used by many dental practitioners [27]. It has strong proteolytic action on pulp tissue remnants aids canal debridement. Research and clinical experience have shown that sodium hypochlorite has several properties that contribute to effective chemical debridement of the root canal system. It acts as a lubricant for instrumentation and can flush loose debris from root canals [28]. Sodium hypochlorite is also an effective antimicrobial agent with the capability of disinfecting the root canal [29]. Moreover, it is effective in dissolving both vital and nonvital tissue, and it has been shown to significantly increase the permeability of dentin [30]. Many practitioners leave sodium hypochlorite in the canal between appointments. Its pH is 11.85 in 5.25% concentration [31].

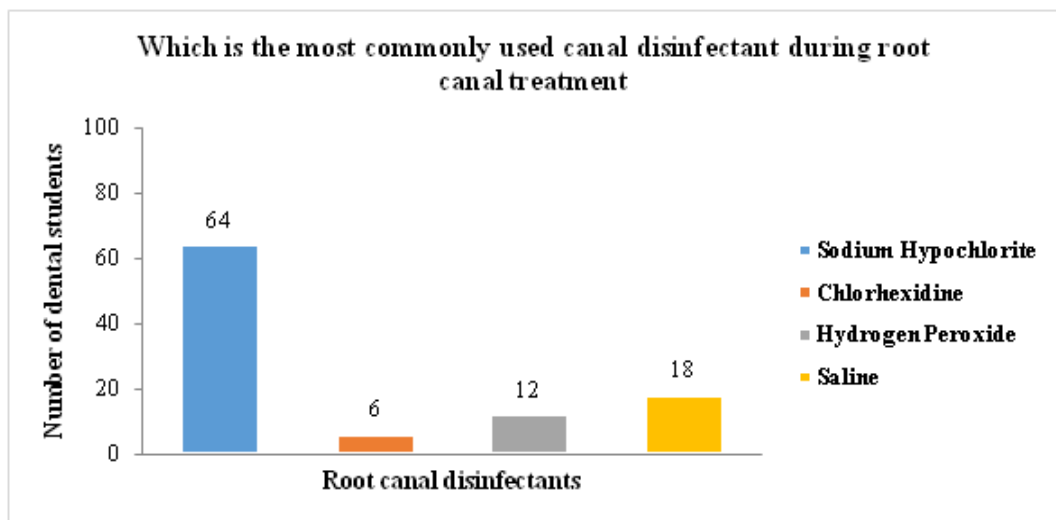
Our survey has pointed out the few common disadvantages of chemical disinfectants like discoloration of the tooth, corrosion of the instruments, irritation to periapical tissues and unpleasant odor. Out of the above, the participants of the survey felt that irritant to periapical was the commonest disadvantage of the chemical disinfectant. Basically, Irrigation must maintain a balance between 2 important goals: safety and effectiveness. This point is particularly true with the most important irrigant solution being sodium hypochlorite, but other irrigants can also cause pain and other problems if they gain access to the periapical tissues [32].

Effectiveness is often jeopardized in the apical root canal by restricting anatomy and valid safety concerns. However, the eradication of the microbes in the apical canal should be of key importance to the success of root canal disinfection. And also Tooth discoloration induced by endodontic materials is a common finding and may impair the aesthetic outcome of root canal treated teeth. A progressive

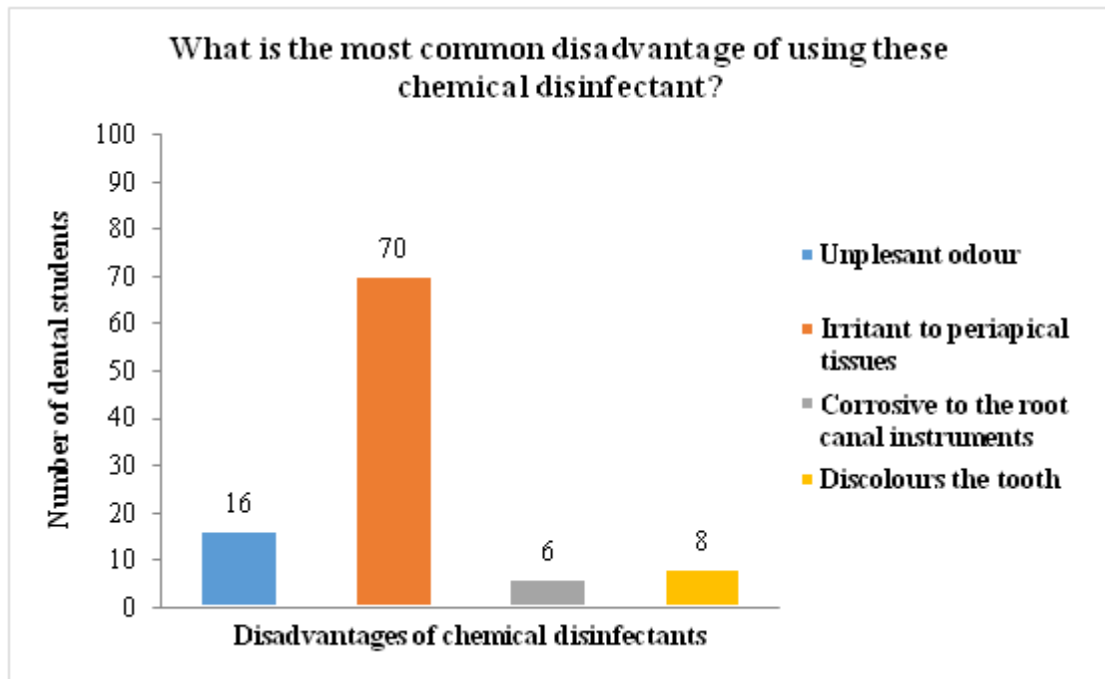
discoloration is suggested to be primarily a result of materials ingressing into the dentinal tubules. However, it has been shown that a visible crown discoloration may not necessarily be associated with tubule penetration and may be caused by material remnants in the pulp chamber, which get darker over time and transmit through the hard tissues [33].



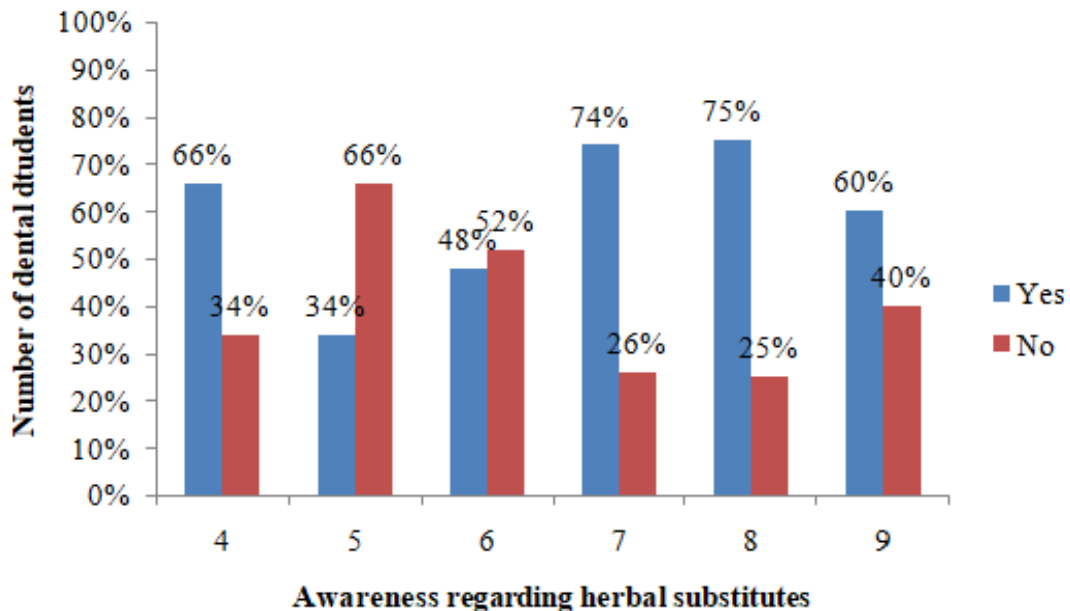
**Fig. 1.** Bar graph representing the knowledge regarding the importance of root canal disinfection among dental students. X axis represents the importance and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (86%) responded that the disinfection of root canals is very important (blue)



**Fig. 2.** Bar graph representing the knowledge regarding root canal disinfectants among the dental students. X axis represents the root canal disinfectants and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (64%) responded that Sodium hypochlorite is the most commonly used root canal disinfectant (blue)



**Fig. 3.** Bar graph representing the knowledge disadvantages of chemical root canal disinfectants among the dental students. X axis represents the disadvantages and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (70%) responded that irritants to the periapical tissues to be the most common disadvantage of chemical root canal disinfectant (orange)



**Fig. 4.** Bar graph representing the various questions on awareness regarding antimicrobial efficacy among herbal substitutes among the dental students. X axis represents the awareness regarding herbal substitutes and Y axis represents the number of dental students. From this graph we can infer that most of the dental students had good knowledge about herbal substitutes for root canal disinfectants

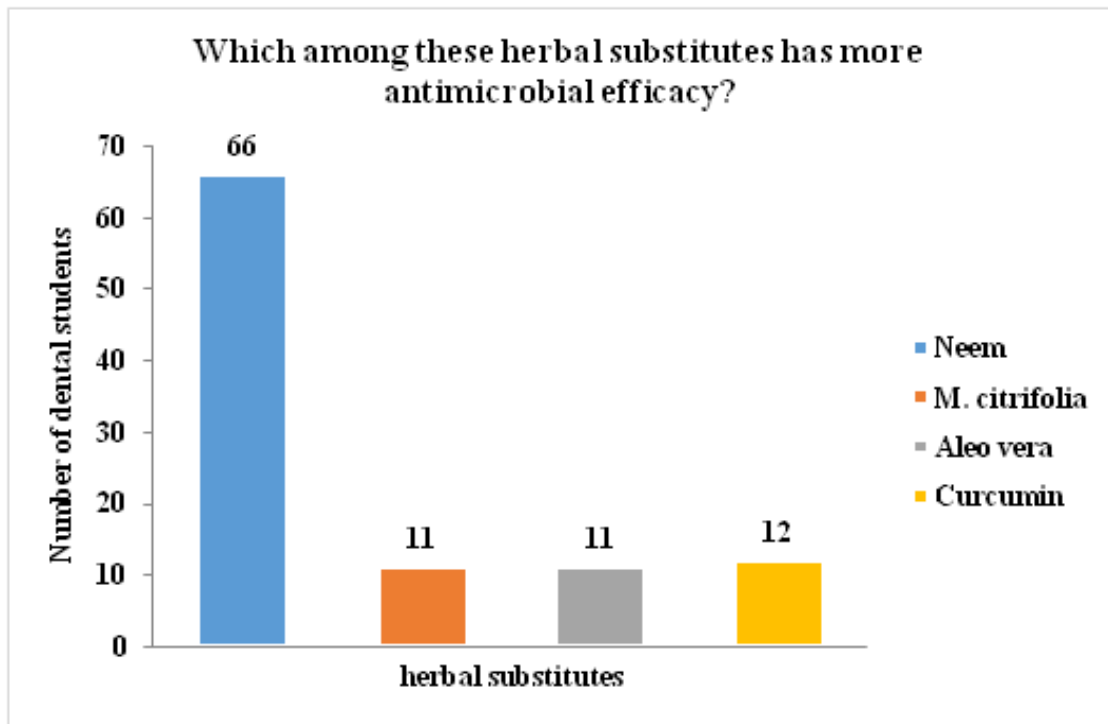


Fig. 5. Bar graph representing the awareness regarding antimicrobial efficacy among herbal substitutes among the dental students. X axis represents the herbal substitutes and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (66%) responded that neem has more antimicrobial efficacy than the rest (blue)

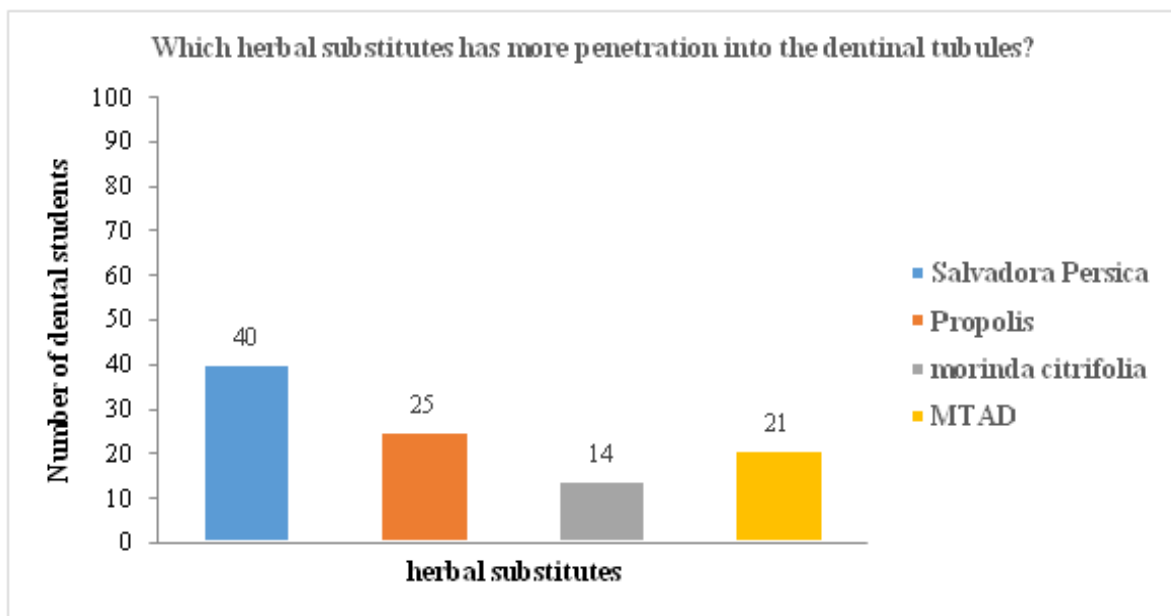
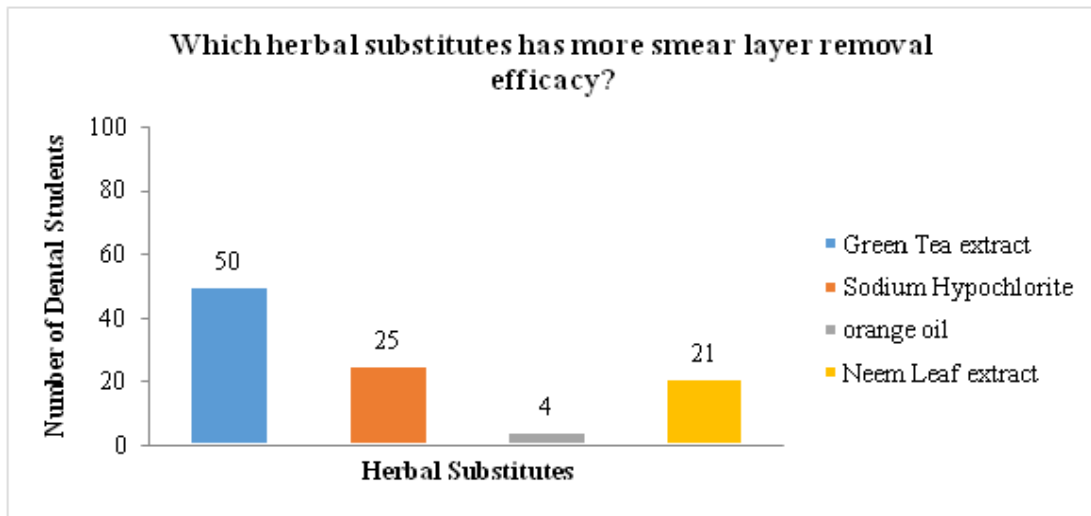
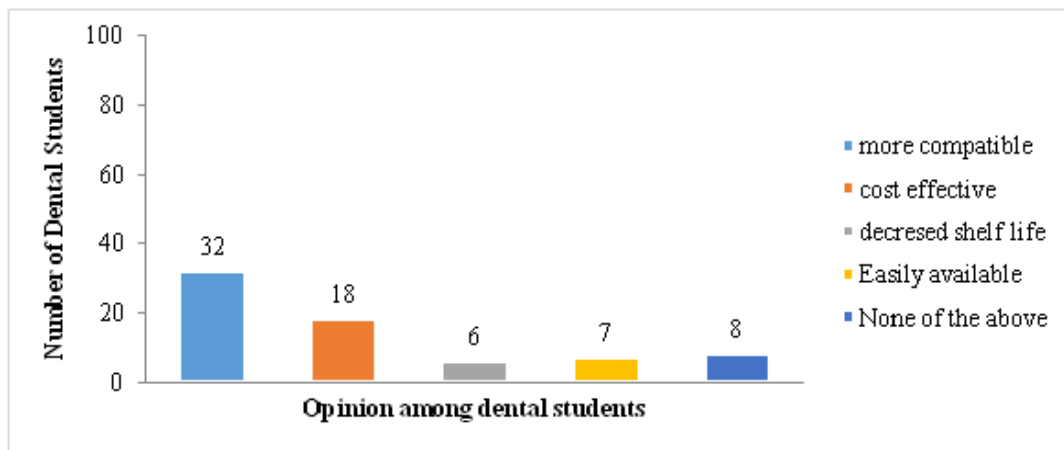


Fig. 6. Bar graph representing the awareness among the dental students regarding penetration of herbal substitutes into the dentinal tubules X axis represents the herbal substitutes and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (40%) responded that Salvadora has more penetration into the dentinal tubules than the rest (blue)



**Fig. 7.** Bar graph representing the awareness among the dental students regarding smear layer removal. X axis represents the herbal substitutes and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (50%) responded that Green Tea extract has more efficacy of smear layer removal (blue)



**Fig. 8.** Bar graph representing awareness among the dental students regarding why herbal substitutes must be used. X axis represents the opinion among dental students and Y axis represents the number of dental students. From this graph we can infer that most of the dental students (32%) responded that herbal substitutes are more compatible than the chemical disinfectants (blue)

Coming to the key interest of this survey, knowledge, and awareness on herbal substitutes for root canal disinfection, the participants had a fair knowledge about the herbal substitutes. Out of the 100 participants, 64 participants were well aware that herbal substitutes for root canal disinfection are being incorporated and being tested in endodontic clinical practice. Chemical disinfectants like CHx have a disadvantage of discoloration of the teeth, 66% of the participants disagree that the herbal substitutes cause discoloration to the tooth structure.

The search for an irrigating solution with antimicrobial properties, tissue dissolving ability, and concomitant biocompatibility with the periapical tissues continues to be the subject of many studies [34]. Sodium hypochlorite is the most commonly used irrigant for the last many years. It has excellent tissue dissolution and antimicrobial properties which makes it the solution of choice for the treatment of teeth with pulp necrosis. However, Sodium hypochlorite has few drawbacks like tissue toxicity, safety concerns, inefficiency in removing the smear

layer completely, and high surface tension. *Salvadora persica*, another herbal extract, possesses various antiplaque, anticaries, anti-inflammatory, and antimycotic effects, and contains important Phyto-constituents [35]. 15% alcoholic extract of *Salvadora persica* is effective against both aerobic and anaerobic bacteria recovered from teeth with necrotic pulp. Its antimicrobial efficacy is not significantly different from sodium hypochlorite and chlorhexidine, but significantly different from normal saline [36].

The participants had a fair knowledge about the efficacy of the herbal substitute to penetrate into the dentinal tubules. Only 40 participants out of the 100 were able to answer the question correctly which is *Salvadora persica*. In a study done Desai AV, Taneja S, Desai NA, Kumari P et al. [35] to check which irrigant solution has more efficacy in penetrating into the dentinal tubules showed that, *Salvadora persica*, compared to other irrigants and herbal extracts like Morinda citrifolia and Propolis, has the lowest surface tension amongst all the tested irrigating solutions and should be able to penetrate dentinal tubules the most and induce its antimicrobial effect.

The participants were asked which herbal substitute is more efficient in the removal of the smear layer and 50% of the participants voted for Green Tea extract and the rest being 25% for Sodium Hypochlorite, 21% for Neem Leaf extract, and 4% for Orange oil.

The smear layer comprises both organic and inorganic phases which have to be removed by an ideal smear layer-removing agent without erosive effects on dentin. Smear layer removal from canal walls is of much importance because this opens up the dentinal tubules, thus allows penetration of irrigants into tubules [37].

In a study done which aimed to evaluate the smear layer removal efficacy of various herbal extracts, namely, green tea extract, orange oil, and neem leaf extract using the scanning electron microscopic analysis revealed that Neem Leaf extract has the highest smear removal efficiency which is contradicting the knowledge of our participants as Green Tea extract had the least smear layer removal efficacy in the study which was done [38].

The role of microorganisms in the development and perpetuation of pulp and periapical diseases has clearly been demonstrated in animal models and human studies [39]. In an in vitro study done,

the herbal agents explored were neem, propolis, turmeric, and liquorice. The microorganisms used in the study were *Enterococcus faecalis* and *Candida albicans*. The objective of the study was to compare the antimicrobial activity of 2% sodium hypochlorite, propolis, and neem leaf extract against *E. faecalis* and *C. albicans*, using the commonly used agar diffusion method [40]. The antimicrobial activity of neem extract was more than the other agents for both microorganisms, the difference being statistically significant. The antimicrobial activity of sodium hypochlorite solution is only less than neem extract for both microorganisms. Turmeric solution shows good activity only against *C. albicans* [40].

The Participants of this were asked which herbal substitute had the most antimicrobial efficacy among Neem leaf extract, *M. citrifolia*, aloe Vera, curcumin; 66% of the participants had a fair knowledge regarding this conduct and answered the question Neem Leaf extract.

*Azadirachta indica* is a commonly seen medicinal tree in India, which is considered holy. Popularly known as "Indian neem / Margosa tree" or "Indian lilac", is well known in India and its neighboring countries for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity [41].

In dentistry, *Azadirachta indica* has been investigated, due to its antimicrobial potential against oral microorganisms. Furthermore, it also has an anti-adherence activity by altering bacterial adhesion and the ability of the organism to colonize. Its biocompatibility to human periodontal ligament fibroblasts is an important factor favoring its clinical application. Use of neem as an endodontic irrigant might be advantageous because it is a biocompatible antioxidant and thus not likely to cause severe injuries to patients that might occur via NaOCl accidents [42]. Neem extract is advantageous in cases of secondary endodontic infections which are dominated by organisms like *E. faecalis* and *C. albicans* [43].

We are living in an age of evidence-based medicine. Any material with the potential clinical application must go through a series of tests to demonstrate biocompatibility to the tissues of the oral cavity as well as marked advantages in terms of efficacy in root canal disinfection when compared to contemporary irrigants [43]. The



major advantages of using herbal alternatives are easy availability, cost-effectiveness, increased shelf life, low toxicity and lack of microbial resistance reported so far [44]. The in vitro observations of herbal products appear promising but preclinical and clinical trials are needed to evaluate the biocompatibility and safety factor before they can conclusively be recommended as intracanal irrigating solutions and medicaments. Herbs are generally safe if used with proper knowledge, but they can be harmful if misused. Many herbal drugs bear potential risk, side effects, and drug interactions that may affect our safe practice of dentistry. Hence herbs should only be used for treatment procedures that have been established to be effective and with minimal risk involved.

Literature has addressed many plants with potential sources for new therapies in endodontics. The studies listed have shown important medicinal activities of plants, with great demand to inhibit or suppress bacteria and their biofilm. However, there is scarce information on the quality, safety, and greater efficiency of these products for use in endodontics. As most of the studies are carried out ex vivo, more of these compounds should be subjected to animal and human studies to determine their effectiveness, side effects, toxicity, and drug interactions.

#### 4. CONCLUSION

From this survey, we can see that the dental students have fair knowledge and awareness about the herbal substitutes for root canal disinfection and It is very important to educate and create awareness and increase the knowledge of our traditional folk medicine where herbs are used to treat and cure individuals among the health care members. Various studies have been done to try substituting herbs instead of chemical disinfectants in root canal therapy and the studies have given promising results that herbal substitutes for root canal disinfection won't cause any harm to the patient.

#### CONSENT AND ETHICAL APPROVAL

As per university standard guideline, participant consent and ethical approval have been collected and preserved by the authors.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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