

# Survey on Recent Advances in Root Canal Disinfection

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## Abstract

Root canal treatment is a procedure done to remove the infected pulp of the tooth to prevent infection. The most important step in root canal treatment is cleaning and shaping which is done to disinfect the root canal. Persistent microorganisms after root canal treatment, can lead to failure of the endodontic treatment. Survey questionnaires were prepared, using an online survey portal it was distributed randomly to 100 participants via social media application. Responses were tabulated and graphs were plotted. From the survey results it was evident that knowledge regarding the recent advancements of root canal disinfection is notable. There was no significant association between the field of practice (specialists / general practitioners) and their response to the questions. Overall, the survey showed a good knowledge and awareness among the responders about the recent advancements in irrigants, used in the root canal treatment.

**Keywords:** Root canal disinfection; Biofilm; Sodium Hypochlorite; Chlorhexidine; EDTA

## Introduction

Root canal harbors a variety of microorganisms, which possess a great challenge to dentists in achieving complete disinfection of the root canal system. Antimicrobial strategies for the removal of biofilm is of utmost importance<sup>1,2</sup>. The most frequent microorganisms in root canal treatment are gram negative anaerobic rods, gram positive aerobic and facultative rods, lactobacillus species, gram positive facultative streptococcus species. Obligate anaerobes are easily removed during root canal treatment, streptococcus, enterococcus and lactobacillus once established, are likely to be persistent if effective treatment and irrigation are not done properly thereby leading to failures<sup>3</sup>. Challenges in effective biofilm

removal during root canal treatment arise due to anatomical complexities and dentin composition<sup>4</sup>.

Conventional antimicrobials such as sodium hypochlorite (NaOCl) are most commonly used in biofilm removal but does not provide adequate disinfection when dealt with tooth having root anatomical complexities<sup>5</sup>. A proper endodontic therapy requires the use of a proper irrigant and intracanal medicament to ensure success in the treatment and prevent infection<sup>6</sup>. Sodium hypochlorite has been used as a potential root canal irrigant as early as the 1920s<sup>3</sup>. Antibacterial property, its tissue dissolving capacity and its toxicity are all dependent on the concentration used for its action. Use of 'full strength' 5.25% leads to adverse reactions and decrease in strength of dentin. Demineralisation agents such as EDTA were bought to use due to its high biocompatibility and great efficacy in smear layer removal<sup>7,8</sup>. EDTA was slightly better than NaOCl in removal of the smear layer and opening of the dentinal tubules<sup>4,9</sup>. Chlorhexidine, is another widely used irrigant due to its high antimicrobial activity, but it lacks tissue dissolving capacity<sup>4</sup>.

The available irrigants have some limitations related to it and hence, newer irrigants were developed.

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Some recent advances in root canal disinfection include MTAD, tetraclean, electrochemically activated solution, ozonated water, photon-induced disinfection and herbal extracts. MTAD is a mixture of tetracycline, acetic acid and detergent for usage as final rinse before obturation<sup>10</sup>. Tetraclean similar to MTAD, it is a mixture of antibiotic(doxycycline), detergent and acid; but with varying concentrations<sup>11</sup>. Tetraclean causes high biofilm degradation when compared to MTAD<sup>11</sup>. Ozonated water is a powerful antimicrobial agent against viruses, bacteria, fungi, protozoa and hence useful in root canal irrigation<sup>12,13</sup>. The killing ability of ozonated water was comparable with 2.5% of NaOCl when irrigated with sonication<sup>12,13</sup>. Methylene Blue has been used in photon-induced disinfection targeting gram positive and gram negative oral bacteria<sup>14,15</sup>. Use of methylene blue and red light (665 nm) showed 97% reduced bacterial viability<sup>16-18</sup>. Herbal alternatives<sup>29</sup> show good antibacterial properties. Triphala, Licorice, cranberry extract, green tea, neem, tulsi, conifer, poplars, generic clusia flowers are some of the herbal extracts used for root canal disinfection<sup>19</sup>.

In photodynamic therapy use of photosensitizer followed by light illumination of sensitized tissue are used for killing microorganisms<sup>20,21</sup>. Photon induced photoacoustic streaming is based on radial firing tips with laser impulses of energies at 15Hz for average 0.3W for root canal disinfection. Gentle wave irrigation aims to clean the root canal through generation of different physicochemical mechanisms including a broad spectrum of sound waves<sup>22</sup>.

Conventionally used irrigants such as chlorhexidine<sup>23,24</sup>, sodium hypochlorite<sup>25</sup> requires proper shaping of the canal for better penetration of the irrigant<sup>26,27</sup>. Use of herbal alternatives as root canal irrigants, has been increasing over the years with usage of licorice, cranberry extract and passion fruit juice as they have good advantages in bactericidal activity<sup>28,30</sup>. Various surveys<sup>31</sup>, in vitro studies<sup>25,32,33</sup> and molecular studies<sup>34</sup> have been conducted to analyse the endodontic therapy which can be employed to improve the outcome of treatment procedures<sup>35</sup>.

The purpose of this survey was to analyse the knowledge and awareness regarding the usage of newer root canal irrigants in clinical practice and their advantage over conventional irrigants.

#### MATERIALS AND METHODS

A cross-sectional study was conducted across various specialists and general practitioners in Chennai. Convenient sampling was done and questionnaires were randomly distributed to 100 participants, comprising 45 specialists(endodontists) and 55 general practitioners respectively. A self administered questionnaire was created using Google Forms in English and was distributed. It took about 5-10 minutes to complete the survey. The questions were directed towards analysing the awareness in recent advances in root canal disinfection. With the help of the survey portal, the results were obtained and graphs were plotted accordingly. The results obtained were then compared with the responses derived from specialists and general practitioners for a comparative analysis. The questionnaires mentioned in the survey mentioned in the table below.

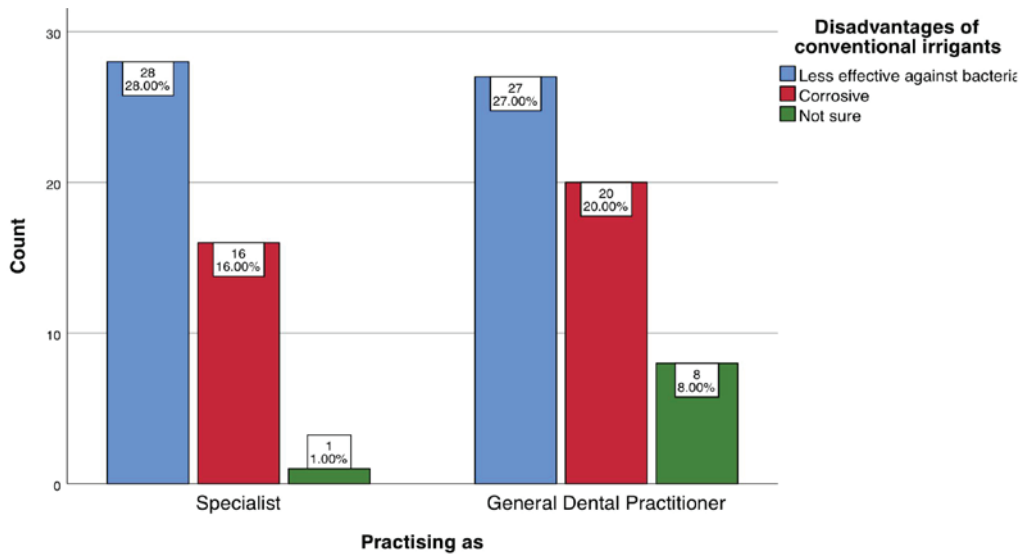
QUESTION	OPTIONS
What are some of the disadvantages of conventional irrigants?	<ul style="list-style-type: none"> <li>• Less effective against bacteria</li> <li>• Corrosive</li> <li>• Not sure</li> </ul>
What happens if bacteria is not completely removed from root canals?	<ul style="list-style-type: none"> <li>• Failure of endodontic treatment</li> <li>• Re-infections</li> <li>• Not aware</li> </ul>
Are you aware that the newly developed irrigants have higher potential for root canal disinfection and has advantages when compared with conventional irrigants?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>

**Cont... Table 1: Questionnaires included in survey**

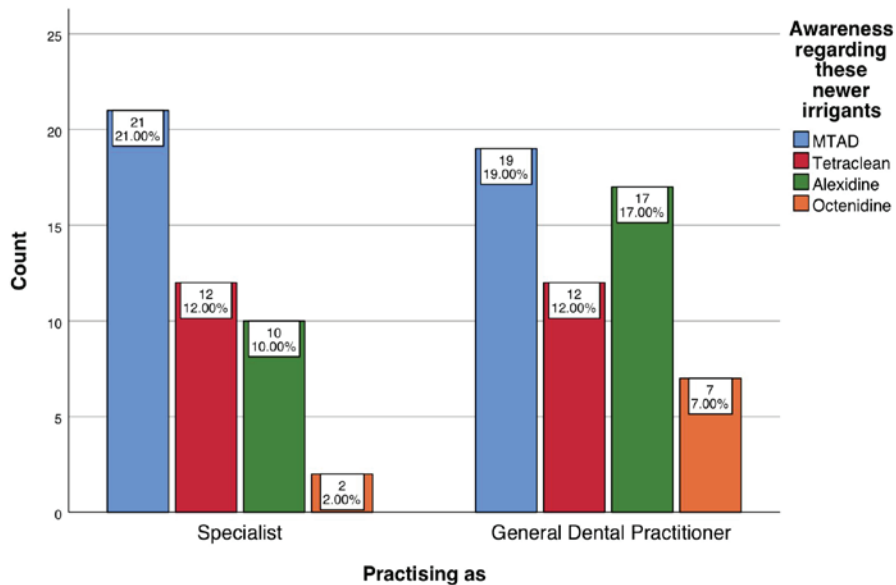
Are you aware of some of these root canal disinfectants mentioned below?	<ul style="list-style-type: none"> <li>• MTAD</li> <li>• Tetraclean</li> <li>• Alexidine</li> <li>• Octenidine</li> </ul>
How efficient do you think is the use of herbal extracts in root canal disinfection?	<ul style="list-style-type: none"> <li>• Highly efficient</li> <li>• Not so efficient</li> <li>• Not aware/ not sure</li> </ul>
Are you aware of the use of antibacterial nanoparticles for root canal disinfection?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Are you aware that MTAD does not erode dentin whereas other conventional irrigants do?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
What do you think are some advantages of MTAD?	<ul style="list-style-type: none"> <li>• Root Surface conditioning</li> <li>• Smear layer removal</li> <li>• Both of the above</li> <li>• None of the above</li> </ul>
Do you know that Tetraclean can disaggregate biofilm better when used with NaOCl?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Are you aware that ozonated water could neutralise LPS(Lipopolysaccharide) within the root canal?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Do you know that antimicrobial photodynamic therapy can be used with conventional root canal treatment?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
What do you think are some advantages of photon-induced photoacoustic streaming?	<ul style="list-style-type: none"> <li>• Doesn't require use of extensive instrumentation</li> <li>• Effective debridement, no thermal effect on dentinal walls</li> <li>• Effective removal of calcium hydroxide from root canal</li> </ul>
Are you aware that lasers are highly effective in root canal disinfection?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
What do you think are some advantages of recent advances in disinfectants?	<ul style="list-style-type: none"> <li>• Broad spectrum of antimicrobial effect</li> <li>• Effective removal of vital and non-vital tissue</li> <li>• Improve the fluid dynamics</li> <li>• Not sure</li> </ul>

### Results and Discussion

From the survey, the following results were observed and demonstrated below (graphs 1-6)

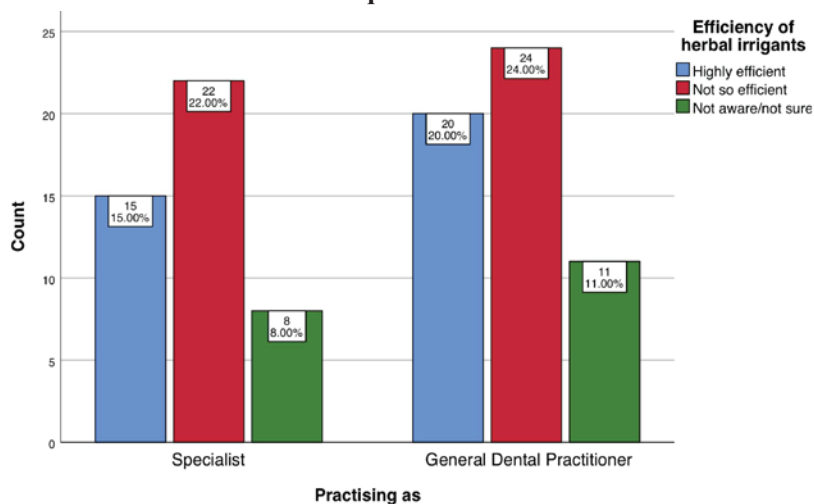


**Graph 1:** Bar graph represents the association between the field of practice (specialists / general practitioners) and their opinion regarding the disadvantage of conventional irrigants, X-axis represents the field of practice and Y-axis represents the number of participants. The blue bar represents that conventional irrigants were less effective against bacteria, red bar represents irrigants were corrosive in nature and the green bar represents indecisiveness. Majority of the respondents (28% of specialists and 27% general practitioners) opted conventional irrigants were less effective against bacteria. Chi square test was done and association was not significant (p value- 0.084;  $p > 0.05$ ) proving there was no statistical significant association between the field of practice (specialists / general practitioners) of the dentists and their response to the question.

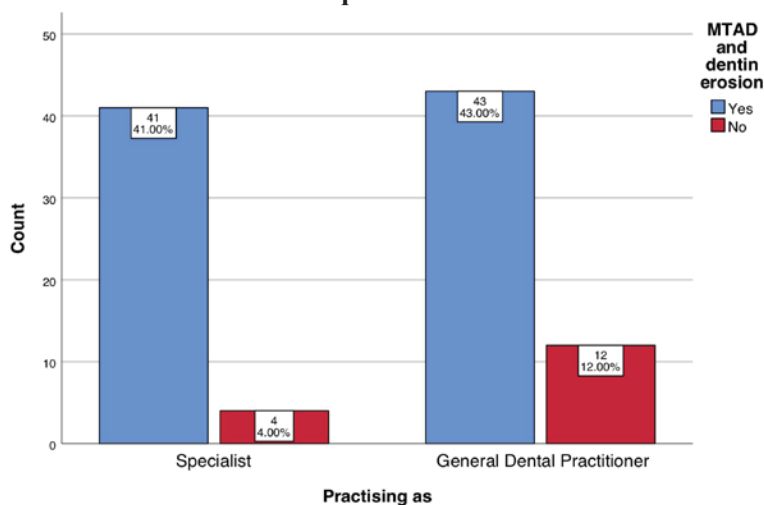


**Graph 2:** Bar graph represents the association between the field of practice (specialists / general practitioners) and their awareness of recently developed irrigants, X-axis represents the field of practice (specialists / general practitioners) and Y-axis represents the number of participants. The blue bar represents MTAD, the red bar represents Tetraclean, green bar represents Alexidine and the orange bar represents Octenidine. Majority of the respondents (21% of the specialists and 19% general practitioners) were aware of the MTAD which is a mixture of doxycycline, citric acid and a detergent. Chi square test was

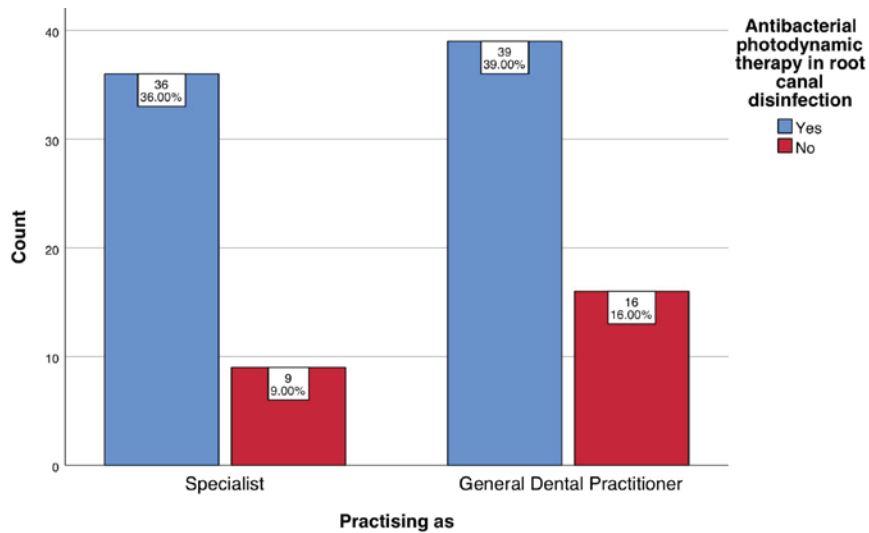
done and association was not significant (p value- 0.292;  $p > 0.05$ ) proving there was no statistical significant association between the field of practice (specialists / general practitioners) and their response to the question.



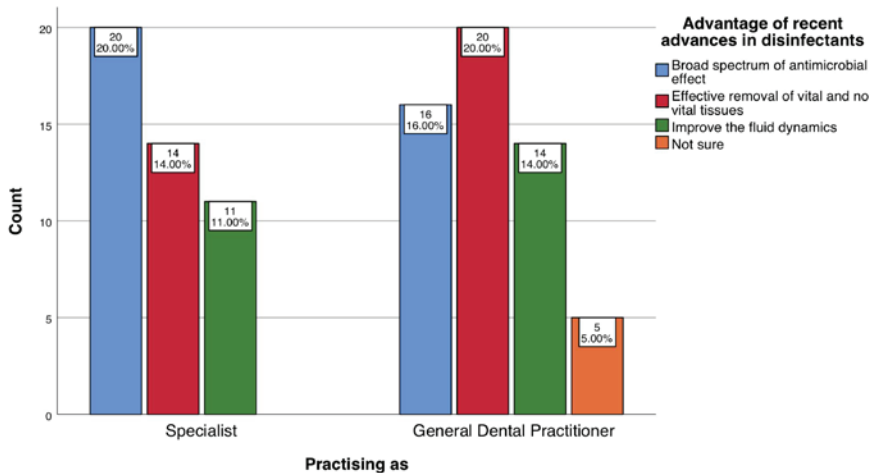
Graph 3: Bar graph represents the association between the field of practice (specialists / general practitioners) and the efficiency of herbal disinfectants, X-axis represents the field of practice (specialists / general practitioners) and Y-axis represents the number of participants. The blue bar represents herbal irrigants were highly efficient, red bar represents not so efficient and the green bar represents unfamiliarity or indecisiveness. Majority of the respondents (22% of specialists and 24% of general practitioners) responded that herbal disinfectants were not so efficient in root canal disinfection. Chi square test was done and association was not significant (p value- 0.870;  $p > 0.05$ ) proving there was no statistical significant association between the field of practice (specialists / general practitioners) and their response to the question.



Graph 4: Bar graph represents the association between the field of practice (specialists / general practitioners) and awareness of dentin erosion that occurs during the use of MTAD. X-axis represents the field of practice (specialists / general practitioners) and Y-axis represents the number of participants. The blue bar represents yes- as an agreement to the statement(or question) and the red bar represents no- as a disagreement to the statement(or question).Majority of the respondents (41% specialists and 43% of general practitioners ) were aware that MTAD can erode the dentin. Chi square test was done and association was not significant (p value- 0.079;  $p > 0.05$ ) proving there was no statistical significant association between the field of practice (specialists / general practitioners) and their response to the question.



**Graph 5:** Bar graph represents the association between the field of practice (specialists / general practitioners) and the knowledge regarding the usage of antibacterial photodynamic therapy in conventional root canal treatment, X-axis represents the field of practice (specialists / general practitioners) and Y-axis represents the number of participants. The blue bar represents yes- as an agreement to the statement(or question) and the red bar represents no- as a disagreement to the statement(or question). Majority of the respondents (36% specialists and 39% of general practitioners) were aware that the antimicrobial photodynamic therapy could be used in conventional root canal treatment. Chi square test was done and association was not significant (p value- 0.296;  $p > 0.05$ ) proving there was no statistical significant association between the field of practice (specialists / general practitioners) and their response to the question.



**Graph 6:** Bar graph represents the association between the field of practice (specialists / general practitioners) and the advantage of newly developed irrigants, X-axis represents the field of practice (specialists / general practitioners) and Y-axis represents the number of participants. The blue bar represents a broad spectrum of antimicrobial activity, the red bar represents effectiveness to remove vital and non vital tissues, the green bar represents improvement of fluid dynamics of irrigants used and the orange bar represents indecisiveness. Majority of the respondents (20% specialist and 16% general practitioners) concluded that the advantage of newly developed irrigants is the broad spectrum antimicrobial activity. Chi square test was done and association was not significant (p value- 0.115;  $p > 0.05$ ) proving there was no significant association between the field of practice (specialist / general practitioner) and their response to the question.

Presence of microorganisms within the root canal threaten to cause re-infections leading to the failure of the endodontic treatment <sup>2</sup>. Hence, complete root canal debridement is very important <sup>6</sup>. Conventional irrigants such as NaOCl and chlorhexidine, have been employed for disinfection from as early as the 1920s <sup>3,6</sup>. Through various researches, it has been found that the conventional disinfectants have some disadvantages that tend to hamper a complete disinfection of the canal<sup>36</sup>. This has given rise to the development of newer irrigants such as MTAD, Tetraclean and Octenidine to challenge the disadvantages of the conventional irrigants, and also have improved properties in canal disinfection <sup>37</sup>. Various researches related to endodontics have been published that suggest that proper treatment is necessary for successful endodontic therapy <sup>38,39</sup>.

The survey sought to analyse the knowledge and awareness of the recent advancements in the dental irrigants used during root canal disinfection. From the varied responses of the individuals, it was clear that a clear knowledge regarding the recent advances in root canal disinfection was present. Conventional irrigants are widely used for root canal disinfection during root canal treatment and they have been employed most commonly. Conventional root canal irrigants revealed that it had some disadvantages such as corrosive to the dentinal layer and reduced effectiveness against certain bacterial species such as enterococcus and lactobacillus. Development of newer variety of irrigants thus began for effective disinfection and also possess additional advantages such as improvement of fluid dynamics and effective bacterial removal. Participants in the survey are well aware of the recent advances in root canal irrigation and were ready to imply them in their clinical practice. There was no significant difference in the responses of the specialists as well as general practitioners, which means that the majority of the general practitioners were also aware of all the recent advances in root canal irrigation. However, there were some limitations in terms of small sample size and that many of the responders might have had an unwillingness to answer resulting in false responses being generated in the survey result. The scope in this study is that it can be used to create knowledge among individuals regarding recent advances in root canal disinfection.

## Conclusion

Within the limitations of the study, the knowledge, attitude and practice regarding recent advances in root canal disinfection were analysed. It showed that the majority of the dentists were aware of newer advancements and the advantages of the same over conventional irrigants and were ready to imply them in their daily practice. There was no significant association between the field of practice (specialists / general practitioners) and their response to the questions. Overall, the survey showed good knowledge in the awareness of recently developed disinfectants among the dentists.

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