IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 3 Ser.1 (March. 2021), PP 50-55
www.iosrjournals.org

Effectiveness of 2% chlorhexidine on Enterococcus Faecalis in Root Canal Treatment

Leela Devi Sivaraj[1], Umsalama Khalid Mahdi Hussain[2]
[1](General Dentist, Multi-specialty Dental Clinic, India)
[2](General Dentist, Davinci dental clinic, Sudan)

Abstract:*Root canal treatment plays an important role in saving the tooth. In Endodontics it is a routine treatment that involves removing the contaminated dentine, infected pulp, inflamed and dead pulp tissue by cleaning and shaping the canal with intracanal medication, disinfecting with irrigants to eliminate the all causative microorganisms.For the long-standing success of the endodontically treated tooth, it is necessary to eliminate persistent bacteria, such as Enterococcus faecalis. The ruinous components of Enterococcus Faecalis, including its capacity to tackle diverse microorganisms, attack dentinal tubules, and contradict nutritional difficulty. Using a good aseptic debridement procedure of diseased pulp and contaminated dentin with a combination of 2% chlorhexidine is the best way to eliminate E. faecalis in root canal procedure. Following a systematic review and metanalysis, the efficacy of 2% chlorhexidine (CHX) on Enterococcus faecalis was evaluated.* ***Aim:*** *The goal of this review was to determine and compare the efficacies of root canal disinfectant 2% chlorhexidine with 5.25% sodium hypochlorite (NaOCl), Calcium hydroxide ($Ca(OH)_2$),17% EDTA, MDTA.*
Materials and Methods*: Literature research is performed in sources of data like MEDLINE, online library journal PubMed NIH, NCBI, WILEY ONLINE LIBRARY, ORAL HEALTH GROUP, Scopus ETC. Electronic information bases had been looked through utilizing the resulting keywords: Root canal irrigants, 2% chlorhexidine, Enterococcus faecalis, Calcium hydroxide NaOCl Root canal irrigation medicine. Our search was done on articles distributed to date.*
Results*: After reviewing the titles and abstracts, many articles met the eligibility.The use of chemical agents with 5.25 percent sodium hypochlorite and 2 percent chlorhexidine resulted in microbial eradication at 100 percent compared to using only 5.25% sodium hypochlorite alone or calcium hydroxide alone which decreased by 97.7 percent compared to baseline microbial count and reduced by 68.42 percent at the same dilutions after mechanical cleaning respectively..*
Conclusion:*In this review study,2% Chlorhexidine has greater disinfection than calcium hydroxide and 5.25% sodium hypochlorite.*
Key Words*:Root canal irrigants, 2% chlorhexidine, Enterococcus faecalis, Calcium hydroxide NaOCl Root canal disinfection intercanal medication, EDTA, MTDA.*

Date of Submission: 20-02-2021 Date of Acceptance: 04-03-2021

I. Introduction

Chlorhexidine gluconate (CHX) is a manufactured cationic bis-guanide comprised of two symmetric 4-chlorophenyl rings and two biguanide bunches associated with a focal hexamethylene chain. CHX is a decidedly charged hydrophobic and lipophilic atom that communicates with phospholipids and lipopolysaccharides on the cell layer of microorganisms and afterward enters the cell through and or detached vehicle component. Its adequacy is a result of the collaboration of the positive charge of the molecule and antagonistically charged phosphate packs on the microbial cell dividers, in this manner modifying the cells' osmotic balance. This expands the porousness of the cell divider, which permits the CHX particle to enter the organisms, most widely used as in mouth wash. Chlorhexidine gluconate is water-solvent and at physiologic pH promptly separates and deliveries the positively charged CHX segment at low concertation (0.2%), low sub-atomic weight substances the potassium and phosphorus will spill out. Then again, at higher concentrations (2%), CHX is bactericidal; precipitation of cytoplasmic substance happens to bring about cell demise.[15]

E. faecalis has certain harmfulness factors including lytic compounds, cytolysin, accumulation substance, pheromones, and lipoteichoic acid.[11] It binds to the host cells, express proteins that permit it to rival other bacterial cells, and change the host responses[10] E. faecalis can stifle the activity of lymphocytes, possibly adding to the cause of endodontic failure. It has serine protease, gelatinase, and collagen-restricting protein (Ace), which help it tie to dentin Serum, which begins from alveolar bone and the periodontal tendon, additionally helps E. faecalis bind to type I collagen. E. faecalis in dentinal tubules has been appeared to oppose intracanal dressings[9] E. faecalis can shape a biofilm that encourages it to oppose obliteration by empowering

the microorganisms to become multiple times more impervious to phagocytosis, antibodies, and antimicrobials than non-biofilm-delivering creatures . [11] Chlorhexidine, in a 2% gel or fluid fixation, is compelling at decreasing or disposing of E. faecalis from the root canal space and dentinal tubules. A 2-min flush of 2% chlorhexidine fluid can be utilized to eliminate E. faecalis from the outer most layers of dentinal tubules up to 100 m. Two percent chlorhexidine gel is compelling at dismissing E. faecalis from dentinal tubules for as long as 15 days. [11] This might be to some extent ascribed to its considerable antimicrobial action. It is sketchy with regards to whether 0.12% chlorhexidine is more successful than calcium hydroxide. A few examinations propose it is more viable, yet neither will destroy E. faecalis. Another investigation proposes 10% calcium hydroxide alone is more viable When warmed to 46°C, both 0.12% chlorhexidine and 10% calcium hydroxide have more noteworthy antimicrobial impacts against E. faecalis than at ordinary body temperature.[6] The reason for this survey to assess the efficiency2% chlorhexidine as an irrigant in eliminating E. faecalis from the root canal of a tooth.

II. Material and Methods

In compliance with PRISMA guidelines and based on the PICO definition, searches were completed. To perform a comprehensive search of the literature and to respond to the focused questions, different databases were used. This review was planned to utilize an investigation of longitudinal examinations from a quantitative assessment. These investigations were chosen towards the viability of 2% CHX against E. faecalis recognized in endodontic contaminations pre and post root canal preparation. English-language articles were recovered from electronic database and hand search through the record.

Review question and PICO strategy:
Is there sufficient evidence that 2% CHX used in root canal treatment as irrigant and intercanal medication eradicates the E. faecalis strain which is one of the most significant causes for root canal failure hygiene?

- Population (P): any human participant
- Intervention (I): 2% CHX IN RCT
- Comparison (C): 2% CHX and alternative like NaOCl, Ca(OH)2, MTDA, EDTA evidence-based interventions
- Outcome (O): effect on E. faecalis and success rate of root canal

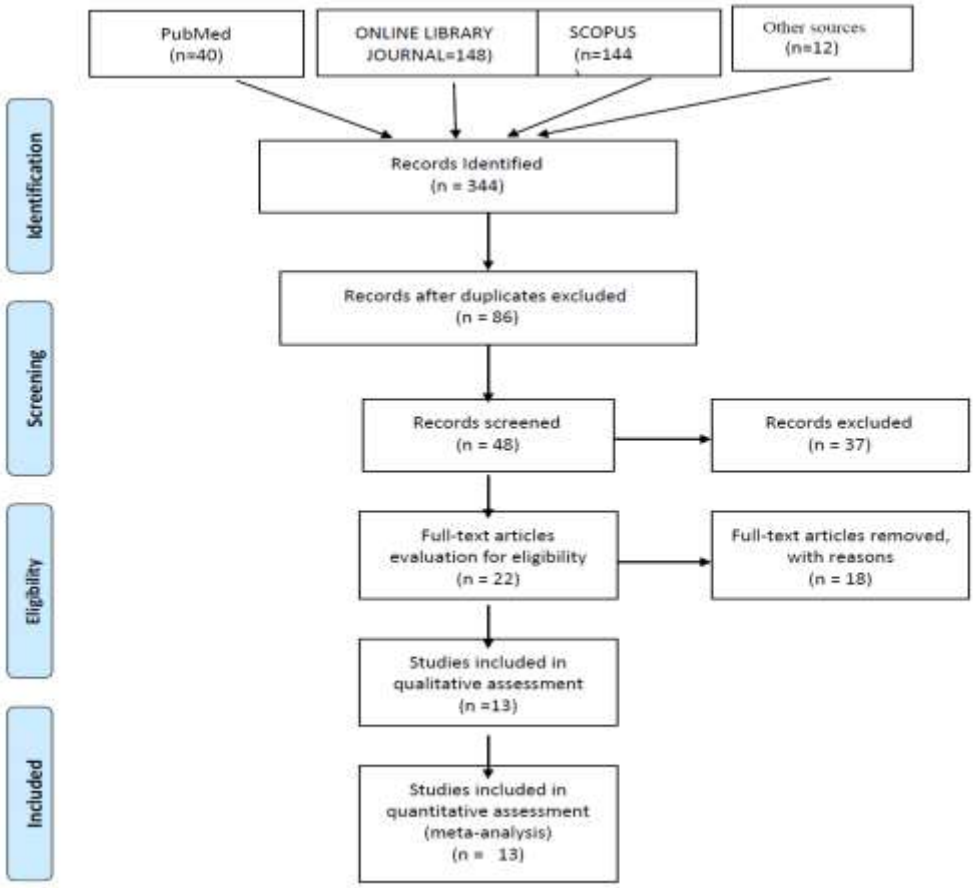
Information sources and search strategy:
Literature research is performed in sources of data like MEDLINE, online library journal PubMed NIH, NCBI, WILEY ONLINE LIBRARY, ORAL HEALTH GROUP, Scopus ETC. Electronic information bases had been looked through utilizing the resulting keywords: Root canal irrigants, 2% chlorhexidine, Enterococcus faecalis, Calcium hydroxide NaOCl Root canal irrigation intercanal medicine. Our search was done on articles distributed to date

Inclusion criteria:
Research article, original article, Systematic reviews, with or without meta-analyses, published in English from 2000 to 2020 and including studies, performed in humans, on the results of on 2% CHX as irrigant and intercanal medication in eradicating Faecalis.

Exclusion criteria:
Letters to the editor, personal opinions, book chapters, case reports, congress abstracts, studies with animals were excluded. Animal studies, studies without a randomized-controlled design, reviews, and studies not using appropriate medicine as an intervention were excluded.

III. Result

The sum of 334 doubtlessly relevant titles and abstracts were found by way of the electronic search and additional assessment of reference lists. During the first screening, 48 publications had been excluded primarily based on the title and keywords. Additionally,10 titles have been excluded primarily based on the abstract evaluation. 86 full-text articles had been thoroughly evaluated. A whole of 248 papers had to be excluded at this stage because they did no longer fulfill the inclusion standards of the current systematic review. Thirteen articles went into qualitative evaluation (Fig. 1). Thus, as a feature of this systematic review, thirteen investigations were incorporated. the layouts a stream outline of the list items as per PRISMA suggestion. (Fig. 1).



Literature Review:

The characteristics of the included studies are summarized in table no:1 as below

Study #	**Scope**	**Results**
Study 1	The potential of 4% NaOCl solutions used in various irrigation protocols of root canal systems was investigated the Elimination of Faecalis.	Found that in group A and B, 30–40% of the roots left infected even after irrigating with 4%naocl solution with E. faecalis [4]
Study 2	Reported that the antimicrobial efficacy of 2.5% and 5.25% NaOCl, 2% gel, and liquid CHX and MTAD against E. faecalis biofilms on human dentin	Compared to liquids and MTAD, the most effective cleaning agents for removing E. faecalis biofilms at test time intervals were 2.5% and 5.25% NaOCl and 2% CHX gel.[7]
Study 3	Showed having an effective final rinse plays an important in achieving better disinfection and ensuring the remaining antimicrobial effects after root canal preparation	There was no significant difference between 0.2% cetrimide and 0.2% chlorhexidine. The final rinse with 2% chlorhexidine showed a residual activity of more than 0.2% chlorhexidine.[8]
Study 4	Demonstrated on non-radical human teeth infected with E. faecalis were treated with Ca(OH)2, 2% chlorhexidine gel, Ca(OH)2 plus 2% chlorhexidine gel or saline (0, 9% NaCl). as a negative control	Chlorhexidine had increased antimicrobial activity compared to $Ca(OH)_2$. $Ca(OH)_2$ in combination with chlorhexidine showed similar antimicrobial activity to chlorhexidine alone. [12]
Study 5	Assessed that after 10 minutes of treatment with 2% CHX solution, the persistence of CHX in the root canal sys	They found that CHX retained in the root canal dentin has antimicrobial effect up to 12 weeks [13]

IV. Discussion

The reason for endodontics treatment is to eliminate all microorganisms from the dentinal tubules and the root canal. It may be achieved by cleaning and shaping the root canals by eliminating infected dentin, inflamed pulp followed by disinfecting with various chemical agents. [1]

Enterococcus faecalis is one of the main reason for root canal treatment failure, essentially because of its protection from the chemo-mechanical method and intracanal items like calcium hydroxide .In a study, Positive control samples in experiments showed that distilled water is ineffective in removing E. faecalis. Also, negative control samples indicated that the condition of the incubation environment used during the experiment was not contaminated. [2]

Walker in 1936, presented NaOCl as a disinfectant solution. NaOCl in general breaks up the contaminated tissue and has antimicrobial movement. [1] Mechanical debridement of the canal is certifiably not a basic method. The complication of the root canal is regarding their anatomy, sclerosis of dentinal tubules, and the smear layer is a struggle to achieve complete debridement.The presence of Enterococcus faecalis and Candida species are resistant to most of the disinfectants and cause relapse or eventually root canal treatment failure [3]

In a study, the antibacterial effects of 2.5% and 5.25% NaOCl, 2% gels, liquid CHX, and MTAD on E. faecalis biofilms on human teeth was assessed by CFU count. The formation of biofilm at the dentin level was confirmed by SEM analysis. The outcomes showed no measurable distinction between CHX gel, 2.5%, and 5.25% NaOCl. However, CHX and MTAD were less powerful than 2.5% and 5.25% NaOCl. Over time CHX liquid and MTAD are less effective. Compared to liquids and MTAD, the most effective cleaning agents for removing E. faecalis biofilms at test time intervals were 2.5% NaOCl, 5.25% NaOCl and 2% CHX gel.[7]

In anexperimental study, 86 anterior human teeth stored in 0.1% thymol solution at 4 °C were decoronated to obtain roots 12 mm in length. The groups were divided into three depending on the irrigant used Group I with 0.2% cetrimide, Group II: 0.2% chlorhexidine Group III: 2% chlorhexidine. The proportion of ungrown specimens over 50 days was evaluated using nonparametric Kaplan–Meier survival analysis. Differences among groups were tested using the log-rank test and the level of statistical significance was set at $P<0.05$. shows the number of regrown samples and the median and mean standard deviation of the day of regrowth. The higher concentration of CHX tested (2%) showed a greater capacity to inhibit E. faecalis regrowth: at 50 days, only 9/26 specimens showed regrowth. There were significant differences with respect to 0.2% chlorhexidine as well as 0.2% cetrimide (both 18/26). At 50 days, E. faecalis development was distinguished in 69.23% examples in Groups I and II, and in 34.61% examples in the 2% chlorhexidine groups., The final rinse with 2% chlorhexidine showed a residual activity of more than 0.2% chlorhexidine and 0.2% cetrimide in root canals infected with E. faecalis [8].

The disinfectant that are used in today's clinical practice, during cleaning and shaping include NaOCl, CHX, EDTA, and MTAD. None of these irrigants has all the characteristics of an ideal irrigants. So, combining one or more agents gives better result. Interappointment pain can be reduced by using both disinfectant and intracanal medication.

In another comparative study, non-radical human teeth infected with E. faecalis were exposed with Ca(OH)2, 2% chlorhexidine gel, Ca(OH)2 plus 2% chlorhexidine gel, or saline (0, 9% NaCl). as a negative control. The chlorhexidine gel had a significantly higher antimicrobial property, measured by CFU and percentage of viable cells than Ca(OH)2. No differences were observed between the antimicrobial effectiveness of the chlorhexidine gel with and without added Ca(OH)2 Both Ca(OH)2 and chlorhexidine have antimicrobial effects on E. faecalis. Chlorhexidine had increased antimicrobial activity compared to Ca(OH)2.Ca(OH)2 in combination with chlorhexidine showed similar antimicrobial activity to chlorhexidine alone. [12]

layer is known to block the entry of antimicrobial agents into dentinal tubules therefore, groups D and E included those who were irrigated with 1.5% and 3% NaOCl but were treated with 17% EDTA before the final administration of NaOCl. It removed the smear layer and improved penetrations to NaOCl within dentinal tubules.[4] Even though removal of the smear layer by this method does not enhance the antimicrobial effect of NaOCl. [2]

Chelating substances, for example, ethylenediaminetetraacetic acid (EDTA), citric acid and antibiotic medication are utilized for the expulsion of the inorganic part of the smear layer.[7] NaOCl is another disinfectant used for irrigation during debridement of organic components. Irrigation with 17% EDTA for one minute followed by a final rinse with NaOCl is the most recommended method to remove the smear layer. Longer exposures can cause excessive removal of both peritubular and intratubular dentin. EDTA has zero antibacterial impact. [6]

In a study, the antibacterial effects of 2.5% and 5.25% NaOCl, 2% gels, liquid CHX, and MTAD on E. faecalis biofilms on human teeth was assessed by CFU count. The formation of biofilm at the dentin level was confirmed by SEM analysis. The outcomes showed no measurable distinction between CHX gel, 2.5%, and 5.25% NaOCl. However, CHX and MTAD were less powerful than 2.5% and 5.25% NaOCl. Over time CHX

liquid and MTAD are less effective. Compared to liquids and MTAD, the most effective cleaning agents for removing E. faecalis biofilms at test time intervals were 2.5% NaOCl, 5.25% NaOCl and 2% CHX gel.[7]

In a study, 86 anterior human teeth stored in 0.1% thymol solution at 4 °C were decoronated to obtain roots 12 mm in length. The groups were divided into three depending on the irrigant used Group I with 0.2% cetrimide, Group II: 0.2% chlorhexidine Group III: 2% chlorhexidine. The proportion of ungrown specimens over 50 days was evaluated using nonparametric Kaplan–Meier survival analysis. Differences among groups were tested using the log-rank test and the level of statistical significance was set at $P<0.05$. shows the number of regrown samples and the median and mean standard deviation of the day of regrowth.

The higher concentration of CHX tested (2%) showed a greater capacity to inhibit E. faecalis regrowth: at 50 days, only 9/26 specimens showed regrowth. There were significant differences with respect to 0.2% chlorhexidine as well as 0.2% cetrimide (both 18/26). At 50 days, E. faecalis development was distinguished in 69.23% examples in Groups I and II, and in 34.61% examples in the 2% chlorhexidine groups., The final rinse with 2% chlorhexidine showed a residual activity of more than 0.2% chlorhexidine and 0.2% cetrimide in root canals infected with E. faecalis [8].

The disinfectant that are used in today's clinical practice, during cleaning and shaping include NaOCl, CHX, EDTA, and MTAD. None of these irrigants has all the characteristics of an ideal irrigants. So, combining one or more agents gives better result. Interappointment pain can be reduced by using both disinfectant and intracanal medication.

In another comparative study, it was demonstrated non-radical human teeth infected with E. faecalis were exposed with Ca(OH)2, 2% chlorhexidine gel, Ca(OH)2 plus 2% chlorhexidine gel, or saline (0, 9% NaCl). as a negative control. The chlorhexidine gel had a significantly higher antimicrobial property, measured by CFU and percentage of viable cells than Ca(OH)2. No differences were observed between the antimicrobial effectiveness of the chlorhexidine gel with and without added Ca (OH)2 Both Ca(OH)2 and chlorhexidine have antimicrobial effects on E.faecalis. Chlorhexidine had increased antimicrobial activity compared to Ca(OH)2. Ca(OH)2 in combination with chlorhexidine showed similar antimicrobial activity to chlorhexidine alone. [12]

Root Canal Irrigants	**Concentration**	**Smear Layer Removal**	**Elimination Of E. Feacalis**
Sodium hypochlorite	2.5%	+/-	+
Sodium hypochlorite	4%	+/-	+
Sodium hypochlorite	5.25%	+	++
Chlorhexidine solution	2%	-	+++
Intercanal Medication	**Concentration**	**Smear Layer Removal**	**Elimination Of E. Feacalis**
Calcium hydroxide		+	-
EDTA	17%	++	-
MDTA		+++	++
Chlorhexidine gel	2%	-	+++

In a study, it was assessed, the persistence of CHX in the root canal system after 10 minutes of treatment with 2% CHX solution. They found that CHX retained in the root canal dentin has antimicrobial effect up to 12 weeks. [13]

The antimicrobial persistence depends on the number of CHX molecules available to interact with dentin. Therefore, treating the root canal with a concentrated CHX preparation should lead to increased resistance to microbial colonization. Recently, the antibacterial persistence of three concentrations of the CHX solution (4%, 2% and 0.2%) was assessed after 5 minutes. The results showed a direct relationship between the concentration of CHX and its persistence. [14]

V. Conclusion

The proper residual debridement of organic and inorganic substances plays a major role in the success of root canal-treated teeth. Enterococcus faecalis Being a prime culprit in the failure of root canal treatment and interappointment pain, Here 2% chlorhexidine plays one of the most essential chemical agents as intercanal medication and as an irrigant in eradiating E. faecalis, The impact of 2% chlorhexidine on microbial biofilms is effective more than sodium hypochlorite and calcium hydroxide. Whereas Ca(OH)2 has no anti-microbial property. The biocompatibility of CHX is acceptable. 2% chlorhexidine has antibacterial substantivity for as long as 12 weeks. Blending 2% CHX gel with calcium hydroxide may upgrade its antimicrobial movement. Final Irrigation with 2% chlorhexidine demonstrated more effectiveness in eradicating E. faecalis. Mixing MTA with CHX builds the antimicrobial properties of MTA. The best irrigants in disposing of E. faecalis biofilms were 2.5% and 5.25% NaOCl and 2% CHX gel, in contrast with CHX fluid and MTAD.

References

[1]. Priyanka H,et. Evaluation of 4% Sodium Hypochlorite in eliminating Enterococcus faecalis from the Root Canal when Used with Three Irrigation Methods: An in vitro Study. J Contemp Dent Pract 2017;18(3):214-217. one.

[2]. Kamberi B, Bajrami D, Stavileci M, Omeragiq S, Dragidella F, Koçani F. The Antibacterial Efficacy of Biopure MTAD in Root Canal Contaminated with Enterococcus faecalis. ISRN Dent. 2012;2012 https://doi.org/10.5402/2012/390526 PMid:22991671 PMCid:PMC3443582.

[3]. Paqué F, Luder HU, Sener B, Zehnder M. Tubular sclerosis rather than the smear layer impedes dye penetration into the dentine of endodontically instrumented root canals. Int Endod J. 2006 Jan;39(1):18-25. doi: 10.1111/j.1365-2591.2005.01042.x. PMID: 16409324.

[4]. Torabinejad M, Shabahang S, Aprecio RM, Kettering JD. The antimicrobial effect of MTAD: an in vitro investigation. J Endod. 2003 Jun;29(6):400-3. doi: 10.1097/00004770-200306000-00005. PMID: 12814224.

[5]. Evanov C, Liewehr F, Buxton TB, Joyce AP. Antibacterial efficacy of calcium hydroxide and chlorhexidine gluconate irrigants at 37 degrees C and 46 degrees C. J Endod. 2004 Sep;30(9):653-7. doi: 10.1097/01.don.0000121620.11272.22. PMID: 15329571.

[6]. Calt S, Serper A. Smear layer removal by EGTA. J Endod. 2000 Aug;26(8):459-61. doi: 10.1097/00004770-200008000-00007. PMID: 11199779.

[7]. Murad et al. Antimicrobial activity of sodium hypochlorite, chlorhexidine and MTAD® against Enterococcus faecalis biofilm on human dentin matrix in vitro. RSBO. 2012 Apr-Jun;9(2):143-50

[8]. María Ferrer-Luque C, Teresa Arias-Moliz M, Ruíz-Linares M, Elena Martínez García M, Baca P. Residual activity of cetrimide and chlorhexidine on Enterococcus faecalis-infected root canals. Int J Oral Sci. 2014 Mar;6(1):46-9.

[9]. Haapasalo M, Orstavik D. In vitro infection and disinfection of dentinal tubules. J Dent Res. 1987 Aug;66(8):1375-9. doi:0.1177/00220345870660081801. PMID: 3114347.

[10]. Natasha Jaiswal, Dakshita-Joy Sinha, Udai-Pratap Singh, Kanwardeep Singh, Urja-Ahuja Jandial, Shivika Goel J Clin Exp Dent. 2017 Sep; 9(9): e1066–e1074. Published online 2017 Sep 1. doi: 10.4317/jced.53777 PMCID: PMC5650207

[11]. Stuart CH, Schwartz SA, Beeson TJ, Owatz CB. Enterococcus faecalis: its role in root canal treatment failure and current concepts in retreatment. J Endod. 2006 Feb;32(2):93-8. doi: 10.1016/j.joen.2005.10.049. PMID: 16427453.

[12]. Delgado RJ, Gasparoto TH, Sipert CR, Pinheiro CR, Moraes IG, Garcia RB, Bramante CM, Campanelli AP, Bernardineli N. Antimicrobial effects of calcium hydroxide and chlorhexidine on Enterococcus faecalis. J Endod. 2010 Aug;36(8):1389-93. doi: 10.1016/j.joen.2010.04.013. Epub 2010 Jun 19. PMID: 20647103.

[13]. Rosenthal S, Spångberg L, Safavi K. Chlorhexidine substantivity in root canal dentin. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2004 Oct;98(4):488-92. doi: 10.1016/j.tripleo.2003.07.005. PMID: 15472666.

[14]. Khademi AA, Mohammadi Z, Havaee A. Evaluation of the antibacterial substantivity of several intra-canal agents. Aust Endod J. 2006 Dec;32(3):112-5. doi: 10.1111/j.1747-4477.2006.00033.x. PMID: 17201752

[15] Zahed MohammadiChlorhexidine gluconate, its properties and applications in endodonticsIran Endod J. 2008 Winter; 2(4): 113-125. Published online 2008 Jan 10.PMCID: PMC3834637

Leela Devi Sivaraj, et. al. "Effectiveness of 2% chlorhexidine on Enterococcus Faecalis in Root Canal Treatment." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(03), 2021, pp. 50-55.