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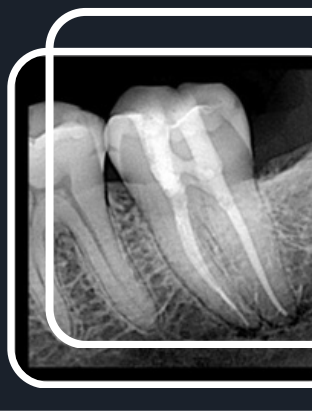

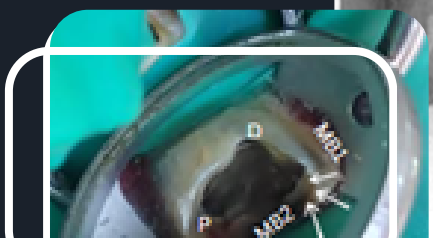

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Journal of Restorative Dentistry and Endodontics

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Journal of Restorative Dentistry & Endodontics

The scope of the journal is to publish manuscripts in the specialty of conservative dentistry & endodontics and aims to influence the practice of dentistry at clinical, research and ethical level on national and international basis.

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Journal of Restorative Dentistry and Endodontics

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EDITORS DESK

Greetings!

On behalf of the Editorial Team, I would like to extend a very warm welcome to the readers of this journal. I take this opportunity to thank our authors, editors and reviewers, all of whom have volunteered to contribute to the success of the journal.

This journal provides an ideal forum for exchange of information on all speciality topics. The journal's editorial board confirms this initiative will provide science-driven, peer-reviewed articles conforming to editorial standards expected by the scientific community.

With each new volume, we anticipate showcasing the remarkable advancements across various domains within our speciality since the previous issue. We sincerely hope that the readers will find the articles interesting, relevant and intellectually stimulating.

Dr. Srirekha. A

ORIGINAL RESEARCH

A Cone Beam Computer Tomography (CBCT) evaluation of retreatability with two Bioceramic sealers- Bioroot RCS (BCS) and Nishika Canal Sealer BG (CS-BG)

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ABSTRACT:

AIM: To evaluate the retreatability of two Bioceramic sealers- Bioroot RCS (BCS) and Nishika Canal Sealer BG (CS-BG) during nonsurgical endodontic retreatment using Cone Beam Computer Tomography (CBCT)

MATERIALS AND METHODS: Mesiobuccal canals in 40 mandibular molars were instrumented using D-RaCe rotary files up to 25.4% and canals were obturated using BCS and CS-BG. Post obturation the teeth were scanned using CBCT. All samples were divided into 2 groups (n=20). Group IA: BCS was removed using D-RaCe retreatment files with Xylene. Group IB: BCS was removed using D-RaCe retreatment files without Xylene. Group IIA: CS -BG was removed using D- RaCe retreatment files with Xylene. Group IIB: CS -BG was removed using D –RaCe retreatment files without Xylene. Samples were scanned using CBCT and remaining filling material were calculated in the coronal, middle and apical thirds. Kruskal-Wallis test was used for analysis.

RESULTS: Sealer residues were present in all groups whether or not solvent was employed. However, retreatability with BCS was better when compared to CS-BG.In all groups maximum sealer residue was observed in the apical third.

CONCLUSION: The results of this study demonstrated that both of the sealers left residues during retreatment.Retreatability of BCS was superior to that of CS-BG. The use of xylene speeded up the retrieval of both sealers.

KEYWORDS: Retreatability, Bioceramic sealers, Bioroot RCs, Nishika CS-BG

INTRODUCTION:

Thorough debridement, disinfection and three dimensional obturation of the root canal up to the working length are the three main factors influencing the success of endodontic treatment. Despite following a meticulous protocol, root canal treatment may treatment may result in failures in 15-22% of the cases[1]

Whenever primary endodontic treatment fails, non-surgical retreatment if attempted as it has a high success rate [4]. According to the Glossary of Endodontics, “Retreatment is a procedure to remove root canal filling material from the tooth, followed by cleaning, shaping, and obturation of the canals”.[2]

The aim of non-surgical endodontic retreatment is to relieve patient symptoms and re-establish healthy periapical tissues. This achieved by removing all previous obturation materials from the root canal space, chemically disinfect the canals before completing a dense, three dimensional obturation.[3]

Gutta-percha (GP) is the most common root filling material used along with various Sealers. During retreatment various techniques such as hand files, ultrasonic instruments, heated pluggers as well as different retreatment file systems may be used. For ease of removing the obturating materials, chemical solvents like chloroform, xylene eucalyptol etc also may be used.[4]

Many NiTi retreatment file systems are in use now for the effective retrieval of root filling materials. D- RaCe file system is more popular. [5] A variety of sealers are presently being employed for obturation. Even though AH Plus sealer is considered as the gold standard material, nowadays, bio ceramic sealers are gaining popularity. Bioceramic sealers calcium silicate materials demonstrating excellent sealability, extraordinary biocompatibility and antibacterial activity along with the ability to stimulate mineralization of periapical tissues[6]. BioRoot RCS (Septodont, Saint-Maur-des-Fossés, France) and Nishika CS BG (NIPPON SHIKA YAKUHIN CO., LTD.) are two newly improved bioceramic sealers.

BiorootRcs is a tricalcium silicate-based material marketed in the year 2015. It has a better adhesion to dentin and gutta-percha points no shrinkage and easy retreatability.[6] Nishika CS BG was introduced in the year 2017 with properties of biocompatibility and improved root canal sealing ability[7].

Cone Beam Computed Tomography (CBCT) has been recommended as a non-invasive method to quantitatively evaluate retreatment procedures[12]. It allows an accurate evaluation of root filling removal without damaging the tooth. At present, there are not many studies using CBCT for evaluating the retreatability of bioceramic sealers.

Hence, the purpose of the present study is to comparatively evaluate the retreatability of BCS and CS-BG using CBCT. Whether the use of a solvent would improve the efficacy of retreatment of both sealers was also examined.

MATERIALS AND METHODS:

Sample preparation

A total of forty extracted mandibular molars were used in this study. Access preparation was done on each tooth using Endo access bur. Working length was established using a size #15 K-file (Mani Dental, Inc., Japan) by introducing the file into the canal until its tip was visible at the apical foramen. The mesiobuccal canals were cleaned and shaped by hand files followed by iRace rotary files for canal preparation. The final apical preparations were done up to 25.4% at working length.

During instrumentation, all canals were irrigated with saline and 5.25% NaOCl between each instrument. Finally, after chemo mechanical preparation, the smear layer was removed using 17% EDTA followed by 5.25% sodium hypochlorite. The canals were dried with paper points and obturation was done using gutta percha and the tested sealers. Mesiobuccal canals in these samples were instrumented using D-RaCe rotary files up to 25.4% and canals were obturated using BCS and CS-BG.

Retreatment with and without xylene

Post obturation the teeth were scanned using CBCT. All samples were divided into 2 groups (n=20), IA, IB, IIA and IIB among which one group was treated with xylene and the other group was treated without Xylene.

Group IA: BCS was removed using D-RaCe retreatment files with Xylene, Group IB: BCS was removed using D-RaCe retreatment files without Xylene, Group IIA: CS -BG was removed using D- RaCe retreatment files with Xylene Group IIB: CS -BG was removed using D –RaCe retreatment files without Xylene. Samples were scanned using CBCT and remaining filling material were calculated in the coronal, middle and apical thirds. Kruskal-Wallis test was used for analysis.

CBCT analysis

CBCT scans were taken before and after the retreatment for the evaluation of the remnants. Grading system (Somma et al) was used to score the amount of filling material residues at the coronal, middle and apical portions of the canal as follows:

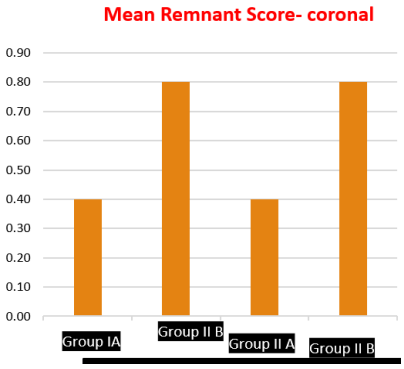
Score1- No or slight presence (0-25%) of debris on dentin surface.

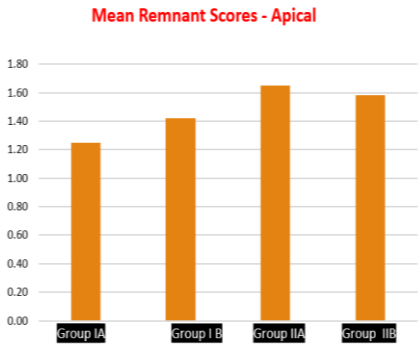
Score 2- Presence of debris (25-50%) on dentin surface.

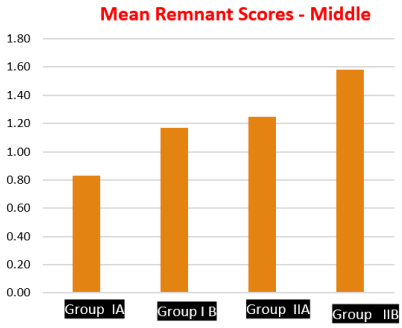
Score 3-Presence of moderate amount debris (50-75%) on dentin surface.

Score 4- Heavy presence (& gt;75%) of debris on dentin surface.

RESULTS:







Mean remnant score

The mean remnant score of remaining filling material in the root canal space after retreatment was calculated for both the sealers at coronal, middle and apical third. Both sealers were better removed when xylene was used as the solvent. However higher amount of remaining filling material was found in the groups treated with CS BG as compared to BCS. For both the sealers apical third had the most remaining filling material than middle and coronal thirds. Nonetheless, complete removal of filling materials was not achieved in any of the group's despite of using solvents.

DISCUSSION:

Non-surgical root canal retreatment is the preferred approach whenever primary endodontic therapy fails. The success of the non-surgical retreatment is up to 84.9%[8] and this depends on the complete removal of the root canal filling material followed by improved debridement and three-dimensional obturation. Most studies evaluating the removal of various root filling materials confirm that complete removal of these materials is not possible. However, regaining working length and apical patency are major factors influencing the outcome of retreatment.[9]

The introduction of rotary files has made retreatment a simpler procedure. The use of rotary nickel-titanium (NiTi) instruments for the removal of root filling materials during retreatment has been found to be safer and quicker, reducing the clinical time and operator fatigue[10]. They have been shown to be more efficient than manual methods.

In this study, a recently developed NiTi retreatment files, namely the D-Race system, was used. D-Race file system consists of two files. DR1 with an active tip of size 30 and 10 taper, used for the removal of filling materials from the coronal third. And DR2 which has a non-active tip with size 25 and 04 taper is used in the middle and apical third of the root canal for retreatment.

Due to their superior sharpness, alternating cutting edges, and smooth surface created by electropolishing treatment, D-RaCe files are reportedly very effective at removing Gp and sealer during retreatment. GP adhered to the flutes, also makes cutting more effective.[11]According to Rödig et al, D-RaCe was significantly more effective than ProTaper retreatment files and hand files in removing filling material from curved canals[5]. Hence this file system was employed in the present study.

Use of solvents like Chloroform, refined orange oil, xylene etc can be used as an adjunct to instruments for efficient removal of obturating materials and sealers.[12] Chloroform being the most popular and widely used endodontic solvent, due to its rapid action and quick evaporation, but its carcinogenic potential and tissue toxicity raise questions regarding its continued use. Researchers have suggested xylene as a viable alternative to chloroform as an endodontic solvent[13].

Xylene is an aromatic organic compound with efficient solvent action and is less toxic than that of chloroform. It softens rather than dissolves the obturating material and when used along with retreatment files, provides a safe and effective way of removing them.[13,14] Hence it was used in this study.

CBCT is quite useful for diagnosis and treatment planning. It is a 3 D, non-invasive method to visualize the entire root canal length.[16]And also it is reproducible way of volumetric evaluation of the residual root filling material.

Presently, Bioceramic sealers are gaining popularity in the fields of endodontics. One of the commonly used bioceramic sealer is BCS. This sealer is a modification of a calciumsilicate cement-Biodentine. It consists of a fine powder of tricalcium silicate and zirconium oxide, and a liquid containing polycarboxylate polymer and calcium chloride.[10,17]

Another newly improved bioceramic sealer is CS-BG, which contains bioactive glass material, which is biocompatible and found to increase root canal sealing ability[7].It is a two-phased paste; Paste A consists of fatty acids, bismuth sub carbonate, and silica dioxide, whereas Paste B consists of magnesium oxide, calcium silicate glass and silica dioxide, etc

Calcium silicate-based sealers can harden upon setting. This distinct setting activity and hardness may increase their adherence and resistance to dislocation from dentin, obstructing their removal during retreatment.[18] The removal of bioceramic sealers has been studied by several researchers. However, data concerning the retreatability of two different commercially available bioceramic material, BCS and CS-BG is limited.

Our study evaluated different parameters, like role of the solvent, the amount of residual remnants in the coronal, middle and apical third of the root canal to assess the retreatability of BioRootRCS and Nishika CS-BG.

The present study reported minimal filling remnants when xylene was used for retreatment of BCS group than CS_BG. Regardless of the retreatment technique used, more filling remnants remained in the apical thirds of the canal.

BCS possesses the ability to form hydroxyapatite upon setting. However, it has low flow characteristics and shows penetration into canal irregularities and dentinal tubules. This may be a factor in easy retrieval of BCS. On the other hand, some studies have reported that BCS which is a pure tricalcium silicate cement is difficult to retrieve. This could be attributed to differences in methodology and not using solvent in those studies[19]

CS-BG has a property of bonding with the dentin wall is through the formation of hydroxyapatite layers. After bonding with dentin, HAp crystals grow into the dentinal tubules as tags and strengthening the bond. This may be a reason for difficulty in retrieving this sealer. A study by Washio et.al, reported that CS – BG is amenable to retreatment by standard method. He also found that not only the sealer was easily removed but dentinal tubules were also re- opened. But use of solvent was not mentioned.[7]

The role of the solvent in speeding up the retreatment process was significant. Along with the retreatment files, the use of solvent resulted in faster removal of gutta percha and sealer in both groups. It must be noted that so far there are only a few reports of xylene being used as a solvent for bioceramic sealer.

Removal of filling material from the coronal portion of the canal was more effective for both sealers than the apical third. This is due to the taper of DR1 and the canal anatomy. Although there is a higher concentration of filling material in the coronal third, the rise in temperature due to the rotational speed of the NiTi instrument readily plasticizes the gutta percha and facilitates the removal. This is supported by other studies.[21]

Presence of more residues in the apical third compared to middle and coronal is because of the compromised accessibility and also filling material may get packed in the apical third during removal.[22] From our results, both sealers exhibited difficulty in complete removal from the apical third. So, we need to explore the role of supplementary irrigation techniques like use of passive ultrasonic methods helps to enhance the removal filling materials.

Both being bioactive calcium-silicate based materials, the exact reasons for the difference in removal efficiency require further research. Presently, there is very limited literature on retreatability of CS-BG. More studies are needed to demonstrate its retreatability characteristics of these sealers. The development of newer solvents, techniques and instruments for retreatment of bioceramic sealers needs to be explored further and in more complex situations like oval and irregular canals. Finally, randomised controlled clinical trials are necessary to validate the findings of the present study.

CONCLUSION:

From this in vitro study it was concluded that none of the sealers could be completely removed from the root canals. Retreatability of BCS was better as there were less remnants and the use of solvents helped further to speed up the retreatment process. Greatest percentage of remnants in the apical-thirds of the canal.

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ORIGINAL RESEARCH

EFFICACY OF STERILIZATION METHODS ON ROTARY ENDODONTIC FILES: AN INVITRO STUDY

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ABSTRACT

BACKGROUND: - In a busy private practice setting, it is not possible to achieve acceptable sterilization results owing to ignorance and hurry in saving time, insisting a rapid chairside sterilization alternative.

OBJECTIVES: -The aim of this study was to evaluate the efficacy of different methods of sterilization on endodontic rotary files.

METHODS: -A total of 40 unused rotary endodontic files were divided into four groups based on the sterilization methods (n=10) - Group A: Autoclave, Group B: Glass bead sterilization, Group C: Chlorhexidine solution (0.2%), Group D: 5.25% sodium hypochlorite solution. In all the groups the test files were presterilized with autoclave and contaminated with Enterococcus faecalis for 24 hours. Then the presterilization colony counts were recorded, followed by sterilization with respective methods. The sterilized files were rinsed with distilled water and 100microliter of the diluted concentration was cultured into agar plates to determine the colony forming units.

RESULTS: - The mean CFUs / ml for Treated files in Group A was 0.989 ± 0.316, Group B was 0.000 ± 0.000, Group C was 2.371 ± 1.005 and in Group D was 3.659 ± 0.328. This difference in the mean CFUs / ml among Treated files among the groups was statistically significant at $p<0.001$.

CONCLUSION: -Glass bead sterilization is considered to be the best sterilization technique to prevent cross infection in endodontic therapy.

KEYWORDS: - Autoclave, chlorhexidine solution, E.faecalis, endodontic files, glass bead sterilization, microorganisms, sodium hypochlorite solution, sterilization.

INTRODUCTION:

The success of endodontic treatment mainly depends on the eradication of micro biotic flora from the pulp chamber and root canal which can be achieved by various endodontic instruments like barbed broaches, reamer and files.

Virtually, 700 bacterial species reside in the oral cavity of human beings with each individual harbouring 100–200 species on an average. Even though most of the oral microorganisms are commensals, under certain circumstances some of these will become pathogenic causing oral infections.[1]

Infection control plays a vital role in eliminating communicable diseases transmitted in health care setting. In present day scenario, autoclave is the most commonly used method for sterilization of the contaminated instruments considering its better penetrating ability, thus providing better sterilization.

Autoclave works by utilizing heat in the form of saturated steam under controlled pressure and temperature. Even though it is time-consuming, this method has several advantages such as excellent microbial lethality, cost-effectiveness, lack of toxic residues, and the ability to be physically monitored.[1]

Glass bead sterilizer works under the principle of dry heat, is the rapid chairside sterilization technique and is the most commonly used method of sterilization of endodontic files.[2]

In a busy dental practice, the necessity to reuse endodontic instruments is often unavoidable. However, relying solely on conventional sterilization techniques can be time-consuming. Conventional sterilization techniques consume a significant amount of time. Hence, sodium hypochlorite 5.25% solution for 5 minutes and 0.2% chlorhexidine solutions are being employed in the present study to evaluate their efficacy to achieve a better chairside rapid sterilization protocol along with autoclave.

MATERIALS AND METHODOLOGY:

The test microorganism used in the present study was Enterococcus faecalis (ATCC No. 29212). Lyophilized forms of the bacteria will be activated by growing it on respective selective media (trypticase soy agar for E. faecalis) which favours the growth of individual bacterium as described by the standard procedure of MTCC, Chandigarh, India.

The study sample consists of 40 files (Neo endo flex files) which were divided into four different groups based on the methods of sterilization.

Group A: - Autoclave. (Ketan semiautomatic autoclave, India)
Group B: - Glass bead sterilizer. (Confident dental equipments ltd, C-63 Bengaluru, India)
Group C: - 5.25% Sodium hypochlorite solution for 5 minutes.
Group D: - 0.2% Chlorhexidine solution. (Colgate Oral Care, Sydney, NSW)

All the files were presterilized in an endodontic instrument box by autoclaving for 30 min at 121^0C at a pressure of 15 pounds for standardization. The pre-sterilized files were placed in the test tubes containing bacterial broth and left for 24 h for contamination at 37°C, followed by transfer of these diluted concentrations (100 µl) onto the agar plates using spread plate technique. After incubating these agar plates for 24 h, they were subjected to colony count which serves as pre-sterilization values. Once these values were obtained, contaminated files in their respective groups are sterilized using the following methods:
In Group A, files were placed in endodontic instrument box and are subjected
to autoclave at 121°C, for 15 min at 15 lbs pressure;

In Group B, files were placed in the periphery of the glass bead sterilizer for 10 s at 240°C with beads of size 1–1.5 mm;

In Group C, files were placed in a scouring sponges saturated with 0.2% chlorhexidine solution followed by ten strokes of the endodontic file in the sponge.

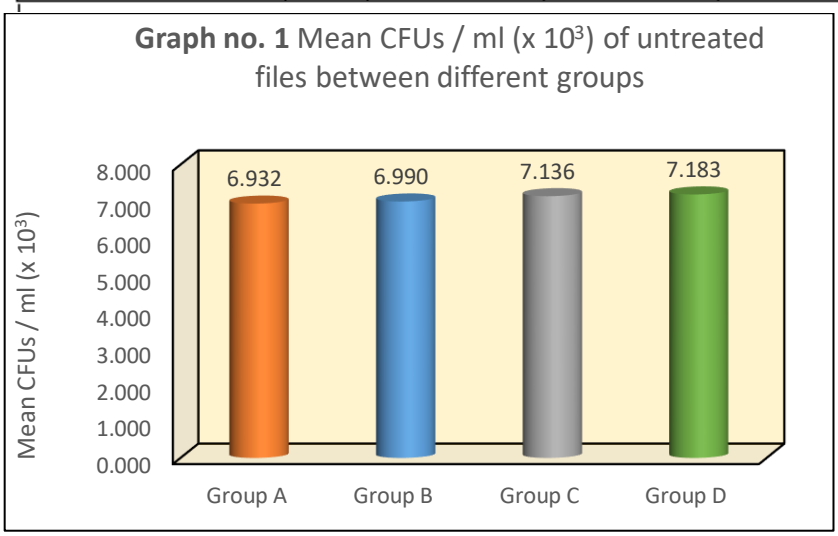
In Group D, files were placed in a test tubes containing 5.25% NaOCl solution for 5 minutes.

After sterilization, the files were rinsed with distilled water and 100 µl of the diluted concentration is transferred onto the prepared petri dishes and incubated at 37°C.
After 24 hours, the samples were assessed for microbial growth, and the colony-forming units (CFUs) were quantified using the formula:
CFU=dilution factor× volume plated Number of colonies.

STATISTICAL ANALYSIS:

After the files were contaminated with E. faecalis, the mean values were calculated for each group. Comparison of mean CFUs / ml (x 10^3) of untreated files between different groups using Kruskal Wallis Test was performed. However, this difference in the mean CFUs / ml between 4 groups was not statistically significant [p=0.65]. Refer graph no.1.

Comparison of mean CFUs / ml (x 10^3) of Untreated files between different groups using Kruskal Wallis Test						
Groups	N	Mean	SD	Min	Max	p-value
Group A	12	6.932	0.478	5.86	7.64	0.65
Group B	12	6.990	0.520	6.16	7.80	
Group C	12	7.136	0.682	6.03	8.04	
Group D	12	7.183	0.566	6.14	7.96	



After the sterilization protocol with respective groups, the mean values were calculated for each group. Comparison of mean CFUs / ml (x 10^3) of treated files between different groups using Kruskal Wallis Test and using Dunn's Post hoc Test was done at a significance level of p<0.001.

Comparison of mean CFUs / ml (x 10^3) of treated files between different groups using Kruskal Wallis Test						
Groups	N	Mean	SD	Min	Max	p-value
Group A	12	0.989	0.316	0.48	1.72	<0.001*
Group B	12	0.000	0.000	0.00	0.00	
Group C	12	2.371	1.005	1.36	4.24	
Group D	12	3.659	0.328	3.16	4.32	

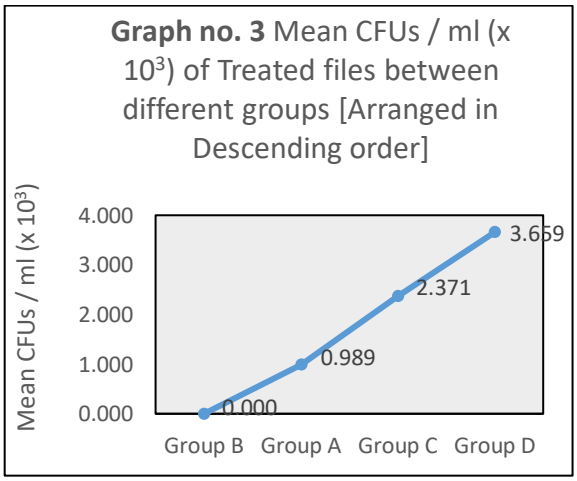
Multiple comparison of mean diff. in CFUs / ml (x 10^3) of treated files b/w groups using Dunn's Post hoc Test					
			95% CI for the Diff.		
(I) Groups	(J) Groups	Mean Diff. (I-J)	Lower	Upper	p-value
Group A	Group B	0.989	0.387	1.591	<0.001*
	Group C	-1.383	-1.984	-0.781	<0.001*
	Group D	-2.670	-3.272	-2.068	<0.001*
Group B	Group C	-2.371	-2.973	-1.770	<0.001*
	Group D	-3.659	-4.260	-3.057	<0.001*
Group C	Group D	-1.287	-1.889	-0.686	<0.001*

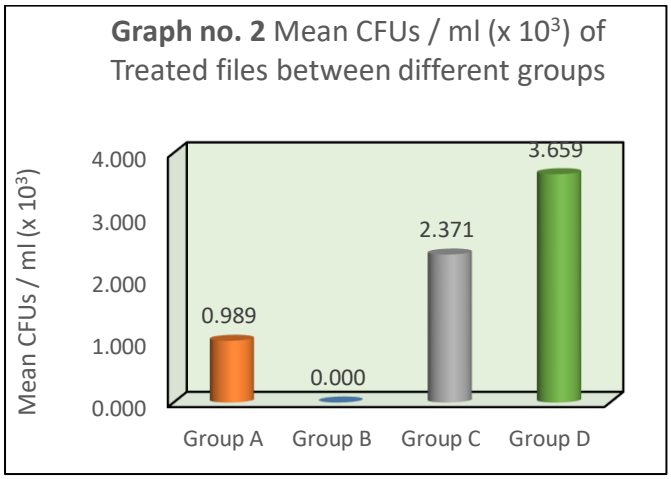
* - Statistically Significant

The mean CFUs / ml for treated files in Group A was 0.989 ± 0.316, Group B was 0.000 ± 0.000, Group C was 2.371 ± 1.005 and in Group D was 3.659 ± 0.328. This difference in the mean CFUs / ml among Treated files between 4 groups was statistically significant at p<0.001. [Refer Graph no. 2].

Multiple comparison between groups revealed that the both Group 2 demonstrated significantly least mean CFUs / ml as compared to other groups at p<0.001. This was then followed by Group A showing significantly lesser mean CFUs/ml as compared to Group C and Group D and the differences were statistically significant at p<0.001. Later, Group C also showed significantly lesser mean CFUs/ml as compared to Group D and the mean difference was statistically significant at p<0.001. This infers that Group B exhibited significantly least mean CFUs / ml followed by Group A, Group C and highest in Group D. [Refer Graph no. 3].

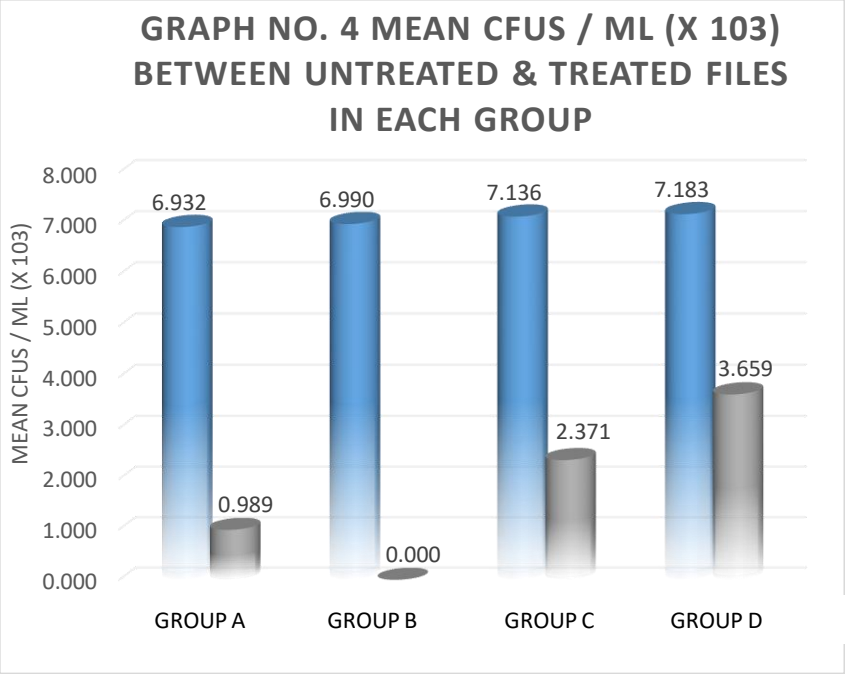
After this, Comparison of mean CFUs / ml (x 10^3) between untreated & treated files in each group using Wilcoxon Signed Rank Test was done at a significance level of p<0.001. However, the mean CFUs / ml for Treated files in Group A, B, C & D was significantly lesser [0.989 ± 0.316, 0.000 ± 0.000, 2.371 ± 1.005 and 3.659 ± 0.328] as compared to Untreated files of Group A, B, C & D [6.932 ± 0.478, 6.990 ± 0.520, 7.136 ± 0.682 and 7.183 ± 0.566]. This difference in the mean CFUs / ml between Untreated and Treated files in each group was statistically significant at p<0.001 [Refer Graph no. 4]





Comparison of mean CFUs / ml (x 10^3) between Untreated & Treated files in each group using Wilcoxon Signed Rank Test						
Groups	Region	N	Mean	SD	Mean Diff	p-value
Group A	Untreated files	10	6.932	0.478	5.943	<0.001*
	Treated files	10	0.989	0.316		
Group B	Untreated files	10	6.990	0.520	6.990	<0.001*
	Treated files	10	0.000	0.000		
Group C	Untreated files	10	7.136	0.682	4.764	<0.001*
	Treated files	10	2.371	1.005		
Group D	Untreated files	10	7.183	0.566	3.525	<0.001*
	Treated files	10	3.659	0.328		

* - Statistically Significant



RESULTS:

Glass bead sterilization has shown complete sterility followed by autoclave and chemical sterilization using 0.2% chlorhexidine and 5.25% sodium hypochlorite solutions. The mean CFUs / ml for treated files in Group A was 0.989 ± 0.316, Group B was 0.000 ± 0.000, Group C was 2.371 ± 1.005 and in Group D was 3.659 ± 0.328. This difference in the mean CFUs / ml among treated files among the groups was statistically significant at p<0.001.

DISCUSSION:

Root canal infection comprises of a broad spectrum of microbial flora, in the present study E. faecalis was chosen as a test microorganism because it comprises of about 29.77% of the primary and secondary endodontic infections.[3,4,5]

E.faecalis is a gram positive facultative anaerobe which can persist in harsh environmental situations like poor availability of nutrients, low pH, and high temperature, prolonged periods of starvation, also has an ability to form biofilms and establish mono-infections in medicated canals. It is considered as the main etiological factor for re-infection in endodontically treated root canals.

The success of endodontic treatment mainly lies on the ability to eradicate the microbes from the intricate anatomy of the infected root canals, which is accomplished by endodontic files and reamers. Thus proper sterilization protocol of the contaminated instruments is imperative to achieve complete debridement of the infected root canals.

In a busy private sitting, owing to lack of time a rapid chairside sterilization protocol is the need of the hour. Endodontic instruments are often reused repeatedly during root canal preparation. The purpose of this study was to evaluate the efficacy of sterilization of autoclave, glass bead sterilization and chemical sterilization using two solutions such as 5.25% of sodium hypochlorite solution and 0.2% chlorhexidine solution.

Autoclave works by utilizing heat in the form of saturated steam under controlled pressure and temperature[1]. It is considered as a gold standard method for sterilization to date. In the present study, autoclave showed 75% sterilization. Although, according to studies conducted by Hurtt and Rossman[6] and Rajkumar and Lakshminarayanan autoclave showed complete sterilization of all the test microorganisms[7]. However, contradictory results were noticed in the study by Schug-Kosters *et al*. who stated that hot steam fails to reach all the intricate parts of the endodontic instruments resulting in incomplete sterilization[8].

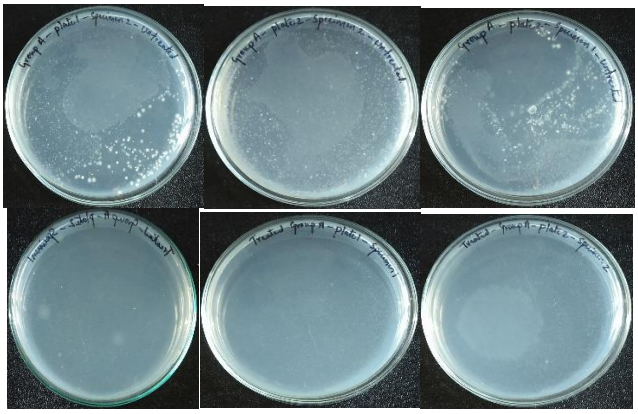


Figure showing the group of untreated and treated colony forming units in group A

Glass bead sterilizer works under the principle of dry heat sterilization wherein glass beads (1-1.5mm) are used. It is most commonly used method for rapid sterilization. Grossman suggested the use of a glass bead sterilizer because of the rapid sterilization effect on endodontic instruments such as reamers & files[9]. The Council of Dental Therapeutics also recommends the use of glass bead sterilizer, preheated to at least 425^0 F for a period of 10 seconds.[10] In the present study, glass bead sterilization showed 100% sterilization, however, according to a study, Glass bead sterilizer showed incomplete sterilization of the samples for both the tested organisms in spite of the smaller sized (1–1.5 mm) beads used, which results in better conduction of heat.[11]

While comparing the efficiency of sterilization with larger and smaller glass beads it was observed that larger glass beads required 35 seconds to kill Bacillus subtilis when compared to 30 seconds with smaller glass beads. This may be attributed to better conduction of heat by smaller glass beads. In this study, the files were placed along the periphery of the sterilizer to utilize the maximum temperature for effective sterilization. The reason for the lower temperature at the center of the cylinder is due to the fact the heat to travel through the glass beads and the dead air space between the glass beads to reach the center. Further, it has been claimed that smaller glass beads result in a better conduction of heat when compared to larger glass beads where the presence of air space results in poor conduction of heat.[12]

Figure depicting placement of the rotary endodontic files at the periphery of the glass bead sterilizer.

The present study showed 50% sterilization by immersing the files in 0.2% chlorhexidine (Colgate Oral Care, Sydney, NSW) in scouring sponges(saturated) with ten 'in –and-out strokes. Ten in-and-out strokes produced significantly better results than five strokes[13]. However, according to Parashos et al, chlorhexidine showed 87% sterilization[13] which is contradictory to the results noticed in our study, hence 2% chlorhexidine cannot be solely relied upon as a rapid chairside alternative protocol.

The present study showed 32.5% sterilization by immersing the files in 5.25% sodium hypochlorite for 5 minutes. However, according to a study immersing in 5.25% NaOCl for 5minutes can effectively be used for chair side sterilization of endodontic hand files[14] proved to be a better chairside alternative. But this finding is contradictory to the results observed in the present study as rotary files have complex design when compared to the hand files. Hypochlorite effectively dissolves pulp tissue but the possibility of corrosion damage to the instruments is a concern. The efficacy of Sodium Hypochlorite (NaOCl) as tissue dissolving and disinfecting agent depends on its concentration and time of exposure.[15]

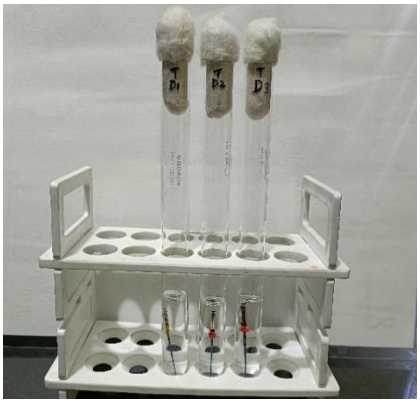


Figure showing immersion of the rotary endodontic files in 5.25%NaOCl solution.

The present study used rotary NiTi files (Neo endo flex file system) which is widely used and can significantly harbour cultivable bacteria post canal instrumentation due to the intricate design of the instrument. NeoEndo Flexfile is a third-generation rotary file with two files shaping system undergone Gold Thermal Treatment renders it extremely flexible. It is available in several sizes and tapers. NeoEndo Flexfile provides better cyclic fatigue resistance. The triangular cross-section and sharp cutting edges of these files will increase cutting efficiency. Noncutting tip prevents accidental apical transportation and also provides extreme flexibility in negotiating canals.[16]

CONCLUSION:

In the present study, glass bead sterilization showed complete sterilization followed by autoclave and chemical sterilization solutions like 0.2% chlorhexidine and 5.25% sodium hypochlorite for 5 minutes. Hence, glass bead sterilizer can be used as a rapid sterilization protocol before reusing the rotary NiTi files.

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REVIEW ARTICLE

Exploring herbal alternatives for endodontic irrigants: A comprehensive review

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ABSTRACT

Root canal infection involves a multitude of microbial species. The eradication of bacteria from the root canal is paramount. There are numerous commercially available irrigants, with sodium hypochlorite being the most common and efficacious. Despite its high efficacy, sodium hypochlorite has drawbacks, including the potential for severe cellular damage if extruded, its non-palatability, and its corrosive nature. Therefore, there's a demand for highly effective irrigants with minimal toxic effects, leading to the emergence of herbal irrigants in endodontics. Herbal irrigants, derived from herbs and plants, have shown good tissue tolerance and acceptability. This review seeks to enlist numerous herbal irrigants currently known and emphasize their distinctive properties.

KEYWORDS: Disinfection, sodium Hypochlorite, smear layer, phytotherapy, plant extracts

INTRODUCTION:

"Traditional medicine", encompasses diverse practices rooted in various societies, emphasizing holistic approaches to health rather than merely treating specific ailments. It is a significant aspect of traditional medicine, which harnesses the therapeutic properties of plants and natural sources. About 80% of the world's population depends on traditional medicine as their main form of primary healthcare, there's a growing interest in exploring herbal remedies for various conditions, including oral health issues[1].

Herbal medicine or phytotherapy can be defined as herbal preparations that consist of active ingredients derived from plants and other natural sources. Since its introduction herbal medicine has been used for tooth and gum-related ailments. To reduce plaque, several traditional cultures recommend using herbal chewing sticks made from plants that possess powerful anti-microbial properties. These herbal formulations offer a diverse range of medicinal properties, such as antibacterial nature, anti-inflammatory effects, immune system fortification, anti-plaque action, and tooth-whitening capabilities.

Even though these herbal remedies offer viable substitutes for managing diverse oral health concerns, there still seems to be a dearth of thorough knowledge about their systemic effects and possible adverse effects on general physical health.

Endodontic infection is caused due to a variety of bacterial species mostly made up of anaerobic bacteria and a few facultative bacteria. Endodontic therapy seeks to sterilize infected root canals through a combination of mechanical and chemical techniques, fostering an optimal environment for healing around the root. For a complete disinfection of root canals, various chemical agents have been employed, most commonly used is the pairing of sodium hypochlorite (NaOCl) and EDTA. Although these irrigants disinfect the root canals by removing the smear layer and the necrotic pulp tissue still various side effects remain such as tissue toxicity and the possible allergy potential. Various other medicaments are also show cytotoxic

reactions and their inability to eliminate bacteria has led to a shift in research towards herbal preparations obtained from medicinal plants which can be used in irrigation[2,3,4].

Numerous facultative anaerobic microbes exist in infected root canals. The key aim of endodontic treatment is to eliminate these microbes and prevent any further ingress into the root canal and render it conducive to tissue recovery. To counteract the various side effects of chemical irrigants, extensive research is being done on herbal preparations that can be used as irrigants[5].

This review intends to list and detail various herbal options currently accessible for use as effective endodontic irrigants.

Cleaning and disinfection in Endodontics:

Maximum disinfection is required for the long-term success of root canal treatment. The most used chemical agents for disinfecting root canals are 1% to 6 % sodium hypochlorite and 2% chlorhexidine solution[6].

While chemical irrigants provide numerous advantages, they also come with several drawbacks, including tissue toxicity, allergic reactions, unpleasant taste, and incomplete removal of the smear layer. Additionally, chlorhexidine has been noted to cause tooth discoloration[7].As a result, natural irrigants have been recommended as alternative options which include-

Garlic (Allium sativum)

Allicin is the main constituent present in Allium sativum, similar to penicillin which provides both bacteriostatic and bactericidal properties. It damages the bacterial cell membrane and reduces its growth[8].It has a strong action against cariogenic gram-positive bacteria such as Actinomyces oris, Streptococcus sorbinus, and Streptococcus mutans[9].Recent studies suggest that the efficacy of garlic extract against a 70% Faecalis biofilm is similar to that of 5.25% Sodium hypochlorite[10].

Bee Glue (Propolis)

Propolis constitutes of 50% resin, 30% essential oils, and waxes in addition to pollen (5%), minerals, ethanol, vitamins, amino acids, and highly active bioflavonoids (10%), as well as bee glue (extract from salivary glands). It has antioxidant, anti-inflammatory, and antibacterial qualities[11]. The active constituents which act as anti-inflammatory agents are flavonoids, cinammic acid, and caffeic acid phenethyl esters. Some studies have also suggested the formation of dentin with the use of propolis in indirect and direct pulp capping with no areas of pulpal degeneration as seen with the use of calcium hydroxide[12].

A study done by Victorino et al highlights propolis as a viable option for use as an irrigant and intracanal medication, showcasing its effectiveness against E. Faecalis biofilm comparable to sodium hypochlorite[13].

Aloe vera

The primary chemical constituents of Aloe vera are, Barbadoins and Aloins, which provide antiviral, antifungal, anti-inflammatory, and anti-bacterial benefits in addition to pain relief[14].Aloe vera gel can be used in clinical practice to disinfect gutta percha cones against bacteria such as Staphylococcus aureus, Escherichia coli, and E. faecalis. It also displays periodontopathic and caries bactericidal properties[15].

Miswak (Salvadora persica)

In 1994, Miswak was found to prevent bacteria from adhering to tooth surface, on further research it was found Miswak reduces the number of S. Mutans from the oral cavity. This antibacterial nature of Miswak could be due to the presence of fluorides that interact with the bacterial glycolytic enzymes and prevent their further growth. A 10% water extract of miswak is said to act as a beneficial irrigant for teeth with necrotic pulps[16].

Curcuma longa (Turmeric)

Turmeric extract causes an increase in the activity of Guanosine triphosphatase enzyme which is harmful for bacteria such as E. Fecalis therefore making turmeric a potential alternative to sodium hypochlorite. To further aid its use as an intracanal medicament, Turmeric is said to enhance the antimicrobial action of drugs such as Cefixime, Vancomycin and Tetracycline[17].

Morinda citrifolia (Noni plant)

Morinda Citrifolia was discovered by the Polynesians and is commonly known as Indian mulberry/cheese fruit. It is found to be rich in Scopoletin, Octanoic acid and Vitamin C which make it markedly efficient as an endodontic irrigant[18].

There have been many studies done to evaluate the efficacy of MCJ against various commercially available irrigants and it has been concluded by several that the antimicrobial activity of MCJ is similar to that of 5.25% NaOCl when used in conjunction with EDTA[19].

Triphala and green tea polyphenols

Dried and powdered fruits from three medicinal plants namely Terminalia Bellerica, Terminalia Chebula, and Emblica Officinalis are taken to form the irrigant. The polyphenols from green tea plants stems are extracted due to their wide antimicrobial activity. Several studies have reported efficacy of triphala against E.Fecalis which was similar to NaOCl, it is also said to remove smear layer due to its chelating nature[20,21].

Arctium lappa

Arctium lappa has shown antibacterial and antifungal properties, along with antioxidant and anxiolytic action when used as an irrigant. It also shows great reduction in E fecalis count which make it suitable as an endodontic irrigant[22].

German chamomile

For centuries German chamomile (Marticariarecutitia L.) is known for its medicinal benefits including its anti-inflammatory nature, analgesic effect, antispasmodic effect and anti-bacterial properties. Recently several studies have been conducted in using scanning electron microscope which have confirmed its antibacterial effect when used as an irrigant, efficacy has been found like that of sodium hypochlorite[23].

Tea tree oil

Tea tree oil acts as an antiseptic and antifungal agent. It also has a mild solvent action which can be attributed to terpinen-4-ol which is its active component. The antibacterial action of the tea tree oil is comparable to 3%NaOCl and 2% CHX when evaluated against E. Faecalis[24].

Neem (Azadirachta indica A.juss)

The U.S National Academy of sciences, recognised Neem as a tree for solving global problems. The ethanolic extract obtained from Neem has shown significant antibacterial activity against E. fecalis, although the bitter taste of the medicament can be a side effect which can be corrected using sweeteners for better patient acceptance[25].

Babool (Acacia Nilotica)

Babool is effective against Streptococcus mutans and E. faecalis, it was discovered an extract with 50% concentration is effective against the pathogenic bacteria indicating its use as an irrigant in endodontics[26].

Nutmeg (Myristica fragrans)

Myristica fragrans contain Myristic acid, which provides antibacterial properties. In a study five various herbal extracts were examined for their antimicrobial nature, the efficiency found in a decreasing order was

as follows: A. indica, C. Longa, Myristica fragrans, Terminalia Chebula, and Aloe Vera, the high order of efficiency justified its use as an irrigant without severe side effects.[27]therefore justifying its use as an endodontic irrigant without much side effects[27].

CONCLUSION:

Herbal products in endodontics offer numerous advantages, such as safety, user-friendliness, extended shelf life, affordability, and limited microbial resistance. However, in today's age of evidence-based medicine, any pharmaceutical proposed for human use must undergo rigorous in vitro and in vivo testing. While herbal products show promise in vitro, their biocompatibility and safety necessitate evaluation through preclinical and clinical research before definitive recommendations can be made for their use in endodontics. Nature provides cost-effective medicinal solutions, and endodontics stands to gain from exploring these alternatives further, provided they pass the necessary scientific scrutiny.

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation.

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CASE REPORT

Resin infiltration - A minimally invasive Technique - Case reports

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ABSTRACT:

This article discusses a minimally invasive treatment option for white spot lesions. Resin infiltration technique for early enamel white spot lesions vastly enhances the esthetic outcome in a single visit. Deeper penetration of the infiltrant into the porous demineralized areas masks these lesions making them almost invisible. Additionally, the occlusion of the micro-porosities by the resin not only prevents caries progression but also reinforces the unsupported enamel crystallites.

KEYWORDS

Aesthetic, Demineralization, Minimally invasive, Resin infiltration, Single visit, White spot lesions.

INTRODUCTION:

A flawless smile is an esthetic demand for every individual. White spot lesions (WSL) resulting due to demineralization under intact enamel defect compromise the esthetic appearance of teeth. These demineralization defects have a lower mineral distribution on the surface and lower interprismatic mineral content compared to the adjacent sound enamel.[1]

The increased porosity within the lesion causes the characteristic whitish appearance of these lesions. However, unlike some other forms of hypoplasia, the surface of the lesion is smooth that an explorer tine can easily glide over it.[2]

The conventional treatment modalities for white spots involve use of remineralization agents like creams, pastes and topical remineralization treatments such as fluoride therapy, casein– phosphopeptide–amorphous calcium phosphate pastes, Novamin (calcium sodium phosphosilicate).[3] Invasive approaches such as microabrasion and composite or ceramic veneers are the other options.[4]

Resin infiltration is a novel approach to treat these WSLs in a minimally invasive manner. The principle of this technique is to perfuse the porous enamel with resin by capillary action. The ability of replacing air in the demineralized enamel with resin masks the WSL by preventing light from scattering inside the lesion. The infiltrated resin also creates a diffusion barrier inside the lesion, thereby arresting lesion progression by occluding the microporosities that provide diffusion pathways for the acids and dissolved materials. Filling the porosities with an adhesive resin also reinforces the unsupported enamel crystallites in the body of the WSL.[5]

This article presents two cases of WSL treated by Resin infiltration successfully.

CASE REPORT 1:

A 23-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of white discolouration in the upper front tooth noted since the past 10 months that made him socially uncomfortable while smiling.

On clinical examination, there was an opaque whitish spot on the incisal third of 21 which was diagnosed as localized WSL [Figure 1]. Minimally invasive treatment option of resin infiltration (DMG-ICON^{TM}) was proposed to the patient which was readily accepted as it was least invasive and a single sitting treatment option.

After rubber dam isolation, the surface of the white spot was eroded by application of a 15% hydrochloric acid gel (Icon etch) for 2 min. The gel was stirred with microbrush from time to time during application [Figure 1B]. Subsequently, the etching gel was thoroughly washed for 30 s using a water spray. The lesion was desiccated by applying ethanol (Icon-Dry) for 30 s followed by air drying [Figure 1C].

Icon resin (Icon infiltrant), composed of tetraethylene glycol dimethacrylate was applied on the lesion surface using a microbrush and allowed to penetrate for 5 min [Figure 1D]. The excess was removed using a cotton roll and light cured [Figure 1E].

Finally, the rough surface was polished using disks and silicone polishers [Figure 1F].

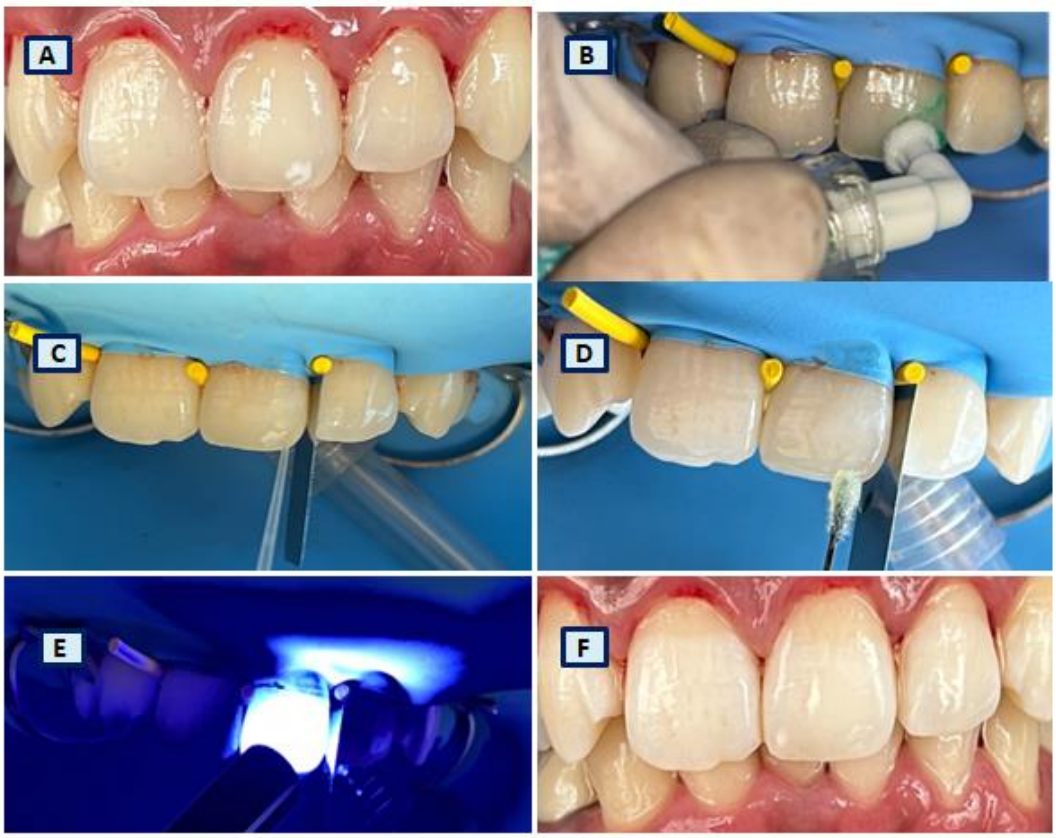

Figure 1. (A) Preoperative image of WSL, (B) Icon etching, (C) Icon dry application, (D) Icon infiltrant application, (E) Light curing after resin infiltration, (F) Post operative

CASE REPORT 2:

A 27 year-old female patient reported with the complaint of white patch on her upper front tooth for past years. It was diagnosed as WSL in relation to 21 [Figure 2]. Resin infiltration technique was the treatment option and similar steps as detailed in Case 1 was performed. The treatment showed satisfactory results.

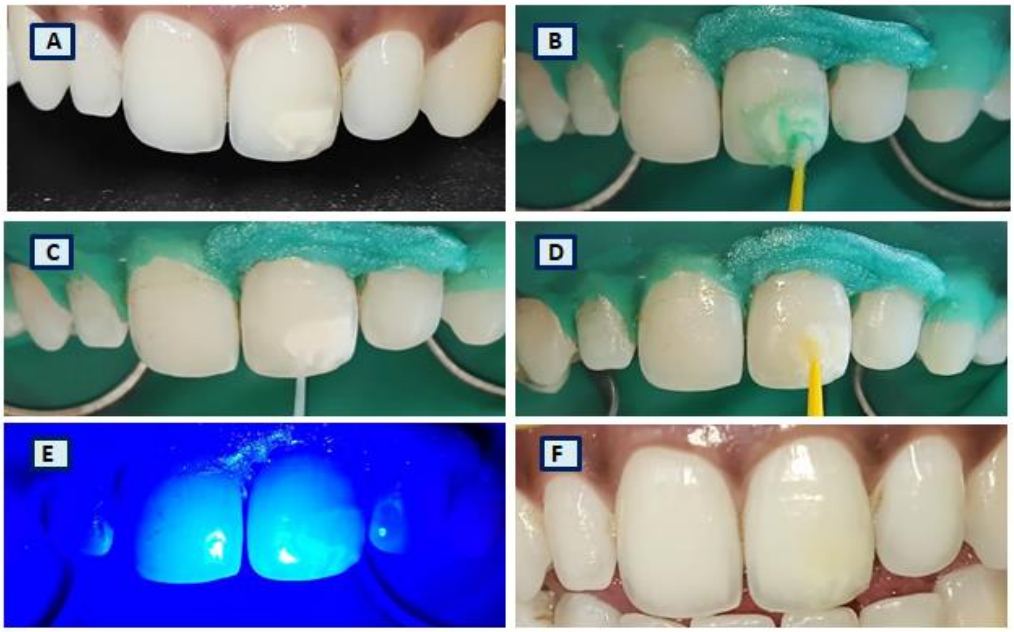

Figure 2. (A) Preoperative image of WSL, (B) Icon etching (C) Icon dry application, (D) Icon infiltrant application, (E) Light curing after resin infiltration, (F) Post operative

DISCUSSION:

WSLs are the early signs of demineralization under intact enamel due to poor oral hygiene, post orthodontic treatment, mild fluorosis etc.[6] Bacteria adherent on the tooth and the acids produced as byproduct of their metabolism form the plaque layer. These acids dissolve the tooth minerals, mainly calcium phosphate, leading to demineralization. The demineralized subsurface, that is, the body of the lesion is often covered by an "apparently intact surface layer" beneath the dental plaque.[7]

Hydroxyapatite in sound enamel has a refractive index (RI) of 1.62. In case of a white spot lesion the value of RI lowers due to destruction of enamel crystallites. When a WSL is hydrated with saliva, the RI of saliva within the enamel porosities is 1.33. This discrepancy in RI between saliva and hydroxyapatite affects light scattering and makes the WSL look slightly opaque. When teeth are dried, saliva is replaced with air within the WSL porosities and reaches RI of 1.0. The difference in RI between air and hydroxyapatite is wider than that between saliva and hydroxyapatite, making the WSL more evident in dehydrated teeth. Resin infiltration technique uses low-viscosity light-cured resin to perfuse the porous enamel by capillary action and replace air in the demineralized enamel of WSLs, thereby bringing RI of 1.52 which is similar to that of hydroxyapatite.[5]

The resin infiltration technique uses 15% hydrochloric acid gel as it has been demonstrated to be superior to 37% phosphoric acid gel in removing the mineralized intact surface layer of WSL. This helps in etching to a deeper depth that facilitates the further penetration of the resin. Application of ethanol at concentration of 99% helps to desiccate the pores and favours resin penetration. Icon-Infiltrant is low viscosity resin that penetrates to the bottom of the WSL to form an enamel hybrid layer.[5]

Conventional treatment options such as remineralizing agents require a few months to remineralize the lesion and require proper patient compliance. On the other hand, microabrasion and veneering are invasive in their approach. Unlike the traditional procedures, resin infiltration technique is minimally invasive and provides immediate esthetic results. Additionally, this reinforced enamel becomes mechanically stronger and more resistant to acid dissolution.

However, the practitioner should select the cases carefully. Resin infiltration technique can treat a smaller white mark much easier than a larger patch. Medium-to-large size patches may require two treatments. If the lesion is very deep, then it is advisable to sandblast the white area prior to applying the hydrochloric acid as an etch to the tooth. The sandblasting helps to open up the enamel tubules so that better penetration of the hydrochloric acid can be achieved.

In the first case report, resin infiltration technique was opted as treatment choice as the lesion was less than 1mm and was confined to the enamel layer. Moreover, the patient was conscious about his smile and desired immediate correction of the white spot.

In the second case, the patient was not willing for any invasive procedure and therefore resin infiltration was suggested for the correction of white spot lesion.

Both the cases have shown satisfactory esthetic results where the white spots were masked completely.

This method has been used for almost two decades and studies suggest effective outcomes with monitoring period of 1.5 years.

CONCLUSION:

Resin infiltration represents a new concept in dentistry that seems to be a clinically effective method in arresting early carious lesions. It has been found to be a promising method in arresting both interproximal and smooth surfaces. It is a microinvasive treatment option for smooth-surface white spot lesions that provides recovery of natural tooth appearance.

PATIENT PERSPECTIVE

All the patients discussed in this case series were satisfied with the treatment provided.

INFORMED CONSENT

Consent was taken from both the patients prior to the treatment initiation.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil

CONFLICTS OF INTEREST

There are no conflicts of interest

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