

EVALUATION OF CHANGE IN PROPERTIES OF SEALERS AFTER ADDITION OF ANTIBIOTICS- A SCANNING ELECTRON MICROSCOPE STUDY.

Dentistry

Dr. Anjali Mishra*	Associate Professor, Bhabha College of Dental Sciences, Bhopal, M.P. *Corresponding Author
Dr. Vaishali Bhalerao	Assistant Professor, Rural Dental College, Pravara Institute of Medical Sciences, Loni Maharashtra.
Dr. Vidya Patil	Practitioner, Bangalore.

ABSTRACT

Aim: To evaluate Sealing ability after obturation and change in properties (setting time, flow and rheological properties) using Zinc oxide and resin based sealers mixed with Triple antibiotic and modified Triple antibiotic powders- A Scanning Electron Microscope study. **Methodology:** 60 single rooted premolar teeth are selected for the study. Access cavity preparation was done. Cleaning and shaping was done with standard protocol upto 25 no. file with 4% taper. Further for obturation 6 groups will be divided with and without antibiotic addition. Various properties like setting time and flow of sealers in all groups are recorded and Viscosity will be determined using Brookfield Viscometer. After obturation, the sealing ability of various sealers will be observed under Scanning electron microscope. **Results:** There was no significant change in properties of sealers after addition of antibiotics.

KEYWORDS

Brookfield Viscometer, Scanning Electron Microscope, Sealing ability, Viscosity

INTRODUCTION

Root canal treatment has evolved remarkably over the past century, transforming from a rudimentary intervention into a highly predictable and sophisticated dental procedure. Advances in endodontics have been driven by the continuous development of innovative instruments, materials, and techniques, all aimed at enhancing the success rate and longevity of treatment outcomes[1]. From the advent of rotary instrumentation to the use of biocompatible sealers and improved obturation methods, each aspect of root canal therapy has undergone significant refinement. Among these, root canal sealers have played a crucial role in ensuring the hermetic sealing of the root canal system, thereby preventing reinfection and promoting periapical healing[2,3].

While advancements in dental materials have significantly improved the treatment of caries, there's a growing emphasis on developing materials that not only treat but also protect and regenerate tooth structure post-treatment like fluoride-releasing materials and self-healing dental composites[2,4].

In recent years, the incorporation of bioactive and antimicrobial agents, including antibiotics, into sealers has opened new avenues for combating persistent microbial challenges within the canal system[5]. This study aims to evaluate and compare the physical[6,7] and sealing properties[8,9] of various root canal sealers, with and without antibiotic incorporation, to determine their potential clinical efficacy.

The integration of Triple Antibiotic Paste (TAP) and Modified Triple Antibiotic Paste (MTAP) into commonly used endodontic sealers like Zinc Oxide Eugenol (ZOE)-based and resin-based sealers. This approach aims to enhance antimicrobial efficacy and promote healing in the root canal system.

METHODOLOGY:

Preparation Of Sealers:

Triple Antibiotic Powder was made up with Metronidazole, Ciprofloxacin and Minocycline. For this study proportions were taken as suggested by Sato, *et al* (1996) i.e. equal amount of metronidazole, ciprofloxacin, and minocycline (1:1:1) mixed together to make the mixture[10].

Then for Modified Triple Antibiotic Powder, Metronidazole, Ciprofloxacin and Clindamycin was used instead of Minocycline[11]. After preparation of these powders, they were mixed with sealers. In Zinc oxide Eugenol based sealer, measurement of antibiotic powder is done as 10% by weight of the zinc oxide powder and mixed. For Resin based sealer, 10% by weight of base paste was considered and mixed[8].

Group Allotment

• Group I: Control Group I- Zinc Oxide Eugenol based Sealer

- Group II: Control Group II- Resin based Sealer
- Group III: Experimental Group I- Zinc Oxide Eugenol based Sealer with Triple Antibiotic Powder (Metronidazole, Ciprofloxacin and Minocycline)
- Group IV: Experimental Group II- Zinc Oxide Eugenol based Sealer with modified Triple Antibiotic Powder (Metronidazole, Ciprofloxacin and Clindamycin)
- Group V: Experimental Group III- Resin based Sealer with Triple Antibiotic Powder (Metronidazole, Ciprofloxacin and Minocycline)
- Group VI: Experimental Group IV- Resin based Sealer with modified Triple Antibiotic Powder (Metronidazole, Ciprofloxacin and Clindamycin).

For checking various properties, following steps were followed:

Setting time:

Setting time for each group was noted in 3 consecutive readings under similar conditions and mean was calculated[10].

Flow:

- The 0.05ml of experimental sealers were deposited on the center of the 10X10cm clean glass surface.
- After three minutes from the beginning of spatulation another glass plate with 100 grams load was applied over the deposited sealer to allow the formation of a circular disc of sealer.
- Ten minutes later the additional load was removed and three different diameters were measured in three different directions around the formed disc of sealer using a digital caliper and arithmetical average was calculated[10].

Rheological Properties i.e. Viscosity

To evaluate the rheological properties BROOK FIELD viscometer (rotational viscometer) was used. 10ml of sealer was mixed and kept in a beaker for immersion and rotation of spindle of viscometer. 3 consecutive readings were noted and mean was calculated[10].

Assessment Of Sealing Ability

60 single rooted teeth with straight roots were selected for the study. Teeth with similar dimensions were finalized as samples. After cleaning and inspecting them, teeth were decoronated at 16mm from apex. Teeth were cleaned and shaped with the standard protocol upto 25 number 4% taper. Teeth were divided into 6 groups (n=10) based on sealers as mentioned previously. Teeth in all groups were obturated with the respective sealers. Then teeth were sectioned in 5x5 mm dimension and Vacuum dried, gold plated and were then scanned under SEM (Scanning Electron Microscope)[5].

The sealer penetration was measured in micrometers from the sealer–gutta-percha interface to the dentinal wall by using scanning electron microscope images at 500x magnification.

Statistical Analysis:

Data were entered into the excel sheet. Data were analysed using SPSS (Statistical Package for Social Sciences) 25.0 version. Descriptive statistics was performed. Intergroup comparison was done using Chi-square test. P-value <.05 was considered statistically significant.

RESULTS:

Presence Of Voids

In groups A, B, C, D, E and F the voids were present in 70%, 70%, 70%, 30%, 30% and 30% of samples respectively. The frequency of voids was non-significantly different amongst the groups. (p-value >.05).

Table1. Inter-group Comparison Of Presence Of Voids.

Groups	Voids		Total	Chi-square value	df	p-value
	Present	Absent				
Group A	7 (70.0%)	3 (30.0%)	10 (100.0%)	9.600	5	.087
Group B	7 (70.0%)	3 (30.0%)	10 (100.0%)			
Group C	7 (70.0%)	3 (30.0%)	10 (100.0%)			
Group D	3 (30.0%)	7 (70.0%)	10 (100.0%)			
Group E	3 (30.0%)	7 (70.0%)	10 (100.0%)			
Group F	3 (30.0%)	7 (70.0%)	10 (100.0%)			
Total	30 (50.0%)	30 (50.0%)	60 (100.0%)			

DISCUSSION:

Since, removal of biofilms from the root canal system entirely is unattainable, so advancements in disinfection strategies will be the last resort to improve the efficacy of endodontic treatments.

Also, extraradicular infections can heal over time following successful root canal treatment, provided that the communication between the root canal system and the oral cavity is effectively sealed. However, if there is improper sealing or microleakage, the infection may persist or recur. In such cases, utilizing obturating materials with antimicrobial properties may offer an additional layer of protection against bacterial infiltration[6,7].

Studies have demonstrated that adding antibiotics to endodontic sealers can significantly improve their antimicrobial properties[6,7]. For instance, mixing amoxicillin with sealers like AH Plus, MTA Fillapex, and BioRoot RCS has been shown to inhibit the growth of *Enterococcus faecalis*, a common pathogen in root canal infections.[9] This antimicrobial effect was observed both in freshly mixed and set sealers, with no significant difference in efficacy over time. The traditional Triple Antibiotic Paste (TAP) consists of metronidazole, ciprofloxacin, and minocycline. While effective, minocycline is known to cause tooth discoloration, which is a significant drawback, especially in anterior teeth. To mitigate this issue, some studies have replaced minocycline with clindamycin in the antibiotic mixture. Research indicates that clindamycin, when combined with metronidazole and ciprofloxacin, exhibits similar antimicrobial efficacy to the original TAP formulation[10].

It is known that addition of any material to sealers may affect its properties like setting time, flow, viscosity etc[10]. Here, in this study because of the change in particle size and suspected reaction among sealer and antibiotics, all the properties were considered and measured. These were within the limit that does not cause any significant difference.

The sealing ability is most important aspect of a sealer, as there is addition of another particle without any standard particle size, so sealing ability may differ[7].

Hence, SEM was used to assess the sealing ability as with it, dentin sealer interface can be assessed and accordingly, gaps can be measured[10]. Although, all the samples showed presence of gaps, it was lesser in resin based sealer groups than zinc oxide based sealer groups because it is an epoxy resin based sealer and reacts with exposed amino groups of collagen. The epoxide ring first opens and becomes available for reaction to amino groups[10]. Whereas, Zinc

oxide based sealer does not react with dentinal components and has poor adhesive properties[6].

When compared amongst Zinc Oxide based sealer groups, no significant change was observed and similarly amongst resin based sealer groups no significant difference was noted. This is probably due to dissolution of antimicrobials in epoxy resin and eugenol.

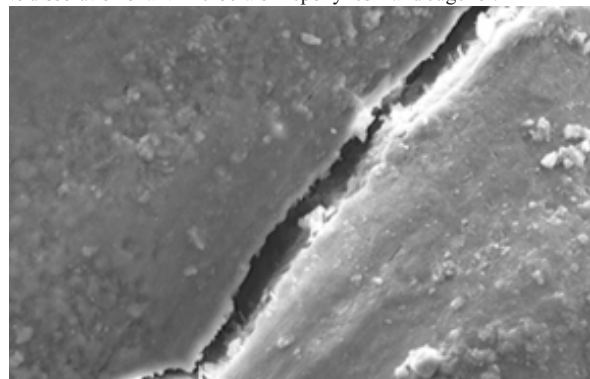


Figure 1: SEM image showing void.

CONCLUSION:

- Combining 10% TAP and 10% MTAP to ZOE sealer did not significantly affect the setting time and sealing ability. The flow of the experimental ZOE sealer was within the recommendable limit.
- Combination of epoxy resin based sealer with 10% TAP and 10% MTAP did not affect the setting time and the flow, neither there is any significant difference in the sealing ability.
- Thus, within the limitations of study, it can be stated that addition of antibiotic powders will not affect the sealing abilities and properties of sealers but will enhance the antimicrobial potential.

REFERENCES:

- Aiello, M. A., and Leuzzi, F. (2010), "Waste Tyre rubberized concrete: Properties at fresh and hardened state." *Journal of Waste Management, ELSEVIER*, 30,1696-1704.
- Batayneh, M. K., Marie, I., and Asi, I. (2008), "Promoting the use of crumb rubber concrete in developing countries." *Journal of Waste Management, ELSEVIER*, 28, 2171-2176.
- Egyptian Code Committee 203, (2003), "Experimental guide for testing of concrete materials." Part 3 of the Egyptian code of practice for the design and construction of reinforced concrete structures.
- Eldin, N. N., and Senouci, A. B. (1993), "Rubber-Tyre particles as concrete aggregate." *Journal of Material in Civil Engineering, ASCE*, 5(4), 478-496. 1) Kishen A, et al.: Advances in endodontics: Potential applications in clinical practice. *J Conserv Dent*. 2016, 19(3): 199-206.
- Kelić K, et al.: Fluoride-Releasing Restorative Materials: The Effect of a Resinous Coat on Ion Release. *Acta Stomatol Croat*. 2020, 54(4): 371-381.
- Huyang G, et al.: Design and development of self-healing dental composites. *Mater Des*. 2016, 94: 295-302.
- Narayanan L, et al.: Endodontic microbiology. *J Conserv Dent*. 2010, 13(4): 233-239.
- Vijayaraghavan R, et al.: Triple antibiotic paste in root canal therapy. *J Pharm Bioallied Sci*. 2012, 4(2): S230-S233.
- Mohammedeen M, et al.: Effect of adding antibiotic to zinc oxide eugenol-based sealer upon the apical seal (in vitro study). *J Dent Sci*. 2019, 22(3): 253-256.
- Razmi H, et al.: Antimicrobial Effects of AH26 Sealer/Antibiotic Combinations Against *Enterococcus Faecalis*. *Int Endod J*. 2008, 3(4).
- Binoy D, et al.: A Comparative Evaluation of Sealing Ability, pH and Rheological Properties of Zinc Oxide Eugenol Sealer Combined with Different Antibiotics: An In Vitro Study. *J Clin Diag Res*. 2014, 8(11): ZC05-ZC08.
- Razmi H, et al.: Comparison of AH26 Physicochemical Properties with Two AH26/Antibiotic Combinations. *Int Endod J*. 2010, 5(1).
- Sato I, et al.: E.Sterilization of infected root-canal dentine by topical application of a mixture of ciprofloxacin, metronidazole and minocycline in situ. *Int Endod J*. 1996, 29(2):118-24.
- Shankar K, et al.: Comparison of Modified Triple Antibiotic Paste in Two Concentrations for Lesion Sterilization and Tissue Repair in Primary Molars: An *In Vivo* Interventional Randomized Clinical Trial. *Int J Clin Pediatr Dent*. 2021, 14(3): 388-392.