



## Comparative evaluation of Removal of Bioceramic sealer and resin based sealer with two different retreatment instrumentation protocols

Dr. Bandana Mishra<sup>1</sup>, Dr.Sarita Bhardwaj<sup>2</sup>, Dr.ParveenKumar Shanwal<sup>3</sup>,  
Dr.Tamanpreet Kaur<sup>4</sup>, Dr.Divyangana Thakur<sup>5</sup>,Dr.Mohit Bansal<sup>6</sup>

<sup>1</sup>PG student, Dept. of Conservative Dentistry & Endodontics, Swami Devi Dyal Hospital & Dental College, Barwala, Panchkula.

<sup>2</sup>Professor & Head, Dept. of Conservative Dentistry & Endodontics, Swami Devi Dyal Hospital and Dental college, Barwala, Panchkula.

<sup>3</sup>PG student, Dept. of Conservative Dentistry & Endodontics, Swami Devi Dyal Hospital and Dental college, Barwala, Panchkula.

<sup>4</sup>Professor, Dept. of Conservative Dentistry & Endodontics, Swami Devi Dyal Hospital and Dental college, Barwala, Panchkula

<sup>5</sup>Senior Lecturer, Dept. of Conservative Dentistry & Endodontics, Swami Devi Dyal Hospital and Dental college, Barwala, Panchkula

<sup>6</sup>Reader, Dept. of Conservative Dentistry & Endodontics, Swami Devi Dyal Hospital and Dental college, Barwala, Panchkula

### Corresponding Author-

Dr. Bandana Mishra

PG Student, Dept. of Conservative Dentistry & Endodontics Swami Devi Dyal Hospital and Dental College

Email [id- drbandanamishra9@gmail.com](mailto:drbandanamishra9@gmail.com)

### Article History

Volume 6, Issue 12, 2024

Received: 26 June 2024

Accepted: 8 July 2024

doi:

10.48047/AFJBS.6.12.2024.4123-4133

### ABSTRACT

#### Objective-

Aim of this study was to evaluate and compare the efficacy supplementary techniques (ultrasonic tip/Neoendo Retreatment files) in removing remaining filling materials (gutta-percha/Resin based sealer/BCSealer) from oval-shaped root canals during non-surgical endodontic retreatment.

#### Materials and methods-

20 mandibular single rooted premolars were taken, disinfected by immersing in 3% hypochlorite solution and then stored in 0.9% saline until use. Samples were decoronated approximately at the level of CEJ maintaining a standardized root length of 15mm. Apical patency was established by size 10 k file. Working length was determined 1mm short of the measurement. Each tooth was performed with access opening followed by instrumentation (BMP) till 30- 4%. Irrigation with 2ml of 3% NaOCl solution was performed after each instrument. Finally instrumented canals were rinsed with 1ml of 17% EDTA followed by 3% NaOCl for using side vented 30G irrigating needle placed 1 mm short of working length. Canals were irrigated with

normal saline, dried with paper points and then master GP cones were selected for each canal. Tooth were randomly divided into two groups (n=10) depending on the sealer used for root canal obturation. GP cone was coated with respective sealer and then obturated using both the sealer till the WL. Both the sealer groups were further divided into two subgroups. The first subgroup of each group had H files along with ultrasonics and the other had Neo Endo Retreatment Files. Samples were grooved, sectioned

longitudinally and examined under stereomicroscope for cleaner portions of the root (coronal, middle and apical thirds). Statistical analysis were performed using Mann Whitney U TEST.

**Results-**

Lower values of remnant filling material were found for BC Sealer (4.1) compared to resin based sealer (5.9) ( $P < 0.05$ ), and considering the supplementary technique, lower values of remnant filling material were found for the ultrasonic tip compared to Neoendo retreatment file. The remaining filling material was observed in all samples regardless the filling material or the supplementary technique employed.

**Conclusion-**

None of the supplementary techniques were able to remove the remaining filling material completely from the root canal. Ultrasonic tips should be considered better for retreatment especially in bioceramic sealer cases.

## INTRODUCTION

Root canal treatment eradicates bacterial infection, prevents re-infection and also promotes healing of periodontal pathologies. Success of endodontic treatment depends on multiple factors with its steps such as access cavity preparation, cleaning and shaping or Biomechanical preparation along with copious irrigation of the root canal and then obturation establishing a three dimensional sealing of root canal system which contributes to the outcome of the treatment.

Despite high degree of stability of gutta-percha it sometimes cannot adequately seal the canal space. Insufficient chemo-mechanical preparation and obturation of the root canal system are probably the main reasons for endodontic treatment failure.<sup>1</sup>

Sealers also are very important component of root canal treatment to fill the gap and voids between the dentinal wall and root filling materials. Sealers prevent leakage of nutrients and ideally possess antimicrobial properties. There can be different types of root canal sealers such as zinc oxide eugenol, calcium silicate based sealers, resin based sealers etc. There can be failure of root canal treatment and a need for non-surgical retreatment due to poor adhesion of root filling material, improper sealing and leakage.<sup>2</sup>

The sole purpose of non-surgical root canal retreatment is to promote the complete removal of filling material and debris followed by re-filling of root canal. Incomplete removal of filling material affects the outcome of the treatment. It also prevents the irrigating solution to come in contact with microorganisms and debris.<sup>1</sup>

Many instruments have been developed and suggested for the procedure starting from hand instrument to supplemental protocols like ultrasonics, reciprocating and rotary instruments. Hence, it feels appropriate to evaluate different instrumentation protocols for better outcome of non surgical endodontic retreatment.

## MATERIAL AND METHODOLOGY

A total of 20 mandibular single rooted premolars were taken, disinfected by immersing in 3% hypochlorite solution and then stored in 0.9% saline until use.

The samples were decoronated with a diamond disc approximately at the level of CEJ maintaining a standardized root length of 15 mm



The apical patency was established by introducing size 10 k file just beyond the apical foramen and subsequently working length was calculated to be 1mm short of the measurement.



Each tooth was performed with access opening followed by instrumentation (BMP) using woodpecker Motopex-M endomotor till 30- 4% (Neoendo) at 300 rpm and 1.5 torque.



Irrigation with 2ml of 3% NaOCl solution was performed after each instrument. Finally instrumented canals were rinsed with 1ml of 17% EDTA for 1min followed by 2ml of 3% NaOCl for 30 sec using side vented 30G irrigating needle Super Endo (Endo Rinse) placed 1 mm short of working length.



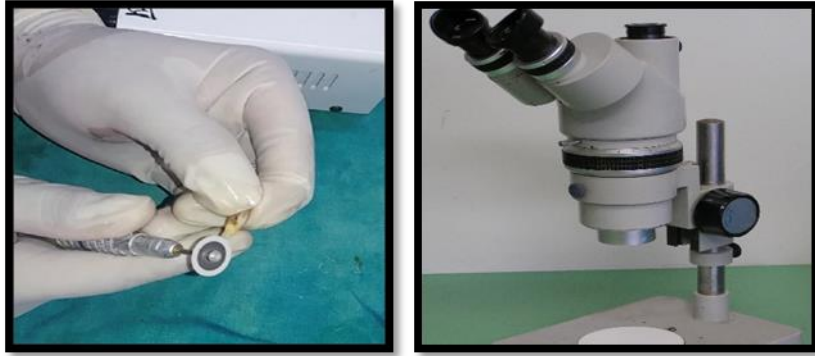
Canals were irrigated with normal saline, dried with paper points and then master GP cones were selected for each canal  
 Tooth were then randomly divided into two groups (n=10) depending on the sealer used for root canal obturation



The sealers were mixed according to manufacturer instructions, applied to the canal wall using lentulospiral (mani). After this the master GP cone was coated with respective sealer. Tooth were then obturated using both the sealer till the WL  
 Both the sealer groups were further divided into two subgroups. The first subgroup of each group had H files along with ultrasonics and the other had Neo Endo Retreatment Files.

<ul style="list-style-type: none"> <li><b>GROUP 1 (n=10)</b> Obturated using Bioceramic sealer</li> </ul>	<ul style="list-style-type: none"> <li><b>GROUP 2 (n=10)</b> Obturated using resin based sealer</li> </ul>
<p><b>Group 1 is divided into two subgroups 1A and 1B</b></p> <ul style="list-style-type: none"> <li><b>Group 1A (n=5)</b> Retreated with H file+ ultrasonic tip</li> </ul>	<p><b>Group 2 is divided into two subgroups group 2A and 2B</b></p> <ul style="list-style-type: none"> <li><b>Group 2A (n=5)</b> Retreated with H file + ultrasonic tip</li> </ul>
<ul style="list-style-type: none"> <li><b>Group 1B(n=5)</b> Retreated with NeoEndo retreatment files</li> </ul>	<ul style="list-style-type: none"> <li><b>Group 2B (n=5)</b> Retreated with NeoEndo retreatment files</li> </ul>

Then all the samples were grooved, sectioned longitudinally and examined under stereomicroscope for cleaner portions of the root.



The scoring criteria were as follows

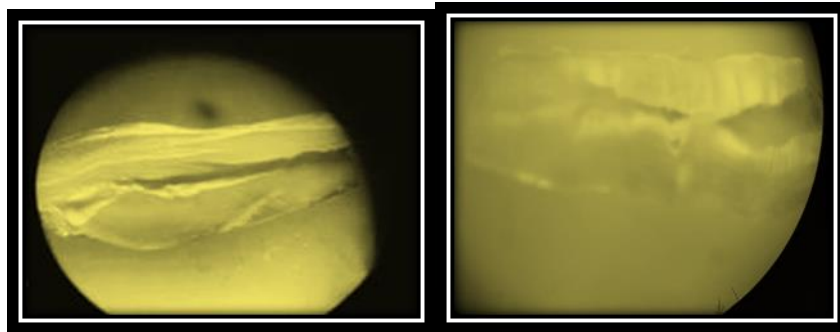
Score 1 – Clean root canal walls, only a few sealer accumulation

Score 2 – Few small agglomeration of sealer

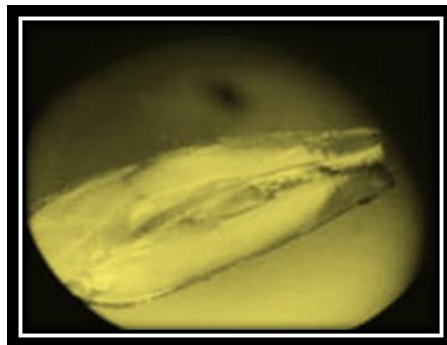
Score 3 – Many agglomerations of sealer covering

Score 4 – More than 50% of the root canal wall covered with sealer

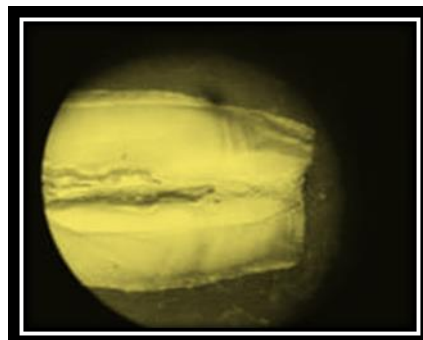
Score 5 – Complete or nearly complete root canal walls covered with sealer



Bioceramic sealer group retreated with Bioceramic sealer group  
Neoendo retreatment file                      H files and ultrasonics



Resin based sealer retreated with H file and ultrasonics



## Resin based sealer retreated Neoendo Retreatment File

**Results**

Lower values of remnant filling material were found for BC Sealer compared to resin based sealer ( $P < 0.05$ ), and considering the supplementary technique, lower values of remnant filling material were found for the ultrasonic tip compared to Neoendo retreatment file.

The remaining filling material was observed in all samples regardless the filling material or the supplementary technique employed.

**Statistical Analysis**

Data was analysed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at  $p < 0.05$ .

Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference between the groups was done using Mann Whitney U TEST.

**TABLE 1-COMPARISON OF REMAINING SEALER- GROUP 1**

	1A	1B
Mean	3.2	5
SD	0.4	0.63
Mann Whitney U TEST	5.59	
P VALUE	0.0001*	

\* $P < 0.05$  is statistically significant (Shapiro Wilkinson test,  $p < 0.05$ )

The statistical analysis by Mann Whitney U test reported statistically significant lower mean value in GROUP 1A compared to GROUP 1B. Mean value of 1A was ( $3.2 \pm 0.4$ ) and that of 1B was ( $5 \pm 0.63$ )

**TABLE 2-COMPARISON OF REMAINING SEALER – GROUP 2**

	2A	2B
Mean	5.8	6
SD	0.74	0.4
Mann Whitney U TEST	1.37	
P VALUE	0.13	

**\*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)**

The statistical analysis by Mann Whitney U test did not report any statistically significant mean value between GROUP 2A & GROUP 2B. Mean value of 2A was (5.8 ± 0.74) and that of 2B was (6± 0.4)

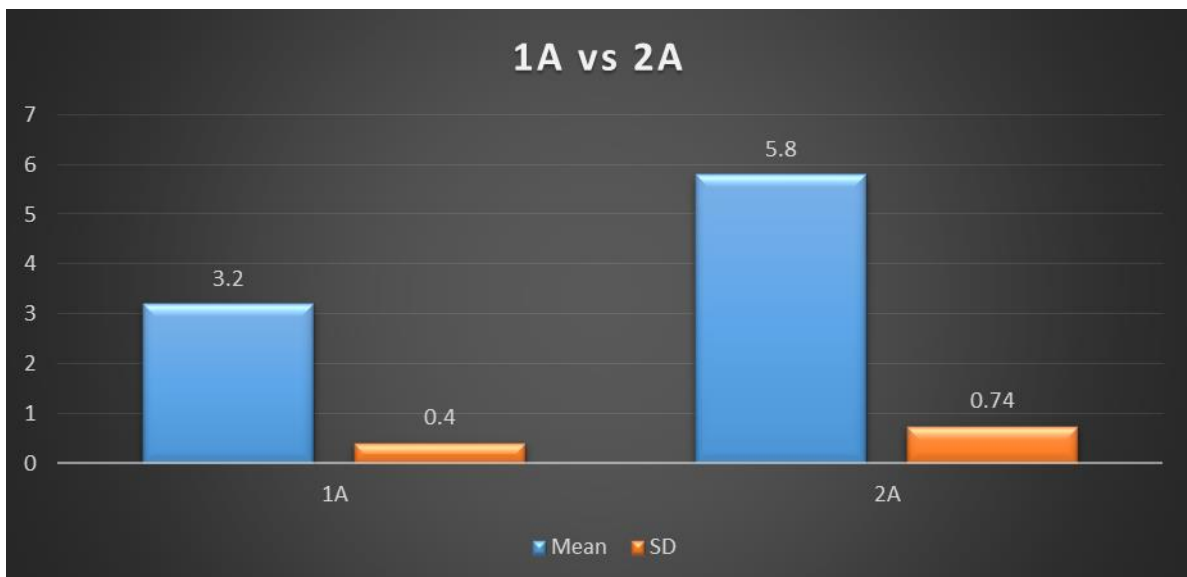


**TABLE 3-COMPARISON OF REMAINING SEALER – GROUP 1A vs GROUP 2A**

	1A	2A
Mean	3.2	5.8
SD	0.4	0.74
Mann Whitney U TEST	5.88	
P VALUE	0.0001*	

**\*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)**

The statistical analysis by Mann Whitney U test reported statistically significant lower mean value in GROUP 1A compared to GROUP 2A. Mean value of 1A was (3.2 ± 0.4) and that of 2A was (5.8 ± 0.74)



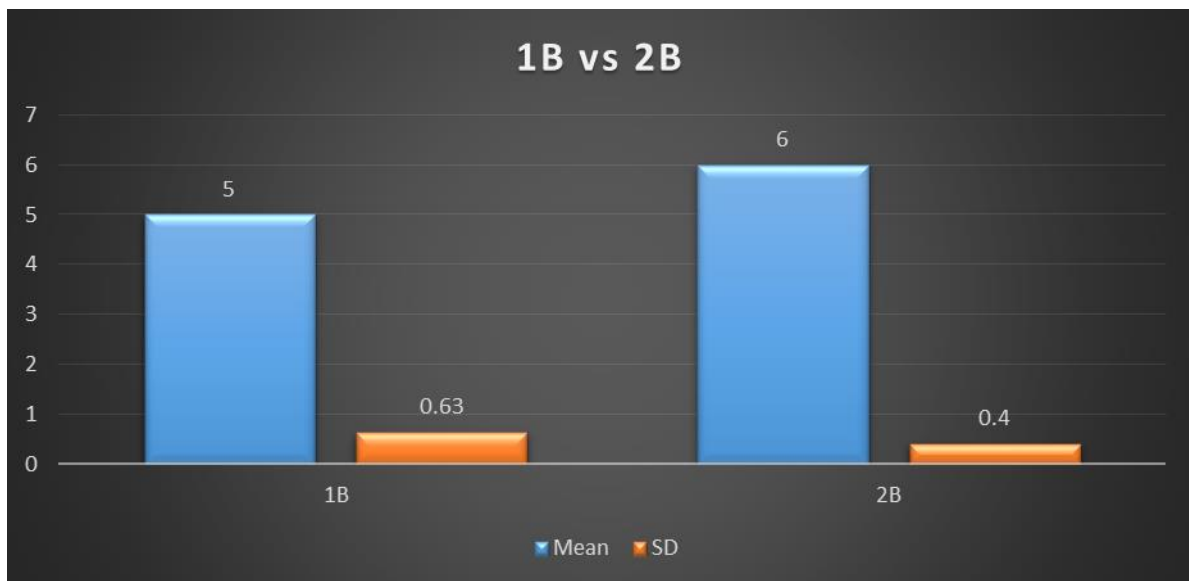


**TABLE 4-COMPARISON OF REMAINING SEALER – GROUP 1B vs GROUP 2B**

	1B	2B
Mean	5	6
SD	0.63	0.4
Mann Whitney U TEST	2.99	
P VALUE	0.02*	

\*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)

The statistical analysis by Mann Whitney U test reported statistically significant lower mean value in GROUP 1B compared to GROUP 2B. Mean value of 1B was (5 ± 0.63) and that of 2B was (6 ± 0.4).



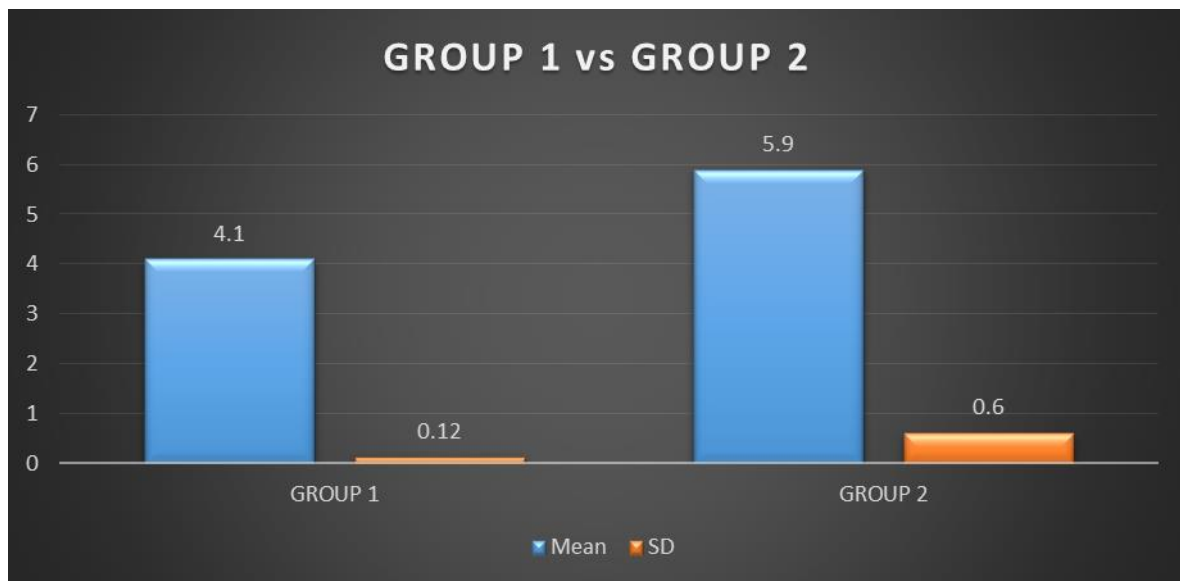
**TABLE 5- OVERALL COMPARISON OF REMAINING SEALER**

	GROUP 1	GROUP 2
Mean	4.1	5.9
SD	0.12	0.6
Mann Whitney U TEST	6.58	
P VALUE	0.0002*	

\*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)

The statistical analysis by Mann Whitney U test reported statistically significant lower mean value in GROUP 1 compared to GROUP 2. Mean value of GROUP 1 was (4.1 ± 0.12) and that of GROUP 2 was (5.9± 0.6)





## DISCUSSION

Literature proves the fact that no instrument or technique can completely remove the filling material from the root canal during non-surgical root canal treatment. Because of the incomplete removal of filling materials there can be failure of the treatment. Therefore newer instruments and supplementary protocols for the removal of remaining filling material have been proved to be useful. In case of oval shaped root canal particularly in mandibular premolars the filling material fills the polar areas making it difficult for its removal. According to many studies there is also a chance of thermal expansion of filling material by the temperature changes in the oral cavity which also affects the bond of dental structure and filling materials.<sup>1</sup>

Twenty mandibular single rooted premolars were taken, disinfected by immersing in 3% hypochlorite solution and then stored in 0.9% saline until use. They were decoronated with a diamond disc at the level of CEJ with a standardized root length of 15 mm. The apical patency was established by introducing size 10 k file just beyond the apical foramen and subsequently working length was calculated to be 1mm short of the measurement.

Each tooth was performed with access opening followed by instrumentation (BMP) using woodpecker Motopex-M Endomotor till 30- 4% (Neoendo) taper in 300 rpm and 1.5 torque. Irrigation with 2ml of 3% NaOCl solution was performed after each instrument. Finally instrumented canals were rinsed with 1ml of 17% EDTA for 1min followed by 2ml of 3% NaOCl for 30 sec using side vented 30G irrigating needle Super Endo (Endo Rinse) placed 1 mm short of working length. Canals were irrigated with normal saline, dried with paper points and then master GP cones were selected for each canal. Teeth were then randomly divided into two groups (n=10) depending on the sealer used for root canal obturation.

Teeth were then obturated using both the sealer. The sealers were mixed according to manufacturer instructions, applied to the canal wall using lentulospiral (mani). After this the master GP cone was coated with respective sealer and then placed in the WL. Then all the samples were grooved, sectioned longitudinally and examined under stereomicroscope for cleaner portions of the root.

The scoring criteria were as follows

Score 1 – Clean root canal walls, only a few sealer accumulation

Score 2 – Few small agglomeration of sealer

Score 3 – Many agglomerations of sealer covering

Score 4 – More than 50% of the root canal wall covered with sealer

Score 5 – Complete or nearly complete root canal walls covered with sealer

Complete removal of existing root filling material is important during retreatment for effective disinfection of the canal system. Both the groups were undergone retreatment. None of them could be done completely free of sealers.

Bioceramic sealers are biocompatible, non toxic to tissues, has good dimensional stability and also good sealing ability. It is a bioactive material that continues to produce hydroxyapatite for a long time after mixing, adapting to the dentinal walls and optimising its sealing capacity. It is an interesting material because it adheres tenaciously to both dentin and gutta-percha.<sup>6</sup>

Bioceramic sealers are said to be difficult to remove completely from the root canal wall, because it was shown that calcium silicate cements interact with the dentine surface and bond to dentine in a certain extent.<sup>7</sup>This sealer have shown the potential of bioactive materials to create a hard barrier provide antimicrobial activity and high pH, and prolong calcium ion release, which are key factors in endodontic and periodontal tissue regeneration.<sup>8</sup>

Bioceramic sealer has high levels of biocompatibility and hydrophilicity. Because of the hydrophilic environment in root canals, water resorption and solubility of root canal sealers are important factors contributing to their stability.<sup>9</sup>

Resin based sealers have reduced solubility, less shrinkage and good dimensional stability along with that has greater retention to root dentin so afford good apical sealing eventually has a problem in retreatability.<sup>3</sup>

Epoxy resin-based root canal sealer has good retention to root dentin, has long-term dimensional stability, reduced solubility, excellent apical sealability, and low toxicity.<sup>10</sup>

With resin based sealers, penetration into dentinal tubules is very extensive. But with resin based sealer it shrinks during setting and results in disintegrate adaptation and de-bonding from root canal.

Apical third of the root canal has smaller tubular density and smaller tubular size than middle and cervical third of root dentin hence the penetration of sealer and its sealing ability to the root canal wall becomes less at the apical portion. The hydrophobic property of resin based sealers also prevents good adaptation to the incompletely dried canal wall.<sup>4</sup>

Precisely, the resin component penetrates tubules, whereas filler particles, which are mostly too large to enter tubules, remain at the interface. This depletion of resin from the interfacial layer was proposed as a reason for the low bond strength.<sup>5</sup>

The hydrophobic property of resin based sealer prevents good adaptation in presence of moisture whereas the bioceramic sealer has higher flowability and smaller particle size. It is hydrophilic and has low contact angle which makes it easier to spread easily on the dentinal wall along with good penetration into the dentinal tubules and its irregularities.

Moisture in the dentinal tubules triggers setting reaction of bioceramic sealer with the production of hydroxyapatite crystals resulting in chemical bond with root dentine. Bioceramic sealers contain calcium phosphate matching the chemical composition of tooth eventually results in good interlocking of the sealer to dentin. Expansion of bioceramic sealer leads to gap free adhesion of the sealer to root canal wall making it difficult for retreatment. Therefore, there was a huge difference between the mean value of remaining sealer in bioceramic group treated with ultrasonic and neoendo retreatment file.

## LIMITATION

Average Particle Size of Bioceramic sealer is 0.2mm and the average particle size of epoxy resin sealer is 0.8mm. Therefore the smaller particle size in the bioceramic sealer increases the penetration into the dentinal tubules so it is very difficult for removal during retreatment.

## CONCLUSION

Despite of having unique micromechanical bond of Bioceramic sealers , Resin based sealers outweighs in the aspect of adhesion to root dentin which proves to be a bane in retreatment procedure. Sealers being a boon for root canal apical sealing can also be a bane in retreatment for which choice of equipment as supplementary protocol is the key.Comparing both sealer groups, retreatment using H file and ultrasonics proved to be better choice specifically for bioceramic sealer.

## REFERENCES

1. Crozeta BM, Lopes FC, Menezes Silva R, Silva-Sousa YTC, Moretti LF, Sousa-Neto MD. Retreatability of BC Sealer and AH Plus root canal sealers using new supplementary instrumentation protocol during non-surgical endodontic retreatment. *Clin Oral Investig.* 2021 Mar;25(3):891-899.
2. Kapralos V, Böcker J, Vach K, Altenburger M, Proksch S, Karygianni L. On the biocompatibility of endodontic sealers. *Swiss Dent J.* 2022 Sep 5;132(9):586-597.
3. Al-Haddad A, Che Ab Aziz ZA. Bioceramic-Based Root Canal Sealers: A Review. *Int J Biomater.* 2016;2016:9753210.
4. Asawaworarit W, Pinyosopon T, Kijssamanmith K. Comparison of apical sealing ability of bioceramic sealer and epoxy resin-based sealer using the fluid filtration technique and scanning electron microscopy. *J Dent Sci.* 2020 Jun;15(2):186-192.
5. Rahimi M, Jainaen A, Parashos P, Messer HH. Bonding of resin-based sealers to root dentin. *J Endod.* 2009 Jan;35(1):121-4.
6. Cecchetti F, Spuntarelli M, Zacccone R, Mazza D, Di Girolamo M, Baggi L. Endodontic retreatment and bioceramics: A case report. *J BiolRegulHomeost Agents.* 2021 May-Jun;35(3 Suppl. 1):147-153.
7. Donnermeyer D, Bunne C, Schäfer E, Dammaschke T. Retreatability of three calcium silicate-containing sealers and one epoxy resin-based root canal sealer with four different root canal instruments. *Clin Oral Investig.* 2018 Mar;22(2):811-817.
8. JurićKačunić D, Tadin A, Dijanić P, Katunarić A, Matijević J, Trutina-Gavran M, Galić N. Efficacy of Reciprocating Instruments in Retreatment of Bioactive and Resin-Based Root Canal Sealers. *ActaStomatol Croat.* 2022 Dec;56(4):338-350.
9. Lim M, Jung C, Shin DH, Cho YB, Song M. Calcium silicate-based root canal sealers: a literature review. *Restor Dent Endod.* 2020 Jun 9;45(3):e35.
10. Silva EJNL, Canabarro A, Andrade MRT, Cavalcante DM, Von Stetten O, Fidalgo TKDS, De-Deus G. Dislodgment Resistance of Bioceramic and Epoxy Sealers: A Systematic Review and Meta-analysis. *J Evid Based Dent Pract.* 2019 Sep;19(3):221-235.