

# Evaluation of Effect of Ultrasonic Activation of Bio C Sealer and Smear Off Irrigant on Sealer Penetration - A Confocal Laser Scanning Microscopic Invitro Study

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## Abstract:-

### ➤ *Background:*

Ultrasonic activation (UA) of irrigants have been always studied and proven that it enhances biomechanical preparation. Similarly, it has been demonstrated that ultrasonic activation of sealers produces a more uniform sealer mix, enhancing the obturation quality. Present study aimed to enlighten ultrasonic activation of sealers and its effect on sealer penetration into dentinal tubules.

### ➤ *Methodology:*

Forty extracted teeth were decoronated with diamond disk and straight handpiece and divided into four groups. Biomechanical preparation was done using Neo Endo S files. After transversely cutting tooth samples, the middle and apical third were evaluated for sealer penetration.

### ➤ *Statistical Analysis:*

The data were analysed using SPSS Version 23. A p-value of less than 0.05 was considered statistically significant.

### ➤ *Results:*

Among the groups, teeth that were irrigated with Smear OFF and undergone ultrasonic activation had a higher sealer penetration rate.

### ➤ *Conclusion:*

The dentinal sealer penetration was better when the bioceramic sealer was used in conjunction with Ultrasonic activation and Smear Off as the final irrigant.

## I. INTRODUCTION

The core of endodontic therapy is the proper sealing of the root canal system (RCS), which comes after chemical and mechanical preparation. In order to increase adhesion to the root canal walls through molecular and physical exchanges, endodontic sealants must navigate the complex anatomical characteristics of the root canal system, including isthmus, ramifications, anomalies, and dentinal tubules. A three-dimensional filling is required for the endodontic treatment to be successful. Its objectives are to facilitate the remaining

bacteria, close the canal system, and encourage the healing of the periapical tissue<sup>1</sup>. Angelus Bio ceramic Sealer is a bioactive sealer composed of calcium silicate, calcium aluminate, calcium oxide, zirconium oxide, iron oxide, and silica oxide. Upon endodontic obturation, Angelus Bio ceramic sealer facilitates a simple pulp chamber cleaning. It permits the release of calcium ions, which promotes the development of mineralized tissue. The primary characteristic is that there is no contraction after setting<sup>2</sup>. Newer root canal irrigant SmearOFF is a combination of EDTA and chlorhexidine gluconate (CHX) <1%wt<sup>3</sup>. Ultrasonics has been widely used for irrigation and instrumentation, but not much study has been done on its usage for sealer activation. To the best of our knowledge, no studies have been conducted to investigate the effects of ultrasonic activation (UA) of sealers using Smear OFF as the final irrigant. Thus, the aim of the study is to evaluate and compare Bio C bioceramic sealer penetration into dentinal tubules with and without ultrasonic activation. To assess and contrast sealer penetration when saline is utilised as the control group and SMEAR OFF (chlorhexidine+EDTA) is applied as the last irrigation method.

## II. MATERIALS AND METHOD

### ➤ *Source of Data*

The study design is an in-vitro comparative study. 40 single rooted mandibular premolars were collected from the Department of Oral and Maxillofacial Surgery from K.V.G Dental College and Hospital, Sullia and other private dental clinics in and around Sullia taluk, D.K. Samples were analyzed under Confocal laser scanning microscope at Manipal institute of Technology, Manipal.

### ➤ *Method of Collection of Data*

Invitro study was done on forty human extracted teeth. Ethical approval for the study was obtained from the ethics committee of the institution. Following tooth extraction, each tooth was cleaned. The teeth were immersed in a 5.25% sodium hypochlorite solution for 30 minutes to eliminate any organic debris. Following cleaning, they were preserved in a 10% formalin solution.

➤ *Following were the Experimental and Control Groups*

- Group A1(n=10): Smear OFF as final irrigant with Ultrasonic Activation of Bio ceramic sealer.
- Group B1(n=10): Smear OFF as final irrigant without Ultrasonic Activation of Bio ceramic sealer.
- Group A2(n=10): Saline as final irrigant with Ultrasonic Activation of Bio ceramic sealer .
- Group B2(n=10) : Saline as final irrigant without Ultrasonic Activation of Bio ceramic sealer . (Control)

➤ *Sample Preparation*

Forty teeth were decoronated with diamond disk and straight handpiece at a standardized length of 15 mm. Glide path was established using no.10k file and working length was recorded 1 mm short of the apical foramen.

Neo Endo S files were used for the biomechanical preparation. Biomechanical preparation was done under copious irrigation of saline and 5.25% hypochlorite .Canals were enlarged to a size of #20 6% .In Group A1 and Group B1 final irrigation was done with Smear OFF followed by which Bio C sealer was injected to canal space. In group A1 ultrasonic activation of Bio ceramic sealer was done for 20 seconds .Group B1 after injecting Bio ceramic sealer ultrasonic activation of sealer was not done .Group A2 and B2 saline was used as final irrigant followed by which bio ceramic sealer was injected .Group A 2 had ultrasonic activation of sealer for 20 seconds. Sealer was activated in mesio distal and buccolingual direction. # 20 6 % gutta percha cones were used for obturation. Rhodamine B was used to mark filling materials at a concentration of roughly 0.1%.

After 24 hours tooth samples were sectioned transversely .Middle and apical third tooth samples were evaluated for sealer penetration

A confocal laser scanning microscope was used to examine ten samples from each group in order to determine the extent to which root filling material had extended into dentinal tubules.

➤ *Statistical Analysis*

Data was entered in the SPSS {(Statistical Package for Social Sciences) version 23 ( IBM SPSS statistics, IBM corp. released 2015} spreadsheet. Descriptive statistics like mean, standard deviation and percentages were calculated. The data were assessed for normality using ANOVA test .Multiple comparisons were done using Tukey test

### III. RESULTS

A sample of forty human teeth were assessed to evaluate and compare Bio C sealer penetration into dentinal tubules with and without ultrasonic activation. The sealer penetration was observed higher in bioceramic sealer when used in conjunction with ultrasonic activation and Smear OFF as the final irrigant (A1) followed by bioceramic sealer when used without ultrasonic activation and Smear OFF as final irrigant(B1), bioceramic sealer when used in conjunction with ultrasonic activation and saline as the final irrigant (A2) and bioceramic sealer when used without ultrasonic activation and saline as final irrigant(B2) ie,  $A1 > B1 = A2 > B2$ .

➤ *Confocal Images of Sealer Penetration (Middle/Apical Third)*

- $A1 > B1 = A2 > B2$

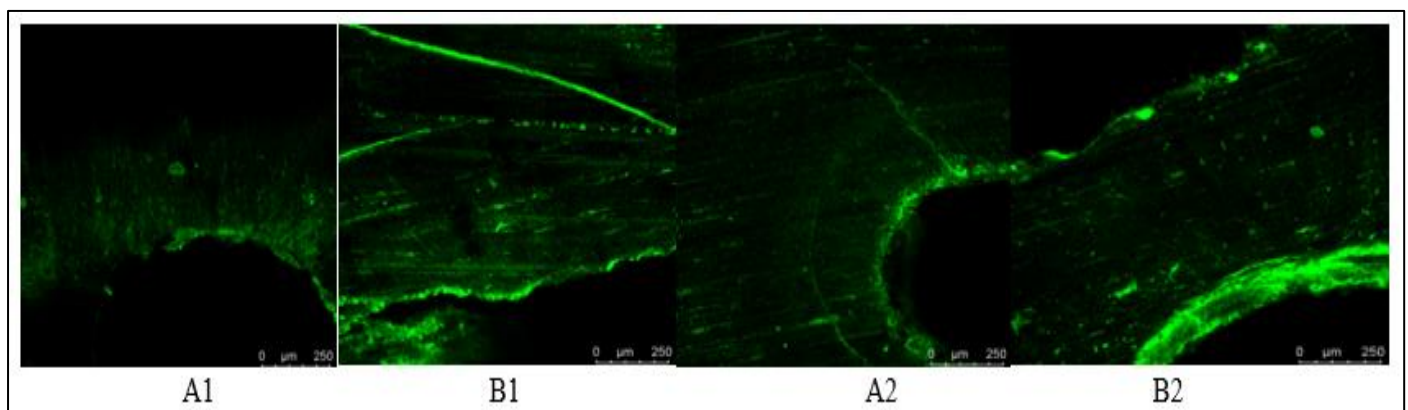


Fig 1 Confocal Images of Sealer Penetration (Middle/Apical Third)

➤ *Results*

Table 1 Mean Distribution and Level of Significance of Sealer Penetration into Dentinal Tubules at Apical / Middle Third using Anova Test

Group	Mean(um)	N	Std Deviation	P Value
A1 SMEAROFF /UA	417.9620	10	61.15213	0.18
B1 SMEAR OFF /WITHOUT UA	342.7610	10	124.95542	
A2 SALINE/UA	322.9430	10	106.01622	
B2 SALINE WITHOUT UA	283.3940	10	52.81363	

Table 2 Intergroup Comparison of Sealer Penetration of Variable Groups Using Tukey Test

Multiple Comparisons						
Dependent Variable: PENETRATION						
Tukey HSD						
(I) GRP	(J) GRP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	75.20100	40.85472	.272	-34.8300	185.2320
	3	95.01900	40.85472	.111	-15.0120	205.0500
	4	134.56800*	40.85472	.011	24.5370	244.5990
2	1	-75.20100	40.85472	.272	-185.2320	34.8300
	3	19.81800	40.85472	.962	-90.2130	129.8490
	4	59.36700	40.85472	.476	-50.6640	169.3980
3	1	-95.01900	40.85472	.111	-205.0500	15.0120
	2	-19.81800	40.85472	.962	-129.8490	90.2130
	4	39.54900	40.85472	.768	-70.4820	149.5800
4	1	-134.56800*	40.85472	.011	-244.5990	-24.5370
	2	-59.36700	40.85472	.476	-169.3980	50.6640
	3	-39.54900	40.85472	.768	-149.5800	70.4820

\*. The mean difference is significant at the 0.05 level.

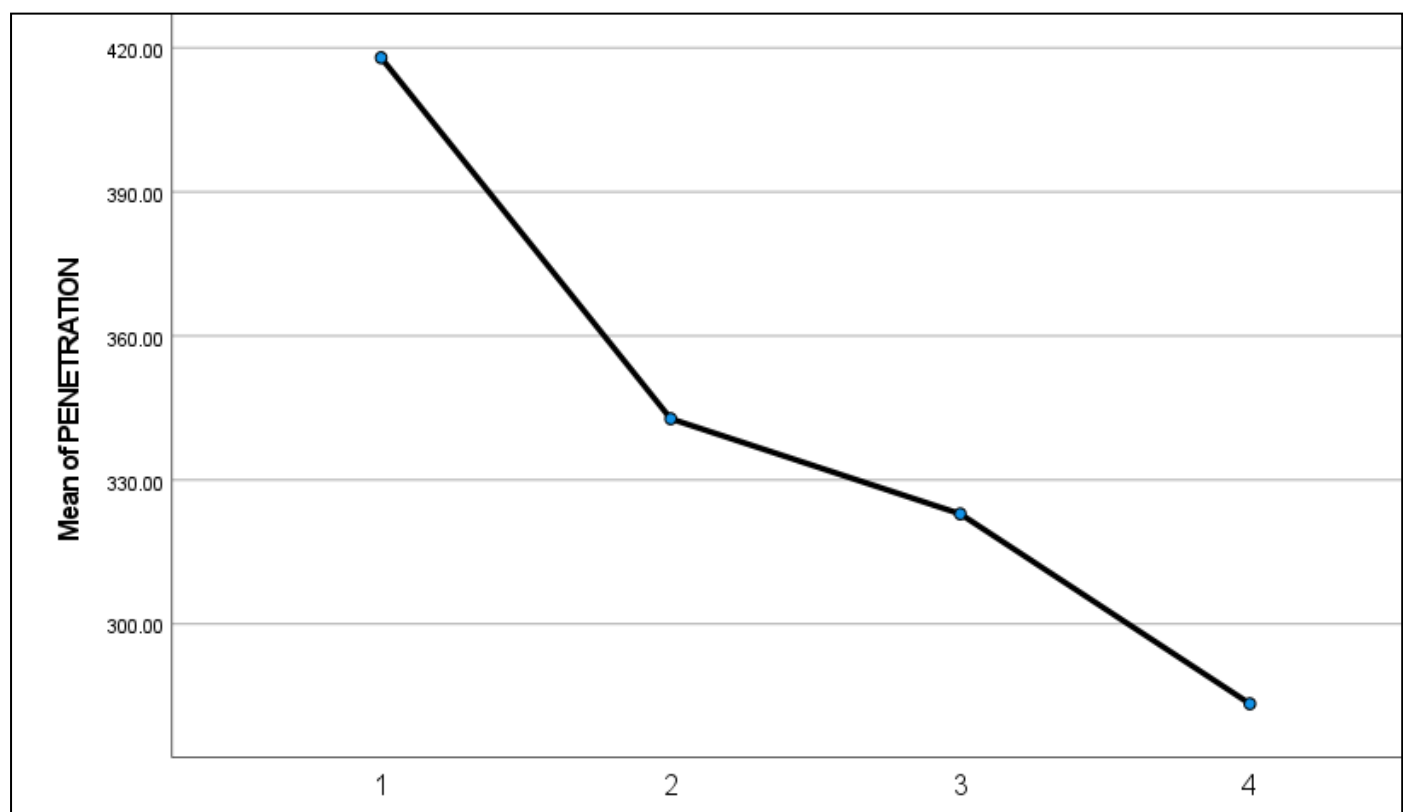


Fig 2 Graphical Representation of mean of Presentation

#### IV. DISCUSSION

The success rate of endodontic therapy is continuously being raised by utilising new methods and tools. UA improves cleansing, disinfection, and bacterial reduction by increasing the irrigant's dispersion throughout the root canal system. For these reasons, research on endodontic sealers and UA has been conducted recently, with the goal of directing the sealer towards dentinal tubules and abnormalities in canals. Quality

of root canal filling significantly improved endodontic success<sup>4</sup>. Since there is limited information available, the purpose of this study was to evaluate and compare Bio C bioceramic sealer penetration into dentinal tubules with and without ultrasonic activation.

Despite having ultrasonic sealer activation in both groups, subgroup A1's sealer penetration rate was higher than A2.

The last irrigant in A1 was Smear OFF, a mixture of EDTA and chlorhexidine gluconate (CHX). Compared to saline, this combination of treatments cleansed more dentinal tubules and created a better calcium suspension. Smear OFF cleared Smear layer from coronal middle and apical third. This could be the reason for better sealer penetration after irrigation with Smear OFF.

A study by Majumdar et al. evaluated sealer penetration comparing Gutta Flow Bioseal, resin-based sealer and calcium hydroxide-based sealer<sup>5</sup>. Gutta Flow Bioseal showed higher sealer penetration, which was a silicone-based, cold-filling sealer containing GP powder and bioactive glass that can induce an osteogenic and osteoconductive response<sup>6</sup>. Moisture is essential for the setting of both Gutta Flow Bioseal and Bio C sealer.

When compared to the same sealer without activation, the Bio C sealer's sealer penetration was enhanced by 20 seconds of UA.

Ultrasonic activation could have favoured a better dentinal penetration and enhancing the interfacial adaptation between the sealer and the root canal walls.

High-frequency UA increases the system's temperature and pressure, encourages turbulent flow and cavitation, lowers the viscosity of the sealer, and improves the packing of the filler particles in the sealer.

In addition to improving sealer adaptation to the dentinal tubule periphery, the use of bioceramic sealers in conjunction with ultrasonic activation can also improve the quality of the obturation.

Kim et al. in a randomized clinical trial checked post op pain when obturation was done using sealer based obturation using calcium silicate sealers and continuous wave condensation with resin based sealer. Their study stated sealer based obturation using Endoseal TCS can be possible alternative CWC with AH Plus sealer<sup>4</sup>.

Caceres et al. in their invitro study evaluated Bio C sealer penetration with the gold standard AH Plus sealer concluding Bio C sealer provided better sealer and dentinal adaptation in the SEM study<sup>7</sup>. Present study is in accordance with above mentioned study.

Another invitro study by Sachin Chadgal et al. stated ultrasonic activation of bioceramic sealer improved adherence of sealer to root canal dentin which improved the sealer's bond strength to dentin<sup>8</sup>.

According to study by Silva et al. 20 seconds of Ultrasonic activation improved the flow of sealers, which improved sealer penetration, calcium ion release and increase in pH<sup>9</sup>. In the present study it was selected to keep ultrasonic activation for 20 seconds based on the study by Silva et al.

According to the study, sealer penetration in the middle and apical third was analyzed as sealer activation improves

the penetration into the apical ramifications and irregularities improving the quality of obturation and success of treatment. Bio-C Sealer has 2 µm particles in its formulation, which improved its penetration into imperfections<sup>9</sup>.

The major advantages associated with the use of bioceramic materials as root canal sealers are their excellent biocompatibility and formation of apatite like crystalline structure<sup>10</sup>.

25-30 KHz high frequency ultrasonic devices promote acoustic transmission and cavitation, which reduce the formation of voids in the filling material and eventually increase the interfacial adaptation between the sealer and canal walls<sup>11</sup>.

By using fluorescent Rhodamine-marked sealers, confocal laser scanning microscopy (CLSM) can obtain detailed information at relatively low magnification regarding the presence and distribution of sealers inside dentinal tubules<sup>12</sup>.

The use of SmearOFF irrigant in conjunction with ultrasonic activation has positively impacted sealer penetration.

## V. CONCLUSION

The results of this investigation, indicated that the dentinal sealer penetration was better when the bioceramic sealer was used in conjunction with Ultrasonic activation and Smear OFF as the final irrigant. More clinical research is needed in the realm of ultrasonic activation of sealers, as this invitro study is only the beginning.

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