

# OUTCOME OF ROOT CANAL TREATMENT USING BIOCERAMIC SEALER AND RESIN-BASED SEALER: AN OBSERVATIONAL ANALYTICAL STUDY

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## ABSTRACT

The proper shaping and cleaning followed by well-sealed root canal system is desired for successful outcome of the endodontic treatment. With the advent of Bioceramic sealers and their beneficial biological properties, they have been widely incorporated in clinical practice. So, the purpose of this study was to find out the difference in the healing outcome of root canal treatments and retreatments carried out with either single cone obturation technique (SCO) or warm vertical compaction technique (WVC). This was observational analytical study (Cohort study), carried out in private practice. The patients were recalled at-least at six months. When association of healing with type of sealer was considered there was a statistically significant association between healing potential and type of sealer (p-value 0.03). Kaplan -Meier analysis for time to healing showed that with progress of time probability of healing was seen to be more in bioceramic sealer group. Within the limitations of this study the SCO had good healing potential and can be used as a safe alternative in obturation.

## KEYWORDS

Ah Plus sealer, bioceramic sealer, root canal, single cone, warm vertical compaction

*Received on:* August 22, 2021

*Accepted for publication:* January 14, 2022

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DOI: <https://doi.org/10.3126/nmcj.v24i1.44144>

## INTRODUCTION

It has been well established that the most important goal of endodontics is properly sealed root canal system after proper cleaning and shaping. The existence of anatomical challenges in the form of lateral canal, fins and isthmuses hinders in the proper obturation of the root canal and thereby holds a determining factor in success of root canal treatment.<sup>1-4</sup> It requires sound knowledge and technical skills to take care of these hindrances because the quality of the procedure done can affect its outcome.<sup>5</sup> Historically, improper sealing is contributed a major cause of failure.<sup>6-7</sup>

Most common technique used to obturate root canal is either “cold” or “warm” gutta-percha condensation techniques in conjunction with a sealer, which helps to seal off the voids, lubricate during the procedure and potentially seal any accessory canal.<sup>8</sup> Also warm vertical compaction (WVC) with the epoxy resin-based sealer (AH Plus sealer) has been recognized as the gold standard.<sup>9-10</sup>

Bioceramic sealers because of its physiochemical and biological properties are gaining popularity in modern endodontic therapy.<sup>11</sup> Bioceramic sealers have been found to be able to promote apical healing, to possess antibacterial activity, and to bond to tooth structure. Their biological properties depend on their chemical composition and their setting reaction which consist of a hydration reaction followed by a precipitation reaction of calcium phosphate and formation of hydroxyapatite.<sup>12</sup>

Single cone obturation technique (SCO) in which the root canal is obturated with a fitted cone matching the shape of the last rotary instrument used in combination with large quantity of sealer has been often regarded as inadequate due to its potential for apical leakage.<sup>13</sup> However, with the advent of hydraulic cement based endodontic sealer this technique is getting increasingly accepted worldwide with both general dentist and endodontic specialists because of its enhanced properties and ease of use.<sup>14</sup>

Using clinical and radiographic parameters the success rate of root canal treatments is normally assessed. The clinical parameter usually is subsidence and absence of signs and symptoms of disease. The radiographic success is identified by the prevention of the development, reduction in size or complete disappearance of apical radiolucency.<sup>15</sup>

The success rate of root canal obturation using calcium silicate or resin-based sealers has been

carried out by one non randomized clinical trial on primary endodontic treatment only but success rate comparing with the primary or secondary treatment using different sealer is still the one to be studied.<sup>16</sup>

Although the material is used widely, there are very few clinical studies and till date none documented in our country. So, the purpose is to study the healing outcome of root canal treatments and retreatments carried out with either SCO or WVC technique.

## MATERIALS AND METHODS

This is observational analytical study (Cohort study) carried out, after ethical approval from Nepal Medical College Institutional Review Committee, in private practice setting with Dental operating microscope (Labomed, USA). The duration of study was from April 2018 - March 2020.

Cohort was drawn from patients who had undergone root canal treatment. Comparison groups were drawn from within the cohort of 100 patients based on type of obturation technique with either SCO or WVC group. Patients visiting the dental clinic of age 18 and above with mature tooth who required nonsurgical root canal treatment or retreatment and with recall of six months or longer were included.

The exclusion criteria were:

1. Documented evidence of perforation
2. Tooth with severe periodontal disease.
3. The tooth with cracks extending to canal orifices.

Teeth were treated by two endodontists from the same practice. A standardised practice involved local anesthesia and rubber dam isolation. In case of primary treatment, initially canals were negotiated with 10 no. stainless steel K file. The working length was determined using an electronic apex locator (Propex mini, Dentsply, Switzerland) and confirmed with radiographs. The rotary instrument of choice was ProTaper Universal rotary instruments (Dentsply Maillefer, Switzerland) at different setting of speed and torque as per manufacturer instructions assigned for each file and were used in a crown-down approach to prepare each root canal to at least F2 as master apical rotary file. In retreatment cases, previous obturation materials and blocks were removed using H file, chloroform as a solvent, Ultrasonics and rotary instruments (Retreatment file D1-D3, Dentsply Maillefer, Switzerland), as per the requirement. The canals were irrigated

with 3.25% sodium hypochloride, 17% EDTA and Normal saline to flush in between the two irrigants. Final irrigant used was normal saline. Passive ultrasonic irrigation was done in all the cases. After the preparation was over depending on the cases, it was either completed in single visit or multiple visits, in case of multi visits calcium hydroxide (Ultradent, USA) was used. On the day of obturation, canals were dried using paper points. The corresponding Gutta percha from ProTaper Universal was used for obturation of canal/s in either SCO using Ceraseal (Meta Biomed, South Korea) or WVC using AH Plus sealer (Dentsply DeTrey GmbH, Germany).

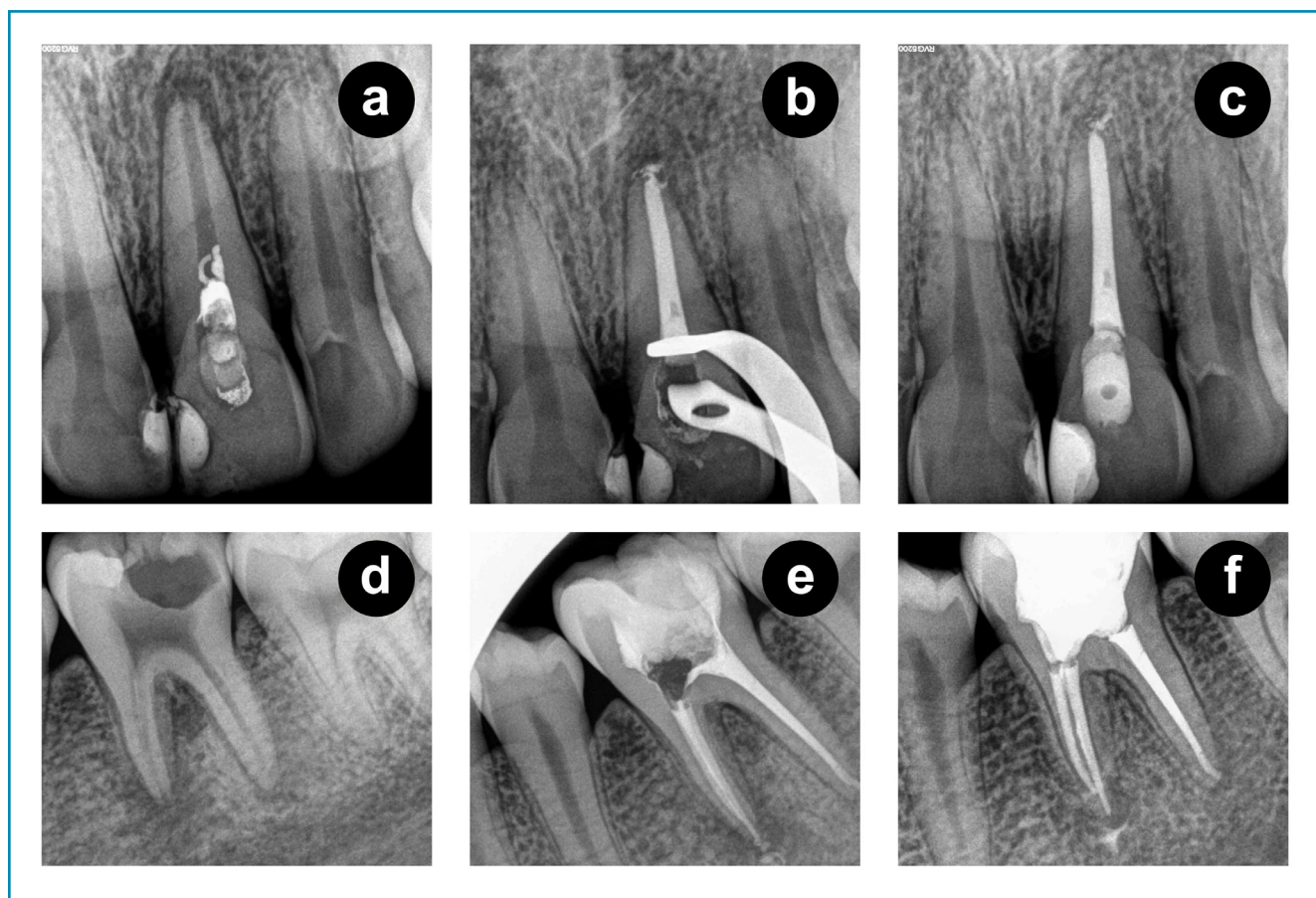
The access cavity was restored with composite (Ivoclar Vivadent, Germany); if restoration was not done on the same day then a cotton pellet and MD Temp (Meta Biomed, South Korea) were used to temporize the tooth and the patient was advised to return for permanent restoration as soon as possible. All procedures were performed under Dental operating microscope.

**Follow-Up Assessment:** The patient who received the treatment were recalled at 6, 12 and 18 months and the treated tooth were

examined clinically and with radiographs. In our study there was no attrition of patients and all the patients came for follow up at recall time of minimum 6 months. Clinical assessment included any signs or symptoms, presence/ resolution of sinus tract, presence/absence of sensitivity to percussion and palpation, presence/absence of swelling, periodontal pockets. Radiographs were evaluated by two calibrated examiners for presence, absence, and change (increase/decrease) in size of any periapical radiolucency.

The teeth were divided into outcome categories based on the following classification:

1. Healed: Functional, asymptomatic teeth with no or minimal radiographic periradicular radiolucency (Fig:1)
2. Nonhealed: Non-functional, symptomatic teeth with or without radiographic periradicular radiolucency or asymptomatic teeth with unchanged, new, or enlarged radiographic periradicular radiolucency
3. Healing: Teeth that are asymptomatic and functional with a decreased size of radiographic periradicular radiolucency (Fig:1)



**Fig. 1:** Representative radiographs for healed (a,b,c) and healing (d,e,f) cases.

**Outcome Assessment:** The outcome assessment was further dichotomized, healed and healing both were considered success and non-healed was considered a failure. Certain variables were taken to identify any possible prognostic factors such as presence or absence of periapical radiolucency along with it the treatment type (initial treatment or retreatment), sealer extrusion and follow up time.

**Statistical Analysis:** The data was entered, edited and coded in Microsoft Excel version 16.45. The data was exported and analysed with the help of Statistical Package for Social Sciences (SPSS) version 17. Data was analysed statistically by Chi square test and Fisher's Exact test was used to determine the difference between the number of successful and unsuccessful outcomes in the two groups. The probability of success was calculated with relative risk. The significance level was set at  $\alpha = 0.05$ . Kaplan-Meier analysis for time to healing was carried out using STATA15 licensed software.

## RESULTS

One hundred patients were included for analysis, the average age of patient was 39.06

years. The cohort was composed of 58% female and 42% male. In SCO group, 34% of cases were of retreatment and 66% were of primary treatment. The WVC group 46% of the cases were retreatment and 54% were of primary treatment. The majority of cases in both the groups were posterior teeth (40% in SCO and 42% in WVC).

No statistically significant association was seen between healing potential and type of sealer when pre-operative lesion was present (p-value 0.05) as well as when pre-operative lesion was absent (p-value 0.27) as in Table 1.

No statistically significant association was seen between healing potential and type of sealer based on type of treatment i.e. p-value 0.05 in case of primary treatment and p-value 0.34 in case of re-treatment as in Table 2.

No statistically significant association was seen between healing potential and type of sealer when sealer extrusion was present (p-value 0.60) as well as when sealer extrusion was absent (p-value 0.05) as in Table 3. More sealer extrusion was seen in Ah Plus group than Bioceramic group.

**Table 1: Association of healing potential with type of sealer based on pre-operative condition**

Pre-operative condition	Intervention group	Healing potential		Total n (%)	p-value
		Healing n (%)	Healed n (%)		
Present	Bioceramic	14 (37.8)	23 (62.2)	37 (100.0)	0.05
	AH Plus	23 (60.5)	15 (39.5)	38 (100.0)	
Absent†	Bioceramic	1 (7.7)	12 (92.3)	13 (100.0)	0.27
	AH Plus	3 (25.0)	9 (75.0)	12 (100.0)	

Chi square test, †Fisher's Exact test

**Table 2: Association of healing potential with type of sealer based on type of treatment**

Type of treatment	Intervention group	Healing potential		Total n (%)	p-value
		Healing n (%)	Healed n (%)		
Primary treatment	Bioceramic	8 (24.2)	25 (75.8)	33 (100.0)	0.05
	AH Plus	13 (48.1)	14 (51.9)	27 (100.0)	
Re-treatment	Bioceramic	7 (41.2)	10 (58.8)	17 (100.0)	0.34
	AH Plus	13 (56.5)	10 (43.5)	23 (100.0)	

Chi-square test



**Table 3: Association of healing potential with type of sealer based on sealer extrusion**

Sealer extrusion	Intervention group	Healing potential		Total n (%)	p-value
		Healed n (%)	Healing n (%)		
Present †	Bioceramic	4 (66.7)	2 (33.3)	6 (100.0)	0.60
	Resin based sealer	11 (61.1)	7 (38.9)	18 (100.0)	
Absent	Bioceramic	11 (25.0)	33 (75.0)	44 (100.0)	0.05
	Resin based sealer	15 (46.9)	17 (53.1)	32 (100.0)	

Chi-square test, †Fisher’s Exact test p-value<0.05 statistically significant\*

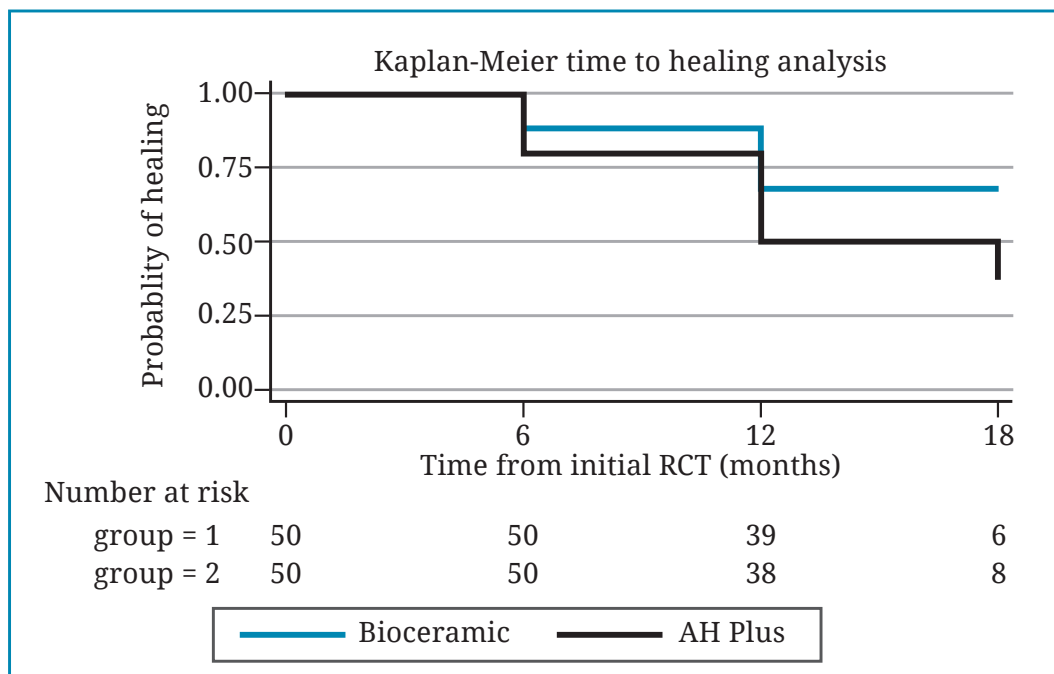
**Table 4: Association of healing potential with type of sealer**

Intervention group	Healing potential		Total n (%)	p-value
	Healing n (%)	Healed n (%)		
Bioceramic	15 (30.0)	35 (70.0)	50 (100.0)	0.03*
Resin based sealer	26 (52.0)	24 (48.0)	50 (100.0)	

Chi-square test, p-value < 0.05 statistically significant\*

When association of healing with type of sealer was considered there was a statistically significant association between healing potential and type of sealer (p-value 0.03) as in Table 4.

Kaplan -Meier analysis for time to healing showed that at six months follow up time both the sealers had similar healing potential but as the time progressed to twelve and eighteen-months probability of healing was seen to be more in Bioceramic sealer group (Fig 2).



**Fig. 2:** Kaplan-Meier time to healing analysis

## DISCUSSION

In this observational analytical study, the clinical outcome of two different root canal obturation techniques was compared based on clinical symptoms and periapical radiographs with follow up duration extending from 6-18 months. All the patients were treated and outcome was assessed by two experienced endodontists.

In this study we did not get non healing lesion or increase in size of lesion post treatment which may be due to smaller sample size and small follow up period unlike other studies reporting cases of non-healing lesion post treatment.<sup>16,17</sup> For Kaplan-Meier time to healing analysis (Fig. 2), irrespective of primary or retreatment the patients were categorized on the type of obturation technique. At the six months among patients obturated with WVC technique 80% were either healing or healed. Among patients obturated with SCO 90% were healing or healed. For the follow up the potential for healing was higher among those treated with SCO. The number of patients that followed up, dropped at 12 and 18 months of follow up. In a large sample size study, the reported success rate was 90.6% for primary treatment and 91.7% for retreatment and using loose criteria it also reported that there is no significant difference between the type of treatment which is consistent with our study.<sup>17</sup>

The presence of pre-operative radiolucency, has been found to be a significant predictor for success in various studies but in our study, we did not find the preoperative lesion to be predictor for success of treatment which is similar to the first cohort study conducted on bioceramic sealer.<sup>9,10,17-20</sup>

During obturation, ideally the material should be contained in the intraradicular space but inadvertent sealer extrusion into the periapical area may occur. Various studies have reported that sealer extrusion has no impact on endodontic outcomes but there is variation in tissue reaction based on the type of sealer.<sup>17,21-26</sup> In one study sealer extrusion was reported in 41.5% of the WVC cases and 13.7% of the SCO cases.<sup>27</sup> This is similar to our study where sealer extrusion in WVC cases was 36% and SCO cases was 12%. In both the group the extrusion had no significant effect clinically or in the outcome as a whole.

Since the bioceramic sealer presents many favorable bioactive properties, including

potential for hydroxyapatite formation, mineralization of dentinal structure, alkaline pH and better sealing, favoring clinicians to use single cone technique.<sup>28</sup> One study has revealed that there are diminished chances of procedural errors when using SCO technique with bioceramic sealer because of its ease in performing the procedure.<sup>29</sup> Several studies proved the high hermetic seal of bioceramic cements which further boost the clinician to create apical plugs as lone obturate on material or in conjunction with gutta percha.<sup>13,28,30</sup>

When analysis of association of healing with the type of sealer was done, the cases treated with Bioceramic sealers healed faster as compared to Ah Plus sealer. Also as seen in the fig1, with increased follow up time the healing outcome is better with Bioceramic sealer. This is also similar to the other studies done where predictable success rate ranged from 84%-90%, at the one year follow up.<sup>16,17</sup>

This study was carried out in the private practice setting and this may reflect the success of root canal treatment in a real-world scenario. As pointed out in another study, selection bias might have played a role in the lack of statistical significance when evaluating certain prognostic factor as presence of lesion and type of treatment in our study too.<sup>17</sup>

Our criteria to put healing and healed in successful outcome may have shown higher success in both the groups skewing the data towards one side. This study has some limitations, as it has smaller number of cases and thus the results cannot be generalized. Although at 6 months, we had 100% follow up it dropped to 77% follow up at 12 months and 14% follow up at 18 months. This also highlights need of more long term follow up data for better outcome study. Need for randomized controlled study evaluating SCO with other current obturation technique cannot be over emphasized.

Within the limitations of this study bioceramic sealer with single gutta percha cone can be safe alternative in both primary and retreatment cases with good healing potential. Further follow up studies with large sample size and long term follow up is needed to establish the reliability of the procedure.

Conflict of interest: None

Source of Research Fund: None

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