

## ORIGINAL RESEARCH

### Evaluation of Apical Leakage After Immediate And Delayed Post space Preparation Using Different Root Canal Sealers: An In Vitro Study

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#### ABSTRACT

**Background:** There is insufficient support for a permanent restoration in endodontically treated teeth with significant tooth structural loss. It's critical to preserve the apical seal when repairing them with post and core.

**Aim:** Apical leakage assessment following both delayed and instant postspace preparation utilizing different root canal sealers.

**Materials and Methods:** The roots of forty single-rooted teeth were biomechanically shaped, while using gutta percha for obturation, and sealed with AH Plus (Group A, n = 20) and Sure-Seal root canal sealer (Group B, n = 20) after being decoronated. A and B Groups were further separated as A1 and A2 and B1 and B2, respectively. Postspace was created straightaway for A1 and B1. After one week of preservation in physiologic saline, the post space for A2 and B2 was created. Rhodamine B dye was applied to the samples for 48 hours, after which they were cut lengthwise to examine dye penetration along the radicular dentinal wall via a stereomicroscope. The penetration of dye was linearly calculated, and then subjected values were analyzed with t-test statistical analysis and one-way analysis of variance

**Results:** The comparative variance between Group A (0.9 mm) and B (3 mm) proved to be statistically significant (P 0.001). Though, no statistically relevant difference between the subgroups for delayed and immediate post space preparation (B1 = 2 and B2 = 3 ; A1 = 0.9; A2 = 1, P 0.001).

**Conclusion:** As compared to Sure-Seal root canal sealing material, AH Plus sealing material shown less leakage. Timing for making postspace has no effect on apical leakage, since the difference in leakage values between the delayed and immediate post space preparation groups was not statistically relevant.

**Keywords:** Sure Seal Root, AH Plus; Microleakage , Delayed And Immediate Postspace Preparation.

## INTRODUCTION

The competence for sustaining an apical seal and the proper 3D obturations are essential for the long term effectiveness of root canal treatment. The tooth becomes reinfected if the apical seal is not maintained, necessitating retreatment. Thus, it is crucial to carefully assess the root canal filler material's sealing property.<sup>1</sup> A intact hermetic apical sealing limits bacterial introduction and other infectious foreign bodies as well as the periradicular exudates into the radicular space and vice-versa. A fluid-tight apical seal is therefore necessary.<sup>2</sup> The sealer/dentin interface or gutta-percha/sealer is where the leaking typically happens. It follows that it is crucial that the sealant adheres to the wall of radicular dentine.<sup>3</sup> A sealer made with epoxy resin is called AH Plus (Dentsply DeTrey, Konstanz, Germany). It is a good option for sealing the root canal because it is hydrophobic and has a very low shrinkage. It achieves a tight seal owing to its self-adhesive qualities and dimensional stability. It is biocompatible and shows modest anti-microbial activity. Due of its high radiopacity, it is easily visible on radiographs. It is regarded as the gold standard for comparing with other endodontic sealers because of these characteristics.<sup>3-5</sup> The hydrophilic bioceramic sealer Sure-seal root canal sealer (Sure Dent Corp., Gyeonggi-do, Korea) contains calcium silicate material. Its remarkable ability to adhere chemically without shrinking gives it outstanding sealing characteristics. It has superior antibacterial characteristics and is biocompatible (over pH 12).<sup>6</sup> Following endodontic therapy, teeth with significant coronal tooth structural loss are more likely to fracture. Post and core restorations are frequently advised in these teeth to restore the functions. It is important to take caution to not compromise the apical seal's integrity when establishing the postspace.<sup>7</sup> Several studies suggest that 4-5 mm of gutta-percha should be retained to ensure a sufficient apical seal.<sup>8-10</sup> The methodology utilized to remove the root canal filling material, how much gutta-percha is left in the canal, when the post space is prepared, the type of sealer used, and the manner in which obturation is done can all have an impact on how well the endodontic therapy succeeds.<sup>11</sup> This research utilized AH Plus sealer and Sure seal root canal sealer to investigate the impact of varied postspace preparation time frames on preserving the apical seal.

## MATERIALS AND METHODS

Non-carious single rooted teeth with single canal which were extracted for either periodontal or orthodontic reasons were chosen. The calculus, stains and soft tissues were eliminated during extraction, and the teeth were then preserved in normal saline until future usage. Excluded from the study were teeth with obvious cracks or flaws, bent roots, numerous or bifurcated root canals, resorptive deformities and an immature apex. Diamond discs with a slow-speed and steady pressure, the teeth were decoronated at the cement-enamel junction under continuous water cooling. By inserting a size 15 K-file (Mani Inc. Japan) into the canal until the file tip was visible at the apical foramen, the working length was ascertained. The ultimate working length was calculated by deducting 1 mm from this measurement. Up until F2, ProTaper rotary files (Dentsply Maillefer) were used to shape the canals. 17% EDTA gel (RC Help) was applied as a lubricant during instrumentation. The canals were irrigated with 5% sodium hypochlorite solution after each file was used. After instrumentation, the canals were subsequently cleaned using sterile saline to get rid of any remnants of dentinal debris. The manufacturers' recommendations were followed when mixing the experimental root-canal sealants. The root canals were sealed off. The preciseness of the obturation was evaluated using the postobturation radiographic images. All of the samples' postspace preparation was done in accordance with the study's procedure. Cavit-G was used to seal the coronal end of the canals after 3-4 mm of the coronal gutta-percha was removed. The samples were kept submerged under normal saline for a week as part of the delayed postspace preparation. Each and every sample's postspace was created using a Peeso

reamer. The Peeso reamer was chosen to fit the original canal size (sizes 1-4) to a depth that would leave at least 5 mm of gutta-percha apically exposed.

Randomly samples were assigned between two groups (n = 20).

These groups were then further divided into two subgroups to:

- Group A1: Gutta-percha + AH plus sealer followed by immediate postspace preparation
- Group B1: Gutta-percha + sure seal root canal sealer followed by immediate post space preparation
- Group A2: Gutta-percha + AH plus sealer and the post space preparation was done 1 week after the obturation
- Group B2: Gutta-percha + sure seal root canal sealer and the postspace preparation was done 1 week after the obturation.

The coronal cavities were sealed by using Cavit G following postspace preparation. The specimens were completely covered in two applied layers of nail polish, including the access repair with the exception of the apical 2 mm. In the following 48 hours, the samples were submerged in Rhodamine dye. The samples were then rinsed with running tap water to remove any remaining color. The nail varnish was scraped off with a scalpel. In order to reach the root canal filling on one side of the samples, they were subsequently cut longitudinally at high speed under continuous water cooling with a cylindrical diamond disc, preserving the thin layer of apical dentin. With no water cooling, a diamond disc spinning slowly was used to remove this deeper layer of dentin. Sections were studied using a stereomicroscope (Model: Olympus CH20 i Microscope) magnified by a factor of 15X. Image Analysis System (Chroma Systems Pvt., Ltd., India. Model: MVIG 2005) was used to determine the depth of dye penetration linearly from the apical root end to the highest amount of dye penetration in the coronal direction. Statistics were calculated on the dye leakage measurements (measured in millimetres).

## RESULTS

The data were described with descriptive statistics. The numerical information was described using the mean and standard deviation. Shapiro-Wilk tests were used to verify the normality of the data. The t-test for independent samples was used to compare two separate groups of numbers. More than two independent numeric variables were compared using one-way analysis of variance. P values less than 0.05 were regarded as significant across groups. The mean microleakage and standard deviation for Groups A and B are displayed in Table 1. The results of microleakage for the two groups demonstrated a statistically significant distinction when the Independent t-test was used to analyze the data. In comparison to Group A (AH Plus 0.9 mm), Group B (Sure Seal, 3 mm) displayed more microleakage (P 0.001) [Graph 1]. The statistically significant variation between Groups A1, A2, B1, and B2 is shown in Table 2 (P 0.001). However, neither group's immediate nor delayed postspace preparation (Group A: A1-0.9 and A2: 1 mm; Group B: B1-2 and B2-3 mm) showed any discernible variations. Group B2 had the highest microleakage value overall, followed by Group B1, A2, and Group A1, correspondingly. [Graph 2]

**Table 1: Comparative evaluation of apical microleakage (mm) for the groups by Independent T-Test**

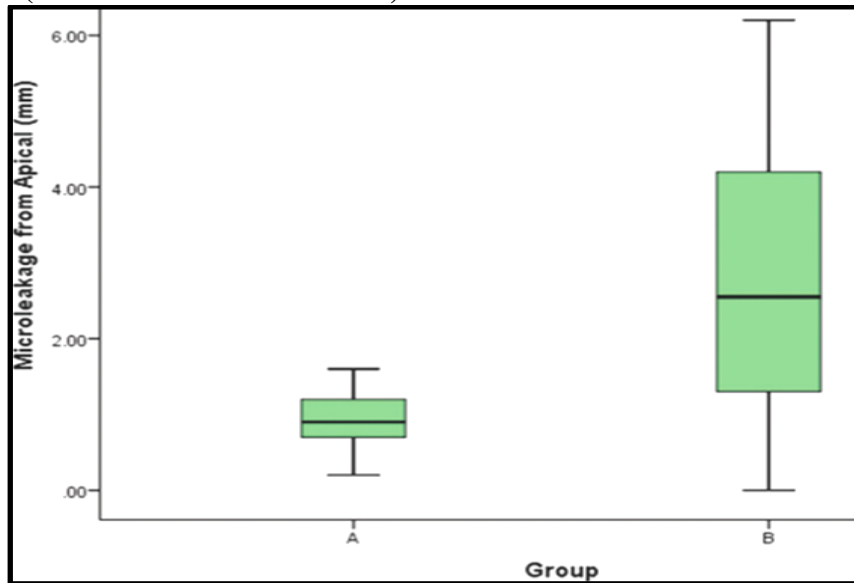
Group	Number of readings (n)	Mean leakage (mm)	SD	P
A	20	0.9	0.40	<0.001
B	20	3	2	
SD: Standard Deviation				

**Table 2: Comparative evaluation of apical microleakage (mm) for sub-groups by One-Way Analysis of Variance**

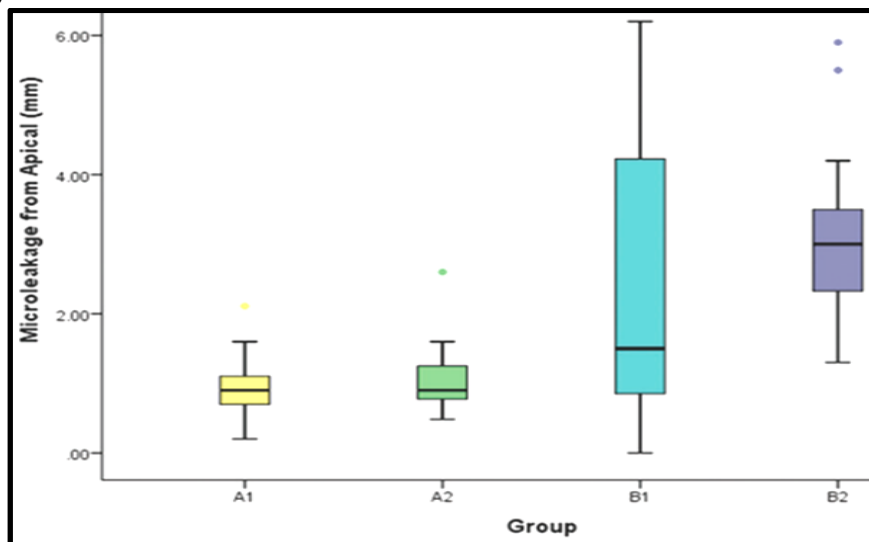
Groups	n	Mean	SD	P
A1	10	0.9	0.47	<0.001
B1	10	2	1.9	
A2	10	1	0.54	
B2	10	3	1.3	
TOTAL	40	1.9	1.5	

SD: Standard Deviation

**Graph 1: Comparative evaluation of apical leakage (mm) in Group A (AH plus sealer) and Group B (Sure seal root canal sealer)**



**Graph 2: Comparative evaluation of apical leakage (mm), for all subgroups (A1, A2, B1, and B2)**



**DISCUSSION**

The goal of this in vitro research was to assess the sealing capabilities of the recently released Sure Seal root canal sealer in comparison to a widely in use AH Plus. The outcomes of this in

in vitro investigation revealed that all four groups had apical dye leakage. The Sure Seal root canal sealer (Group B; 3 mm) had more mean microleakage than the AH Plus sealer in terms of the sealer (Group A; 0.9 mm). The sealer's sealing capacity may be influenced by a variety of elements, including chemical and micromechanical bonding. Recently released premixed, injectable bioceramic sealer Sure-Seal (Sure Dent Corp., Gyeonggi-do, Korea) contains calcium silicate ingredient.<sup>6</sup> It is hydrophilic, strongly bactericidal (pH = 12), osteogenic, and biocompatible.<sup>12</sup> According to the producers, it has outstanding physical characteristics and doesn't shrink during setting. It has a strong dentinal connection.<sup>6</sup> According to these assertions, the Sure-Seal root canal sealer should exhibit least amount of apical leakage; yet, in our study, it exhibited greater apical leakage than the AH Plus sealer. As AH Plus makes cross-linked polymers that are hard and robust using dentinal collagens,<sup>13</sup> it would have displayed reduced microleakage. Relatively not many experiments using Sure Seal root canal sealer have been done, but those that have were evaluated for dentinal tubule penetration, anti-bacterial capabilities, and root canal removal after retreatment.<sup>15</sup> The sealing capacity of Sure-Seal Root canal sealer was recently assessed by Pramudita et al., who also compared it to mineral trioxide aggregate. In this trial, the Sure-Seal root canal sealer produced improved outcomes. Our findings conflict with this research. The fact that Sure-Seal hardens in a wet environment from the root canal may be the cause of the increased microleakage with this sealant. When operating in vitro, it might be challenging for conditioning teeth with humidity of 100% to mimic in-patient circumstances. This may affect the amount of time and hardness the root canal sealer takes to harden in the teeth.<sup>16</sup> The epoxy resin-based AH Plus sealer holds numerous benefits, including a high degree of radiopacity, favourable tissue biocompatibility, lower solubility, while with minimal shrinking.<sup>5</sup> Epoxy resin sealers have demonstrated strong adhesion to both dentin and gutta-percha when contrasted with different kinds of cements in an in vitro adhesion test.<sup>17</sup> Stronger adhesion between sealer and gutta-percha was attributed to the light acidic pH and a potential chemical bonding as a result of ring-opening, whereas this was explained by the resin's ability to react with any exposed amino groups in collagen to form covalent bonds with dentin when the epoxide ring opens.<sup>18</sup> The hermetic sealing capacity of the root canal filling materials is determined using a variety of procedures, including the dye penetration technique, the radioactive isotope penetration technique, the fluid filtering method, and SEM examination.<sup>19,20</sup> The dye penetration test is the usual and widely used approach since it is the simplest, most affordable, and earliest way to analyse microleakage. It's a passive technique that relies on flow of capillary fluid.<sup>20</sup> We applied dye penetration method in this study. After one week, Groups A2 and B2 had postspace preparation in accordance with the study protocol (delayed). Delayed group specimens were kept in normal saline at 37°C for 7 days.<sup>21</sup> This was done to prevent any water from evaporating during measurements and to give sealers time to cure entirely.<sup>18</sup> Even though there was reduced leakage when post preparation was executed properly away, the apical leakage values of the delayed and instant postspace preparation groups weren't really statistically meaningful. The reason for this could be that when a postspace was prepared straightaway after filling, the sealer was still within its working time, enabling the sealer to set without trying to introduce microcracks, as compared to when a postspace was prepared later, the sealer had already completely set and it was possible that the rotational effect of Peeso reamers may have caused mobility of gutta-percha and developed microcracks within set sealer, breaking the bond at the sealer dentine interface.<sup>2</sup> The impact of delayed and instant postspace preparation on apical leakage has been adequately studied. There was no discernible difference between delayed and immediate postspace preparation with Resilon/Epiphany in an ex-vivo investigation by Lyons et al.<sup>22</sup> Saunders et al.,<sup>23</sup> Rybicki and Zillich et al.,<sup>24</sup> Madison and Zakariassen,<sup>25</sup> and other researchers all came to similar conclusions.<sup>8</sup> Our findings were consistent with these research. To be an in vitro study, it was

not possible to assess how other elements of the intra-oral environment, such as periapical fluids, oral fluids or tissue fluids, would affect sealers' capacity to seal. Although these in-vitro results cannot be applied to in-vivo circumstances, they do allow for fair comparison. Therefore, additional research is needed to verify the sealer selection during obturation and timing of postspace preparation.

## CONCLUSION

Considering the constraints of this in vitro study, the following conclusions can be drawn:

1. Apical leakage was found in all groups regardless of the sealers utilised and the timing of postspace preparation
2. For both subgroups, the instant postspace preparation group and the delayed postspace preparation group, AH Plus sealer demonstrated less apical leakage than Sure-Seal Root canal sealer.
3. For the two sealers, apical leakage was lower in the instantaneous postspace preparation group than in the delayed postspace preparation group, but the disparity was not statistically significant.

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