

The Effect of Time of Post Space Preparation on the Seal and Adaptation of Resilon-Epiphany SE and Gutta-percha-AH Plus Sealer- A SEM Study

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ABSTRACT

Background: The field of endodontics is dynamic and ever expanding. With the availability of a wide array of products in the dental market it is an absolute necessity to evaluate their efficiency before including them into routine clinical practice. Hence, the purpose of this study is to evaluate the effect of immediate and delayed post space preparation and sealing ability of new root canal filling material and sealers.

Aim: The effect of time of post space preparation on the seal and adaptation of Resilon-Epiphany SE and Gutta-percha-AH Plus Sealer - A SEM study.

Settings and design: Eighty extracted permanent maxillary central and lateral incisors selected for the study were decoronated. Roots canals were prepared and obturated.

Materials and Methods: Samples were divided into four groups depending on the time of post, space, preparation and obturated material. GROUP I & II: Immediate and Delayed post space preparation respectively with Gutta-percha / AH Plus as

obturing material. GROUP III and IV Immediate and Delayed post space preparation with Resilon / Epiphany as the obturing material. The samples were sectioned, then measured and studied by Scanning Electron Microscope (SEM).

Results: There was a significant difference found between immediate and delayed post space preparation in Resilon-Epiphany group ($p < 0.001$). Similarly significant difference was seen between immediate and delayed post space preparation in AH Plus-GP group ($p < 0.001$). Difference in the adaptation of the two materials was seen in the delayed group ($p = 0.030$) but the immediate group showed no significant difference ($p = 0.971$).

Conclusion: Within the limitations of this study, immediate post space preparation shows less leakage in both the groups. Resilon-Epiphany shows better results when post space is delayed amongst the two whereas in immediate post space preparation there is no significant difference.

Keywords: Immediate post space preparation, Delayed post space preparation, Sealing ability, Resilon-Epiphany SE, Gutta-percha-AH Plus Sealer

INTRODUCTION

The root canal system is the clinician's road way to success. The current concept among clinician is that after complete debridement, a three dimensional obturation of the root canal space that is free of inflammation constitutes the key factor for successful endodontic therapy [1]. One of the major factors of root canal failures is coronal leakage caused by recurrent caries, open crown margins, leakage through temporary restorations or failure to have a provisional placed on a treated tooth in timely manner. Therefore placement of a post to retain the core if indicated and restoration without delay is the need of the hour [2].

Endodontic treatment is a common step in prosthetic rehabilitation [3] and endodontically treated teeth with insufficient tooth structure generally require radicular posts to assist in restoring the tooth to function [4]. Any failure caused by apical leakage will result into a re-infected tooth making the entire procedure come to a zilch. Therefore it is deemed necessary to evaluate the sealing ability of the obturating material especially in the apical portion before making it a material of choice. A sealer is used along with gutta-percha to fill the anatomical variations that cannot be mechanically debrided or chemically irrigated totally. However, numerous studies have indicated that gutta-percha along with sealer are unable to seal the root canal meticulously.

Gutta-percha remains to be the golden standard, [5] but studies showed that when gutta-percha filled canals were challenged by bacteria, 50% allowed penetration through the entire length of the canal with in 30 days. Hovland and Dumsha stated, that all root

canal sealers leak, but there is probably a critical level of leakage that is unacceptable which might lead to endodontic failure. They also found that leakage could occur at the interface between the sealer and dentin, sealer and gutta-percha, through the sealer itself, or by dissolution of the sealer [6]. In addition, One of the study compared two commonly used root canal sealers to evaluate whether post placement before or after the sealer setting shows a difference in post stability, and concluded that there is no significant difference [7]. Another study done with fiber post with 5–8 mm of gutta-percha and resin bonding sealer, there was 50 % improvement in prevention of leakage [8]. Resin obturation materials right from the advent have become exceedingly popular. AH Plus is an epoxy amine resin sealer, which has gained momentum because of its high flexural strength and sealing ability.

In order to improve obturation of the root canal system, new techniques and materials have been developed as shown in the. One such material is resilon. The Resilon system (Epiphany @, Pentron clinical technologies, USA) consists of self etch dentin primer, dual cure resin sealer and ployster polymer cones or pellets in various sizes. With advancement in this material self etch sealer is also available. Resilon is a thermoplastic, synthetic obturating material based on polyster chemistry that performs handles and looks like gutta-percha [6]. Since these materials have readily gained momentum its important to evaluate their ability as obturating materials against the benchmark extremely widely used gutta-percha.

In terms of post space preparation, the required post space

may be prepared either immediately after the completion of the endodontic procedure using hot pluggers or alternatively at a later stage after full setting of the sealer using rotary instruments [9]. Performing post space immediately after root canal obturation but before sealer cement sets may, however mean that the apical seal remains intact [10]. Yet the common procedure is late removal of the coronal part of the root canal filling at a subsequent visit [9].

If post space and post itself are prepared in the same session as the root canal fillings, these aseptic conditions may be easily followed with no additional efforts but in some cases the evaluation period is needed to analyse the restorability of the tooth with post & core [9]. Since there are different schools of thoughts regarding the critical time to carry out this procedure, this aspect is under extensive research. The dye penetration commonly used for leakage studies do not require any sophisticated materials but they give questionable result. SEM is a better means of assessing the adaptation because it has larger depth of field, higher resolution and better magnification at the interface [11].

Hence, the purpose of this study is to evaluate the effect of immediate & delayed post space preparation & sealing ability and adaptation of Resilon and Epiphany SE sealer with gutta-percha and AH Plus sealer with SEM [Table/Fig-1].

PROPERTIES OF THE MATERIALS

Sealer	Examples	Properties
Epoxy resin based sealer	AH Plus AH 26	Excellent apical sealing ability, biocompatible, tissue tolerance, cytocompatible, long term dimensional stability. Disadvantage: dose dependent genotoxicity
Dimethacrylate based sealer	Resilon Real seal	Biocompatible, non- cytotoxic, non –mutagenic, enhances root strength, superior sealing ability, monoblock of dentin adhesive and obturating material. Disadvantage: biodegradation of resilon by bacterial and salivary enzymes needs further investigations

[Table/Fig-1]: Comparison of various sealers

MATERIALS AND METHODS

Eighty extract non-carious human permanent intact maxillary central and lateral incisor teeth with straight and single patent root canal which had completely formed apices, were included and teeth with fractured roots, root cracks, incompletely formed, apex, bifurcated canals, and resorptive defects were excluded. The teeth were decoronated at cemento-enamel junction and standardized to 16 mm length. The working length was established by placing No.15 stainless steel K-file into the canal until visible at the apical foramen and subtracting 1mm from the measured length. Biomechanical preparation was done with Protaper universal files. Irrigation was performed using 3% NaOCl solution, after every change of file size throughout the cleaning and shaping of root canal using a 2ml syringe with 26-gauge needle. 17% EDTA rinse

was used during and after instrumentation for 5 min to remove the smear layer. After completion of instrumentation the root canals were finally rinsed with 10 ml of 17% EDTA, followed by 10 ml of 3% sodium hypochlorite solution to remove the smear layer. After this, 10 ml of distilled water was used to remove any residue of sodium hypochlorite. No.10 K file was used through the apical foramen of the canal before and after instrumentation to ensure patency. The root canals were dried with paper points before obturation

Depending on the obturation material and on the time of post space preparation teeth were divided randomly into 4 groups of 20 samples each

GROUP I: Immediate post space preparation + GUTTA-PERCHA/AH PLUS

GROUP II: Delayed post space preparation + GUTTA-PERCHA/AH PLUS

GROUP III: Immediate post preparation + RESILON/EPIPHANY SE

GROUP IV: Delayed post space preparation + RESILON/EPIPHANY SE

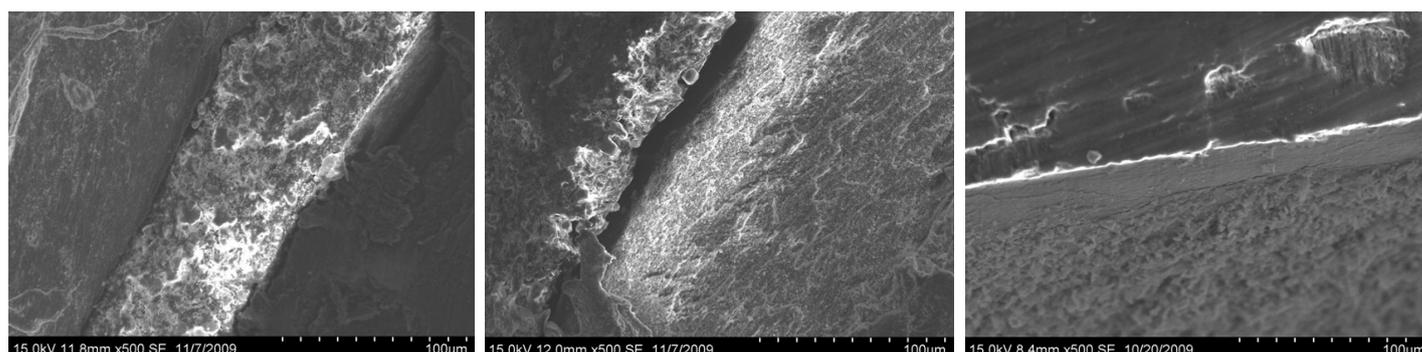
GROUP I: Gutta-percha / AH Plus sealer + Immediate post preparation

An ISO size 40 master gutta-percha cone of 0.06 taper was taken till the working length and checked for tug back. Samples were coated with AH Plus sealer using lentulospiral on the inner canal walls and then obturated using lateral compaction. Group specimens were subjected to post space preparation immediately after the obturation. The post space was prepared using a peeso reamer leaving apical 4 mm of gutta-percha. Temporization was done withcavit-G (3M ESPE).

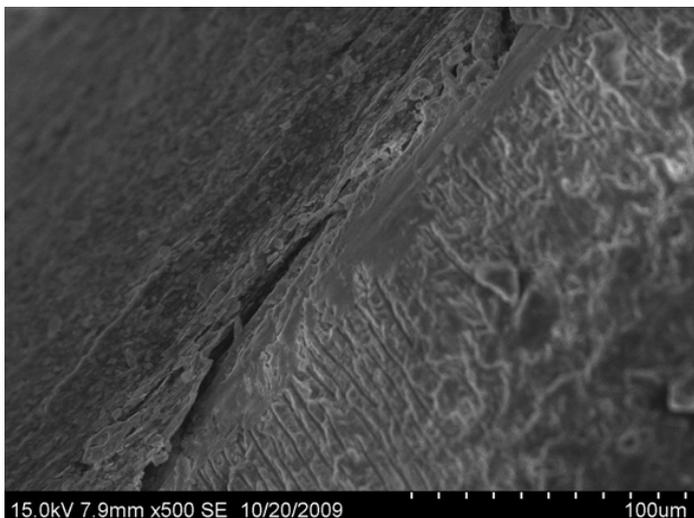
Group II: GUTTA-PERCHA - AH PLUS sealer + delayed post space preparation- The samples were obturated the same way as in group I. After obturation the teeth were sealed with caviti-G and placed in saline at 37°C in an incubator for one week and then the post space was prepared later same as group I. Coronally it was sealed with caviti-G (3M ESPE).

Group III: RESILON -EPIPHANY SE system +immediate post space preparation. – The ISO size 40 Resilon Master cone was inserted in the canal and checked for tug back. Samples were coated with Epiphany SE sealer using microbrush on the inner walls of the canal. Samples were obturated using resilon master cone and accessory cones. After obturation the cones were sheared of at the orifice of the root canal and were light cured for 40 seconds using a QTH curing unit. After obturation samples were subjected to post space preparation immediately. The post space was prepared with the help of a peeso reamer leaving apical 4 mm of resilon and coronally sealed with caviti-G (3M ESPE).

Group IV: RESILION-EPIPHANY SE system +delayed post space preparation. The samples are obturated the same way as in group III. After the obturation the teeth were sealed with caviti-G and



[Table/Fig-2]: SEM photomicrograph (X 500) showing the gap between the sealer and the interface in a sample of Resilon-epiphany immediate group. [Table/Fig-3]: SEM showing Resilon epiphany delayed group under 500X. [Table/Fig-4]: SEM of Gutta-percha/AH Plus showing good adaptation between the sealer and dentin in immediate group under 500X. (Images from left to right)



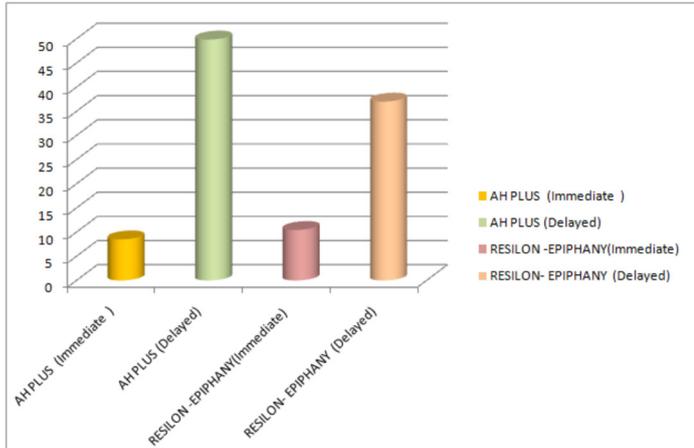
[Table/Fig-5]: SEM showing weak area in AH Plus –Gutta-percha delayed group showing poor adaptability under 500X

S No.	GROUP I	GROUP II	GROUP III	GROUP IV
MEAN	8.5	49.85	10.44	37.02
S.D.	+4.22	+17.43	+5.06	+6.37

[Table/Fig-6]: Mean and standard deviation

Comparison between	p-value	Inference
Group I and II	<0.001	Significant
Group III and IV	<.0001	Significant
Group I and III	0.971	Not Significant
Group II and IV	0.030	Significant

[Table/Fig-7]: ANOVA with Post Hoc was used to compare the respective groups



[Table/Fig-8]: Graph showing mean gap between the dentin and sealer of the groups

placed in saline at 37°C for one week in an incubator and later the post space was prepared same as group III

After obturation and after post space preparation radiographs were taken to discard specimens with voids or excess removal of GP.

All the 80 samples were grooved longitudinally in bucco-lingual direction using a double diamond disc in low speed under constant cooling with distilled water without disturbing gutta-percha filling. they were split with the help of chisel. Then the samples were subjected for SEM analysis to see the adaptation of the leakage. The adaptation of the obturation material to dentinal walls and the interface were examined under SEM at apical area between 2 mm and 3 mm. Microphotographs were taken from 50 X to 500 X magnification. The gap formed between the obturating material

and the dentin wall in each group was measured between 2-3 mm area [Table/Fig-2-5]. Two blinded evaluators independently measured the minimum and the maximum gap seen between 2-3 mm. The mean of the two reading were taken and if the reading from both the two evaluators was very different, then the two evaluators jointly examined and gave measurements.

STATISTICAL TEST

The data were then subjected to statistical analysis using ANOVA [Table/Fig-6] and POST-HOC test to determine whether there was significant difference between the groups [Table/Fig-7].

RESULTS

Influence of time of post space preparation and the material was seen on the adaptation and in turn on the sealing ability of remaining root filling material. There was significant difference found between immediate [Table/Fig-4] and delayed [Table/Fig-5] post space preparation in Resilon–Epiphany group (p <0.001) as shown in [Table/Fig-4 and 5]. Similarly significant difference was seen between immediate [Table/Fig-2] and delayed [Table/Fig-3] post space preparation in AH Plus-GP group (p<0.001).

Difference in the adaptation of the two materials [Table/Fig-8] was seen in the delayed group (p = 0.030) but the immediate group showed no significant difference (p =0.971).

DISCUSSION

The field of endodontics is dynamic & ever expanding. With the availability of a wide array of products in the dental market it is an absolute necessity to evaluate their efficiency before including them into routine clinical practice. The classic Washington study has reported that apical percolation accounted for 60% endodontic failure. Other research works have shown that incomplete apical seal is the major cause for the failure of root canal therapy [11].

The integrity of the remaining filling material that is providing the apical seal is very important and it depends on a number of factors like techniques and instruments used for removal, length of the remaining materials, endodontic obturation techniques, used cements and time of their setting and time of removal of the root filling [12]. Immediate post space preparation by the same operator, who has just finished obturating the canal, can be done under rubber dam, using the same aseptic conditions and additional advantage of this protocol is that the condensation of the remaining gutta-percha can be assessed and improved if necessary. Finally the familiarity of the operator with the root canal system minimizes the risk of perforation or stripping [7,9].

The majority of studies have evaluated apical or coronal microleakage, and few have focused gap formation at the dentin/sealer interface. SEM used in this study is helpful as it uses electromagnets rather than lenses allowing more control over the degree of magnification, thereby providing strikingly clear images [11].

Present study results are in accordance with the observations by Biggs SG et al., Paque F et al., [13,14]. The Immediate group showed less gaps than delayed group of Resilon/Epiphany SE and the probable reason for the result could be that if post space is created prior to the complete setting of sealer the result should be better adaptation because sealer would less likely be disturbed during the removal of excess resilon with rotary instruments [15].

The mean value in immediate preparation of AH plus/Gutta-percha was similar to immediate preparation of Resilon/Epiphany which again confirms with the study by Bodrumulu E et al., [5]. One of the reason could be the stress generated during the polymerization shrinkage of Epiphany sealer has probably influenced the integrity loss at the sealer/dentin interface. In addition, the cavity Configuration factor (C-factor) is highly unfavorable for adhesion inside root canals [6]. One of the reason of similarity with AH

plus/Gutta-percha may be the result of filling any gaps and voids caused by the post preparation through the flow of the AH plus before setting or polymerization occurred [5].

Better results of Resilon/Epiphany SE in delayed preparation as compared to AH Plus/gutta-percha may be because of the better adhesion of Epiphany sealer to dentine as demonstrated by Shipper G et al., [8]. Having more tensile strength [9] and setting of the sealer after light curing might [16] have allowed it to resist crumbling caused by the rotary action of drills in delayed post space preparations [5]. In case of gutta-percha the rotational forces of the rotary instruments cause the movement of the gutta-percha thus breaking the bond at the sealer interface [17].

Present study also showed better adaptation with immediate procedure as compared to delayed in AHplus/gutta-percha group as seen by Solano F et al., [2] and Fan B et al., [10]. The hypothesis is that when the post space is made at the time of obturation the sealer has not formed a lasting bond to the gutta-percha or canal wall. When the heated instrument or rotary instrument is introduced in the canal to remove the gutta-percha, the sealer is still in its working time and allows the sealer to set within the microfractures where the sealer is in contact with the gutta-percha and canal [2].

In spite of its resin based nature few samples of Resilon/EpiphanySE showed more gaps. This could be because during polymerization, shrinkage stresses are relieved by the "move and flow" of the unbonded surface. As the unbonded surface area becomes small, in long narrow canals, there is insufficient stress relief by flow and a high probability that one or more bonded area will pull off or debond thus creating weak areas [15,18].

Another observation made was that the debonding was mainly seen at the sealer and root dentin interface which indicates that the bond between the core and the sealer is better than the bond made with the dentin.

CONCLUSION

Within the limitations of this results immediate post space preparation was preferred to delayed post space preparation. Resilon has shown good adaptation in delayed group and shows promising results. So the further investigations are required to overcome the drawbacks in this material. Also the long term investigations are required. Nevertheless, these in vitro results cannot be extrapolated to in vivo situations, but they do permit reasonable comparison. There is a need to study this material in

in vivo situation.

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