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RETENTION OF POSTS LUTED WITH RESIN CEMENT IN CANALS OBTURATED USING A EUGENOL SEALER -AN INVITRO STUDY

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ABSTRACT: ***Objectives:*** *to examine the effect post-obturation sequencing had on the retention of prefabricated posts luted with a resin cement into canals previously obturated using a eugenol based sealer.* ***Materials and methods:*** *64 single rooted upper anterior teeth were decoronated , and root canals were filed, cleaned and shaped with gatesglidden drills and stainless steel hand k-files. Teeth were then divided into 4 groups of 16 specimens each. Group 1 was not obturated and served as a control. The other 3 groups were obturated with gutta-percha and a eugenol based sealer. Post space preparation and post cementation were completed at 3 different post obturation intervals – immediate(Group 2) , 1 week(Group 3), and 4 weks(Group 4). Ten mm deep post spaces were prepared with peso reamers and prefabricated posts were cemented with Rely-X-Arc cement. Following 48 hours of storage,specimens were mounted in metal tubes with acrylic and posts were removed in tensile mode using an Instron testing machine at 1mm/min with data recorded in kgs.* ***Results****: using 1-way ANOVA and bonferroni tests,Group 1 demonstrated significantly greater mean retention strength values than Group 2 and 3($P<0.05$) which in turn had significantly greater mean retention strength values than Group 4($P<0.05$).* ***Clinical significance and conclusion:*** *post space preparation and post cementation with resin cement should not be significantly delayed following obturation when a eugenol containing sealer has been used. Additionally, removal of some canal wall dentin beyond the periphery of the obturated canal is recommended.*

Key words: *Prefabricated posts , Resin Cement, Eugenol Sealer, Tensile Bond Strength, Mean Retention Strength Values*

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INTRODUCTION:

Modern endodontic therapy has provided dentistry with the ability to retain teeth that would have been extracted without hesitation few decades ago.[1] With proper endodontic treatment and an adequate post endodontic restoration, pulpless teeth can serve indefinitely as an integral part of the dental apparatus.

Once the endodontic treatment has been completed these teeth which are already weakened due to caries, previous restoration, fracture, endodontic access opening and instrumentation need to be adequately restored.[1,2,3] *Weine*[4] claimed that "more endodontically treated teeth are lost due to poor post endodontic restoration". *Swartz, Skidmore and Griffin*[5] found that "failure rate of endodontically treated teeth was almost double in cases without adequate post endodontic restoration".

The post endodontic restoration very often includes the placement of a post in the root canal to provide support to the core which replaces the missing coronal tooth structure. Current literature suggests that the post helps to retain the core and distribute the forces of mastication evenly to the root, periodontal ligament and surrounding bone[1].

A large variety of post designs have been described in the literature. They may be custom-made or prefabricated. Prefabricated posts allow fast and easy techniques to be used in the restoration of endodontically treated teeth. These posts are still the preferred choice for many because of their retention values and high strength. They are stronger and have different surface designs for added retention[6,7]. There are basically two types of prefabricated posts that are currently available: Active and passive. . Irrespective of their retentive qualities, all posts require a luting cement to seal the irregularities between the post and the canal walls.

The need for cementation of posts was first recognized by *Fauchard*[7] in 1742 when he recommended the use of specifically formulated mastic compound[7]. Traditionally, zinc-phosphate , zinc-polycarboxylate and glass ionomer cements have been used to lute posts. Advances in dental material sciences produced resin cements which were shown to provide micro mechanical and chemical bonding to both dentin and metal[8]. Studies have reported that retention strength afforded by the resin cements is 150-200% more than zinc-phosphate and glass ionomer cements[9].

Eugenol based sealers have remained the gold standard for endodontic obturation due to their various beneficial properties and long term clinical success[10,11]. However concern has been expressed that the radical scavenging properties of residual eugenol (2-methoxy-4-allyphenol) inhibits the polymerization of composites[12],thereby significantly reducing the bond strength of resin cements.

A vital point to note is the length of time eugenol containing sealers remain in contact with dentin prior to their removal for post space preparation. Several studies have reported that the release of eugenol from zinc oxide-eugenol sealers into the dentin is rapid during the first 24 hours, after which it decreases slowly over a period of time[13,14,15]

In order to improve bond strengths of posts luted with resin cements in canals obturated with eugenol sealer, it is important to identify the optimum time for post cementation when the residual eugenol in dentin is negligible enough to affect the polymerization of the composite resin. Therefore, the aim of the present study was to investigate the effect of three different post-obturation intervals (immediate, 1 week and 4 weeks) on the retention of posts luted with a resin cement into canals obturated using a eugenol based sealer.

MATERIALS AND METHODS:

Sixty four human single rooted maxillary anterior teeth that were freshly extracted due to gross caries involvement were selected for the study and stored in distilled water. The teeth were decoronated at the cemento enamel junction using carborundum disks rotating at slow speed in a micromotor straight hand piece. The coronal pulp tissue was removed and the root canal spaces were debrided manually using barbed broaches. Teeth deemed to have significantly smaller or larger root canal spaces were discarded to standardize the extent of dentin preparation as much as possible. A single operator performed all specimen preparation and post cementation. The canals were negotiated with sizes 10 and 15 stainless steel K-files until the tip of size 15 was observed to exit from the apical foramen. Working length was then established 0.5 mm short of this length. The coronal portion of each canal was shaped with sizes 2-6 gates glidden drills. The canals were then subsequently cleaned and shaped using successively larger stainless steel hand K-files till size 40. The size of master apical file was kept constant at 25. 1 ml of 3% NaOCl was introduced into the canals after every instrument using a 2 ml syringe. Smear layer was removed using 17% EDTA (Rc Prep) coated on each file during instrumentation of the canal.

The canals were also recapitulated with a size 25 K-file to ensure patency of the canal terminus.

The specimens were randomly divided into 4 groups, each containing 16 teeth. Group 1 was not obturated and served as a control. Group 2, 3, and 4 were obturated with gutta-percha and a eugenol based sealer (Endoflas FS)

With the exception of no obturation for the controls (Group 1), all specimens were treated in the following sequence.A size 25 gutta-percha point was placed into the canal and fitted to the working length to establish a tugback. The canals were then dried with paper points. The sealer was prepared and used according to the manufacturer's instructions. The master cone coated with sealer was placed twice to the working length, to ensure that the sealer coated the root canal walls adequately. Accessory cones were placed and warm lateral condensation in conjunction with vertical compaction was accomplished using stainless steel hand spreaders and pluggers respectively.

Post space preparation and post cementation were then completed at three different post-obturation intervals.

Group 2: Immediate (45-60 minutes following obturation)

Group 3: 1 week

Group 4: 4 weeks

Group 1 (Un-obturated controls) had post spaces prepared and posts cemented at 1 week. Specimens were then stored in 100% humidity at room temperature.

For post space preparation, the coronal 10mm of each root canal was instrumented with size 1-6 peeso reamers. The purpose of the canal preparation was to completely remove gutta-percha and sealer from the post space to establish a fresh dentin surface, and to provide an adequate dimension for resin cement around the post.

The canals were then rinsed with water and dried with paper points, followed by acid etching with 37% Orthophosphoric acid for 15 seconds. Following this the canals were rinsed and blot-dried to leave the dentin surface moist. Dentin bonding agent (single bond, 3MESPE)was then applied to the canal walls with a fine applicator tip and light cured for 20 seconds. Rely X-Arc resin (3M ESPE) cement was then dispensed onto the mixing pad and mixed according to the manufacturer's instructions. The surface of the posts as well as the canal space was coated with resin cement and the posts were manually inserted as close to

the centre of the post space as possible to maintain an even film thickness of the cement circumferentially. Cement flash was removed with a probe and glycerin was placed over the exposed cement to facilitate setting. This was followed by light curing for 20 seconds. After this, the roots were gently notched using a carborundum disk and the specimens were mounted into 1 cm diameter metal tubes using acrylic. Dental surveyor was used in mounting the specimens to enable subsequent post removal in a direction parallel to the long axis of the posts.

FIG 1: Mounting the specimens with a surveyor to ensure parallelism

The specimens were secured and the posts were extracted using vise clamps mounted in a universal testing machine (Instron machine) operated in a tensile mode at 1mm/ min until the posts were dislodged from the canals. Data was recorded in kilograms and subsequently examined using ANOVA and Bonferroni tests.

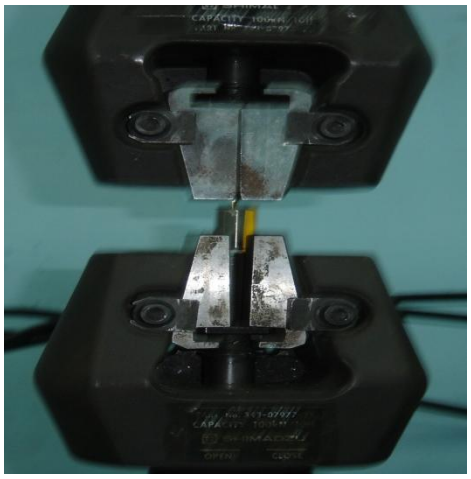

FIG 2: Post gripped using vise clamps in an Universal Instron testing machine

RESULTS:

All the specimens were subjected to tensile force using an Instron universal testing machine and the load at which fracture occurred was recorded in kilograms (kgs) as shown in **(Table 1)**

Mean tensile bond strengths of all the groups tested along with the standard deviation.

Analysis of variance technique (one-way ANOVA) was used to evaluate the difference among 4 groups. (**Table 2)**

Table 1: Retention strength values in Kgs

S. No.	Group 1	Group 2	Group 3	Group 4
1	59.31	38.60	43.38	20.62
2	60.23	36.32	41.8	19.63
3	61.42	38.73	43.15	18.82
4	58.76	39.41	42.76	21.34
5	63.68	37.05	40.26	19.37
6	61.26	38.46	41.86	18.61
7	62.80	39.24	36.62	25.84
8	61.06	37.27	39.98	18.62
9	64.71	36.86	42.43	19.47
10	58.67	39.02	44.64	18.38
11	61.63	38.80	40.18	19.13
12	60.08	33.03	39.62	20.36
13	62.94	38.62	43.29	18.43
14	61.76	39.14	42.86	19.49
15	59.85	38.44	42.73	17.92
16	63.30	37.19	41.93	18.92

Table 2: One-way ANOVA test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14007.90	3	4669.30	1416.79	.000
Within Groups	197.74	60	3.29		
Total	14205.64	63			

* The mean difference is significant at the .05 level.

Normal plot of the data on tensile bond strength indicated that the observations had come from normal distribution. Hence, to carry out test of equality of mean tensile bond strength for the four groups, Post Hoc test with multiple comparisons using Bonferroni procedure was carried out with SPSS software.

The results showed that **Group 1** (unobturated controls) demonstrated highest mean retention strength values than groups 2, 3 and 4. **Group 3** (1 week) showed highest mean retention strength values among all the obturated groups tested. Group 2 (immediate) showed significantly higher ($P<0.05$) mean retention strength values than Group 4 (4 weeks). Group 4 (4 weeks) had the lowest mean retention strength values than all groups. There were statistically significant differences between all groups but there was no significant differences in mean retention strength values between Group 2 (immediate) and Group 3 (1 week). **(Fig 3)**

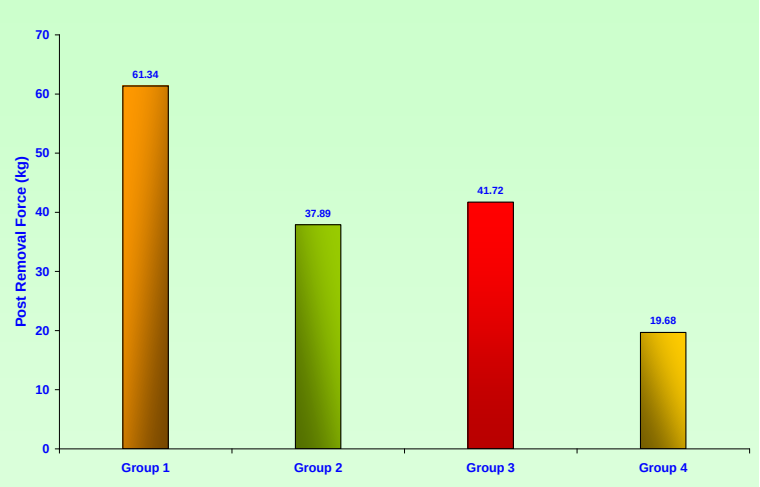

Figure 3: Comparison of mean retention strength values of all study groups

DISCUSSION:

The working hypothesis in this study is that either immediate or considerably delayed removal of eugenol based sealer might provide mean retention strength values equivalent to unobturated controls. However, both of these experimental premises were disproved as all of the obturated groups had lower mean retention strength values than the unobturated group. This finding implies that bond strengths to canal well dentin may have been compromised by residues of eugenol sealer despite removing sufficient eugenol contaminated dentin[10,16].

Specimens prepared immediately (Group 2) and at 1 week (Group 3) did not have significantly different mean retention strength values. These values compared favourably with the reports of *Boone et al*, who examined the effects of sequencing on post space preparation and cementation using eugenol and resin based sealers. They also reported no significant difference in post retention when the post space preparation was done

immediately or after 1 week following obturation. The reason for this result could be because, the diffusion of eugenol immediately and after 1 week of obturation into the dentinal tubules would not have been considerable enough to affect the bond[10,16,17,18]Also post space preparation immediately and at 1 week might have atleast partially counteracted the eugenol diffusion as described by *Hume*[13].

However, specimens prepared at 4 weeks (Group 4) did have significantly lower mean retention strength values than the immediate and 1 week group. These findings are similar to those reported by *Boone et al*[19] who suggested that may be some mechanical removal of eugenol contaminated canal wall dentin is necessary for optimal post retention. Though this was done in the present study, it did not improve bond strengths considerably. The significantly reduced mean retention strength values in Group 4 suggest that eugenol dispersion may have progressed considerably into the dentinal tubules well beyond the dentinal layer removed by the larger sized peeso drills so that the residual eugenol adversely affected the cement tooth bond[10,13,19].

In the present study, overall higher mean retention strength values were observed as compared to other reports[18,19,20,21]. One reason could be that in those studies, matched sizes of preparation drills and posts were employed. It could be that the close fit of the post to the canal walls may have reduced the film thickness of the resin cement, thus lowering the retention strengths. Whereas in our study, post spaces were prepared with size 6 peeso reamers with a diameter of 1.7mm, while the posts employed had a diameter of 1.5mm. This made the post passive and provided a uniform space for the resin cement.

Various methods have been suggested for increasing bond strengths of resin cements to negate the eugenol influence. These include Canal irrigation with ethyl alcohol[22],Etching the prepared post space with 37% H_3PO_4[23],Removing the smear layer prior to post cementation by using 17% EDTA with 5.25% NaOCl[24,25,26,27]. Of these methods, in the present study H_3PO_4 was used for etching the post space, as it is a part of bonding process. But this did not produce bond strengths as high as the unobturated controls.

On analyzing the results of this study, the ideal time for post space preparation and post cementation using resin cement in the presence of eugenol sealer is still unclear. In the present study, both immediate and delayed groups exhibited lesser retention values than the unobturated controls. This suggests that in both cases eugenol influence was still

present. Future studies could be directed towards identification of optimum time when residual eugenol may have absolutely no effect on the retention of posts by resin cement.

CONCLUSION:

This invitro study was undertaken to investigate the effect post obturation sequencing had on retention of endodontic posts luted with a resin cement into canals previously obturated using a eugenol based sealer.

The following conclusions can be drawn from the present study -

1. The complete absence of eugenol in the root canal will guarantee the highest possible bond strength obtainable using resin cements to lute posts.
2. Whenever possible, post space preparation should be carried out within a week after obturation.
3. If delayed, it is better to wait more than 4 weeks to completely negate the influence of eugenol.
4. In any case, removal of sufficient amount of eugenol-impregnated dentin surrounding the root canal will enhance the bond strength.
5. Selecting a slightly undersized post allows for a uniform thickness of resin cement to develop adequate bond strength.

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