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Assessment of effect of post space preparation on the sealing ability of mineral trioxide aggregate and gutta-percha

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Abstract

Background: Post space preparation and creation of an empty space in the coronal third of the root canal creates conditions for the penetration of bacteria and their endotoxins because under these conditions, there is an inadequate root canal obturation material in the root canal space to prevent bacterial penetration. This study was undertaken to assess the effect of post space preparation on the sealing ability of mineral trioxide aggregate and Gutta-percha.

Material and method: 32 freshly extracted human teeth were used for this study (premolars for orthodontic treatment). No 10 K file was used to establish the working length. Following canal preparation and drying the teeth were grouped into 4 study groups: Group A: (n = 8) cold lateral Gutta-percha compaction, followed by immediate post space preparation, Group B: (n = 8) 8 mm MTA apical plug as obturation, followed by removal of 4 mm MTA for post space preparation, Group C: (n = 8) 4 mm MTA apical plug only, followed by delayed post space preparation, Positive control: (n = 8) did not receive any filling material after instrumentation. All these samples were then subjected to the bacterial leakage test after 5 days. The number of leaking samples for each group at different time intervals were observed and noted.

Results: It was observed that all samples of group A showed turbidity. 3 samples of group B and 4 samples of group C did not show any leakage. Moreover the control group showed bacterial leakage in all cases in just a couple of days. Group A exhibited leakage at a mean period of 18.25 days. Group B and C showed signs of bacteria leakage at a mean period of 90.6 and 94.75 days respectively. The control group showed leakage at 1.65 days only. A significant difference between group A and Group B, with a P-value of .001. Similarly there was also a significant difference between group C and group A with a P value of .002. However group B and Group C did not show any significant difference statistically.

Conclusion: MTA exhibited superior sealing ability as compared to gutta-percha that in teeth requiring post and core space preparation.

Keywords: Bacterial micro leakage, mineral trioxide aggregate, post and core, post space preparation.

Introduction

The aim of root canal therapy is to preserve tooth function through the elimination of inflammation and infection from the pulp and periradicular tissues. In this context, significant progresses have been made in the preparation and obturation of root canals. Several factors are involved in the failure of root canal treatment, including inadequate debridement, unidentified root canals, improper root canal obturation, over-filling and over-instrumentation, operator errors, and inadequate apical and coronal seal^[1-2]. Various studies have been performed to evaluate apical sealing of root canals after immediate and delayed post preparations. Most studies have shown retention of the apical seal as long as 3 to 5 mm of obturation material is left intact. One way of evaluating the integrity of the apical seal is to test its resistance to apical fluid leakage^[3].

Endodontically treated teeth often lack sufficient support for a permanent restoration and therefore may require the use of an intracanal post for retention of the core. It is important not to disrupt the integrity of the remaining filling material that is providing the apical seal during post space preparation. It is possible that the residual filling may be dislodged, twisted or

vibrated during postspace preparation which might create a pathway for bacterial invasion and reinfection of the root canal system [4-5].

Mineral trioxide aggregate (MTA) has also been suggested as a root canal obturating material in permanent teeth with fully developed roots [6-7]. Sufficient literature regarding MTA as an apical third restorative material for post and core indicated tooth is not available⁸. Hence, this study was undertaken to assess the effect of post space preparation on the sealing ability of mineral trioxide aggregate and Gutta-percha.

Material and methods

This study was undertaken to assess the effect of post space preparation on the sealing ability of mineral trioxide aggregate and Gutta-percha. 32 freshly extracted human teeth were used for this study (premolars for orthodontic treatment). No 10 K file was used to establish the working length. The teeth were prepared and shaped till no 40 K file using the step back technique. Gates glidden drill were used to enlarge the middle and coronal portions of the root canals. Irrigation of the root canals was done using 5.25% sodium hypochlorite and 17% ethylenediaminetetraacetic acid, followed by final irrigation with saline. Following this the canals were dried and grouped into 4 study groups:

- Group A: (n = 8) cold lateral Gutta-percha compaction, followed by immediate post space preparation.
- Group B: (n = 8) 8 mm MTA apical plug as obturation, followed by removal of 4 mm MTA for post space preparation.
- Group C: (n = 8) 4 mm MTA apical plug only, followed by delayed post space preparation.

- Positive control: (n = 8) did not receive any filling material after instrumentation.

All these samples were then subjected to the bacterial leakage test after 5 days. The apparatus used to evaluate microbial leakage was modified from the apparatus previously described by Siqueira et al and Gomes et al. Before the test the external root surface of group 1-3 were coated with three layers of nail varnish except the apical 2mm. The control group was coated with the varnish all around. The number of leaking samples for each group at different time intervals were observed and noted.

Entire data was recorded in the Microsoft excel sheets. SPSS software was used for statistical analysis. Chi square test and student T test were used to compare the variables. P-value of less than 0.05 was considered significant.

Results

This study was undertaken to assess the effect of post space preparation on the sealing ability of mineral trioxide aggregate and Gutta-percha. Table 1 demonstrates the number of samples in each group that exhibited turbidity and the days at which turbidity was observed. It was observed that all samples of group A showed turbidity. 3 samples of group B and 4 samples of group C did not show any leakage. Moreover the control group showed bacterial leakage in all cases in just a couple of days (table 1).

The current study observed that group A exhibited leakage at a mean period of 18.25 days. Group B and C showed signs of bacteria leakage at a mean period of 90.6 and 94.75 days respectively. The control group showed leakage at 1.65 days only (table 1).

Table 1: Onset of bacterial leakage

Sample	Group A Cold lateral Gutta-percha compaction, followed by immediate post space preparation.	Group B 8 mm MTA apical plug as obturation, followed by removal of 4 mm MTA for post space preparation.	Group C 4 mm MTA apical plug only, followed by delayed post space preparation.	Control Did not receive any filling material after instrumentation.
1	11	88	NIL	2
2	35	NIL	NIL	2
3	14	56	103	1
4	11	NIL	68	2
5	16	97	NIL	1
6	21	NIL	94	1
7	13	113	NIL	2
8	25	99	114	2
Samples showing turbidity (%)	8(100%)	5(62.5%)	4(50%)	8(100%)
Mean	18.25	90.6	94.75	1.65

On statistical comparison between the groups it was observed that there was a significant difference between group A and Group B, with a P-value of .001. Similarly there was also a significant difference between group C and group A with a P value of .002. However group B and Group C did not show any significant difference statistically (table 2).

Table 2: Statistical comparison between different groups

Groups	Mean ± SD	P-value
Group A versus Group B	18.25±11.57 90.25±14.23	.001
Group B versus Group C	90.25±14.23 94.75±18.87	.68
Group C versus Group A	94.75±18.87 18.25±11.57	.002

Discussion

Endodontically treated teeth often lack sufficient support for a permanent restoration and therefore may require the use of an intracanal post for retention of the core. It is important not to disrupt the integrity of the remaining filling material that is providing the apical seal during post space preparation. It is possible that the residual filling may be dislodged, twisted or vibrated during postspace preparation which might create a pathway for bacterial invasion and reinfection of the root canal system [9-10].

An ideal endodontic repair material ideally would adhere to tooth structure, maintain a sufficient seal, be insoluble in tissue fluids, dimensionally stable, non-resorbable, radiopaque, and exhibit biocompatibility if not bioactivity [11-12]. Mineral trioxide aggregate (MTA) is a biomaterial that has

been investigated for endodontic applications since the early 1990s. MTA was first described in the dental scientific literature in 1993 and was given approval for endodontic use by the U.S. Food and Drug Administration in 1998 [13-14].

In this study Table 1 demonstrates the number of samples in each group that exhibited turbidity and the days at which turbidity was observed. It was observed that all samples of group A showed turbidity. 3 samples of group B and 4 samples of group C did not show any leakage. Moreover the control group showed bacterial leakage in all cases in just a couple of days (table 1). Sandeep S Metgud et al evaluated the effect of post space preparation on the sealing ability of teeth obturated with mineral trioxide aggregate (MTA) and Gutta-percha. Fifty intact human mandibular premolars, after decoronation and biomechanical preparation, were randomly divided into three experimental groups. In Group A (n = 10), the canals were obturated with Gutta-percha using cold lateral compaction technique, followed by immediate post space preparation. In Group B (n = 10), the canals were obturated with 8 mm of MTA and in Group C (n = 10), sectional obturation with 4 mm of MTA was done, followed by delayed post space preparation. All specimens were subjected to bacterial leakage analysis, and the occurrence of turbidity was checked. All specimens in the lateral compaction group leaked. The mean number of days at which leakage was observed in Groups A, B and C were 18.5 days, 93.6 days and 95.5 days. MTA can be considered as an alternative to Gutta-percha as an apical third restorative material for teeth indicated for post and core, as it demonstrates better-sealing ability compared with Gutta-percha. Further, the removal of set MTA for post space preparation does not disrupt the integrity of the remaining apical MTA [15].

The current study observed that group A exhibited leakage at a mean period of 18.25 days. Group B and C showed signs of bacteria leakage at a mean period of 90.6 and 94.75 days respectively. The control group showed leakage at 1.65 days only (table 1). AA Khademi *et al.*, compared the coronal microleakage of mineral trioxide aggregate (MTA) plug and gutta-percha in short roots prepared for post placement using the bacterial penetration technique. In the present in vitro study, 40 extracted single-rooted anterior teeth measuring 13 mm in root length were selected. Since the roots were short, 3 mm of the root length was allocated to the root canal obturation material and 10 mm of the root length was allocated to post placement. After preparation of the root canals, post spaces were prepared and the samples were randomly divided into two groups of gutta-percha and MTA. Fifteen root canals were obturated with gutta-percha and the post space was immediately prepared, with 3 mm of gutta-percha remaining in the apical end of the root canal. In 15 teeth, MTA plugs were placed, which measured 3 mm in length. The samples were placed in the Enterococcus faecalis bacterial microleakage system for 120 days. The time for the turbidity of each sample was recorded. Data were analyzed with Fisher's exact test. During the study period, turbidity was observed in all the gutta-percha samples and in only four MTA samples, with statistically significant differences between the two groups ($P < 0.001$). Based on the results, MTA exhibited much better sealing ability compared to gutta-percha as a root canal obturation material in teeth with short roots [16].

On statistical comparison between the groups it was observed that there was a significant difference between group A and Group B, with a P-value of .001. Similarly there was also a significant difference between group C and group A with a P

value of .002. However group Band Group C did not show any significant difference statistically (table 2). Kaveri Baruah *et al.*, compared the apical sealability of mineral trioxide aggregate (MTA) Fillapex and Endosequence BC sealer at three different lengths of remaining gutta-percha after postspace preparation. A total of 80 freshly extracted human maxillary anterior teeth were decoronated, biomechanically prepared, and randomly divided into four groups; Group A and Group B served as positive and negative control with 10 teeth each. The teeth in Group C and Group D (with 30 teeth each) were obturated with gutta-percha using MTA Fillapex sealer and Endosequence BC sealer, respectively. Teeth in Group C and Group D were further subdivided into three subgroups depending on the length of remaining apical gutta-percha, i.e., 3, 4, and 5 mm after postspace preparation. Apical leakage was assessed using dye penetration method under stereomicroscope. In both the Groups C and D, there was overall no statistically significant difference in leakage; however, Group C showed slightly more leakage than Group D. There was a statistically significant difference in leakage at 3 mm and 5 mm level in both groups. Although less microleakage occurred, the bioceramic sealers could not totally eliminate leakage [17].

Conclusion

For the study the author concluded that in teeth requiring post and core space preparation MTA exhibited superior sealing ability as compared to gutta percha. Further studies are recommended.

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