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INFLUENCE OF POST SPACE PREPARATION ON THE MARGINAL INTEGRITY OF MINERAL TRIOXIDE AGGREGATE (MTA), A ROOT END RESTORATION: AN IN VITRO STUDY

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ABSTRACT The aim of this study was to compare and evaluated the influence of post space preparation on the marginal integrity of MTA root end restoration.

Methodology: 60 Freshly extracted human maxillary anterior teeth were collected, and decoronated to obtain a uniform root length of 14mm. Cleaning, shaping and obturation of root canals was performed. These teeth were then randomly divided into three groups of twenty each. In Group I, post space preparation was followed by retrograde preparation and restoration by MTA. In Group II, firstly root end cavity preparation and restoration was done. Post space preparation was done after the completion of above procedures. Group III, served as positive control. These samples were covered with fingernail polish and immersed in 0.2% rhodamine B dye for 48 hours. The specimens were sectioned longitudinally using a diamond disc to measure dye penetration under stereomicroscope.

Results: revealed that, Group I, showed minimum mean dye penetration of 52.50 µm whereas the mean leakage scores observed in Group II i.e of 1087.50.

Conclusion: The post space should be prepared before the root end surgery.

KEYWORDS : Post space, Mineral Trioxide Aggregate, Microleakage

INTRODUCTION

Successful endodontic therapy rests on the triad of proper diagnosis, thorough preparation and three dimensional obturation of the root canal system. The main aim of obturation of the root canal system is to maintain an apical and coronal seal[1]. Endodontic therapy is a conservative, nonsurgical treatment. But when the conventional therapy fails, e.g. in cases where there are large periapical lesions as well as severely compromised tooth structure, the clinician have to opt for surgical intervention. As a result, the treatment becomes two fold, surgery as well as post-endodontic restoration of tooth with post and core[2]. But it has been seen that if the preparation of post space is done after doing the retrograde filling, the apical seal is disturbed. So material selected for root-end filling should be biocompatible with the periradicular tissues, nonresorbable, impervious to dissolution or breakdown by the tissue fluids, and capable of adapting as closely as possible to the dentinal walls of the root-end preparation[3].

Several materials have been recommended for root end restorations which include amalgam, gutta percha, zinc polycarboxylate, resin composite, GIC and most recently mineral trioxide aggregate (MTA)[4]. The key determinant for periapical healing is microleakage that occurs at the margins of root end restoration[2]. The quality of apical seal has been assessed by different ways such as degree of dye penetration, electrical impedance, bacterial penetration, radio-isotopes and fluid filtration techniques. But dye penetration is most commonly used method because dyes are cheap, safe, easy to be stored and their penetration is evaluated quantitatively.

Endodontically treated teeth with insufficient coronal tooth structure require posts to assist in restoring the tooth to function[1]. But during the preparation of the post space, it is important not to disrupt the integrity of the apical seal. So whether the clinician prepares post space before or after the root end surgery, it becomes mandatory to maintain the marginal integrity of retrograde filling material.

This present in vitro study is undertaken to determine the microleakage of root end restoration following root end surgery before and after post space preparation when MTA is used as root end filling material.

MATERIALS AND METHOD

The present in vitro study, was conducted at the Dental department of MAMC, Agroha, Hisar, Haryana. Sixty freshly extracted human maxillary anterior teeth with closed apices were selected for the study. The anatomical crowns of all the teeth were removed by using carborundum disc to obtain a uniform root length of 14mm.

Cleaning and shaping of root canal was performed by step back technique using K-files with an apical enlargement upto size 40. Obturation of root canal was performed with 0.02 taper gutta-percha cones (Dentsply Maillefer) with cold lateral compaction technique using AH plus (Dentsply Maillefer) an epoxy resin based sealer. Radiographs were taken to confirm the quality of obturation (fig 1a).

These teeth were then randomly divided into three groups of twenty each and were labeled as Group I, Group II and Group III.

GROUP I:- In this group, gutta-percha was removed from the coronal 5mm of the root canal using peeso reamers (Mani Inc., Japan) and then post space was prepared with the same instrument(Fig 1b). After post space preparation, apical 2mm of root was resected with a carborundum disc in a slow speed handpiece without placing a bevel. 3mm deep root end cavity was prepared using tapered fissure diamond point in a slow speed contra-angle handpiece (Fig 1c). The mineral trioxide aggregate (ProRoot MTA, Dentsply Maillefer) was mixed according to the manufacturer's instructions and was filled into the prepared root end cavity using amalgam carrier. The material was then thoroughly condensed with the help of finger pluggers (Fig 1d). Root end was then covered with moistened cotton to enable the MTA set properly.

GROUP II:- All teeth in this group first received MTA as root-end restoration with its concomitant preparatory procedure. Once MTA is completely set, then post space will be prepared in the same manner as in group I.

GROUP III:- Teeth in this group served as positive controls. In these, apices of teeth were resected followed by root end cavity preparation. But these cavities was neither restored with MTA nor the canals was prepared for post space.

MEASUREMENT OF DYE LEAKAGE:-

- The coronal opening of all the samples was covered with modelling wax. The root surfaces of all the teeth except at the apex were coated with two coats of fingernail varnish and allowed to dry (Fig 2). These samples were then immersed in 0.2% rhodamine B dye for 48 hours. Following this, the roots were rinsed for 15 minutes under tap water. The nail varnish was removed using scalpel blade no. 15. The specimens were sectioned longitudinally using a diamond disc to measure dye penetration. The extent of apical dye penetration into root canal system from root apex was measured in micrometers using stereomicroscope (Motic

stereozoom binocular microscope) (10x magnification) in all the three groups (Figure 3a,b,c) and the results thus obtained from each group were compared (Table-1)and put under statistical analysis.(Table-2)

RESULTS:-

Table-1 - Extent of dye penetration (leakage) in micrometer (µm) in three Groups

Sample No.	Group I	Group II	Group III
1.	0.00	1200.00	3000.00
2.	0.00	325.00	3000.00
3.	0.00	500.00	3000.00
4.	250.00	1500.00	3000.00
5.	0.00	1250.00	3000.00
6.	0.00	400.00	3000.00
7.	0.00	1300.00	3000.00
8.	0.00	900.00	3000.00
9.	175.00	1400.00	3000.00
10.	0.00	1000.00	3000.00
11.	50.00	1500.00	3000.00
12.	0.00	1250.00	3000.00
13.	0.00	1450.00	3000.00
14.	0.00	1025.00	3000.00
15.	0.00	850.00	3000.00
16.	275.00	975.00	3000.00
17.	300.00	1425.00	3000.00
18.	0.00	1250.00	3000.00
19.	0.00	875.00	3000.00
20.	0.00	1375.00	3000.00
Minimum leakage	0.00	325.00	3000.00
Maximum leakage	300.00	1500.00	3000.00

(STATISTICAL EVALUATION

Table 2 -Post Hoc Tests

Multiple Comparisons
Dependent Variable: values
Bonferroni

(I) group	(J) group	Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
I	II	-1035.000(*)	68.432	<.001**	-1203.80	-866.20
	III	-2947.500(*)	68.432	<.001**	-3116.30	-2778.70
II	I	1035.000(*)	68.432	<.001**	866.20	1203.80
	III	-1912.500(*)	68.432	<.001**	-2081.30	-1743.70
III	I	2947.500(*)	68.432	<.001**	2778.70	3116.30
	II	1912.500(*)	68.432	<.001**	1743.70	2081.30

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

Post Hoc Tests indicate that:-

1. Group I (post space preparation prior to root end restoration with MTA) when compared statistically with Group II (post space preparation after root end restoration) and Group III (positive control), the mean leakage scores were found to be statistically highly significant (p = <.001).
2. Group II when compared statistically with Group I and Group II, the mean leakage scores were found to be statistically highly significant (p = <.001).
3. Group III when compared statistically with Group I and Group II, the mean leakage scores were found to be statistically highly significant (p = <.001).

DISCUSSION

The objective of endodontic treatment is to eliminate microorganisms from the root canal system and to fill the intracanal space with proper materials to prevent a new bacterial colonization[5]. But in cases where conventional endodontic treatment fails, surgical endodontic therapy is needed to save the tooth[6]. This procedure involves exposure of the root apex, periradicular curettage, resection and preparation of root-end and placement of root-end filling material[7].

The quality of root-end filling is an important determinant of healing after periapical surgery. The purpose of placing a root end filling material is to provide a tight, fluid free apical seal, which inhibits the leakage of residual irritants from the root canal into the periradicular tissue and from the periapex into the root canal system[6]. Although a variety of materials is available, no material has been found which fulfills all the requirements of ideal root end filling material.

Later, MTA was developed at Loma Linda University in the 1990s as a root-end filling material. It received acceptance by the US Federal Drug. The physicochemical basis for the biological properties of MTA had recently been attributed to the production of hydroxyapatite when the calcium ions released by the MTA comes in contact with tissue fluid[5]. MTA has been shown to have biocompatibility when embedded in bone and subcutaneous connective tissue[8]. Histological studies have revealed that it actually induces cementogenesis, and bone deposition with minimal inflammatory response[6]. MTA is used in the various endodontic treatment including immature apices, for repairs of perforations, direct pulp capping and root end restorations. MTA is more radiopaque than conventional gutta percha and dentin, thus is easily distinguishable on radiographs when used as a root end filling material[1]. All these properties, favor its use as a root end filling material hence MTA was selected as root end material for this study.

Torabinejad M et al (1993)[9] compared the sealability of amalgam, Super- EBA and MTA as root-end filling materials using Rhodamine B dye and found that MTA leaked significantly less than other materials. **Pereira CL et al (2004)[10]** evaluated the sealing ability of MTA, reinforced ZOE, vitremer and zinc free amalgam using dye penetration method and concluded that MTA leaked significantly less.

In this study Rhodamine B dye was used as its molecular size is relatively small measuring only 1 nanometer. To assess leakage, it is important to select a dye that is as small in size as possible and can pass through the smallest of discrepancies at the tooth-restoration interface. **Vogt BF et al (2006)[11]** determined that rhodamine B dye showed more penetrability than silver nitrate and methylene blue when used for evaluating the microleakage in root-end cavities.

Endodontically treated teeth should be restored properly to replace missing tooth structure, maintain function and esthetics. In situations where the tooth has a large periapical lesion and also lacks coronal tooth structure, a post and core must also be planned as a part of the post endodontic restoration[12]. The required post space may be prepared immediately after completion of endodontic treatment or after root end surgery. But during the preparation of the post space, it is important not to disrupt the integrity of the apical seal. Long term clinical success of these teeth requires integration of the endodontic, restorative and surgical disciplines[3]. Results of this study showed that microleakage was minimum i.e 52.50 µm for Group I in which post space preparation was followed by root end resection, preparation and restoration of same with MTA. Whereas in Group II in which post space was prepared after the root end restoration, the mean leakage score was more i.e 1087.50 µm.

Dutta A et al (2005)[6] determined the effect of post space preparation on the microleakage of GIC root end restoration. They found that GIC showed more leakage when post space preparation was done after the complete setting of the material. It could be due to the vibrations set up in the tooth by the canal preparation procedure, which disrupts the hydrated silicate inorganic co-matrix.

The results of our study are in congruence with the above study.

Solano F et al (2005)[13] stated that removal of gutta-percha immediately after a root canal filling results in less microleakage than delayed removal of gutta-percha. This is because 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 rotary instruments are introduced into the canal to remove the gutta-percha, sealer is still within its working time and allows the sealer to set without introducing micro-fractures. When the sealer is set during delayed post space preparation, it is possible that rotational forces of the instrument cause movement of the gutta-percha thus breaking the bond at the sealer interface. **Abramovitz I et al (2000)[14]** showed that there is no significant difference between the immediate and delayed post space preparation by using an increased sensitivity pressure driven system. **Yildirim T et al (2009)[15]** concluded that when post and core is indicated, MTA should be used as apical filling material.

CONCLUSIONS

From the result of present study, it can be concluded that when the treatment encompasses two procedures that relate to surgery and those that relate to post and core, than post space should always be prepared

before the root end surgery, where MTA is to be placed as a root end filling material. Also, Root end resection and restoration should be done to prevent microleakage.

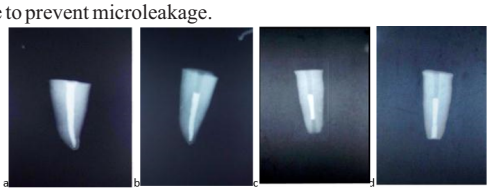

Figure-1(a) Radiograph showing obturation of tooth, (b)post space preparation, (c) after post space and root end cavity preparation and (d) restoration with MTA.

Figure -2 Specimens covered with fingernail varnish and modeling wax (except root end)

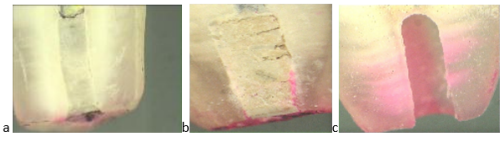

Figure -3(a)microleakage in group I, (b) group II, (c) group III

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