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RESEARCH ARTICLE

EVALUATION OF SEALING ABILITY OF ROOT END FILLING MATERIALS-AN IN VITRO STUDY

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ABSTRACT

Aims: The aim of the present study was to compare and evaluate the sealing ability of different root end filling materials by testing their microleakage.
Methods and Material: One hundred and fifty extracted human single rooted anterior teeth were resected at an angle of 0^0 and an apical cavity of 2 mm depth was made in each root. All the specimens were divided into five groups of 30 each. The roots were then decalcified by using clearing technique.
Stastistical analysis used: The stastitical analysis was perfomed by using stereomicroscope at 10X magnification to measure dye penetration from the surface of the filling upto deepest portion of penetration.
Results: Statistical differences ($P<0.0010$) were seen among all the groups in the descending order amalgam (Septalloy), glass ionomer cement (ChemFlex), cermet cement (Hidense), compomer (Dyract) and mineral trioxide aggregate (Pro Root MTA).
Conclusions: Mineral trioxide aggregate provided best sealing ability as compared to the other Groups. Sealing ability of the compomer was better than glass ionomer cement. Amalgam exhibited maximum microleakage as compared to the other groups.

INTRODUCTION

In modern dentistry, carious teeth are aimed at restorations, mutilated teeth are conserved by crown fabrication and teeth with pulpal involvement are treated by endodontic treatment. When conventional treatment is unsuccessful, periapical surgery may be necessary.

An ideal root end filling material should be dimensionally stable, non absorbable and not affected by the presence of moisture. This study is done to compare and evaluate the microleakage produced by different root end filling materials like amalgam, glass ionomer cement, cermet cement, compomer and mineral trioxide aggregate.

Different methods are used to evaluate the sealing ability of the root end filling materials including scanning electron microscope, autoradiography and dyes. Methylene blue dye is an accepted method to evaluate leakage of dental materials and has been used in the study.[2,3]

Subjects and Methods: One hundred and fifty extracted human single rooted anterior teeth were selected. The crowns were resected at cementoenamel junction. After obturating the root canals, apical 3 mm of each root was resected at an angle of 0^0 and apical cavity of 2 mm depth was made in each root. All the specimens were divided into five groups of 30 each. Each group received different material as a root end filling material:

Group one:

Roots retrofilled with amalgam (Septalloy, Septodont).

Group two:

Roots retrofilled with glass ionomer cement (ChemFlex, Dentsply).

Group three:

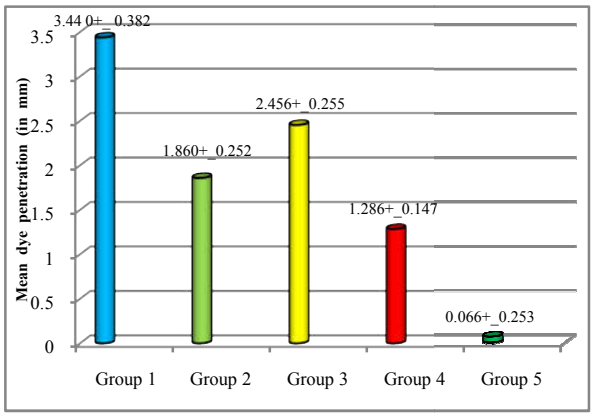
Roots retrofilled with cermet cement (Hidense, Shofu).

Group four:

Roots retrofilled with compomer (Dyract, Dentsply).

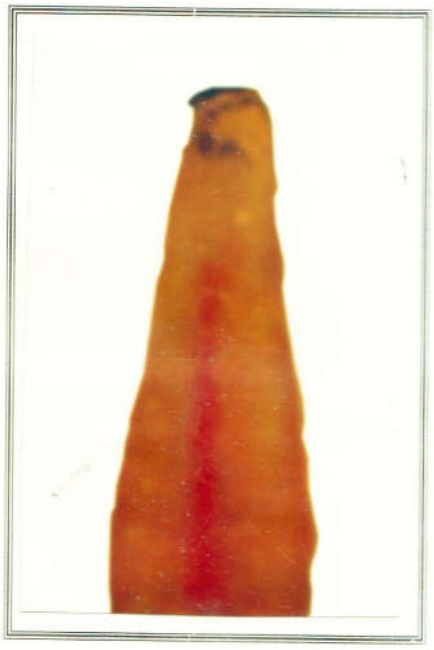
Group five:

Roots retrofilled with mineral trioxide aggregate (ProRoot MTA, Dentsply).



Group-1 Septalloy (Amalgam with one layer of cavity varnish)
Group-2 ChemFlex (Glass ionomer cement)
Group-3 Hidense (Cermet cement)
Group-4 Dyract (Compomer)
Group-5 ProRoot MTA (Mineral Trioxide Aggregate)

Photograph Showing Dye Penetration in Septalloy (**Group 1**)



Photograph Showing Dye Penetration In Hidense (**Group 3**)

Photograph showing dye penetration in dyract (**Group 4**)

The roots were stored individually in screw capped vials in an incubator at 37^0 C for 48 hours. Then all the roots were coated with two layers of nail polish except one mm area around the retrofilling and immersed in methylene blue dye for 72 hours. The roots were then cleared by decalcifying in 5% nitric acid followed by dehydration in ethyl alcohol and finally putting them in methyl salicylate. All the cleared roots were observed under stereomicroscope at 10X magnification to measure the dye penetration from surface of the filling upto the deepest point of the penetration. The data collected was subjected to statistical analysis.

Photograph Showing Dye Penetration In Proroot Mta (**Group 5**)

RESULTS

The results the present study showed that mineral trioxide aggregate (ProRoot MTA, group five) exhibited the least mean value of dye penetration 0.066 $^{+}_{-}$ 253 mm. Amalgam (Septalloy, group one) exhibited maximum microleakage value as compared to other groups 3.440 $^{+}_{-}$ 0.383 mm. The mean microlekage value for glass ionomer cement (ChemFlex, group two), and cermet cement (Hidense, group three) was 1.860 $^{+}_{-}$ 0.252 mm and 2.456 $^{+}_{-}$ 0.255 mm which showed that glass ionomer cement significantly leaked less than cermet cement. Average dye penetration for compomer (Dyract, group four) was 1.286$^{+}_{-}$0.147 mm which leaked less as compared to glass ionomer cement, cermet cement and amalgam. Statistical analysis of the results showed that there was a significant difference in dye penetration between all the groups (P<0.001).Mineral trioxide aggregate significantiy leaked the least when compared with the other groups whereas amalgam leaked significantly more as compared to the other groups.

Comparison of Mean Dye Leakage of Retrofilling Materials In Experimental Groups

Group	No. of Teeth	Range in (mm)	Mean (mm)	±SD
I. Septalloy (Amalgam)	30	3-4	3.440	± 0.382
II. ChemFlex (Glass ionomer Cement)	30	1.5-2.0	1.860	± 0.252
III. Hidense (Cermet Cement)	30	2-2.9	2.456	± 0.255
IV. Dyract (Compomer)	30	1-1.6	1.286	± 0.147
V. ProRoot MTA (Mineral Trioxide Aggregate)	30	0-1	0.066	± 0.253

From the above table it was observed that highest mean leakage value (3. 440 mm) was associated with Group I (Septalloy) and the lowest value (0.066mm) was associated with Group V (ProRoot MTA) in cleared specimens.

Showing Comparison of Dye Penetration of All The Groups

Comparison	't' value	'p' value	Significance
Group I versus II Septalloy versus Chem Flex	18.89	<0.001	Significant
Group I versus III Septalloy versus Hidense	11.71	<0.001	Significant
Group I versus IV Septalloy versus Dyract	28.79	<0.001	Significant
Group I versus Septalloy versus Pro Root MTA	40.29	<0.001	Significant
Group II versus III Chem Flex versus Hidense	9.09	<0.001	Significant
Group II versus IV ChemFlex versus Dyract	10.72	<0.001	Significant
Group II versus V ChemFlex versus Pro Root MTA	27.43	<0.001	Significant
Group III versus IV Hidense versus Dyract	21.70	<0.001	Significant
Group III versus V Hidense versus ProRoot MTA	36.35	<0.001	Significant
Group IV versus V Dyract versus ProRoot MTA	22.75	<0.001	Significant

On statistical analysis it was found that there was significant difference in the penetration of dye in all the groups in the descending order:-

Group V - Mineral Trioxide Aggregate (ProRoot MTA)
Group IV - Dyract (Compomer)
Group II - ChemFlex (Glass lonomer Cement)
Group III - Hidense (Cermet Cement)
Group I - Septalloy (Amalgam)

ProRoot MTA (GroupV) showed significantly minimum microleakage as compared to other groups where as Septalloy (GroupI) showed significantly maximum microleakage as compared to other groups.

DISCUSSION

The quality of both root canal obturation and the apical seal has been shown to be important in normal healing. Gilheany P A *et al* (1994) 4 demonstrated that as angle of bevel increased, an apical leakage also increased due to permeability of dentinal tubules. An apical cavity of 2mm depth was made with inverted cone bur to prevent leakage from flattened root surface as described by Olson A K *et al* (1996) 5. In group one, the roots were retrofilled with amalgam after applying cavity varnish. Abdal A K *et al* (1982) 6 and Tronstad L *et al* (1983) 7 found that apical seal was significantly improved after applying varnish to the cavity prior to the placement of retrofilling.

The retrograde cavities of group two were filled with glass ionomer cement that is chemically bonded with dentin but contamination with blood and moisture adversely affected the success rate.8 Cermet cement, a mixture of silver and glass ionomer cement has faster setting time, more rounded particles, low porosity, high packing density that did not chip or flake during finishing process. Cermet cement showed less microleakage than amalgam due to excellent mechanical strength and corrosion resistance.9

Compomer is a mixture of composite resin and glass ionomer cement. No pre-acid etching of dentin is required as dentin bonding agent contains polymerizable phosphate monomer which decalcify dentin sufficiently to permit penetration into intercollagenous spaces.10 Mineral trioxide aggregate has been suggested to seal off the pathways of communication between root canal system and external surface of the roots. The potential sealing ability is due to its hydrophilic nature and slight expansion, which

might occurred on being cured in environment. Torabinejad M *et al* (1993)11 found that MTA significantly leak less as compared to Super-EBA and amalgam. Methylene blue dye is the accepted method of choice for evaluating marginal leakage because it actually measures the depth and volume of the leakage.2,3 The dyes are simpler, earlier, cheaper and safer to handle.

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