Indian Journal of Dental Sciences.
June 2013 Issue:2, Vol.:5

www.ijds.in

Original Article

Indian Journal
of Dental Sciences

E ISSN NO. 2231-2293 P ISSN NO. 0976-4003

A Comparative Evaluation Of The Apical Sealing Ability Of Bonded Amalgam, Amalgam With Varnish, Super Eba And Mineral Trioxide Aggregate- A Dye Preparation Study

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Submission : 31st August 2012
Accepted : 26th April 2013

Abstract
The present study evaluated the apical microleakage of bonded amalgam, amalgam with varnish, Super-EBA cement and Mineral trioxide aggregate. 72 maxillary anterior were selected and the crown of each tooth was removed at the level of the cement-enamel junction. Apical preparation was done up to 40 K file and all the canals were obturated with guttapercha and AH-26 sealer using lateral and vertical condensation techniques. The apical 3mm of all the root was resected perpendicular to its long axis and 3mm root-end cavities were prepared. The roots were then randomly placed into four groups andretrofill with one of the experimental materials. After 72 hours in 1% methylene blue, the teeth were sectioned and dye preparation was measured under stereomicroscope and profile projector. Linear measurements to hundredths of millimetre were made. 3mm was selected as the greatest possible leakage value.

Key Words
mineral trioxide aggregate, periradicular surgery, regeneration, root-end FIlings.

Quick Response Code

Introduction

Periradicular surgery encompasses surgical procedures performed to remove the causative agents of periapical pathosis and to restore the periodontium to a state of biological and functional health.

According to [Rud et al.,][1] inefficient retrograde sealing of the root canal following root- end resection is a major factor in surgical endodontic failure. A large number of invitro studies dealing with the marginal adaptation and sealing ability (leakage) of various root- end filling materials have been published. However, the results of these studies have often been inconsistent, contradictory, confusing and questioned as to their clinical relevance.

Amalgam, which till recently was the most favored root end filling material is falling out favor because of its disadvantages.[2],[3] In vitro studies have shown that a durable bond can be affected between amalgam and the tooth structure using unset glass ionomer luting cement [4],[5],[6]. The use of such a bonded amalgam restoration as a retrofill has not found any mention in scientific literature.

Super EBA (Bosworth) provided a viable option as a root end filling material. Conflicting views prevail as to the efficacy of this material[7],[8]. The nature of this material for root end fillings hence merits further evaluation. Torabinejad and associates developed Mineral trioxide aggregate (ProRoot Densply). It has been extensively analyzed for its sealing properties at the root end and investigators have demonstrated superior results with this in comparison to any other material[9],[10]. It therefore appears to be a promising material for use as a root end filling.

Hence the purpose of this study was first to reinvestigate amalgam with modified cavity design and bonding of amalgam with luting glass ionomer **(Fuji 1)** as a bond mediating agent and second to compare the apical sealing ability of bonded amalgam with amalgam over varnish, Super EBA and Mineral trioxide aggregate as root end filling materials using 1%methylene blue as a tracer in a dye penetration method.

Materials And Methods

72 recently extracted single rooted maxillary anterior teeth were used for this study. The anatomic crown of each tooth was removed at the level of the cemento-enamel junction to get a standardized length. The canals were instrumented and enlarged to an ISO size 40 K-File. All canals were obturated with guttapercha and AH-26 sealer with lateral compaction technique. Most of the specimen apical 2-3mm was resected so as to ensure adequate width of dentin around the root-end cavity to avoid micro fractures during condensation of the root-end filling materials. The access opening was sealed with glass ionomer cement GC Fuji II (GC Corporation Tokyo, Japan). Each root was then placed in a relative humidity & allowed to set at 370c for 1 week. Apical root resections were performed on all roots by removing 3 mm of each apex at 900 to the long axis of the tooth with #701 fissure bur. A 3 mm deep, tapered root end cavity was prepared with diamond points by marking on bur head corresponding to 3 mm. The teeth were

randomly divided into four experimental groups of 15 roots each and two control

Table.1 Group wise Mean, And Standard Deviation of Specimens

Group No	Experimental Material	Mean Apical Microleakage (mm)	Standard Deviation
Group I	Bonded Amalgam	0.9153	0.8530
Group II	Amalgam With Varnish	2.6847	0.5221
Group III	Super Eba	2.3767	0.7510
Group IV	Mta	1.0980	1.2348

Table 2.Percentage of Specimens Showing Complete dye penetration in each of the Groups(Group I-IV)

Group	No. Of Specimens	Percentage of specimens
I	0	Nil
II	10	66.6
III	5	33.3
IV	1	6.66
V	6	100
VI	0	Nil

Table 3. Comparison between intergroups

	Z	P	Remarks
Bonded amalgamvs amalgam with varnish	4.29	.000	VHS
Bonded amalgam vs super EBA	3.784	.000	VHS
Bonded amalgam vs MTA	.769	.442	NS
Amalgam with varnish vs Super EBA	1.485	.137	NS
Amalgam with varnish vs MTA	3.581	.000	VHS
Super EBA vs MTA	2.838	.005	HS

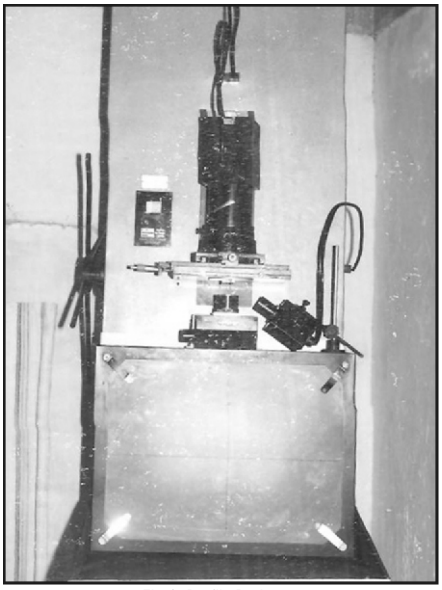

Fig.1. Profile Projector

microleakage values between any two groups was evaluated using the non parametric Mann-Whitney' U' tests**(Table No. 3)**.

Discussion

According to Wiene[11], the most common cause of endodontic failure is the lack of apical seal .A study conducted by Hirsh and colleagues[12] found that the quality of root-end filling was an important determinant of healing after periapical surgery.

Clinically, silver amalgam is the most extensively used root-end filling material. Recently, many authors have questioned the suitability of amalgam as a root-end filling material. Seltzer has stated that amalgam, regardless of time, leak more than other newer root - end filling materials. Whereas Frank et al[13] reported 60% success of such restorations.

The important aspects that was not considered by Frank et al includes Size and shape of root end cavity, Root end bevel, Type of amalgam used, whether it was bonded or not. This experiment is based on the fundamental improvement in Cavity design and Bonding.

Studies have shown that affective bond can be mediated between amalgam and tooth structure using unset luting glass ionomer cement to eradicate marginal percolation[4],[6]. Initially when the cement paste is fluid, there are many free pendant -COOH available for hydrogen bond formation that enhances the wetting of the active substrates. As the reaction proceeds, these hydrogen bridges will be progressively replaced by the metal bridges, thus providing more rigid attachment[14]. As amalgam alloy contains tin, silver, copper and zinc, it can be expected to bond with glass ionomer.
Available literature shows Polyacrylic acid is a more effective conditioning agent and was used in this study. It also did not disturb the smear layer, which was rich in calcium and phosphate and played an important role in adhesion to dentin[15].
Dorn and Gartner[7] reported 94% success for Super-EBA as a root-end filling material. Therefore this material was chosen for comparison. Reports suggest MTA to be a promising root-end filling material. MTA[9],[10] was therefore selected for comparison in this study.

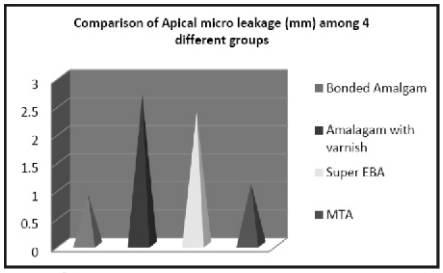

Fig 2. Comparison of Apical micro leakage (mm) among 4 different groups

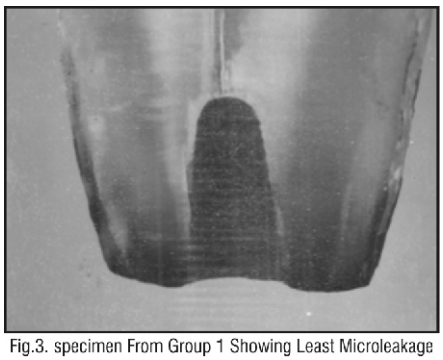
Fig.3. specimen From Group 1 Showing Least Microleakage

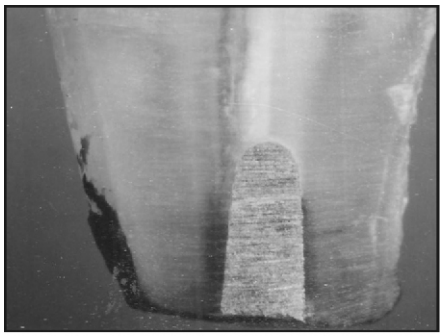
Fig.4. Specimen From Group 2 Showing Least Microleakage


Fig.5. Specimen From Group 3 Showing Least Microleakage

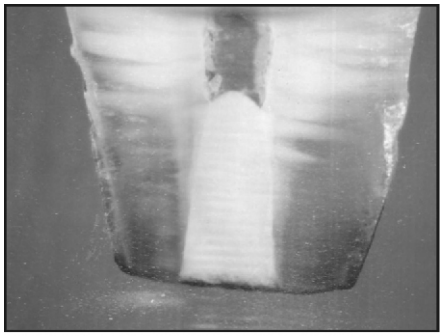
Fig.6. Specimen From Group 4 Showing Least Microleakage

This investigation was thus conceived to reinvestigate amalgam with suitable modifications in cavity design and bonding and compare the apical microleakage of amalgam with varnish, super-EBA and Mineral trioxide aggregate using a dye-penetration method.

According to literature resection angle of 30 or 40 exposed many dentinal tubules as compared to a flat, 0 degree cut[16]. Mattison et al[17] and Gangliani[18] have recommended that an apical cavity depth of 3 mm or more along the vertical axis produce a safe and effective seal.

Microleakage tests have been criticized because tracers are not representative of 'disease-causing' agents in the canal and often attempt to standardize conditions of tests obviate the clinical limitations of access and artificially improve the chances of favorable results. Despite this, microleakage tests will remain the easiest and most useful means of comparing the efficacy of different materials and techniques in achieving this goal.[19]

Methylene blue is water soluble, easily penetrates the water compartment of the tooth, and does not adsorb to the dental matrix or apatite crystals. Apical 1/3rd of all specimens were immersed in 1% methylene blue for 72 hours, to allow maximum penetration. To observe dye penetration at the filling material- dentin interface stereomicroscope along with profile projector was used for making linear measurements. Literature review indicates hardly any studies that have utilized profile projector. This could become an additional or alternative supplement, which can be used while making the linear measurements of dye penetration.

From the analysis, it is evident that Group I, bonded amalgam, showed the least mean apical microleakage (0.9153). Scrutiny of published research indicates hardly any studies that have performed a comparative evaluation between the sealing abilities of bonded amalgam and other advocated root-end filling materials.

Mineral trioxide aggregate, also showed promise in this present dye leakage study. Torabinejad et al have stated that the sealing ability and marginal adaptation of MTA was superior to that of silver amalgam with or without varnish or to super-EBA cement in both dye and bacterial leakage methods. The mean apical microleakage of MTA (1.0980mm) was more than bonded amalgam (0.9153mm) but was not statistically significant.

From the analysis it is evident that there is no significant difference in the mean apical microleakage of high copper amalgam with varnish and super-EBA cement. This finding is in concurrence with various studies. However, this is in contrast with studies done by Szermeta Browar et al[20], Bondra[21], which might be due to difference in depth of apical preparation.

Mean apical microleakege of amalgam with varnish **(Group II)** was very highly statistically significant compared to bonded amalgam **(Group I)** and MTA **(Group IV)**. This difference can be explained as Fuji 1 provides mechanical and chemical bond in the intermingled unset Glass ionomer and amalgam. In this study, the roots were kept moist to simulate clinical conditions, since MTA sets in the presence of moisture; this helps in enhancing the sealing property of MTA. Whereas when varnish was used it prevented microleakage only temporarily because of its eventual solubility and also by occupying space and not by bonding.

Similarly, differences between bonded amalgam **(Group I)** and super-EBA **(Group III)** were very highly statistically significant. This difference can be attributed to variations of temperature and humidity within the operatory, which effected the setting time of super-EBA. In contrast, amalgam-working time was more predictable.

The differences between super-EBA **(Group III)** and MTA **(Group IV)** were highly statistically significant. These differences could be related to physical and chemical properties of the material, as well as to handling during mixing and insertion.

The present study revealed excellent sealing ability of bonded amalgam as a root-end filling material when compared with materials in other experimental groups. However, further studies with better evaluation criteria with different clinical situations are required to

substantiate the results of the present study.

Conclusion

Based on the data presented herein, it is not possible to make a recommendation about the best material to be used. Yet, bonded amalgam showed promise in this study. This proves the hypothesis that conservative cavity preparation and bonding does play a significant role in decreasing microleakage. So this can be considered as one of the potential alternatives along with MTA for root- end filling.

Acknowledgement

We thank Dr. Raj Shekar Patil, Mangalore University, Dr. Venkatesh Murthy, MIT & Manipal College of Dental Sciences, Manipal.

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Source of Support : Nill, Conflict of Interest : None declared