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ORIGINAL ARTICLE

COMPARISON OF MINERAL TRIOXIDE AGGREGATE AND OTHER RESTORATIVE MATERIAL AS SEALING MATERIAL - AN IN VITRO STUDY

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ABSTRACT:
Introduction: The successful root canal treatment is achieved by a fluid impervious seal at the coronal and apical ends. Hence we have compared the sealing ability of mineral trioxide aggregate (MTA) and glass ionomer and composite resin when used as a seal over gutta-percha. **Materials & Method**: Fourty extracted anterior teeth were endodontically treated. After removal of 4 mm of coronal gutta-percha, the teeth were randomly divided into four groups depending on the restorative material being placed namely: MTA, GIC and composite resin. A positive control group received no barrier. All the teeth were covered with 2 layers of sticky wax, except for the access openings. The teeth were then immersed in Indian ink for 48 hrs, decalcified, dehydrated and cleared. Microleakage into the canals was measured in millimeters using stereomicroscope. The values obtained were statistically analyzed. **Results:** Results showed that the MTA group provided an excellent coronal seal, followed by glass ionomer cement. Composite showed the highest amount of coronal microleakage.
Conclusion: MTA provides excellent coronal seal and hence can be preferred over glass ionomer cement, composite resin as an intra orifice barrier following root canal treatment to prevent contamination.
Key words*:* Coronal microleakage, GIC, Composite resin, Mineral trioxide aggregate.

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INTRODUCTION

Endodontic surgery is often conducted when non-surgical endodontic treatment is unsuccessful. It includes root-end resection, retrocavity preparation and the placement of a root-end filling. Microorganisms play an essential role in pulp and periapical disease.[1] The purpose of endodontic treatment is to eliminate microorganisms from the root canal system and to prevent recontamination by creating a seal between the oral microflora and the root canal system as well as the periapical tissue. Creating a tight apical, lateral, and coronal seal is necessary to prevent such recontamination and to achieve long-term clinical success.[2] Several root-filling materials and techniques have been developed for the purpose of obtaining a tight root canal seal. Ideally, the root canal filling should be a complete, homogenous mass that completely fills the prepared canal.[3]

Gutta-percha, silver amalgam, zinc oxide-eugenol, dentin bonding agents, glass–ionomer cements and other restorative materials have been proposed. Various factors have been associated with root canal treatment failures and apical leakage was believed to be the main causative factor. Hence several investigations have been carried out to achieve good apical seal and its importance in successful root canal treatment has been emphasized.[4] However, Vire[5] attributed upto 59% of failures of endodontically treated teeth to restorative reasons, whereas only 8.6% were endodontic failures. The remaining 32% of the failures were periodontal in nature. Mineral trioxide aggregate (MTA) was introduced in 1993 as a root-end filling material. MTA has excellent biocompatibility and sealing ability. More recently, it was found that endodontically treated were contaminated apically with bacteria from saliva exposed to the coronal part of the root canal. All canals were contaminated after 30 days of exposure.[6] The results of these studies indicate that coronal leakage will be consistent and extensive if the access cavity is left unfilled and thus exposed to fluids and bacteria. This microleakage has the potential to dissolve the sealer from around the gutta-percha and compromise the ultimate prognosis of the tooth.

The present study has been designed to compare the sealing ability of mineral trioxide aggregate with glass ionomer cement and composite resin.

MATERIAL & METHODS

This study was conducted in department of endodontics in 2015. This study included fourty freshly extracted maxillary and mandibular anteriors teeth. Teeth were cleaned and stored in distilled water. Coronal access preparations were done with a tapered fissure bur and the patency of the canal was checked using a No.10 stainless steel K-file. Working length of teeth in all the groups was recorded by using a No.15 K-file till it emerged at the apical foramen. It was then withdrawn and working length recorded at 1.0 mm within the apex. Straight line access was achieved using Gates Glidden drills. Canals were cleaned and shaped using K-Files in a step back manner. Copious irrigation using 2.5% NaOCl was carried out between each instrument. Canals were dried with paper points and obturated using gutta-percha and a zinc oxide eugenol based sealer with lateral condensation technique. Access openings were closed with cotton pellets and the teeth were placed in a humidor at 37ÚC for one week to allow sealer to set uniformly. The level of guttapercha was reduced to 4mm below the cement-enamel junction with a help of a heated hand plugger (Denstply). The sixty teeth were then randomly divided into five groups, each group comprising of fifteen teeth.

Group I: MTA group.

Group II: GIC group

Group III: Composite resin group

Group IV: Positive control group

In group I, ten endodontically treated extracted anterior tooth was filled with mineral trioxide aggregate It was placed in the pulp chamber over the condensed gutta-percha with the help of an amalgam carrier and a plastic filling instrument. The material was then packed with a hand plugger. The access cavity was then covered with a moist cotton pellet.

In group II, ten teeth were filled with Glass- ionomer cement which was mixed as per the manufacturer's instructions and placed in the pulp chamber using a plastic filling instrument and then condensed with an endodontic plugger. The plugger was coated with the cement powder of the material to enable condensation. Single mixes were used for each tooth sample.

In group III, the composite resin material was placed in 2mm increments and condensed into the cavity. It was light cured with a curing light for forty seconds.

In Group IV (positive control), the canals were prepared and obturated in a similar manner as in the other experimental groups. No barrier material was placed over the gutta-percha to evaluate leakage.

After filling all the extracted anterior teeth with different sealing material, radiographs were taken to ensure adaptation, length, and consistency of the material over gutta-percha filling. The entire crown and the root surfaces of all the experimental groups and the positive control group was covered with 2 layers of sticky wax, leaving the access cavity open for the penetration of the dye. The negative control group was completely covered with sticky wax. All the teeth were aligned vertically in the glass bottles and immersed in Indian ink for 48 hrs. The sticky wax was then removed after dye exposure. Teeth were then decalcified in 5% nitric acid for seventy two hours with fresh solution being used everyday. After a four hour running water wash the teeth were dehydrated gradually in ascending concentrations of ethanol and then cleared in methyl salicylate overnight. The cleared specimens were then placed in glass bottles and kept moist in methyl salicylate. The maximum point of coronal dye penetration from the cement-enamel junction was measured using stereomicroscope at 15X magnification.

Table I shows different restorative materials and number of teeth. Five groups were made. Group I consisted of MTA, group II GIC, group III composite resin, group IV positive control.

RESULTS:

Table I: Distribution of different restorative material

	Restorative Material			
	MTA	**GIC**	**Composite Resin**	**Positive Control**
No. Of Teeth	**10**	**10**	**10**	**10**

Table II: Distribution of the degree of microleakage of all groups

	MTA	GIC	Composite Resin	Positive Control
Microleakage (MM)	**0.06**	**0.22**	**2.12**	**5.87**

Table II shows distribution of the degree of microleakage in all groups. Positive control group showed maximum microleakage followed by composite resin, GIC and MTA.

DISCUSSION

Three dimensional sealing of the root canal is one of the principle goals of endodontic treatmentand is essential for preventing apical and coronal leakage in the root-canal system. Several test methods have been described to evaluate sealing quality of obturated root canals.[7]

The major goal of endodontic therapy is the complete removal of necrotic debris, microbes and their byproducts followed by obturation of the root canal space. This creates a fluid -tight seal in order to prevent microleakage and the ingress of oral fluids and micro- organisms into the root canal. [8]

The present study was conducted in department of endodontics. Fourty extracted maxillary and mandibular teeth were sealed with different restorative material. The purpose of this study was to evaluate the sealing ability of mineral trioxide aggregate when placed as an intra-orifice restorative material and compare it with glass ionomer and composite resin and positive control group.

In present study, Four groups were made. Group I consisted of MTA, group II GIC, group III composite resin, group IV positive control. Each group consisted of 10 teeth.

It was found that in MTA group the amount of leakage was minimal. There was significant difference between MTA & composite ($P<0.001$) and MTA & no barrier ($P<0.001$). But, there was no significant difference between MTA & GIC ($P>0.05$). There was significant difference between GIC and all the other groups ($P<0.001$).

The positive control group showed highest micro-leakage when compared to the other groups and the difference in micro-leakage is statistically significant ($P<0.001$).

The scores of Composite is higher than MTA and GIC and this difference is statistically significant ($P<0.001$).

Many anatomical parameters and clinical considerations can influence the outcome of nonsurgical root canal treatment. But the most commonly encountered problem influencing the long term success of endodontic treatment is microleakage. [8]

Microleakage refers to the movement of fluid and microrganisms along the interface of the dentinal walls and the root filling material or through voids within the root filling material. Earlier, apical microleakage was considered to be the main causative factor for failure of endodontic treatment. Hence, the literature is replete with studies evaluating apical microleakage in endodontically treated teeth. However a plethora of recent studies have identified the coronal seal as being equally important as that of apical seal in the ultimate success or failure of root canal therapy.[9]

Glass ionomer cement is most widely used esthetic restorative material that chemically binds to dentin. It is the first truly adhesive restorative materials. It sets via an acid base reaction. In this study, glass ionomer cement showed good coronal seal when compared to composite resin but its sealing ability was not comparable to MTA. The results were in accordance to the investigations conducted by Carmen et al[10] who found that by using glass ionomer cement as a coronal barrier significantly decreased microleakage.

Composite resin is one of the restorative material used. It produces poor results, exhibiting the highest leakage rate. These observations are in accordance to studies conducted by Galvan et al[11] where composite showed substantial of leakage.

MTA was first described in 1993 by Lee et al. MTA was found to show excellent coronal sealing characteristics. Clinical support for the use of MTA as an obturating material has been presented in some case reports. In one report, O'Sullivan et al.[12] used MTA as the obturating material for the root canal system of a retained primary second molar. At the 4-month follow-up the patient was asymptomatic, clinical finding were within normal limits, and there was evidence of radiographic healing.

CONCLUSION

Author concluded that MTA and GIC provided good coronal seal compared to composite However, MTA provided superior coronal seal compared to GIC. Hence MTA should be preferred over GIC, composite resin and can be recommended to be used as a coronal barrier placed immediately following root canal treatment to prevent reinfection of the canal system.

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