Original Article

Comparative Evaluation of Coronal Microleakage in Teeth with Intraorifice Barriers under Stereomicroscope – An *Ex Vivo* Study

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Abstract

Aim: The aim of this study is to evaluate and compare the intra-orifice sealing ability of four experimental materials after obturation of the root canal system with (i) Biodentine, (ii) mineral trioxide aggregate (MTA), (iii) Flowable composite, and (iv) Cavit under Stereomicroscope: An *ex vivo* study. Coronal microleakage is an important factor in endodontic failure. It is important that the intracanal barrier should provide adequate coronal seal and prevent the entry of bacterial toxins into the root canal that compromises the success of the RCT. Without an adequate coronal seal, long-term success remains questionable and failure to maintain the seal may expose obturated root canals to microbes that could retard healing and create infection in the periradicular, periodontal ligament or supporting osseous structures. Materials and Methods: One hundred freshly human extracted mandibular premolars were randomly divided into five groups (n = 20). Cleaning and shaping procedure was carried out using Hyflex EDM file, obturated using guttapercha and different intraorifice barriers were placed. The intraorifice barriers placed were Biodentine, MTA, Flowable Composite, and Cavit. Moreover, a control group was used with no intraorifice barrier. The samples were then examined under stereomicroscope. **Results and Conclusion:** Data suggested all the four materials used in the study showed some microleakage throughout the experimental period. Of the four materials used, Biodentine and MTA have significantly less microleakage when compared with Flowable Composite and Cavit.

Keywords: Stereomicroscope, Intraorifice Barriers, Coronal Microleakage

Introduction

Coronal microleakage studies after completion of endodontic treatment have shown that the intra-orifice barrier is an efficient alternative method to decrease microleakage in an endodontically treated teeth.[1] This procedure includes placing additional material into the canal orifice immediately after removal of the coronal portion of gutta-percha and sealer.

Several materials have been used in an attempt to provide an intra-coronal seal to prevent microleakage, such as Cavit, amalgam, intermediate restorative material (IRM), calcium enriched mixture cement, Super-EBA, composite resin, glass-ionomer cement, and mineral trioxide aggregate (MTA).

The objective of present study was to evaluate and compare the intraorifice sealing ability of Biodentine, MTA, Flowable composite, and Cavit after obturation of the root canal system in mandibular premolar.

Materials and Methods

A total of 100 extracted intact caries free human permanent mandibular first premolars with single straight root canals and mature apices were selected. These teeth were scrubbed with detergent using ultrasonic cleaner to clean off visible blood and gross debris and maintained in a well hydrated state containing 10% formalin. The teeth were then examined under an operating microscope to evaluate for microleakage. All the teeth were stored in normal saline under 4°C until use.

Radiographs were recorded in buccolingual and mesiodistal dimension before the instrumentation to assess the internal anatomy of tooth. All the specimens were then autoclaved at 121°C, 15 psi for 30 min to allow safe handling and were then stored in incubator for 7 days at 37°C with 100% relative humidity, immersed in normal saline in a glass beaker.

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Coronal access was achieved using high speed water cooling. Air rotor along with Endo-Access Bur and Endo Z Bur, to obtain a straight line access. Canal patency was established using a #10K Stainless Steel File. Working lengths were determined by subtracting 1mm from the length at which the tip of the 10K file is just visible to the naked eye at the apical foramen.

The coronal half of each canal was preflared using gates glidden size 1 and 2 corresponding 90 and 110 ISO sizes. Biomechanical preparation was done using Hyflex EDM. These files were used in a gentle in-and-out motion with a rotational speed of 500 rpm and 2.5 N.cm torque. The HyFlex files were used in the sequence of 25/0.12 which is the orifice opener followed using the 10/0.05 glide path file up to the WL to create a glide path. Then, HyFlex EDM 25/~ Onefile for enlargement of the root canal till the WL was used. The instrument was coupled to a 16:1 speed-reducing contrangle handpiece. The speed was 500 rpm and the torque was 3N cm as per the manufacturer's instructions.[2]

During cleaning and shaping, passive irrigation was performed using 30G side vent needle with 5 mL of 2.5% NaOCl. When instrumentation of the root canals was completed, 17% ethylenediaminetetraacetic acid was used for 1 min for smear layer removal, and the canals were again irrigated. Canals were then dried with absorbent paper points.

A gutta percha master cone of size 25/0.06 taper was selected and inserted to the full working length and checked for the snug fit tugback. The sealer MTA fillapex was manipulated as per manufacturer's instructions. It was coated in the root canal using lentilospiral along the walls. Master cone was selected and coated with sealer and inserted into the root canal till the working length. Finger spreader was placed along with the master cone for lateral condensation technique for obturation. The process was repeated till the spreader no longer advanced in the coronal one-third of the canal. Excess gutta percha was removed with the hot instrument and respective intraorifice barriers were placed.

Each specimen was radiographically evaluated in buccolingual and mesiodistal direction for the proper obturation. Criteria for the assessment of the good obturation was that the filling was well adapted to the walls and show minor areas of radiolucency. One hundred samples were stored in the incubator at a temperature of 37°C and 100% humidity for 2 weeks. Then were divided into four experimental groups and one control group with 20 teeth in each group.

In control group Group 1 – Teeth obturated to the level of the orifice, no intraorifice barrier was placed.

In experimental group, Gutta-percha was removed to a depth of 3.5 mm from the orifice using a # 5 Gates Glidden bur (Mani Inc, Japan) in 80 teeth and respective intraorifice barriers were placed.

- Group 2: Biodentine (Septodont, France)
- Group 3: MTA (Angelus)
- Group 4: Flowable composite
- Group 5: Cavit

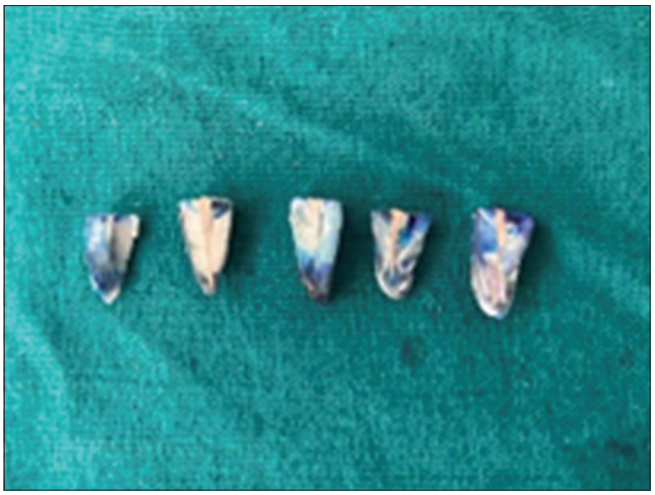


Figure 1: Sections of the sample

The samples were dried for two minutes and two layers of nail varnish was applied on the external root surfaces except at the apical 2 mm to allow dye penetration into the accessory and lateral canals. The samples were immersed in freshly prepared 1% methylene blue dye for 72 h. After 3 days, the nail varnish was scrapped off from the root surface, the roots were longitudinally sectioned for stereomicroscopic imaging of the vertical dye penetration at 30X magnification [Figure 1]. Microleakage associated with different root canal sealers was evaluated and the measurement of dye penetration obtained in micrometers.

All specimens were sent for study under Stereomicroscope. The amount of microleakage after intraorifice barriers placement was evaluated and values were subjected to analysis.

Results

The sealing ability was determined in each and among the groups.

Table 1 and Graph 1 demonstrate the sealing ability of various materials. Biodentine exhibited the best seal with a mean of 1.6280 ± 0.28796, closely followed by MTA with a score of 2.0720 ± 0.76689. Flowable composite sealant material ranked third in sealing capacity at 6.2218 ± 1.30980, while CAVIT was the least which was significant at $P = 0.000$.

0	Control	Biodentine	MTA	Flowable Composite	CAVIT
Series1	15.8084	1.628	2.072	6.2218	12.778

Table 2 shows *post hoc* analysis of sealant materials between them. On comparing control group demonstrated significant difference with Biodentine, MTA, and Flowable Composite at $P = 0.000$, but non-significant with CAVIT at $P = 0.185$.

Discussion

Coronal microleakage is an important factor in endodontic failure.[1] Bacteria have been shown to penetrate the root

Table 1: Comparative evaluation of sealing ability of intraorifice barriers

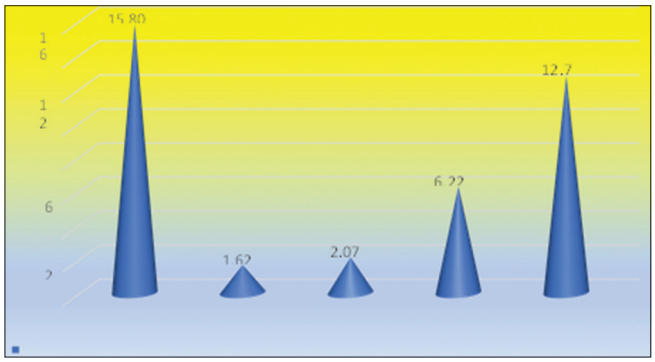
Variable	Mean	SD	SE	ANOVA statistic	Df	*P*-value
Control	15.8084	1.98356	0.88707	46.893	4	0.000*
Biodentine	1.6280	0.28796	0.12878			
MTA	2.0720	0.76689	0.34296			
Flowable Composite	6.2218	1.30980	0.58576			
CAVIT	12.7780	3.91221	1.74960			

*: Significant, NS: Not significant

Table 2: Pair-wise comparison of Intraorifice barriers

Pair-wise Comparison	Mean Difference	Std.Error	Significance
Control versus Biodentine	14.18040*	1.31534	0.000*
Control versus MTA	13.73640*	1.31534	0.000*
Control versus flowable composite	9.58660*	1.31534	0.000*
Control versus Cavit	3.03040	1.31534	0.185(NS)
Biodentine versus MTA	−0.44400	1.31534	0.997 (NS)
Biodentine versus Flowable Composite	−4.59380*	1.31534	0.017*
Biodentine versus CAVIT	−11.15000*	1.31534	0.000*
MTA versus flowable composite	−4.14980*	1.31534	0.036*
MTA versus CAVIT	−10.70600*	1.31534	0.000*
Flowable composite versus CAVIT	−6.55620*	1.31534	0.001*

*: Significant, NS: Not significant



Graph 1: Comparative evaluation of microleakage of various intraorifice barriers

canal obturating materials and influence the periapical tissues. Endotoxin, a component of Gram-negative bacteria, is a potent inflammatory agent and may be able to penetrate obturating materials faster than bacteria.[6] However, endotoxin penetration was faster than bacteria. such a rapid penetration of endotoxin could lead to an early periapical reaction, with subsequent treatment failure and need for retreatment or periapical surgery. The need for an immediate and proper coronal restoration after root canal treatment is therefore reinforced.[8]

Microleakage around a conservative access restoration can result in intrinsic discoloration of the tooth as well as dissolution of the endodontic sealer, thus compromising the prognosis of the tooth.[3,7] Due to their cariostatic and adhesive properties, glass ionomer materials are advocated for use in situations where microleakage or recurrent caries are likely.[4]

Chadgal *et al*. compared the coronal sealing ability of Cavit G, IRM and Orafil-LC by methylene blue dye penetration method. Cavit-G and Orafil-LC seal against marginal leakage better than IRM when used as a temporary filling material in endodontic access preparations.[5]

Nabeel *et al*. evaluated the sealing ability of ProRoot MTA and Biodentine as root end filling materials. At 1 month interval, ProRoot MTA samples showed a decrease in leakage mean value, while the Biodentine samples showed a further increase in leakage mean value.[9]

In our study, the results revealed highest microleakage in Cavit group followed by Flowable composite, MTA and Biodentine.

Conclusion

The success of endodontic treatment is associated with an appropriate apical sealing. However, the coronal seal reached using restorations has been considered important. Coronal leakage after the completion of root canal treatment has been recognized as one of the most important endodontic failure reason. Lack of the coronal seal such as delay in placement of a permanent restoration, fracture of the coronal restoration, and inadequate thickness of the temporary restoration may result in the possibility of coronal recontamination of obturated root canals.

All the four materials used in the present study showed some microleakage throughout the experimental period. Of the four materials used, Biodentine displayed minimum microleakage followed by MTA, while microleakage with Cavit was found to be maximum.

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