

Original Research

A comparative study to evaluate coronal bacterial penetration in Class II endodontic access cavities with various temporary restorative materials: An in-vitro Study

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ABSTRACT:

Background: In Endodontics, it is important to prevent bacterial penetration. Coronal penetration of bacteria can occur if there were inadequate temporary restorations which result in reinfection of the root canal system. Hence, the present study was conducted to compare coronal bacterial penetration in Class II endodontic access cavities with various temporary restorative materials. **Material & methods:** A total of 30 freshly extracted human molars were collected, stored, and surfaced. The standard class II mesioocclusal cavities were prepared. The teeth were stratified into three groups i.e. group A restored with Cavit-G, group 2 restored with IRM, and group 3 restored with Clip Flow. The data was collected and analysed using Statistical Package for Social Sciences (SPSS version 25, Armonk, NY: USA). **Results:** In cavities restored with Cavit-G, score 1 was seen in 7(23.33%) specimens, score 2 was seen in 3(10%) specimens and score 3 was seen 0% specimens. In cavities restored with IRM, score 1 and 2 was seen in 1(3.33%) specimens respectively, score 3 was seen in 8(26.66%) specimens. In cavities restored with Clip Flow, score 1 was seen in 6(20%) specimens, score 2 and 3 was seen in 2(6.66%) specimens respectively. **Conclusion:** The study concluded that although all three materials help in providing a barrier against bacteria, there was less bacterial penetration with Cavit G followed by Clip Flow and IRM.

Keywords: Bacterial penetration, Cavit G, Clip Flow, IRM.

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INTRODUCTION

Microorganisms play a major role in the development of pulp and periapical disease.¹ Therefore, the successful outcome of endodontic treatment depends on eliminating bacteria and prevention of reinfection.² For any restorative method to preserve pulpal health and improve the restoration's longevity, the marginal seal's integrity and durability are critical.^{3,4} Use of temporary restorative materials between appointments is one of the considerations for deciding root canal therapy quality. These materials temporarily seal the tooth and prevent the escape of intracanal medicaments out of root canal system into the oral cavity between root canal appointments.⁵ Temporary and interim

restorations are placed to provide a barrier against bacterial entry into the tooth.⁶ A variety of intermediate restorative materials (IRMs) have been studied for use as an intracoronal seal to avoid microleakage, including Cavit, IRM, glass ionomer cement (GIC), and mineral trioxide aggregate (MTA). The IRM and Cavit are the most frequently studied temporary restorative materials.⁷ Many methods have been used to assess in vitro coronal penetration including the use of radioactive isotopes⁸, dyes⁹, bacteria^{10,11} and fluid filtration¹². In vitro studies have used different methods to simulate oral conditions such as thermocycling, cyclic loading⁸ or a multiple axis chewing simulator¹³. The aim of the present study was to compare coronal

bacterial penetration in Class II endodontic access cavities with various temporary restorative materials.

Material & methods:

The present in vitro study was carried out at the Department of Conservative and Endodontics, National Dental College & Hospital, Dera Bassi. A total of 30 freshly extracted human molars were collected, stored, and surfaced. Teeth should be sound, free of caries, have no cracks or fractures, have no history of orthodontic or restorative treatment, and are free from any internal or external defects and abnormalities were included in the study. Teeth with visible multi-surface carious decay, fractures, and preexisting restorations were excluded. All the teeth included in the study were cleaned with an ultrasonic scaler to eliminate all soft tissues and debris. Teeth were then disinfected with 5.25% Sodium hypochlorite solution for 24h and kept in distilled water at 37°C. A single researcher prepared the standard class II mesioocclusal cavities using a high-speed airrotor under water coolant. The bur was replaced after every eight cavity preparations. The teeth were stratified into three groups i.e. group A restored with Cavit-G (n=10), group 2 restored with IRM (n=10), and group 3 restored with Clip Flow (n=10). Tofflemire matrix and retainer were placed around the tooth and held by finger pressure against the gingival margin of the cavity, so that the preparation would not be overfilled at the gingival margin. All materials were mixed and handled according to the manufacturer’s recommendation. The temporary materials were incrementally introduced into the cavity from the bottom up with a plastic filling instrument. The restorative materials were carefully pressed against the cavity walls. All three groups were exposed to the thermocycling machine for the temperature aging process. Specimens were put in a thermocycler for 5000 cycles in a cold bath followed by a temperature of 55°C with a dwell time of 30 seconds, equivalent to 2 years of simulation. The root apex was completely sealed with acrylic resin. Each sample was sealed with two coats of nail varnish, leaving a 1 mm window around the cavity margins. Coated teeth were then immersed in 0.5% methylene blue dye for 48 h. Teeth were rinsed with water and then dried. After removal from the dye solution, the teeth were sectioned in the mesiodistal direction along the center of the restoration using a slow-speed sectioning disc under water irrigation. Each specimen was examined under a stereomicroscope. Standardized digital images were obtained. Grading was done according to dye penetration. The dye penetration was measured using 4-point criteria: score 0—no dye penetration, score 1—dye penetrates up to 1mm, score 2—dye penetrates up to 2mm, and score 3—dye penetrates up to 3mm or more.¹⁴ The data was collected and analysed using Statistical Package for Social Sciences (SPSS version 25, Armonk, NY: USA).

Results:

Table 1: Microleakage score of various temporary restorative materials

Group s	Score 0 N(%)	Score 1 N(%)	Score 2 N(%)	Score 3 N(%)
Cavit-G	0(0%)	7(23.33%)	3(10%)	0(0%)
IRM	0(0%)	1(3.33%)	1(3.33%)	8(26.66%)
Clip Flow	0(0%)	6(20%)	2(6.66%)	2(6.66%)

The study results revealed that 0% specimens restored with all three temporary restorative materials did not show any dye penetration. In cavities restored with Cavit-G, score 1 was seen in 7(23.33%) specimens, score 2 was seen in 3(10%) specimens and score 3 was seen 0% specimens. In cavities restored with IRM, score 1 and 2 was seen in 1(3.33%) specimens respectively, score 3 was seen in 8(26.66%) specimens. In cavities restored with Clip Flow, score 1 was seen in 6(20%) specimens, score 2 and 3 was seen in 2(6.66%) specimens respectively.

Discussion:

A minimum thickness of 3.5 mm to 4 mm of the temporary filling material is said to be required when placing in an endodontic access cavity to ensure adequate sealing and for the prevention of microleakage.^{15,16}

In this study, the sealing ability of 3 different temporary filling materials were observed, 2 of which i.e. Cavit-G and IRM are routinely used in dental practice. The third material Clip-Flow is relatively a new resin-based, pre-mixed and light-cured product.¹⁷ The study results revealed that 0% specimens restored with all three temporary restorative materials did not show any dye penetration. In cavities restored with Cavit-G, score 1 was seen in 7(23.33%) specimens, score 2 was seen in 3(10%) specimens and score 3 was seen 0% specimens. In cavities restored with IRM, score 1 and 2 was seen in 1(3.33%) specimens respectively, score 3 was seen in 8(26.66%) specimens. In cavities restored with Clip Flow, score 1 was seen in 6(20%) specimens, score 2 and 3 was seen in 2(6.66%) specimens respectively.

Pawar M et al did a study in 60 freshly extracted teeth and divided them into four classes of 15 teeth each. Group I was treated with amalgam, Group II was GC G-aenial Posterior, Group III was G-aenial Universal Flo as a liner and then restored with packable composite (GC G-aenial Posterior), and Group IV was EQUI FORTE FILL. The study concluded that the glass hybrid restorative device had less microleakage than the resin-based restorative material, indicating that it had better sealing capacity.¹⁸

Shanmugam S et al found that bacterial growth was observed in 5 of the 27 (18%) Cavit G samples and in 11 of the 27 (40%) IRM samples which was not significant. Coronal restoration thickness of 4–5 mm

and proximal restoration thickness of more than 2.15 mm for Cavit G and 2.35 mm for IRM are recommended to prevent bacterial penetration over 7 days.¹⁹

P. intermedia and *P. gingivalis* identified in experimental samples with positive growth have been reported to be prevalent in teeth with endodontic infections.²⁰ Therefore, maintaining optimal thickness of restorative materials is essential for successful outcomes of endodontic treatment.

Paulo S et al concluded that Ketac™ Silver had the lowest infiltration at 2 and 4 weeks, whereas the highest infiltration was found in the Cavit™ group at two weeks and in the IRM® group at 4 weeks.²¹

Al Khowaiter SS et al concluded temporary restorative material e-Temp showed the least microleakage values followed by System Inlay and IRM.⁷

A similar study by Adnan S et al revealed that in a complex access cavity made adjacent to a pre-existing amalgam restoration, CLIP exhibits the least microleakage, followed by IRM and Cavit.²²

Conclusion:

The study concluded that although all three materials help in providing a barrier against bacteria, there was less bacterial penetration with Cavit G followed by Clip Flow and IRM.

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