

Original Research

Sealing ability of three different interim restorative materials- A comparative study

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ABSTRACT:

Background: The coronal seal is a crucial factor in success of any pulp therapy. When endodontic therapy is being carried out in multiple visits, there is a need to seal the access cavity by interim restorative materials that prevents the leakage of oral fluids and bacterial invasion into the access cavity and thus obviating reinfection. Hence the aim of the present study was to assess the sealing ability by evaluating microleakage of three different types of interim restorative materials. **Method:** A total of 45 extracted human premolars were divided randomly in to 3 groups. Group-1: Cavit G (3M), group-2: IRM (Dentsply Sirona), group-3: Temp.it (Spident co. ltd). Standardized access cavity preparation was done followed by placement of cotton pellet in the access cavity, interim restorative materials were placed as per the assigned group of restorative materials. Teeth were stained with 10% methylene blue dye for 1 week after which all the teeth were analysed for dye penetration under stereomicroscope. Statistical analysis of data was done using one-way ANOVA and Post Hoc Tukey test with a significance level of $P \leq 0.05$. **Results:** Temp.it showed the least micro leakage value (5.28mm). Intergroup comparison showed statistically significant difference between Temp.it and other groups whereas IRM and Cavit G showed no statistical significance. **Conclusion:** Though none of the tested materials were completely able to prevent the micro leakage, newer light cure interim restorative material Temp.it provided better marginal seal than the other commercially available hand mixed and ready to use interim restorative materials.

Keywords: Interim restorative material, bacterial microleakage, marginal seal, coronal barriers

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INTRODUCTION:

Dental caries is widespread globally. It is the most common chronic childhood disease. If not treated in initial stage can lead to early pulpal involvement especially in deciduous teeth due to thin enamel and high pulpal horns. Pulp therapy has become routine in pediatric and adult dental practice. The objectives of endodontic treatment are complete elimination of microorganism from the root canal system and providing hermetic seal apically and coronally to maintain the tooth in the disinfected state.

There are several instances such as presence of any periapical pathology, persistent infection, iatrogenic procedural mishaps or lack of co-operation by the patient especially children, where endodontic treatment has to be carried out in multiple visits. In such instances endodontic cavity is sealed and is restored with interim restorative materials between the visits.

The success or failure of endodontic treatment largely depends on the prevention of contamination of root canal system by salivary fluids, and bacteria after the access cavity preparation. A suitable temporary restorative material should seal the tooth temporarily thus preventing the entry of salivary fluids, microorganisms, and other debris into the root canal space. These temporary restorative materials also prevent the escape of the medicament placed in the pulp chamber and the root canal system.^[1,2]

A coronal temporary restorative material is considered as effective when it is able to fulfil certain properties which includes good sealing of the tooth margins, lack of porosity and dimensional changes to hot and cold temperature, good abrasion and compression resistance, easy insertion and removal, compatibility with intracanal medicament and should provide good aesthetics.^[3] Microleakage is defined as the leakage of microorganisms and toxins through the interface

between the restoration and the walls of the cavity.^[4] Coronal leakage compromises the outcome of nonsurgical endodontic treatment.^[5] The quality of the coronal seal is as critical as the apical seal of the root canal filling for periapical health after root canal therapy.^[6] Several studies have been carried out to investigate the coronal microleakage of different interim restorative materials used during the endodontic treatment.^[7-10] These studies have shown contrary results due to the different methodologies used in these studies, particularly techniques used to determine the extent of microleakage over various periods of time. However, there is an acceptance that occurrence of coronal microleakage around the margins is seen with majority of the temporary restorative materials. In present times, some of the permanent restorative materials are also used as temporary restorative materials after endodontic treatment. However, coronal microleakage still can occur.^[10]

Various studies have evaluated the coronal microleakage of the temporary restorative materials by using dye penetration with either thermocycling or load cycling procedures.^[3,10-14] Cruz *et al.* concluded

that thermal cycling procedures seemed to affect the sealing ability of certain types of temporary endodontic filling materials whilst load cycling did not.^[9]

Recently introduced Spident temporary filling material Temp.it is light-cured, single component, provisional elastic filling material for temporary restorations. The aim of this in vitro study was to evaluate and compare sealing ability and microleakage of three different types of commercially available interim restorative materials Temp.it, IRM and Cavit G and the null hypothesis tested was that there is no statistical difference i.r.t. microleakage between the tested materials.

MATERIALS AND METHOD:

A total of 45 extracted premolars were selected for the proposed in-vitro study. Premolars which were extracted due to orthodontic or periodontal purpose and with no dental caries or previous restorations were included in the study (Figure-1). The teeth present with cracks or fractures were excluded. The extracted teeth were stored in 10% formalin after extraction until the study was carried out.



Figure-1: Samples distribution

Standardized coronal access cavities of 4mm x4mm were prepared using high speed handpiece with water as coolant and #4 carbide round bur initially and afterwards diamonds fissure burs were used for refining the access cavity preparation. After access cavity preparation the pulp chambers were cleaned for remaining smear layer, pulp tissue, and debris in pulp chamber using 5% sodium hypochlorite and then rinsed using distilled water for 30 seconds, followed by air drying of the pulp chambers with dry air with oil-free handpiece for 30 seconds. A dry cotton pellet was placed in the pulp chamber leaving behind a 4mm space for the placement of temporary restorative material.

Forty-five teeth were randomly assigned to three experimental groups of sample size of 15 in each group. The temporary restorative materials group-1: Cavit G (3M ESPE, Minnesota, USA), group-2: IRM (Dentsply Sirona, Milford, USA) and group-3: (Spident Co. Ltd, South Korea) were then placed according to the manufacturer’s instruction (Table-1). The utmost care was taken to press the material against the cavity walls. For IRM the powder and liquid were mixed according to the powder liquid ratio recommended by manufacturer.

Table-1: Materials used in the study and their composition

Material	Group-1: Cavit G	Group-2: IRM	Group-3: Temp.it
Manufacturer	3M ESPE, Minnesota USA	Dentsply Sirona, Milford, USA	Spident Co. Ltd, South Korea
Composition	Zinc oxide, calcium sulphate, zinc sulphate, glycolacetate, polyvinyl acetate, polyvinyl chloride acetate, tri ethanolamine.	Powder: zinc oxide, polymethyl methacrylate Liquid: eugenol	Urathane dimethacrylate, hydroxyethyl methacrylate, silicon dioxide, BHT, camphorquinone, ethyl 4-(N,N dimethylamino) benzoate
Available form for use	Ready to use form	Powder-liquid form	Light cure packable form

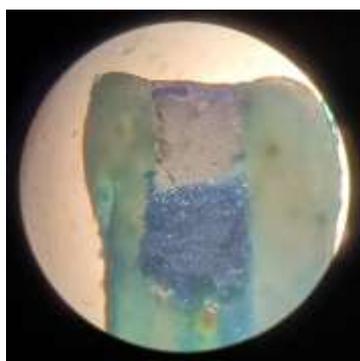


Figure-2.1



Figure-2.2

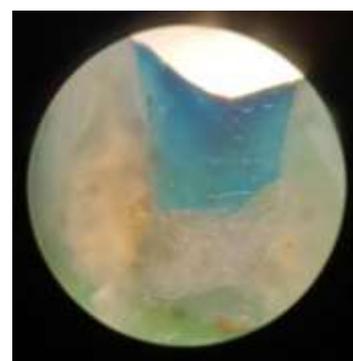


Figure-2.3

Figure-2: Photographs of longitudinal section of Cavit G (figure-2.1), IRM (figure-2.2) and Temp.it (figure-2.3) under stereomicroscope.

After the placement of assigned temporary restorations, the prepared specimens were stored under 100% humidity at 37°C for 24 h to ensure the setting of restorations, and then the samples were subjected to 500 thermocycles at 5°C and 55° C with a dwell time of 30 seconds in each bath. Following the thermocycling process, the samples were dried and Araldite (epoxy resin) was applied to seal the apical portion of the tooth and two coats of nail varnish were applied on all the tooth surfaces except 1 mm around the restoration margin to prevent the leakage.

The prepared teeth were then kept in 10% methylene blue dye solution for 1 week to allow penetration of the dye solution. After 1 week the samples were then removed from the dye solution and washed with running tap water, air-dried and longitudinally sectioned in buccolingual direction using a diamond disk.

The longitudinal sections of the teeth were viewed under stereomicroscope with 4X magnification and photographs were captured. ImageJ software was used to measure greatest depth of dye penetration in millimeters. (Figure-2).

The data was assessed with IBM SPSS 20 for windows statistical software. Statistical analysis was done using One-way ANOVA test and Post Hoc Tukey Test. For all statistical analyses, probability levels of $P \leq 0.05$ was consider statistically significant.

RESULTS:

The result of this study showed highest mean microleakage in Cavit G followed by IRM and Temp.it. Temp.it demonstrated least microleakage as it presented minimum amount of depth of dye penetration and the results amongst all groups were statistically significant. (P= 0.011) (Figure-3)

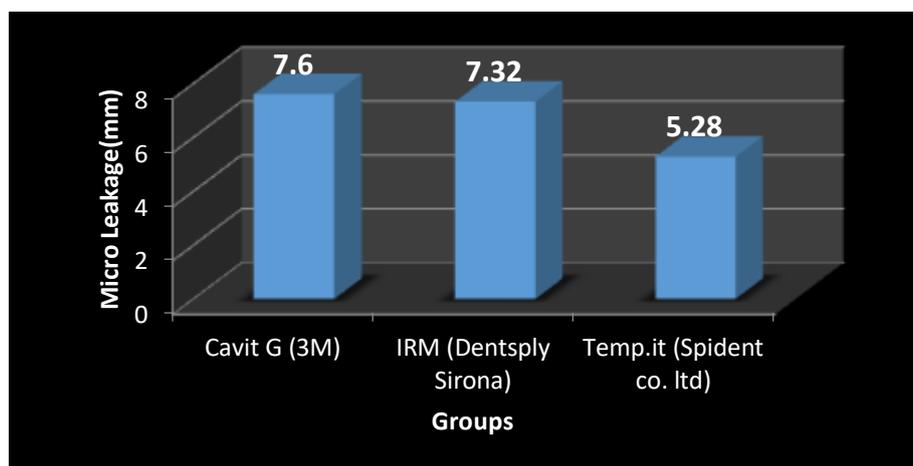


Figure-3: Mean microleakage of interim restorative material groups using one-way ANOVA test.

Intragroup comparison by Post Hoc Tukey test suggests no statistically significant difference between Cavit G and IRM group. However, statistical significance was noted when Temp.it was compared with both Cavit G (P=0.016) and IRM (P=0.037).(Table-2).

Table-2: Comparison of mean microleakage amongst the groups using Post Hoc Tukey test.

Groups		Difference	P Value
Cavit G (3M)	IRM (Dentsply Sirona)	0.28	0.935 NS
	Temp.it (Spident co. ltd)	2.32	0.016 S
IRM (Dentsply Sirona)	Temp.it (Spident co. ltd)	2.04	0.037 S

DISCUSSION:

An interim restoration can be defined as a restoration that has been placed in a tooth after the previous restoration, cracks in enamel and dentin, and/or caries have all been removed at the commencement of endodontic treatment. While a temporary restoration can be defined as a restoration placed within an endodontic cavity that has been cut through an interim restoration or tooth structure.^[15] Several materials are commercially available which serves both as interim restorative materials and temporary restorative materials.

The interim restorations are used during the endodontic treatment to prevent bacterial ingress into the root canal system, they should meet the following criteria:^[15,16]

- It should allow the tooth to continue functioning.
- They should comprise of good tensile strength and dimensional stability.
- It should allow the patient to maintain oral hygiene measures around the tooth to prevent caries and the retention of plaque and calculus.
- They should have a satisfactory appearance in the areas of aesthetic concerns.
- They should adhere well to the tooth structures by requiring no additional retention form and indirectly allow them to preserve the tooth structure.
- They should be easy to place and handle.
- They should be cost-effective.
- They should have a long shelf life.

In recent times, most of the commercially available interim restorative materials are hydraulic interim restorative materials, zinc oxide eugenol-based materials and resin based interim restorative materials.^[17] In this study the interim restorative materials used were Cavit G, IRM and Temp.it. Cavit G is a calcium sulphate-based material which is also known as hydraulic material, IRM is a zinc oxide eugenol-based material and Temp.it is a resin based interim restorative material.

In the present study, extracted human premolars were used. After access cavity preparation, a dry cotton was placed in the pulp chamber leaving behind approximately 4 mm space for the placement of interim restorative materials. Webber et al suggested that a minimum of 3.5-4 mm of interim restorative materials should be placed to provide a good coronal seal.^[1]

Thermocycling procedure was carried out to simulate the environment of the oral cavity. The samples were subjected to 500 thermocycles at 5°C and 55°C with a dwell time of 30 seconds in each bath. Thermocycling is the most preferred procedure in the microleakage studies which tests thermal changes that can affect the dimensions of interim restorative materials by expansion and shrinkage. Temperature in the oral cavity is believed to be approximately around 35°C which changes upon the foods and drinks consumed,

ranging between 1°C to 58.5°C.^[18] Deveaux et al found no significant effects of thermocycling on the microleakage but it does affect the various interim restorative materials.^[3] Calcium sulphate based hydraulic materials sets by hygroscopic expansion which expands under hot moistened and cold moistened environment to provide a better marginal seal.

Various methods have been used to test the microleakage of the interim restorative materials by different authors, which includes dye penetration, radioisotopes, bacterial penetration model, glucose penetration model etc.^[9,15,19-23] Dye penetration is one of the most frequently used method for assessing the microleakage of the restorative materials. For dye penetration, various dyes can be used, for example black India ink, methylene blue, eosin. Although dye penetration is regarded as destructive, it is still a good indicator of bacterial invasion and it is a simple, easy and accurate method to measure the microleakage through the restoration. In this study, methylene blue dye was used with a concentration of 10% for 1 week. The results of the present study revealed that all the tested materials showed microleakage to larger extent extending till pulp chamber, which was also seen in the studies done by Shahi S et al^[24] and Madarati A et al.^[25] Also, the microleakage was assessed after 7 days which could have affected the depth of penetration. In the present study, least microleakage was seen in the Temp.it group followed by IRM and Cavit G. Temp.it is a newer interim restorative material which is a light cure packable resin material, provides a durable and tight marginal seal and has a lower rate of polymerization shrinkage. It is ready to use, easy to place, better to adapt and has quick set.

Samira Adnan et al in an in vitro study compared the microleakage of temporary restorative materials in complex endodontic cavity. They compared the microleakage of Cavit, IRM and CLIP light cure temporary restorative material and concluded that the light cure material CLIP exhibited least microleakage in complex endodontic cavity followed by IRM and Cavit.^[26] This result of study by Samira Adnan was similar to the present study. In a study carried out on primary teeth by NSV Babu et al^[27] they compared the microleakage of IRM, Cavit G, Orafil-G and Dia-temp and found the least microleakage with UDMA based Dia-temp and recommended its use in between sessions of endodontic treatment in primary teeth.

The sealing ability of IRM in this study was poor when compared with light cure interim restorative material Temp.it, which was in accordance with the studies carried out by Balto H et al^[28], Pieper et al^[22] and Deveaux et al^[3]. The presence of dye observed within the body of IRM is due to the extensive degradation of the material.^[7] Studies have stated that stresses which are caused by the thermocycling promotes significant degradation of IRM^[29,30], while some author stated that variation in volume resulting

from contraction of the material and heterogenous mixing could be the reason for poor sealing of IRM.^[31] No statistically significance was found between IRM and Cavit G which is in accordance with a study by Deepak S et al^[31], where they compared coronal microleakage of ZOE, IRM and Cavit G and found no significant difference in the microleakage of Cavit G and IRM. Cavit-G and Cavit-W are varieties of Cavit that differ in the content of resin and their resulting hardness and setting. Cavit and Cavit-W provides almost equal water tight seals, which is significantly superior to the seal provided by Cavit-G.^[32] Various studies have been carried out which suggests that IRM is superior than Cavit G in terms of providing coronal seal^[32-34]. Also, study by Jensen AL found IRM to be more wear resistant and relatively stronger than Cavit.^[15]

The constraint for this study was that it was carried out for a fixed duration of one week and the occlusal loading of the samples was not performed which could have affected the end result.

Adequate care should be taken in choosing the temporary restorative so as to avoid secondary infections, repeat procedures, and possible physical, financial and psychological stresses for the patient.

CONCLUSION:

Within the limitation of this study, it can be concluded that

- ❖ The correct placement and appropriate bulk of interim restoration play a vital role in preventing ingress of bacteria and contamination of the root canal.
- ❖ Light cure temporary restorations Temp.It proved to be more effective and efficient against microleakage in comparison to other commercially available materials like IRM and Cavit G.

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