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Original Research Article

Coronal Sealing Ability of Three Temporary Restorative Materials Used in Endodontics: an in vitro Dye Penetration Study

Sachin Chadgal[1], Riyaz Farooq[2], Aamir Rashid Purra[3], Fayaz Ahmed Ahangar[4], Tusev Thapa[5]

[1]Post Graduate Student, [2]Professor and Head, [3]Associate Professor, [4]Assistant Professor, [5]Intern (Indira Gandhi Government Dental College, Jammu)
Department of Conservative Dentistry and Endodontics, Government Dental College, Srinagar (J&K), India.

Corresponding Author: Sachin Chadgal

ABSTRACT

Background: The sealing ability of temporary restorative material is an important parameter for the success of endodontic therapy. Cavit-G and IRM have been widely used for the same purpose. A novel material Orafil- LC, light cured resin based material, has been recently introduced for sealing the access preparations and preventing the microbial re-colonization of root canal system.
Aim: To compare the coronal sealing ability of Cavit G, IRM and Orafil-LC by means of methylene blue dye penetration method.
Methodology: The root canals of fifty mandibular premolars were prepared with Ni-Ti rotary instruments under irrigation with 5% NaOCl and 17% EDTA. Samples were obturated and divided into three experimental and two control groups. All three materials were manipulated according to manufacturer instructions and placed into 4mm deep access cavities. Samples were incubated, thermocycled and then placed in 2 % methylene blue dye for one week. Samples were sectioned bucco-lingually and viewed under stereomicroscope. Degree of dye penetration was evaluated and scored for each group.
Results: Data from each group was compared using one way ANOVA and post hoc Tukey test ($P<0.05$). Cavit and Orafil-LC showed significantly lower dye leakage than IRM. Conclusion: Cavit and Orafil-LC have better coronal sealing ability than IRM

Keywords: [Dye penetration, Cavit, IRM, Orafil-LC]

INTRODUCTION

The purpose of an endodontic temporary restoration is to prevent the ingress of oral bacteria into the root canal system between the appointments. Leakage of temporary restorations can lead to bacterial penetration of the root canal fill and can complicate the course and outcome of treatment. [1,2] The quality of coronal seal is as important as the apical seal for the periapical health after the endodontic therapy. [3] There are various temporary restorative materials available these with different compositions and setting mechanisms. Cavit-G (3M Deutschland GmbH, Germany) is a pre-manipulated eugenol free, Zinc oxide/zinc sulphate based cement which sets by water absorption. [4] Together with Cavit, Intermediate Restorative Material IRM (DentsplyDeTrey GmbH, Germany) has been the most commonly used temporary filling material in endodontics. IRM is a zinc oxide eugenol cement reinforced with polymethyl

methacrylate. This reinforcement provides the restoration with improved compressive strength, abrasion resistance and hardness. [5] One of the recently introduced temporary restorative materials is the Orafil-LC (PrevestDenpro, Jammu, India). It is a urethane dimethacrylate based light cured temporary material that can be easily placed and removed from the access preparation. Various methods are available for assessing the coronal sealing ability of restorative materials namely fluid infiltration method, bacterial leakage, dye extraction and dye penetration. [6] Dye penetration has been widely used for leakage assessment studies because of its relative technical simplicity. [7] The aim of this study was to compare the sealing ability of three different endodontic temporary restorative materials namely Cavit, IRM and Orafil LC by dye penetration method.

METHODOLOGY

Fifty extracted, intact, and caries-free human premolars were selected for this study. These teeth were immersed in 5 % sodium hypochlorite (Prevest Denpro, Jammu, India) for 5minutes to disinfect teeth and remove the soft tissue from the root surfaces. Subsequently, teeth were rinsed and stored in normal saline. The same operator prepared standardized access cavities. Working lengths were determined using K-file size #15 (Dentsply Maillefer, Ballaigues, Switzerland) 1 mm short of the apex. Rootcanal cleaning and shaping was carried out using Protaper Universal rotary files (DentsplyMaillefer, Ballaigues, Switzerland) upto F3 file. Approximately 2 mL of 5% sodium hypochlorite solution was used for irrigation between each instrumentation procedure. 3 ml of 17 % EDTA liquid (PrevestDenpro, Jammu, India) was used for 1 minute to manage the smear layer. After cleaning and shaping, the root canals were dried with paper points and obturated with Protaper Universal F3gutta-percha (DentsplyMaillefer, Ballaigues, Switzerland) and AH Plus sealer (DentsplyMaillefer, Switzerland). When root canals obturations were completed, a hot instrument and a plugger were used to remove excessive gutta-percha and to ensure good condensation in the coronal part of the root obturation. In this way, a minimum of 4 mm coronal space was available for the temporary restorative material. The teeth were randomly divided into 5 groups (3 experimental and 2 control groups) of 10premolar teeth each (n=10). The teeth in the positive controls (Group P) were not filled with restorative materials; only a small dry cotton pellet was placed in the pulp chamber. In the negative control group (Group N) cavities were completely filled with inlay wax (BEGO, Germany). In the three experimental groups, all the materials were mixed according to manufacturer's instructions by the same operator. Group A was filled with Cavit-G and it was condensed using a wet cotton pellet. In Group B, IRM was mixed with a powder to liquid ratio of 6:1 and placed into the cavity. In Group C, Orafil G was placed into the access preparation and condensed. Then it was light cured for 40 seconds and excess removed using a scalpel. After placement of the test materials, the specimens were stored in an incubator at 37°C at 100%humidity for 24 hours. The specimens were thermocycled for 500 cycles in distilled water at 5-55°C; i.e. 30 seconds in each bath. [8] After thermo-cycling, the specimens were air dried. The teeth in the negative control group were completely covered with two layers of nailvarnish. The experimental groups and positive control group were also coated twice except the occlusal surfaces. All specimens were placed in 2% methylene blue solution (HiMedia Laboratories, India) at neutral (pH 7.0) in an incubator, at 37°C and 100% humidity for 7 days. They were then removed from the dye solution, washed under tap water, and air dried. A scalpel was used to remove the nail varnish and wax layer. The teeth were sectioned bucco-lingually using a diamond disc. The samples were then analyzed under 25 X magnification using a stereomicroscope

(Kyowa Getner, Japan). The degree of marginal and surface dye penetration (Table 1) was evaluated according to criteria by Lee et al. [9] Scores were obtained from different groups and data analysis was done using one-way ANOVA and post hoc Tukey tests (P<0.05).

Table 1: Criteria for the evaluation of the marginal seal of temporary fillings in the dye penetration test (Lee et al.)

Degree	Criteria
0	No dye penetration into the filling material or along the filling-tooth interface
1	Dye penetration into the filling material or along the filling-tooth interface up to the enamel dentine interface
2	Dye penetration into the filling material or along the filling-tooth interface up to the filling edge
3	Dye penetration into the filling material or along the filling-tooth interface up to the endodontic cavity (cotton pellet is discolored)

RESULTS

The negative control group showed no dye penetration (Group N) and the positive control group demonstrated maximum dye penetration (Group P). The mean marginal dye leakage scores for each group are presented in Table 2. In the experimental groups, the lowest dye leakage score was observed in Group A (Cavit-G). However there was no significant difference between Cavit-G (Group A) and Orafil- LC (Group C). Both Cavit-G and Orafil- LC performed significantly better than IRM (Group B) in terms of sealing property.

Table 2: Dye penetration scores of three experimental groups.

Group 0 1 2 3				
Cavit-G[a] (Group A)	0	9	1	0
IRM[b] (Group B)	0	0	2	8
Orafil-LC[a](Group C)	0	8	2	0

[a,b]Groups with different letters are significantly different (P<0.05)

DISCUSSION

A tight sealing temporary restorative material is paramount to success of endodontic therapy. A good seal between filling material and tooth prevents the ingress of microbes and salivary components into the root canal system thus preventing its recontamination. [10] In the present study, a new light curing temporary material (Orafil-LC) was compared with two commonly used temporary restorative materials (Cavit G, IRM). All of the experimental groups demonstrated leakage within the material. Cavit-G and Orafil-LC showed les marginal leakage than IRM. In the present study, we used a thickness of 4 mm of restorative material because it has been proved that a minimum of 3.5-4 mm of restorative material is necessary to prevent micro leakage. [11] Our study used thermal cycling procedures to simulate intraoral conditions. The temperature range between 5 2°C and 55 2°C that was chosen because these were the extremes temperatures that could be experienced in the oral environment. [12] In the present study, IRM showed more leakage than the other two materials tested. This can be due to the fact that the components have to be mixed together to produce the paste and the mixing may be the cause of reduced homogeneity. A study showed numerous voids on the visible surfaces of IRM samples after sectioning. [13] Apart from our study, other past studies have also shown that more microleakage occurs with IRM than with Cavit or Cavitron. [9,14-16] Cavit-G is a premixed temporary restorative material that contains zinc oxide, calcium sulfate, glycol acetate and polyvinyl acetate resins. It possesses a high coefficient of linear expansion, resulting from water sorption. This expansion permits the material to adapt more tightly to dentin walls and providing a good seal under different conditions. [8,16,17] One of the major disadvantages of Cavit-G is its slow setting time. In contrast, Orafil-LC setting process is initiated by exposure to a visible light source. It is a durable light-curing temporary filling material which can be cured upto the depth of 4 mm with tight margins, ready to use, easy to place, and can be removed in one piece with no damage to tooth preparation. Being eugenol free, it has no negative effect on composite bond strengths.

CONCLUSION

The results of this study indicate that Cavit-G and Orafil-LC seal against marginal

leakage better than IRM when used as a temporary filling material in endodontic access preparations.

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