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Comparative evaluation of coronal sealing ability of light cure temporary restorative materials with conventional temporary restorative material using stereomicroscope: An in vitro study

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Abstract--Background: The coronal seal is a crucial factor in success of endodontic therapy. 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 80 extracted human premolars were divided randomly in to 4 groups. Group A: Control group, Group B: Systemp Inlay, Group C: Temp IT Blue, Group D: Cavit-G. 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 2% methylene blue solution 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: Systemp Inlay showed the least micro leakage value followed by Temp.it blu and Cavit G. Intergroup comparison showed statistically significant difference between Systemp Inlay and other groups whereas Temp IT Blue 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 Systemp Inlay provided better marginal seal than the other commercially available interim restorative materials.

Keywords--microleakage, temporary restorative materials, dye penetration method, caviti G.

Introduction

Sealing the access cavity with an appropriate temporary material between appointments in a multi-visit endodontic therapy is of paramount importance for successful treatment outcome. An ideal temporary filling material should be impervious in nature, adequately resistant to abrasion and compressive forces and should temporarily seals the tooth averting the ingress of microorganisms, fluids or debris into the root canal space between appointments or until a final restoration is placed.^[1] This pathway of fluid through the restorative material into the tooth from oral cavity is known as microleakage which leads to endodontic treatment failure.^[2,3] Literature search in the past have revealed many studies reporting post-operative pain and infection when the access cavity was not sealed with an adequate temporary filling between appointments.^[4] Therefore, the main objective of an inter-appointment temporary filling material is to seal and prevent saliva leakage leading to invasion of bacteria into the root canal space and root canal dressing.^[5]

There are numerous studies evaluating the coronal sealing ability of a temporary endodontic filling material.^[6-10] Aytül Ciftçi et al (2009) compared the sealing ability of the temporary restorative materials Cavit-G, Ketac Molar Easymix, and IRM with a new light-curing temporary material, Clip, using a methylene blue dye penetration test and concluded that The new light-curing temporary material Clip seals against marginal leakage as effectively as Cavit when used as a temporary filling.^[11] Similarly, Zalilah Tapsir et al (2013) compared the microleakage of various restorative materials used as coronal barriers between endodontic appointments and concluded that light cure temporary restorative material Fuji II LC has better sealing ability as compared to conventional temporary restorative material GC Fuji IX and Caviton.^[12]

Until now, Cavit-G is the gold standard temporary restorative material for endodontic access cavities but there are many studies which gives conflicting results on its coronal sealing ability.^[13] Lately, several light cure temporary restorative materials like Systemp Inlay and Temp.it Blu are commercially available in the market. Considering that sealing ability of temporary restorative material is an important key in success of an endodontic treatment and with the introduction of light cure temporary restorative material like Systemp Inlay and Temp.it Blu, their sealing abilities have not received much research attention and therefore, there is a need to investigate about the same.

Materials and Method

This study was approved by the Institutional Ethics Committee IEC299022021 Version No:001. Sample size of 80 was calculated using one-way analysis of variance (ANOVA) based on the microleakage scores with Cavit-G and Clip as reported by Ciftci et al (2009). 80 extracted single or multirooted mandibular premolar teeth extracted for orthodontic reasons were included in the present study to be randomly assigned to 4 groups as follows: Group 1: Control group, Group 2: Systemp Inlay, Group 3: Temp.it Blu and Group 4: Cavit-G.

In order to eliminate the debris and calculus, samples were cleaned using an ultrasonic scaler (Woodpecker) and stored in 0.1% Thymol solution for five days for disinfection. Samples will then be stored in normal saline for 2 weeks until the study was performed. Standard coronal access preparations were made on the teeth samples with BR46 round bur for entry and cavity was then refined using a diamond fissure bur. Pulp tissue was then debrided and irrigation was done with 5.25% sodium hypochlorite solution. Following which the pulp chamber will be dried and the floor of the chamber will be packed with cotton pellet such that 4mm thickness of temporary restorative material could be accommodated and will be confirmed by measuring with periodontal probe. The teeth specimens were then randomly allocated into 4 groups. In Group 1: Control group, cotton pellet was placed on the floor of the prepared pulp chamber but temporary restoration was not placed in the access cavity.

In the remaining 3 experimental groups, respective temporary restorative materials were properly condensed and adapted to the access cavity margin and walls. Teeth specimens were then incubated using a Scientec incubator at 37degree Celsius and 100% humidity for 1 day. This was done to ensure proper

setting of the experimental materials. Teeth specimens were then coated with a layer of varnish excluding only the 1mm area surrounding the access cavity margins and the apical foramen was sealed with sticky wax.

Teeth specimens were then stored in 2% methylene blue solution for 7 days in which 37°C and 100% humidity was maintained. After 7 days, they were removed and washed under tap water and air dried. Samples were then sectioned in the buccolingual direction and were fixed on slide and viewed in stereo microscope as shown in Figure 1a-1d. The greatest depth of dye penetration for each tooth sample was recorded and scoring was done according to the dye penetration assessment criteria test as shown in Figure 2.

Results

After obtaining the data, samples were subjected to statistical analysis using one-way ANOVA and Post Hoc Tukey test with a significance level of $P \leq 0.05$. Data obtained was compiled on a MS Office Excel Sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States) and the data were subjected to statistical analysis using Statistical package for social sciences (SPSS v 26.0, IBM).

Post Hoc Tukey test was performed to obtain inter group comparison of frequencies of scores (n=20 per group) as shown in the table 1. A difference was noted for the dye penetration value between all pairs of groups except group 1 and group 2. Group 3 performed better than group 4 but the difference was non-significant ($p > 0.05$).

The control group showed greatest dye penetration (Group 1) and the lowest score for dye leakage was seen in Group 2 (Systemp Inlay). No significant difference was seen between Temp.it Blu (Group C) and Cavit G (Group D). However, Systemp Inlay performed notably superior than Temp.it Blu and Cavit G in regards to sealing property.

		Microleakage Score							
		0	1	2	3	Total	Chi square value	p value of chi square test	
group	A	0	0	0	20	20			
	B	4	9	7	0	20	51.736	0.000**	
	C	0	3	9	8	20			
	D	2	6	7	5	20			
Total		6	18	23	33	80			

Table 1: Inter group comparison of frequencies of scores

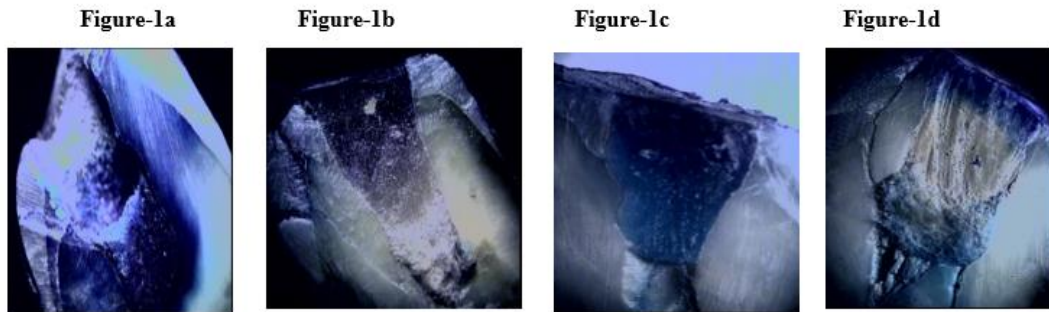


Figure-1: Stereomicroscope Photographs of longitudinal section of Control (figure-1a), Systemp Inlay (figure-1b), Temp.it Blu (figure-1c), and Cavit G (figure-1d).

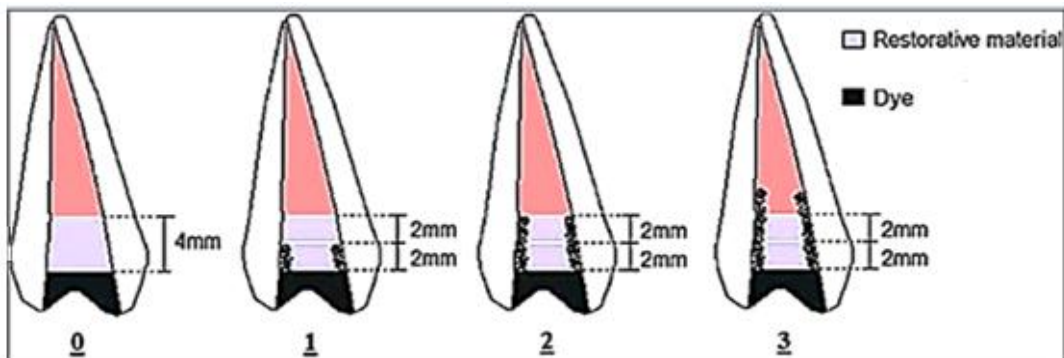


Figure 2: Dye penetration scores

Discussion

Microleakage is a preeminent risk factor in multi-visit endodontic therapy leading to endodontic failure.^[14] The requirement of a temporary restorative material also depends on the complexity of the clinical case and the need for a multi visit endodontic therapy where an appropriate coronal seal between the visits is significant. Over the years, many temporary restorative materials have been introduced in dentistry including zinc oxide eugenol-based, resin based and hydraulic interim restorative materials and till date various clinical studies, both in vivo as well as in vitro studies have been performed to assess their coronal sealing ability.^[15,16]

Webber et al recommends minimum 3mm thickness of a temporary restorative material for a good coronal seal. Hence in this present study, for standardization, 4mm thick temporary restorative material was placed in the access cavity except for control group in which only cotton pellet was placed.^[17,18] Setting of temporary restorative material and simulation of the clinical environment was made sure by incubating the experimental samples at 37 degrees in 100% humidity. Naseri et al in their study examined the coronal sealing ability of temporary restorative materials after a duration of 7 days citing it as most common duration for root canal interappointment. Therefore, in this present study time duration of one week was selected to assess the microleakage of temporary restorative materials.^[19]

The present study uses Methylene blue dye owing to its high-water solubility, ability to move by simple diffusion, resistant to absorption by hydroxyl apatite crystals present in dentin and the molecular size of methylene blue dye is smaller than the size of bacteria. This explains the methodology of using 2% methylene blue dye to assess coronal sealing ability of temporary restorative materials. [20]

In this study, comparative evaluation of microleakage between three commercially available temporary filling materials is done, out of which one is the Control group (Group), two are light cured temporary restorative materials i.e., Systemp inlay (Group 2) & Temp.it Blu (Group 3) whereas the remaining is conventional temporary restorative materials i.e., Cavit G (Group 4). Systemp inlay is a Poly Esther Urethane Dimethacrylate and monofunctional Ethyl Triglycol Methacrylate based temporary restorative material. It is a single unit composite and has a command set. Similarly, recently introduced temporary restorative material Temp.it Blu which is ready to use, sets on command and gives a tight seal with the cavity margins. Cavit G is a premixed temporary restorative material which is auto-polymerized and has a moisture-initiated setting. All of the above-mentioned experimental groups have shown microleakage within the restorative material, which was also seen in the studies done by Shahi S et al and Madarati A et al. [21] In this present study, Systemp inlay showed least microleakage as compared to Temp.it Blu and Cavit-G. An in vitro study by Samira Adnan et al compared the microleakage of Cavit, IRM and a light cure temporary restorative material CLIP and concluded that in a complex endodontic cavity, CLIP exhibited least microleakage followed by IRM and Cavit. This result of study by Samira Adnan was similar to the present study.[22] NSV Babu et al compared the microleakage of IRM, Cavit G, Orafil-G and Diatemp and concluded that UDMA based Diatemp showed the least microleakage and vouch for its use as interappointment temporary restorative material.[23]

Microleakage scores were not statistically significant between Temp.it Blu and Cavit-G. Cavit G is a hygroscopic material which sets by absorbing water. This allows the material to have a close adaptation to the cavity margins owing to its high coefficient of linear expansion resulting from water sorption. Cavit G is pre mixed and ready to use making it a commonly used inter appointment temporary restorative material. This may be the reason that conventional temporary restorative material Cavit-G has similar microleakage score as light cure restorative material Temp.it Blu.[24] Also, the reason for statistically significant difference between microleakage score between Systemp inlay and Temp.it Blu may be attributed to absence of micromechanical retention or chemical bonds to the tooth which leads to polymerisation shrinkage.[25] Although resin-based materials have the property of water absorption which increases its volume, it cannot counterbalance the microgaps formed during polymerisation resulting in microleakage.[26]

This in vitro study does not include occlusal loads and simulation or mimic of oral environment as there are controversies in literature regarding their influence in microleakage. [27,28] Moreover, methylene blue dye used in this study might not be able to represent the variety of molecules in a real in vivo situation, where simultaneously multiple enzymes and factors are present. Therefore, studies are

required to understand how the simulation of oral environment and inclusion of occlusal loads or masticatory forces affect microleakage.

Conclusion

Within the limitation of this study, it can be concluded that choosing an appropriate temporary restorative material gives an excellent coronal seal and thereby preventing microleakage and root canal contamination. Recently introduced light cure temporary restorative material Systemp inlay is superior to other commercially available restorative material like Cavit G and Temp.it Blu in regards to coronal microleakage.

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