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An in vitro analysis evaluating the sealing ability of Light Cure Glass Ionomer Cement and Light Cure Composite as coronal seal

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Abstract

This study was aimed to evaluate the sealing ability light cure GIC as coronal sealing material. 30 extracted human teeth (divided into two groups of 10 teeth each) were obturated without using any material for coronal seal (Group I) and light cure GIC (3M ESPE VITREMER) as coronal seal (Group II) and Light Cure Composite (3M ESPE filtek z250) (Group III) after removing 2mm of coronal gutta percha. The teeth were suspended and sealed in methylene blue for 72 hours after which they were removed, washed under running water, dried and sectioned longitudinally, separating buccal and lingual halves. The distance from the cavosurface margin of the access cavity to the most apical extent of dye penetration point gave the linear extent of dye penetration. The percentage linear micro leakage was estimated by measuring the length from the cavosurface margin to the apex of the tooth. Data was statistically analyzed using one-way ANOVA. The specimens in group Ii showed the minimal amount of linear micro leakage of 6.49 percent. It can be concluded coronal seal reduces the micro leakage, and light cure GIC has better coronal sealing ability as compared to Light Cure Composites.

Keywords: Coronal seal, methylene blue, microleakage, light cure GIC, Light Cure Composites

Introduction

Thorough biomechanical preparation for the removal of necrotic debris and bacteria from the root canal followed by sealing the root canal to prevent ingress of bacteria and tissue fluids is the key for the success of endodontic therapy. It is this biomechanical preparation that forms one of the cornerstones of successful endodontic procedures. Dow and Ingle stated that the

most common cause for the endodontic failure is inadequate apical seal, which allows periapical fluids, proteins, and bacteria to access the root canal.[1] Because of this, an inflammatory reaction is initiated which often results failure of root canal therapy. Thus, the perfect periapical seal forms the second cornerstone of successful endodontic therapy. However, successful endodontic treatment requires good coronal seal. Swatz found that the failure rate was twice as high in cases with inadequate coronal restoration compared to cases with adequate coronal restoration.[2] This, no doubt, is the third cornerstone for a successful endodontic therapy. Swanson and Medison found that none of the root canal sealers used with laterally condensed gutta-percha could prevent coronal microleakage.[3] As a result, it was difficult to achieve a perfect cor0nal seal. Bacteria present in the saliva seeps in <30 days into root canal irrespective of the condensation technique. Hence there is a need for a coronal restoration, which will provide dimensionally stable, inert, and fluid tight coronal seal. Studies have shown that a second barrier between the permanent filling material and the obturant can reduce coronal microleakage.[5] This is termed as coronal seal and it acts as a barrier between the coronal and radicular part of the tooth. Coronal seal prevents the entry of microorganisms into the root canal. Esthetic adhesive restorative materials have shown a better sealing ability than other restorative materials. These materials have included Glass Ionomer Cements, intermediate restorative materials, light cure composite material etc. Newer resin-modified glass ionomer cements (GICs) with increased strength, chemical bonding, and fluoride releasing property make it a good option to be used as a coronal seal in root canal treated teeth. [6]

This study was aimed to evaluate the sealing ability light cure GIC as coronal sealing material.

Materials and Methods

Thirty single-rooted mandibular premolars with one canal each, stored at 100% humidity were used for the study. All the teeth were shaped, cleaned, and obturated by the same operator. Access cavity was prepared by Airotor using a no. 4 high-speed round carbide bur (S.S White) with water spray. After negotiating canal, root canal patency was established by placing a K-file #10 (Dentsply, Maillefer, Ballaigues, Switzerland). The working length was determined using Endoblock (Dentsply/Maillefer, Switzerland). The working length was calculated to be 0.5 mm less than the length obtained from this initial file. The ProTaper rotary system comprised six NiTi files and was used in the crown-down pressure-less technique using NSK (Japan) torque control endomotor with 16:1 reduction gear contra-angle handpiece at 300 rpm and the torque of 0.2 Ncm. During instrumentation, lubrication of canals was carried out using Glyde (Dentsply/Maillefer, Switzerland) and the canals were prepared till F2. After each instrumentation, the canals were irrigated with 3% sodium hypochlorite solution and then dried with paper points. Once instrumentation was completed, the canal was rinsed with 2 ml of 17% ethylene diaminetetraacetic acid solution (Henry Schein Inc., USA) and a final rinse of chlorhexidine 0.2% w/v (ICPA Health Products Ltd., India). Canals were dried with sterile paper points (Dentsply/Maillefer, Switzerland). The samples were obturated with size 25, 6% Taper gutta-percha points (Dentsply, Maillefer, Ballaigues), and AH-plus sealer (Dentsply Detrey of MbH Germany) using the cold lateral compaction technique. The samples were randomly divided into threo experimental groups of 10 each. Light cure GIC

(3M ESPE Vitremer), was placed into the orifice in Group II. Light Cure Composite(3M ESPE filtek z250 was placed into the orifice in Group III. Each tooth was placed into a coded container and allowed for sealer and all experimental materials to set in a humidor. After 72 h, teeth were removed, washed under running water, dried and sectioned longitudinally, separating buccal and lingual halves. The distance from the cavosurface margin of the access cavity to the most apical extent of dye penetration point gave the linear extent of dye penetration. The percentage linear micro leakage was estimated by measuring the length from the cavosurface margin to the apex of the tooth. Three layers of nail varnish were placed on all experimental teeth coating their root surface from the root apex to the level of the cementoenamel junction.

Samples were submerged in a vacuum flask containing rhodamine-B dye, subjected to vacuum pressure of 75 torr for 30 min and allowed to remain in the dye for 7 days. The experimental samples were then rinsed with running water to remove dye from the external surface. The samples were subsequently longitudinally sectioned with the help of a diamond disc and observed under a stereomicroscope. The leakage was measured using a ×10 stereomicroscope (Vardhan, India) by measuring the distance from the coronal extent of the orifice material to the greatest depth of penetration of the dye. Statistical analysis was performed using the Statistical Package for Social Sciences version 11.5 for MS Windows (SPSS Inc., Chicago, IL, USA).

Results Data were statistically analyzed using one-way ANOVA. The specimens in Group II showed the minimal amount of linear microleakage of 6.04% while those in group 1 had amicroleakage of 37.7%[Tables 1,2and 3].

Table 1: Percentage of linear microleakage of group 1 (without coronal seal)

Specimen no	Total length of specimen (mm)	Linear microleakage (mm)	Percentage of linear microleakage (%)
1	18	6	33.3
2	21	5	23.8
3	21	15	71.4
4	22	10.5	47.7
5	18	4	22.2
6	21	7	33.3
7	17	11	64.7
8	21	5.5	26.1
9	21	6.5	30.9
10	19	4.5	23.6
Mean	19.9	7.5	37.7

Table 2: Percentage of linear microleakage of group II (with coronal seal of Light Cure GIC)

Specimen no	Total length of specimen (mm)	Linear microleakage (mm)	Percentage of linear microleakage (%)
1	21	0	0
2	20	2	10
3	19	0	0
4	20	4	20
5	22	1.5	6.8
6	21	1	4.8
7	18	1	5.5
8	18	1.5	8.3
9	21	0	0
10	20	1	5
Mean	20	1.2	6.04

Table 3: Percentage of linear microleakage of group II (with coronal seal of Light Cure Composite)

Specimen no	Total length of specimen (mm)	Linear microleakage (mm)	Percentage of linear microleakage (%)
1	20	1	5
2	20	2	10
3	21	2	9
4	20	2.5	12.5
5	19	2	10.5
6	19	1.5	7.8
7	18	1	5.5
8	19	1	5.2
9	21	0.5	2.3
10	18	1	5.5
Mean	20	1.45	7.33

Discussion

The goal of all the endodontic treatments is to achieve a three-dimensional fluid tight seal. The failures seen in

root canal treatments are usually due to microleakage of microorganisms or their products. Thus, we need create a perfect seal in apical, coronal, and lateral directions. A good restoration after the endodontic treatment prevents loss of coronal seal. This postendodontic restoration should have the ability to prevent recontamination of the root canal system from food debris, oral fluids, and microorganisms in the oral cavity. [7] Various materials have been used to achieve a coronal seal such as cavit, intermediate restorative material, GIC, zinc oxide eugenol cement, resin-modified GIC, compomer, and composites. Each of these materials has their own benefits and limitations.[8] The quality of the apical seal obtained by root-end filling materials has been assessed by the degrees of dye, radioisotope or bacterial penetration, electrochemical means, scanning electron microscopy, and fluid filtration technique. Dye penetration technique is the most frequently used methods to evaluate the sealing ability of various root-end filling materials. Usage of dyes is simpler, cheaper, safer, easier, and there is no need of special setup compared with other methods such as electrochemical method. In the present study, methylene blue dye was used because it can serve as an adequate indicator of passage of microorganisms and larger sized endotoxins as well as toxic agents of lower molecular weight. Methylene blue has a lower molecular weight (319.9) which penetrates deeper than other dyes thus ensuring greater sensitivity. Better sealing ability of light cure GIC may be attributed to adhesion of light cure GIC by development of an ion-exchange layer adjacent to dentin and shear bond strength of light cure GIC.

Conclusion

In the current study, Light Cure GIC was found to be a good coronal seal and can be recommended as coronal sealing material to prevent microleakage in an endodontically treated tooth. However, to definitely prove the effectiveness of Light Cure GIC, an in vivo study with a larger sample should be carried out.

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