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Original Research

To evaluate and compare microleakage in teeth restored with Conventional Glass Ionomer Cement and two newer restorative materials EQUIA Forte and Cention N using Stereomicroscope

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ABSTRACT:
Background: Adaptation of dental restorative materials to the walls of the cavity and the retentive ability of a material to seal the cavity against microleakage is one of the significant factor which attributes in success of restoration .Microleakage may be defined as the passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material applied to it. The present study is undertaken to evaluate and compare the sealing ability of three commercially available restorative materials **(**EQUIA Forte, Cention N, Glass Ionomer cement**)**. **Materials and Methods:** Standard class V cavities of size 3 mm x 2 mm x 2 mm were prepared on a total of 30 caries free extracted teeth and restored with the Conventional Glass Ionomer, EQUIA Forte and Cention N according to manufacturer's instructions. After thermocycling, teeth were immersed in 0.5% methylene blue dye for 24 h. They were then sectioned buccolingually. Microleakage was assessed for the occlusal and gingival walls and evaluated for microleakage using a stereomicroscope. **Results:** Mean microleakage for conventional GIC (3.7) was the highest of all and it was least for Cention N (0.3). **Conclusion:** Cention N displayed the least microleakage and came to be better than the Equia Forte and Conventional Glass Ionomer Cement.
Keywords: Cention N, EQUIA Forte, Microleakage.

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INTRODUCTION

The longevity of a restorative material depends on many factors, a perfect adaptation and a strong bond between the restorative materials and tooth structures. Poor bonding of the restorative material with tooth structure often leads to microleakage. Microleakage has been defined as "the passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material applied to it."

Microleakage always has been a major concern for restorative materials. It leads to debris retention and bacterial influx, which in turn can lead to recurrent caries, hypersensitivity, marginal staining, pulpal inflammation and failure of restoration.[1] It is but natural that there has been a constant quest for development of restorative materials which have potential to minimize this major limitation. Glass Ionomer Cement, more precisely termed polyalkenoates, are restorative materials with acid base reaction and represent probably

the first bioactive material. They have certain unique advantages like ionic union to tooth structure, anticariogenicity due to fluoride release, thermal compatibility and good biocompatibility.[2] On the flip side, they are brittle, have low fracture toughness, poor wear resistance and susceptibility to moisture contamination and dehydration especially during the early stages of reaction.[3]

Composite materials have better physical and mechanical properties than GIC. It bears high fracture toughness and working time of Composite is under control of operator. Major disadvantage associated with composite is polymerization shrinkage. Polymerization shrinkage leads to gap between tooth and the restorative material, causing microleakage. With time there will be debris accumulation and bacterial invasion in this gap, this leads to recurrent caries. This problem of polymerization shrinkage is not seen in case of glass ionomer cements. So, attempts have been made to improve the performance of glass ionomer cement.[2]

Various newer restorative materials are being developed with improved properties. Microleakage serves as an essential tool in assessing newer materials. EQUIA Forte is a newer restorative system that harnesses the benefit of both the restorative materials GIC and composite. It is a two stage restorative system that consists of high viscosity GIC component and a composite resin coating. The resin coating protects GIC from water contamination during the early setting phase and also occludes surface cracks and porosities. Thus, it increases the wear resistance and toughness along with translucency and better marginal seal.

Cention N is a newer basic tooth colored restorative material. It is resin based alkasite restorative. It is basically a subgroup of the composite material class which is having alkaline filler. It is a self cure material. To increase its setting time and decrease its setting time, light curing can be used. Cention N has capability of fluoride, calcium and hydroxide release. Its powder contains various glass fillers, initiators and pigments and liquid contains dimethacrylates and initiators.

Both EQUIA Forte and Cention N claim to have superiority over Glass Ionomer Cement but scientific data comparing these newer restorative materials clinical performance in relation to GIC is not aplenty. In this study we have compared the microleakage of two newer restorative materials EQUIA Forte and Cention N with the conventional Glass ionomer cement.

MATERIALS AND METHODS

Material used for study: Conventional Glass Ionomer Cement, Equia Forte, Cention N, Thermocycler, 0.5% Methylene blue dye, Carborundum disc, Stereomicroscope

Sample Size: The sample size was determined to be 30 per group with 95% confidence interval and 80% power.

Methodology:

Thirty non carious premolars that were extracted for orthodontic causes were chosen. The teeth selected for the study were cleaned and hand scaling was done to remove any debris on their surfaces and were kept in saline till they were not used.[4] To avoid any errors, before preparation Class V cavities were marked with a permanent marker on buccal surface of all teeth at DEJ with dimensions of 3 * 2 * 2 (length 3.0 mm, height 2.0 mm, depth 2.0mm). After that the cavities were prepared using carbide bur (Fig. 1). High speed contra angle air rotor hand piece was used for this using water as a coolant during preparation. Periodontal probe was used for checking dimensions of cavities.[5]

Fig. 1

The teeth were randomly assigned with computer generated random numbers to three experimental groups consisting of 10 teeth each.

Group A: Restoration with Conventional Glass Ionomer Cement

Group B: Restoration with EQUIA Forte

Group C: Restoration with Cention N

The root apices were covered with acrylic[6] and teeth were painted with one coat of nail varnish excluding 1 mm around restorative material margins to avoid dye penetration through these areas.[5] Then the samples underwent thermocycling between 5ºC ± 4ºC and 55ºC ± 4ºC for 500 temperature cycles.[4] After this the samples were placed in a solution of 0.5% Methylene blue dye for 24 h.[7] Samples were removed from dye and were kept for drying. (Fig. 2)

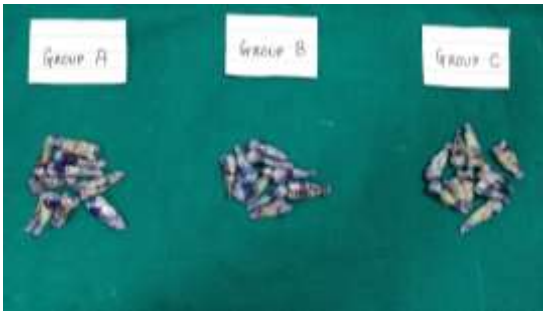

Fig. 2

For assessing the dye penetration, each sample was sectioned in a buccolingual direction through the center of sample using diamond disk (Fig. 3a, 3b) .[4] Evaluation of specimens was done under stereomicroscope to measure the depth of the dye penetration on the occlusal and gingival walls of the teeth.

Fig. 3a

Fig. 3b

Fig. 4

EVALUATION CRITERIA

"The degree of microleakage was determined by the following criteria described by Khera and Chan as follows (Fig. 4):

0=No leakage

1=Less than and up to one-half of the depth of the cavity preparation penetrated by the dye

2=More than one-half of the depth of the cavity preparation penetrated by the dye but not up to the junction of the axial and occlusal or gingival wall

3=Dye penetration up to the junction of the axial and occlusal or gingival wall but not including the axial wall

4=Dye penetration including the axial wall

Scoring was performed by two examiners independently to prevent biasing. Data analysis was done using one way ANOVA, with 16.0 SPSS package."

RESULTS

Scores of microleakage & P value are given in Table 1 & 2 respectively. Within group A, none of the samples showed 0 microleakage. Occlusally, eight samples showed maximum microleakage with scores of 4 whereas five sample showed minimal microleakage of score 2, gingivally. For group B, the microleakage score ranged between 1 and 4, both occlusally and gingivally. Microleakage scores in group C did not exceed much. Seven samples exhibited score 0 in the occlusal wall and three samples in the gingival wall, only one sample exhibited score 4 in this group.Mean microleakage for conventional GIC (3.7) was the highest of all and it was least for Cention N (0.3).

Specimen No.	Group A (Conventional GIC)		Group B (Equia Forte)		Group C (Cention N)	
	Occlusal	Gingival	Occlusal	Gingival	Occlusal	Gingival
1	4	4	3	2	0	2
2	3	2	1	1	0	1
3	4	4	4	4	0	3
4	4	2	4	4	1	4
5	4	3	4	4	1	1
6	4	4	4	3	0	1
7	2	4	2	3	0	0
8	4	4	4	4	0	3
9	4	4	4	4	0	0
10	4	3	3	2	1	0

Table 1: Scores of Microleakage

P- value			
GROUPS	**OCCLUSAL**	**GINGIVAL**	
Group A & B	**0.492**	**0.831**	**Non-Significant**
Group B & C	**0.000**	**0.012**	**Significant**
Group C & A	**0.000**	**0.003**	**Significant**

Table 2: P value

DISCUSSION

Microleakage is used as an important criteria to evaluate the performance of the restorative materials. According to studies, the restorative margins are not stable and impenetrable but relatively have crevices through which leakage occurs.[8] Marginal leakage may occur either due to shrinkage and poor adaptation of restorative material to the cavity walls. This microleakage leads to recurrent caries and pulpal disease.

For longevity of restoration adaptability is of utmost importance. The manufacturers of the products used in this study i.e. Conventional GIC, EQUIA Forte and Cention N, claim them to be the best in every aspect including adaptation to the tooth surface.

In this study, class V cavities were used for comparing microleakage because this area provide challenges in bonding because of presence of two different dental tissues with different composition for bonding i.e. enamel on the occlusal side and cementum on the gingival side. Weak bonding in this area makes it more prone to microleakage. Standardization of the cavities was done to avoid any biasing due to difference in size of cavities. They were restored with the three experimental materials.

Apices of the samples were covered with acrylic. Remaining tooth excluding 1 mm around the restoration was painted with one coat of nail varnish after restoration to avoid dye penetration through these channels. Specimens were subjected to thermocycling to simulate the effect of temperature changes occurring in oral cavity on the restoration. This exposes the tooth to hot and cold extremes, thus showing relation between the linear coefficient of thermal expansion between both of them.

Different test methods exist for investigating and assessing marginal integrity of dental restorations. The microleakage test is listed as a standard method of testing of adhesion of restorative material to tooth structure by the ISO.[9] Various techniques have been used in past to assess the microleakage using radioactive isotopes, Scanning electron microscope, Neutron activation analysis, dyes.[8] The dye penetration method used for assessing microleakage is the most popular method. Methylene blue dye was used to evaluate the microleakage in this study because of its very low molecular size (1 nm). This size is smaller than the diameter of dentinal tubules which allows it to penetrate between interface of the tooth and restoration.[10] The teeth were sectioned in buccolingual halves to examine the dye penetration at both the occlusal and gingival levels. The two halves were examined under stereomicroscope (Carl Zeiss).

No study has been done yet to compare the microleakage associated with use of conventional GIC, EQUIA FORTE and Cention N. This in vitro study was carried for evaluating Conventional Glass Ionomer Cement and two newer restorative materials EQUIA Forte and Cention N**.** The results show that there is significant difference in microleakage of three restorative materials.

Cention N showed least microleakage followed by Equia Forte and Conventional GIC. This may be due to presence of crosslinking methacrylate monomers and its low volumetric shrinkage. Cention N exhibits a high polymer network density and higher degree of polymerization over complete depth of restoration. It has stress reliever, isofiller in it that acts as shrinkage stress reliever which reduces polymerization shrinkage which in turn reduces microleakage. A study by Samanta et al (2017) compared flowable composite, conventional GIC and Cention N. In his study flowable composite showed highest shrinkage followed by conventional GIC. Least microleakage was shown by Cention N. [11]

Samples restored with EQUIA forte showed microleakage less than conventional GIC. These results may be due to the nanofilled resin coating done over the GIC base. Equia coat grants a good marginal sealing, prevents early wear of the restoration, prevents water contamination and dessication during initial setting stage and enhanced mechanical properties of the restoration.

Within the limitations of this study, Cention N seems to be a promising restorative material. But more clinical data needs to be evaluated before this can be authenticated.

CONCLUSION

None of the three restorative materials compared were free from microleakage. Cention N displayed the least microleakage and came to be better than the Equia Forte and Conventional Glass Ionomer Cement.

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