

Assessment of Microleakage among Newer Composite Materials: A comparative study

Tanuj Singh¹, Dinesh Kumar²

¹Medical Officer (Dental), Himachal Pradesh

² Medical Officer (Dental), Himachal Pradesh

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ABSTRACT

Background

Composite restorative materials represent one of the many successes of modern biomaterials research, since they replace biological tissue in both appearance and function. Hence; the present study was undertaken for assessing and comparing the extent of microleakage among Newer Composite Materials.

Materials & methods

A total of 30 freshly extracted mandibular premolars were enrolled in the present study. After cavity preparation, all the specimens were divided into three study groups with 10 specimens in each group as follows: Group 1: Conventional microfilled composite was used, Group 2: Nanocomposite was used and Group 3: ORMOCER was used.

Drying of all the specimens was done followed by reforestation of cavities with restorative materials according to their respective groups. Sealing of the apices was done using clear self-cure acrylic resin. Tooth specimens were coated with nail varnish. After finishing of this procedure, the tooth specimens of the respective groups were immersed in freshly prepared 50% silver nitrate solution for 4 hours. After sectioning, analysis of the specimens was done under stereomicroscope for analysing the depth of penetration of dye.

Results

Mean dye penetration among specimens of group 1, group 2 and group 3 was found to be 0.593 mm, 0.268 mm and 0.058 mm respectively. While analysing statistically, it was observed that mean dye penetration was highest for group 1 specimens, while it was lowest for group 3 specimens. However; mean dye penetration of group 2 specimens was in between group 1 and group 3 specimens.

Conclusion

One of the key roles for the success of restored tooth is the correct choice of restorative material. Hence; ORMOCER had superior marginal sealing ability in comparison to conventional composite and Nanocomposite.

INTRODUCTION

Dental professionals must assume responsibility over time for providing a level of care that is expected to be no less than continuous quality improvement above historically related standards. The materials for sealing elements have special requirements, especially

considering the conditions of operation of such equipment: long production cycle without service, reverse of natural movement, lack of special lubricants, influence of hostile environment and increased temperatures. The widespread use of polytetrafluoroethylene composites in friction units and

* Corresponding author: **Dinesh Kumar**, Medical Officer (Dental), Himachal Pradesh.

seals of various kinds of machinery and equipment is due to features of the molecular and supramolecular structure of polytetrafluoroethylene (PTFE), which ensure the implementation of a unique combination of deformation and strength, tribotechnical, anticorrosive, thermophysical, and other service characteristics, and determine the efficient use of these products.¹⁻³

Composite restorative materials represent one of the many successes of modern biomaterials research, since they replace biological tissue in both appearance and function. At least half of posterior direct restoration placements now rely on composite materials. Unfortunately, demands on these restorations with regard to mechanical properties, placement, and need for in situ curing leave significant room for advancements, particularly with respect to their mechanical properties, polymerization shrinkage and polymerization-induced stress, thermal expansion mismatch, fracture, abrasion and wear resistance, marginal leakage, and toxicity.⁴⁻⁶ Hence; the present study was undertaken for assessing and comparing the extent of microleakage among Newer Composite Materials.

MATERIALS & METHODS

The present study was conducted with the aim of assessing microleakage among newer composite materials. A total of 30 freshly extracted mandibular premolars were enrolled in the present study. Deformed, malformed, carious and teeth with presence of structural anomalies were excluded from the present study. Preparation of standard class II cavities of uniform dimension was done. With the help of William's probe, uniformity of the cavities was checked. After cavity preparation, all the specimens were divided into three study groups with 10 specimens in each group as follows:

Group 1: Conventional microfilled composite was used,

Group 2: Nanocomposite was used, and

Group 3: ORMOCER was used

Drying of all the specimens was done followed by reforestation of cavities with restorative materials according to their respective groups. Thermocycling of all the specimens was done after placing them in three different petri dishes according to their respective groups. After the finishing of the thermocycling procedure, sealing of the apices was done using clear self-cure acrylic resin. Except for the restored are and 2 mm distance from its periphery, the entire remaining surface of tooth specimens was coated with nail varnish. After finishing of this procedure, the tooth specimens of the respective groups were immersed in freshly prepared 50% silver nitrate solution for 4 hours. Excess dye was washed off and the specimens were sectioned buccolingually. After sectioning, analysis of the specimens was done under stereomicroscope for analysing the depth of penetration of dye. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Student t test and one way ANOVA were used for evaluation of level of significance.

RESULTS

In the present study, a total of 30 freshly extracted mandibular premolars were enrolled in the present study. After cavity preparation, all the specimens were divided into three study groups with 10 specimens in each group as follows: Group 1, Group 2 and Group 3. Mean dye penetration among specimens of group 1, group 2 and group 3 was found to be 0.593 mm, 0.268 mm and 0.058 mm respectively. While analysing statistically, it was observed that mean dye penetration was highest for group 1 specimens, while it was lowest for group 3 specimens. However; mean dye penetration of group 2

specimens was in between group 1 and group 3 specimens.

Table 1: Mean dye penetration of all the three study groups

Group	Mean dye penetration (mm)	SD
Group 1	0.593	0.218
Group 2	0.268	0.094
Group 3	0.058	0.012

Table 2: Comparison of mean dye penetration in between different study groups

Study group	t value	p- value
Group 1 versus Group 2	8.23	0.00 (Significant)
Group 2 versus Group 3	7.37	0.01 (Significant)
Group 1 versus Group 3	12.19	0.00 (Significant)

DISCUSSION

In recent years, development of tooth-colored restorative materials has accelerated. Flowable resin composites have been proposed as liners under a hybrid composite resin or for stand-alone use. Their viscosity eases material placement and improves adaptation to cavity walls. It is generally accepted that the use of materials with a low modulus of elasticity reduces marginal leakage. The development and implementation of composite dental restorative materials rely on a comprehensive understanding of each component of the composite and consideration of methods for changing each component. Composites are composed of three distinct phases, each with its own role in dictating material properties: the polymerizable resin, filler, and the filler-resin interface. The resin phase is composed of polymerizable monomers that convert from a liquid to a highly crosslinked polymer upon exposure to visible light, which catalyzes the formation of active centers, typically radicals, that induce polymerization. The filler has several roles, including enhancing modulus,

radiopacity, altering thermal expansion behavior, and reducing polymerization shrinkage by reducing the resin fraction. Finally, the filler-resin interface serves as a bridge by coupling polymerizable moieties to the particle surface.⁷⁻⁹ Hence; the present study was undertaken for assessing and comparing the extent of microleakage among Newer Composite Materials.

In the present study, a total of 30 freshly extracted mandibular premolars were enrolled in the present study. After cavity preparation, all the specimens were divided into three study groups with 10 specimens in each group as follows: Group 1, Group 2 and Group 3. Mean dye penetration among specimens of group 1, group 2 and group 3 was found to be 0.593 mm, 0.268 mm and 0.058 mm respectively. Sudhapalli SK et al compared the microleakage among newer composite materials. Forty-five extracted healthy premolars were collected; standard Class II cavities were prepared. They were randomly divided into three groups of 15 teeth each. The groups were made based on the different composite restorative materials used for restoration. Group A consisted of conventional microfilled composite resin restorations, and Group B was posterior nanocomposite resin. Group C was restored using ORMOCER – Admira. After completion of restorations, all teeth were subjected to thermocycling at 5° C, 37° C, and 55° C for 250 cycles. Later, all samples were immersed into 50% silver nitrate dye group wise for for 4 hours (h), and teeth were sectioned buccolingually. Sectioned teeth were observed under a stereomicroscope for the evaluation of microleakage. The results of their study showed that Group C (ORMOCER – Admira) presented with the least microleakage followed by Group B (Tetric N-Ceram) followed by Group A (Tetric Ceram). Overall ORMOCER – Admira performed better than the other two composite materials with the least microleakage.¹⁰

In the present study, while analysing statistically, it was observed that mean dye penetration was highest for group 1 specimens, while it was lowest for group 3 specimens. However; mean dye penetration of group 2 specimens was in between group 1 and group 3 specimens. Abouelleil H et al evaluated the mechanical and physical properties of a newly developed fiber reinforced dental composite. Fiber reinforced composite EverX Posterior (EXP, GC EUROPE), and other commercially available bulk fill composites, including Filtek Bulk Fill (FB, 3M ESPE), SonicFill (SF, Kerr Corp.), SureFil (SDR, Dentsply), Venus Bulk Fill (VB, HeraeusKulzer), Tetric evoceram bulk fill (TECB, Ivoclar Vivadent), and Xtra Base (XB, Voco) were characterized. Composite samples light-cured with a LED device were evaluated in terms of flexural strength, flexural modulus (ISO 4049, n = 6), fracture toughness (n = 6), and Vickers hardness (0, 2, and 4 mm in depth at 24 hr, n = 5). The EXP samples and the fracture surface were observed under a scanning electron microscopy. EXP, FB, and VB had significantly higher fracture toughness value compared to all the other bulk composite types. SF, EXP, and XB were not statistically different, and had significantly higher flexural strength values compared to other tested composite materials. EXP had the highest flexural modulus, VB had the lowest values. Vickers hardness values revealed SF, EXP, TECB, and XB were not statistically different, and had significantly higher values compared to other tested composite materials. SEM observations show well dispersed fibers working as a reinforcing phase. The addition of fibers to methacrylate-based matrix results in composites with either comparable or superior mechanical properties compared to the other bulk fill materials tested.¹¹

CONCLUSION

From the above results, the authors concluded that one of the key roles for the success of restored tooth is the correct choice of restorative material. Hence; ORMOCER had superior marginal sealing ability in comparison to conventional composite and Nanocomposite.

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