

“COMPARATIVE EVALUATION OF MICROLEAKAGE OF COMPOSITE
RESTORATIVE MATERIALS”

- | | |
|-----------------------------|----------------------------------|
| ¹ Jesudass G | ¹ Associate professor |
| ² Vijay Kumar R | ² Senior lecturer |
| ³ Suresh P | ³ Associate professor |
| ⁴ Yesuratnam Y | ⁴ Assistant professor |
| ⁵ Vijay Kumar KV | ⁵ Associate professor |

¹Department of pedodontics, ^{2,3}Department of periodontics, ⁴Department of Oral surgery, ⁵Department of Community Dentistry, Government dental College and Hospital, RIMS campus, Kadap, Andhra Pradesh.

ABSTRACT: Objectives: To evaluate and compare the marginal leakage in class V cavities restored with three different tooth colored restorative materials using dye penetration system. **Materials and methods:** Thirty extracted premolars were randomly selected for this study. Standardized classV cavities were prepared and then divided into three equal groups. Group I was restored with nano filled composite, Group II was restored with hybrid composite and group III with polyacid modified composite. They were then subjected to thermo cycling, immersed in 2% methylene blue dye, sectioned and examined under stereomicroscope. Dye penetration for each section was recorded and data was analyzed. **Results:** Lowest micrileakage was recorded in group I and highest leakage recorded in Group III.**Conclusion:** Nanofilled composite resins provide a better sealing than hybrid and polyacid modified composites.

KEYWORDS: Microleakage, Nanofilled composite, Hybrid composite, Polyacid modified composite.

INTRODUCTION

A major goal of successful restorative treatment is the effective replacement of natural tooth structure. To achieve this, the restoration must be durable and functional. The durability of a restoration is largely based on maintenance of the tooth/restoration interface. To help to maintain the integrity of the restoration, the tooth/restoration interface must resist dimensional changes to prevent microleakage and possible further deterioration of the restoration ¹.

The clinical use of composite and polyacid modified composite restoration has increased substantially over the last few years due to improvements in formulation, invention and simplification of successful bonding techniques, increased aesthetic demands to maintain the tooth/restoration interface and decline in the popularity of amalgam. Composites are defined as three dimensional combinations of at least two chemically different materials with distinct interface². Dental composites consist of a resin matrix, inorganic filler particles, filler-matrix, coupling agent, and minor additions of polymerization initiators, stabilizers and coloring pigments.

Poly acid-modified resin composite is a direct esthetic restorative material that combines the desirable properties of light curing composites with those of fluoride releasing

glass ionomer cements³. Hybrid composite is a particle-filled resin that contains a graded blend of small and colloidal silica filled particles to achieve an optimal balance among the properties of strength, polymerization shrinkage, wear resistance and polishability. Nano composites contain unique combination of nano fillers (5 – 75 nm) and nano clusters embedded in an organic polymer matrix. The nano fillers are discrete, non-glomerated and non-aggregated particles of 5 – 75 nm in size. Nano cluster fillers are loosely bonded agglomerates of nano-sized particles. These nano-sized filler particles allow the polish and polish retention typical of a microfill in addition to good handling, strength and wear properties.

Aims and Objectives

To evaluate the microleakage in occlusal margin in all three restorative materials.

Methodology

Thirty non-carious human extracted pre-molar teeth were collected and used as test specimens. Standardized Class V cavities with classical kidney shape were prepared on the buccal surfaces of all teeth 1mm above the CEJ.(**Diagram.1 Fig.1.**) The teeth were stored in

isotonic saline and were not allowed to dehydrate under any circumstances. The teeth were randomly assigned to three groups of 10 each.

- Group-I:** Teeth Restored with Nano filled composite
Group-II: Teeth restored with hybrid composite
Group-III: Teeth restored with polyacid modified composite

After acid etching for 15 seconds, teeth were rinsed and then dried bonding agent was applied and cured according to manufacturer's recommendations. Then composite was placed and cured in incremental pattern using visible light cure unit. These teeth were thermocycled. Following the thermocycling (**Fig.2.**) the teeth were inversely placed in a solution of 2% methylene blue dye for 24 hours at room temperature. After removal of superficial dye with slurry of pumice and rubber cup, each tooth was sectioned longitudinally in a bucco- lingual direction with low speed diamond disc.

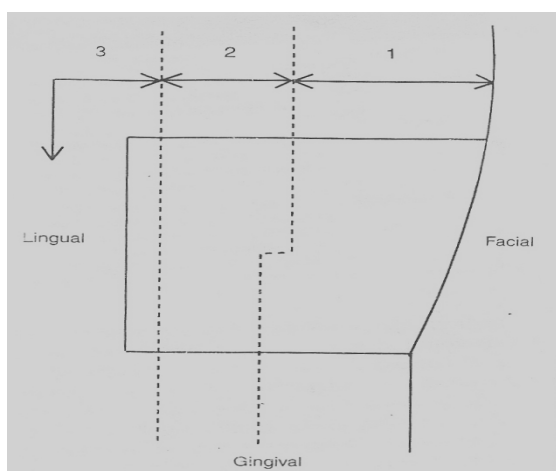
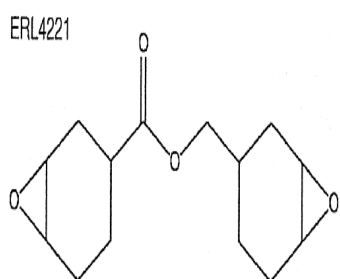


Diagram.1. Standardized Class V cavity preparation



**Chemical structure of cyclohexane
carboxylate**

The microleakage was evaluated by stereo microscope (**Fig.3**). The following scoring criteria were used to assess the extent of dye penetration at the tooth restoration interface.

- Score 0:** No evidence of dye penetration.
Score 1: Dye penetrates to less than half the cavity depth.
Score 2: Dye penetration to full cavity depth.
Score 3: Dye penetration to axial wall and beyond.

Results

The individual and mean values of microleakage of each group Mean values are Group I - 0.8 Group II- 1.2 Group III – 1.5 (**Table.1.**). ANOVA for microleakage in which the source of variation between the groups, the sum of squares is 2.467, mean squares is 1.233. The source of variation within the group, the sum of squares is 7.700, mean square is 0.2852. ANOVA gives p-values of microleakage as (0.023) which is statistically significant. Comparison between I and II groups gives t-value -1.41 and p-value >0.005 which is statistically not significant. Comparison between II and III groups gives t-value -1.66 and p-value >0.05 which is statistically not significant. Comparison between I and III groups gives t-value -2.35 and p-value <0.05 which is statistically significant.

Discussion

The coefficient of linear thermal expansion of resin composites is three (or) four times that of tooth structure. In addition to the difference in thermal expansion coefficients, the shrinkage of composite material induces stress at the tooth / restoration interface and generally results in gap formation. Therefore, polymerization shrinkage and the thermal expansion coefficient of these restorative materials have been suggested as major cause of microleakage. Poor adhesion between dentin and restorative material predisposes gap formation which then leads to marginal leakage⁴.

The gap permits the diffusion of ions and molecules such as enzymes, acids, and migration of bacteria along the cavity walls. Attempts have been made to limit the marginal gap by incremental placement of the resins⁵. The theory of incremental layering infers that increments of material built on each other will distribute the polymerization shrinkage throughout the layers. A strong bond between the layers of resin has been reported.

The nano composite has been shown to exhibit low polymerization shrinkage, which is only a quarter of currently used methacrylate – based composites. It also exhibit a low thermal expansion coefficient of $49.8\mu\text{m}/\text{mc}$ which is lesser than the methacrylate based composites $51.2\mu\text{m}/\text{mc}$. A stronger interfacial interaction between the resin and fillers at nanoscales was demonstrated by an



Fig.1. Premolars with classV cavity



Fig.3. Thermocycler



Fig.3. Stereomicroscope.

Table1 – Microleakage values

Sl.No.	GROUP-I	GROUP-II	GROUP-III
1.	1	1	1
2.	1	1	1
3.	1	1	2
4.	0	1	2
5.	0	1	1
6.	1	1	1
7.	2	2	2
8.	0	1	1
9.	1	2	2
10.	1	1	2
Mean	0.8	1.2	1.5

ANOVA for Microleakage

Source of Variation	Df	Sum of squares	Mean Squares	'F' ratio	'F' probability
Between the groups	2	2.467	1.233	4.325	0.023* (<0.05)
Within groups	27	7.700	0.2852		

* Significant

observed high strength and higher thermal stability of the nano composites.

The polymerization shrinkage of the epoxy based dental restorative resins is 2-3% less compared to the traditional system⁶. The good adhesion properties of epoxy resins would be expected to minimize microleakage⁷.

For nano composites, an improvement in physical properties is expected due to the increased interfacial interaction between resin and fillers⁸. This nano composite restorative material was developed based on epoxy resin 3, 4 epoxy cyclohexylmethyl – (3,4 – epoxy) cyclohexane carboxylate (ERL 4221) and nano silicon fillers.

According to the present study, microleakage values are less in nano filled composite (0.80 ± 0.63) when compared with hybrid (1.20 ± 0.42) and poly acid modified composite (1.50 ± 0.52). The microleakage values of nano composites are less due to the low polymerization shrinkage and good adhesion property. This is correlates with the study done by^{9,10,11,12}

CONCLUSION

Composition of the composite materials has a definite effect on the microleakage values. Smaller particle size improves the marginal adaptation between the tooth and the restorative material which leads to less microleakage and more resistance to fractural forces.

References

1. Lopes LG, Cefaly DF, Franco EB, Mondelli RF and Lauris JR: "Clinical evaluation of two packable posterior Composite Resions". Clinical Oral Investigations 2002,6(2),79-83.(5)
2. Almeida JB, Platt JA, Oshida Y, Moore BK, Cochr Phillips RW: "Effect of Food-Stimulating Liquids on Shear Punch Strength of Composite and Polyacid-Modified Composite Restoratives." Oper Dent 1989, 28-5,530.
3. Dukes ES: "Polymeric adhesion to dentin: Contrasting substrates American Journal of Dentistry 1990,3(6),264-270.
4. Going RE: "Microleakage around dental restoration." J Am Dent Assoc, 1972, 84, 1349-1357. <http://dx.doi.org/10.14219/jada.archive.1972.0226>
5. Til brook DA, Clark RL, Howle NE and Braden M: Photocurable epoxy-polyol matrices for use in dental composites". Biomaterials, 2000, 21, 1743-53. [http://dx.doi.org/10.1016/S0142-9612\(00\)00059-4](http://dx.doi.org/10.1016/S0142-9612(00)00059-4)
6. Lee H and Neville K: "Hand book of epoxy resins, 1972".
7. Giannels EP: "Polymer layered silicate nanocomposite". Adv Mater, 2006, 8, 29-35. <http://dx.doi.org/10.1002/adma.19960080104>
8. Schwartz JL, Anderson MH and Pelleu GB: "Reducing Microleakage with the Glass-Ionomer/Resin Sandwich Technique". Oper Dent 1990, 15,186-192.

9. Rodrigues Joes Augusto, Shinohara MS, Pimenta Luiz "In vitro Micro leakage of Composite restoration after non-vital bleaching." Quintessence Int 2001, 32,101-109.
10. Almeida JB, Platt JA, Oshida Y, Moore BK, Cochran MA and Eckert GJ: "Three Different Methods of Evaluate Micro Leakage of Packable composites in class II Restoration". Oper Dent 2003, 8(4), 453-460.
11. Augiar L FHB, Santos AJS, Franca FMG, Paulillo LAMS jr, and Lovadino: "A Quantitative method of measuring the Microleakage of thermocycled (or) Non – thermocycled posterior tooth restoration". Oper Dent 2003, 28(6), 793-798.
12. Momoi Y, Iwase H, Nakano Y and Kohno A: "Gradual increases in marginal leakage of resin composite restorations with thermal stress". Journal of Dental Research, 1990, 69-10, 1659-1663.

Corresponding Author

Dr .G. jesudass,
Associate professor,
Government Dental College and Hospital,
RIMS,Kadapa.
Phone No.:09618810707
Email:jesudass.govada@gmail.com