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Research Article

Comparative Evaluation of Inter Surface Gap of Three Composite Restorative Materials-Sem Analysis

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Abstract: To evaluate and compare the intersurface gap in class V cavities restored with three different tooth-colored restorative materials using the scanning electron microscope. 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 nanofiller composite, Group II was restored with hybrid composite and group III

with polyacid modified composite. They were then subjected to thermocycling, sectioned and examined under scanning electron microscope. An intersurface gap for each section was recorded and data was analyzed. Lowest intersurface gap was recorded in group I and highest leakage recorded in Group III. Nanofiller composite resins provide a better sealing than the hybrid and polyacid modified composites.

Keywords: Microleakage, Nanofilled composite, Hybrid composite, Inter Surface Gap 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 major disadvantage of resin-based materials is polymerization shrinkage that can lead to the formation of the gap between the tooth and restorative material[2].

Aims & Objectives

1. To evaluate the marginal sealing ability of three commonly used tooth-colored restorative materials under scanning electron microscope

2. To compare the marginal sealing ability of these three tooth-colored restorative materials.

METHODS

Thirty non-carious human premolar teeth were collected. Standardized Class V cavities with classical kidney shape were prepared on the buccal surfaces of all teeth 1mm above the CEJ.The teeth were randomly assigned to three groups of 10 each. Then composite was placed and cured in incremental pattern using visible light cure unit. These teeth were thermocycled subjected to 1000 temp cycles. Each cycle consisted of the 30s at 60C and 600C. Each tooth was sectioned longitudinally in a bucco-lingual direction with a low speed diamond disc. All the groups were prepared for the intersurface gap. The marginal sealing ability indicated by the intersurface gap was evaluated under SEM at a magnification of 500X

OBSERVATIONS AND RESULTS

Table – I: Table I show the individual and mean values of an intersurface gap between the restoration and tooth surface of 10 specimens each in three groups. Mean values are Group I – 51.14 μm, Group II – 60.80 μm and Group III – 76.63 μm.

Table – I: Inter Surface Gap (µm)

S.NO.	GROUP-I	GROUP-II	GROUP-III
	45.0	50.0	60.0
	45.0	55.0	60.0
	48.0	60.0	60.0
	50.0	60.0	65.0
	50.2	60.0	70.0
	50.2	60.0	70.0
	53.0	65.0	70.0
	55.0	65.0	72.0
	55.0	65.0	74.0
	60.0	68.0	75.0
Mean	51.14	60.8	67.63

Table – II: shows analysis of variance (ANOVA) of inter surface gap in all 3 groups. ANOVA for inter surface gap in which the source of variation between the groups, the sum of squares is 1368.0, mean square is 684.1.

Table – II: Analysis of Variance

ANOVA for Inter Surface Gap

Source of Variation	Df	Sum of squares	Mean Squares	''F' ratio	'F' probability
Between the groups	2	1368.0	684.1	23.99	0.000* (<0.05)
Within groups	27	770.1	28.5		

* **Significant**

The source of variation within the group, the sum of squares in 770.1, mean square is 28.5.

ANOVA gives p-values of inter surface gap as 0.000(<0.05) which is statistically significant.

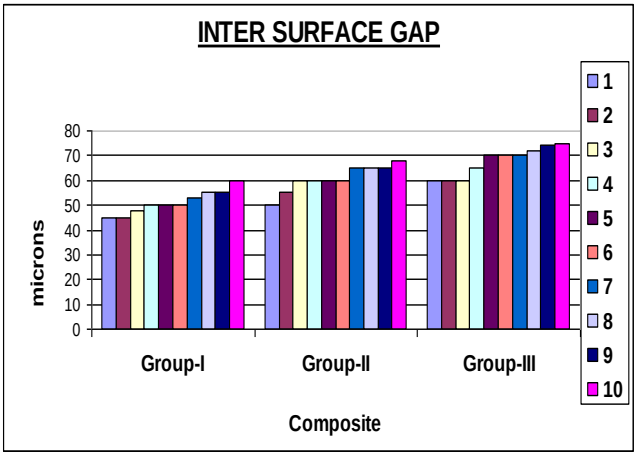
Table-III: Comparison between I and II groups gives t-value gap-6.67 and p-value <o.05 which is statistically significant. Comparison between II and III groups gives t-value -4.34 and p-value <0.05 which is statistically significant. Comparison between I and III groups gives t-value -1.32 and p-value <0.05 which is statistically significant.

Table –III: Comparison between Groups

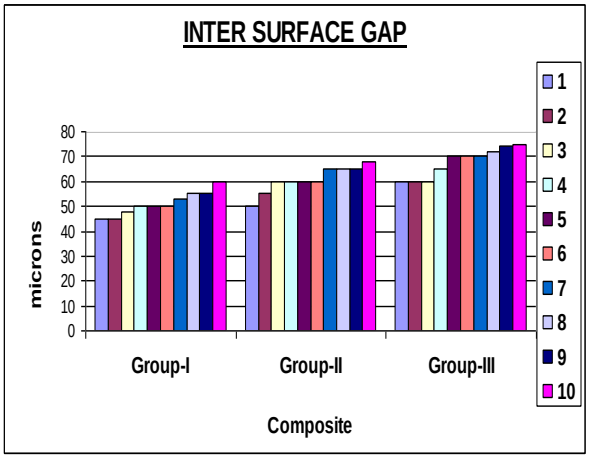
GROUP	d.f.	't' value	'p' value	Inference
Inter Surface Gap				
I and II	18	- 6.67	< 0.05	Significant
II and III	18	- 4.34	< 0.05	Significant
I and III	18	- 1.32	< 0.05	Significant

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[3]. Attempts have been made to limit the marginal gap by incremental placement of the resins[4]. 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. Nano composites contain a unique combination of nanofillers and nanoclusters embedded in an organic polymer matrix. These Nano-sized filler particles allow good handling, strength and wear properties. 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 49.8µm/mc which is lesser than the methacrylate based composites 51.2µ/mc. The polymerization shrinkage of the epoxy based dental restorative resins is 2-3% less compared to the traditional system[5]. The good adhesion properties of epoxy resins would be expected to minimize microleakage[6]. For nano composites, an improvement in physical properties is expected due to the increased interfacial interaction between resin and fillers[7].This nanocomposite restorative material was developed based on epoxy resin 3, 4 epoxy cyclohexyl methyl – (3, 4 – epoxy) cyclohexane carboxylate (ERL 4221) and nano silicon fillers.

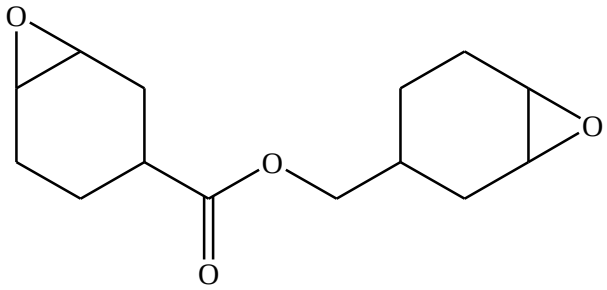


Graph-1



Graph-2

For nano composites, an improvement in physical properties is expected due to the increased interfacial interaction between resin and fillers[7].This nanocomposite restorative material was developed based on epoxy resin 3, 4 epoxy cyclohexyl methyl – (3, 4 – epoxy) cyclohexane carboxylate (ERL 4221) and nano silicon fillers.



(7-oxa-bicyclo[4.1.0]heptan-3-ylmethyl 7-oxa-bicyclo[4.1.0]heptane-3-carboxylate)

ERL4221

The inter surface gap was evaluated under the scanning ELECTRON microscope which revealed that minimal gap is seen in the nanocomposite filled specimen (51.8 $\pm$ 4.72) compared to the hybrid (60.8 $\pm$ 5.35) and polyacid modified composite (67.6$\pm$ 5.89). The results show that the nanoparticles of the epoxy based composite exhibited good adhesion with the cavity surface that this is in accordance with the study done by Lee H and Neville K[6].

Figure-1. Polyacid modified composite

Figure-2. Hybrid composite

Figure-3. Nanofilled composite

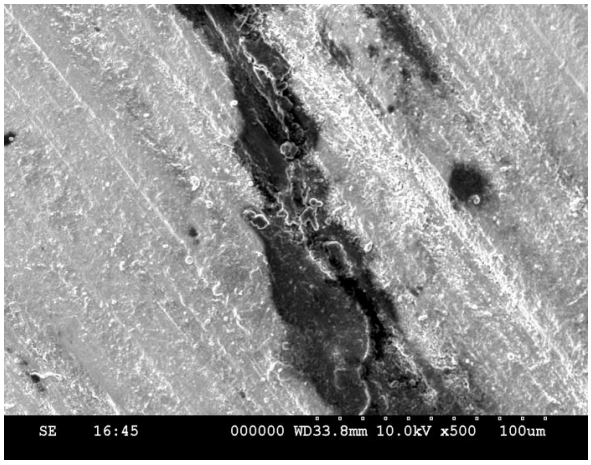


Figure-4. Nano filled composite

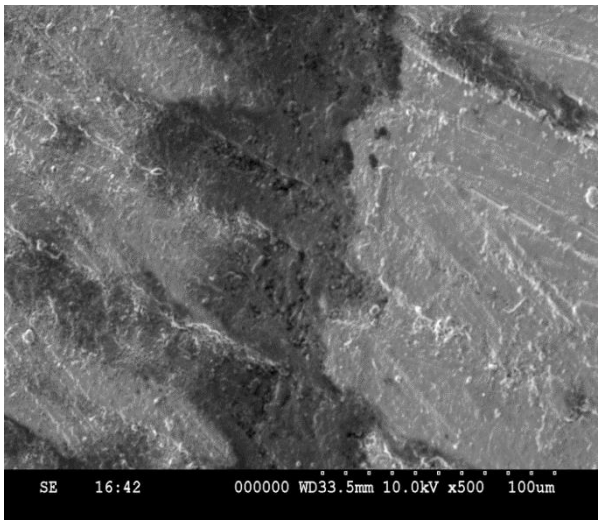


Figure-5. SEM of hybrid composite

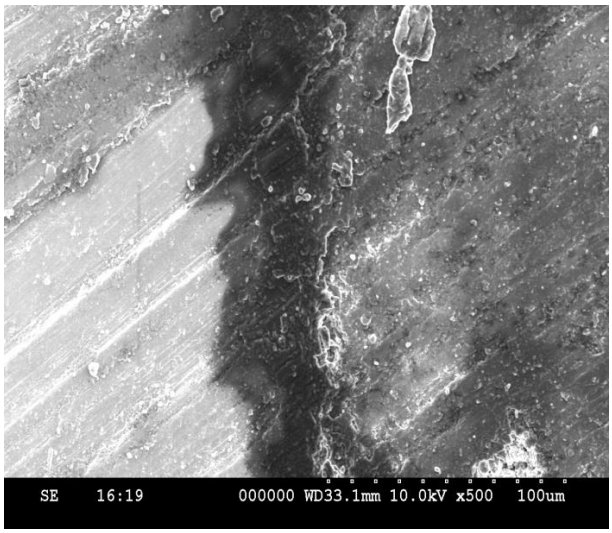


Figure-6. SEM of Nanofilled composite

From the results of this study it can be concluded that smaller particle size improves the marginal adaptation between the tooth and the restorative material which leads to minimum intersurface gap. The results of this study are clearly showing that the newly developed nano filled composite material has better physical properties than poly acid modified composite, and hybrid composite, and these nano filled composites can be reckoned as restorative materials of future generation.

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