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EVALUATION OF MICROLEAKAGE IN CLASS V RESTORATIONS USING COMPOSITE RESIN - AN IN VITRO STEREOMICROSCOPIC STUDY

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ABSTRACT

Background- Secondary caries is one of the most common causes of failure of dental restoration. One of the purposes of a dental restoration is to create a fluid tight seal at the material/tooth interface, which should be resistant to contamination from oral fluids. Recent Advancements have included the introduction of "packable" and "flowable" composites—allowing for enhanced adaptability of restorative materials, thereby reducing microleakage. **Aim:** Aim of this In vitro study is to compare and evaluate the microleakage in occlusal Cavo surface margin at Class V cavity preparation using different Restorative materials. **Materials & Method:** Thirty freshly extracted mandibular molar teeth were collected, randomly assigned into three different groups, standardised class v cavity preparation was done and restored with following 3 materials Group A Nanohybrid composite (Tetric N Ceram) Group B Flowable Composite (Tetric N Flow) + Nanohybrid composite (Tetric N Ceram) Group C Flowable composite (Tetric N Flow) Standardised class V cavities on the buccal surface were prepared. Dimensions of cavity being 2x3x2 mm (Height x Width x Depth). Enamel bevel in occlusal third 0.5mm depth (35 to 45 degree) is given using flame shaped Fine grit Diamond bur. Teeth in A, B & C group were restored with respective Composite resins and Light cured. Samples were then coated with Nail varnish and Immersed in Rhodamine B dye for 24hrs at 37-degree C. Restorations are sectioned longitudinally in a buccolingual direction (0.5mm thick appx.) using diamond discs. Dye Penetration was examined under Stereomicroscope at 40x Zoom. **Statistical Plan:** Kruskal Wallis test with the post-hoc Dunn's test was used to analyze the differences between the three groups. The P value of ≤0.05 was considered as the level of significance. **Results:** It was observed that the highest amount of microleakage was exhibited by Group C (Mdn:1.5, IQR:1-2.25), followed by Group A (Mdn:0, IQR:1-1.25), and the least by Group B (Mdn:0, IQR:0-1). **Conclusion:** This study will give us a clear comparison of Microleakage of composite resins used to restore a Class V Cavity.

INTRODUCTION –

Microleakage has been defined as "a clinically undetectable movement of bacterial fluids, molecules, and ions in microgaps (10 $^{-6}$ m) between the cavity wall and the restorative material applied to it."[1]

The marginal seal is an essential component of a successful restoration. Repairing Class V cavities involves what is never an easy task at the dentin interface, since there is no enamel to attach to. Bonding is more challenging between dentin and cementum at the gingival margin due to dentin's larger organic components, tubular structure, fluid pressure, and lower surface energy.[2] But even enamel cavosurface margin show microleakage. Now recently suggested method to address the drawbacks of resin composites is to use flowable composites as the liner. These resins serve as stress breakers and are used as the first thin layer beneath composites.[8]

Aims and objectives of the study- Aim of this In vitro research is to compare and evaluate the microleakage in occlusal cavo surface margin at Class V cavity preparation using different composite resins.

MATERIALS AND METHODS-

Thirty freshly extracted teeth have been collected from the Department of Oral and Maxillofacial Surgery for periodontal purposes. The extracted teeth were cleaned of calculus and soft-tissue remnants using an ultrasonic scaler and were disinfected using 5.25 % sodium hypochlorite for 30 min and rinsed with distilled water. The teeth were stored in 0.1% Thymol solution until use.

Every sample was wax-mounted till the root. Standardised measurements of 2 mm for height, 3 mm for width, and 2 mm for depth were used to prepare the cavities. Enamel bevel in occlusal third 0.5mm depth (35 to 45 degree) is given using flame shaped Fine grit Diamond bur. Samples were divided into 3 groups.

Group A -Nanohybrid composite, **(**TETRIC –N -CERAM**)**
Group B -Flowable Composite **(**TETRIC - FLOW**)** first 1 mm followed by packable composite resin **(**TETRIC –N -CERAM**)** 1 mm.
Group C- Flowable Composite (TETRIC -FLOW)

Materials	Composition	Company
TETRIC –N -CERAM	Monomer matrix-Dimethacrylates (19-20 weight %) Fillers contain barium glass, ytterbium trifluoride, mixed oxide, copolymers (80-82 weight %) Additives, catalysts, stabilizers and pigments	Ivoclar Vivadent
TETRIC -FLOW	Monomer matrix: 28 wt% of monomethacrylates and dimethacrylates. Fillers: 68.2 wt%/46.4 vol%. of barium glass, ytterbium trifluoride, and copolymers Additives: <1.0 wt% of additives, initiators, stabilizers, and pigments	Ivoclar Vivadent

TETRIC N-BOND	Methacrylate, water, ethanol, silicon dioxide, photo stabilizers, stabilizers ph: 2.5 – 3.0	Ivoclar Vivadent

The surface was then blotted dry and self-etching adhesive (Tetric N-Bond, Ivoclar vivadent) was applied and light cured (1200mW/cm^2) for 20 seconds for Group A, B & C.

In group A - Nanohybrid composite **(**TETRIC –N -CERAM**)** was placed into the cavity in 1 mm incremental manners and each increment was light cured for 20 sec.

In group B- Flowable Composite (TETRIC - FLOW) first 1 mm was placed and light cured for 20 sec followed by packable composite resin **(**TETRIC –N -CERAM**)** was placed into the cavity and light cured for 20 sec.

In group C -- Flowable Composite (TETRIC -FLOW) was placed into the cavity in 1 mm incremental manners and light cured for 20 sec.

After being covered in nail polish except on restorative material, the samples were submerged in a 0.5% Rhodamine B solution for one day. After that Using a diamond disc, the teeth were cut in the following manner, first cut is made Buccolingually through till middle of the tooth, second cut is made mesiodistally through till middle of the tooth, third cut is made 1 mm cervical to occlusal margin of the restoration. Under a stereomicroscope with a ×20 magnification, sectioned restorations were inspected.

Statistical Analysis -
Descriptive statistics were used to report the quantitative variables in terms of median (central tendency) and Inter-quartile range (IQR) (measures of dispersion). Kruskal Wallis test with the post-hoc Dunn's test was used to analysed the differences between the four groups. The P value of ≤0.05 was considered as the level of significance.

RESULTS-
As recommended by Silveira de Araujo et al., the depth of dye penetration was assessed using a 0–3 scale grading system.[3]
0 = No dye penetration
1 = Dye penetration up to half of the cavity depth
2 = Dye penetration more than half of the cavity depth
3 = Dye penetration arriving to the cavity floor

The stereomicroscope images showed that, to varying degrees, Rhodamine B dye penetration indicated microleakage in each specimen.

Table 1: Descriptive statistics and comparison of the fracture resistance(N) between the study groups

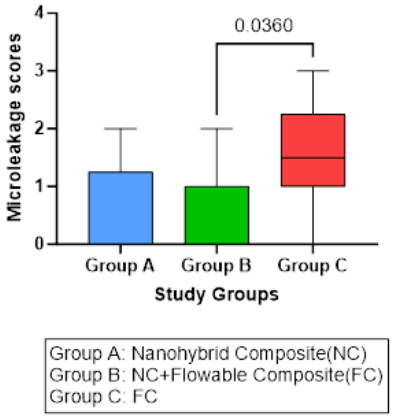
Study Groups	Median (IQR)	Minimum	Maximum	*P* value
Group A(*n*=10)	0(0-1.25) ab	0	2	0.02*
Group B(*n*=10)	0(0-1) a	0	2	
Group C(*n*=10)	1.5(1-2.25) b	0	3	

n: sample size per group
*: statistically significant (P<0.05)
Different lowercase letters indicate a significant difference between the study groups

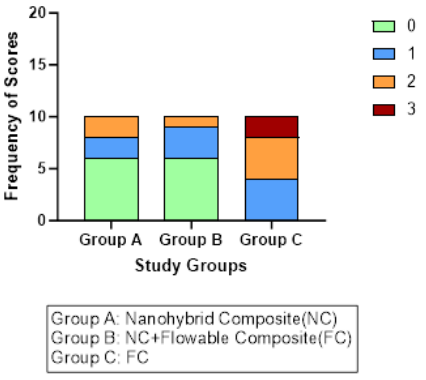
It was observed that the highest amount of microleakage was exhibited by Group C (Mdn:1.5, IQR:1-2.25), followed by Group A (Mdn:0, IQR:1-1.25), and the least by Group B (Mdn:0, IQR:0-1)

The difference in the values of microleakage was compared using the Kruskal Wallis test which inferred a significant difference existing between the study groups (P=0.02). Dunn's test was carried out as a part of a post-hoc analysis and it indicated that the microleakage scores were significantly higher in group C specimens as compared to group B(P=0.036).

It was also observed that no significant difference existed between Group A and Group B or between Group A and Group C



Box Plot: Comparison Of The Microleakage Values Between The Study Groups



Stacked Bar Graph Showing The Distribution Of Microleakage Scores Between The Study Groups

DISCUSSION-
Due to the continuous rise in aesthetic expectations, composites resin has become the preferred option for aesthetically restoring class V lesions. Interfacial defects in composites often arise from prolonged exposure to heat and mechanical strains, as well as stresses produced by polymerization shrinkage and the material's physical and chemical characteristics. Interfacial flaws can result in microleakage, which is concerning due to its potential to cause staining at the edges of dental restorations, recurrent tooth decay, increased sensitivity, and injury to the dental pulp. Nanohybrid resin composites (Tetric N Ceram) showed the least microleakage. These results were consistent with those of Shah et al (2020) who compared nanohybrid resin composites to micro filled resin composites. According to Shetty et al (2021), nanohybrid resins may provide desired results when compared to other resin composites. [3] . The reduction in marginal leakage of bacteria and contaminants is automatically facilitated by filler technology (80-82 Wt%), which contributes to greater strength and fewer spaces between adjacent particles, thereby aiding in the mitigation of microleakage. [7] The predominant resin matrix in (Tetric N-Ceram) is UDMA, which have high molecular weight but low

viscosity, high flexibility, reduced water sorption and great polymerization rate. There are some advantages of liner under packable composite is to reduce the stress magnitude in composite restoration a low stiffness material is applied between the restoration and cavity walls to increase the compliance of bonding substrate. Another benefit from this procedure is that stress distribution is more uniform along the low elastic modulus layer. This technique is called elastic cavity wall and is accomplished using intermediate layer of low viscosity flowable composite which causes reduction in microleakage. Simi and Suprabha [4] showed that the marginal adaptation of a composite improved when used in conjunction with a flowable composite. Chuang et al. [5] concluded that a 0.5–1.0 mm layer of flowable composite liner used under packable composite restorations resulted in a significant reduction in microleakage. Yazici et al. [6] found a combination of flowable and nanohybrid composites to yield the most effective reduction in micro-leakage. The property of microleakage is directly related to the amount of filler content present in the composite material. This filler loading capacity enhances the strength of the flowable composite. Additionally proves the fact that the more the amount of filler (vol%), the lesser will be the microleakage experienced at the material margins.

Size and type of particle also influence the microleakage of composites. [9] Tetric N Flow (Group III) contains Barium glass, ytterbium fluoride, and silica, which have a smaller particle size showed maximum microleakage.

CONCLUSION-

All examined restorative systems exhibited microleakage to some extent, with varying levels of significance between them. Flowable Composite (Tetric N Flow) + Nanohybrid composite (Tetric N Ceram) group shown superior performance in reducing microleakage compared to Flowable composite Tetric N-Flow and Nanohybrid composite Tetric N ceram.

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