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"COMPARATIVE EVALUATION OF MICROLEAKAGE IN CLASS V CAVITIES RESTORED WITH TWO NEWER FLOWABLE COMPOSITES"

Dentistry

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ABSTRACT

Aim: The aim of this study was to evaluate microleakage around class V cavities restored using two flowable composites namely GC G-aenial Flow composite and 3M Filtek Supreme Flow Composites." **Materials and Methods:** Sixty human premolars with no anomaly or decay extracted for orthodontic reasons were included in this study. The samples (n= 60) were divided into four groups (n=15) based on the materials used for the restoration. In group1,2 and 3, conventional class V cavities were prepared on the facial surface of all teeth parallel to the cemento-enamel junction. In Group1 (n=15), the samples were restored with GC G-aenial Universal flow composite. In Group2 (n=15), the samples were restored with 3M Filtek supreme flow composite. In Group3 (n=15), the only class V cavity preparation was done without restoration. In group 4 (n=15), no cavity preparation was done. The samples were subjected to 500 thermocycling and microleakage was assessed using 2% methylene blue. The teeth were then sectioned in a bucco-lingual direction through the centre of the restoration. The sections were assessed under stereomicroscope at 40x magnification. **Results:** In between Group 1 (GC G-aenial Universal Flow) and Group 2 (3M Filtek Supreme Flow), least microleakage was exhibited by Group 1. In Group 1 there was no significant difference between occlusal and cervical microleakage. In Group 2 microleakage was found to be significantly higher at cervical margin." **Conclusion:** GC G-aenial flow composite showed less microleakage as compared to 3M Filtek Supreme Flowable Composite in both occlusal and cervical margins.

KEYWORDS

3M Filtek Supreme Flow, Class V cavity, GC G- aenial Universal Flow, Microleakage, Stereomicroscope.

INTODUCTION

Restoring Class V cavities poses a significant challenge in modern dentistry due to their location and minimal retention form.[1] Resin-based composites have revolutionized restorative dentistry by preserving more natural tooth structure and offering superior adhesion properties compared to traditional amalgam and glass ionomer cement.[2] However, their clinical longevity is often compromised by microleakage at the restoration interface, primarily due to debonding, leading to issues such as marginal discoloration, sensitivity, and recurrent caries.[3]

The lack of adaptation of composites may occur partly due to their polymerization contraction and extreme temperatures in the oral cavity, which may break the adhesion between the adhesion and the cavity walls, forming micro gaps. Such gaps allow the penetration of microorganisms, fluids and chemical substances from the oral environment, which may result in postoperative sensitivity, marginal deterioration, recurrent caries and pulp injury. Marginal adaptation becomes even more difficult in class V cavities where there is little or no enamel at the cervical margins, and the restoration comes in contact with cementum. This decreases adhesion considerably, facilitating the dislodgment of the material towards occlusal surface during polymerization, because adhesion of a composite resin to enamel surface is better when compared to dentin surface.[3]

The use of flowable composites is recommended technique in restoring class V cavities for overcoming the microleakage of composite resins.[4] Recently a new generation of flowable composite resins have been introduced with improved physical and mechanical properties over conventional composite resins namely GC G-aenial Universal Flo and 3M Filtek supreme flow. It is a light-cured composite resin claiming to have improved qualities that allow restoring different types of cavities while offering good viscosity and ease of handling.

Another material 3M ESPE Filtek Supreme Ultra Flowable Restorative is a low-viscosity, visible-light activated, radiopaque, flowable nanocomposite. Filtek Supreme Flowable Restorative contains Procrylat, BisGMA, and TEGDMA resins.[4]

The present study was an attempt to compare the microleakage of G-aenial flow and 3M filtek supreme flow, newly introduced flowable composites in class V cavities.

MATERIALS AND METHOD

1. Sample Preparation:

Sixty human premolars with no anomaly or decay extracted for orthodontic reasons were cleaned using ultrasonic device and stored in 1% thymol solution for 1 week and kept in normal saline to prevent dehydration. Conventional class V cavities, 3 mm wide, 2 mm deep and 2 mm height were prepared on the facial surface of the teeth parallel to the cementoenamel junction using 1.2 mm diamond cylindrical bur in a high-speed handpiece with water coolant. The cervical margin of the preparation was located in dentin and the occlusal margin was located in enamel. The cavities were washed with water for 20 seconds and then dried using an air syringe.

The specimens were then divided into four groups:

Group 1 (n=15): teeth restored with G aenial flow (GC)
Group 2 (n=15): teeth restored with Filtek supreme flow (3M)
Group 3: 15 teeth with only cavity without restoration
Group 4: 15 teeth without cavity preparation

After etching using 37%phosphoric acid, bonding was done using PRIME & BOND UNIVERSAL (Dentsply sirona, USA). Cavities were restored using GC G-aenial flow composite in Group 1 and restored with 3M Filtek supreme flow composite in Group 2 which were cured for 20 secs using a light source with an irradiance of 1200 mW/cm2. The restorations were finished with the composite finishing burs (Shofu, Japan) and polished with Soflex discs (3M dental products).

Group 3: A standardised class V cavity was prepared on the facial surface of all the fifteen teeth and were left unrestored for the study and

was designated as positive control group

Group 4: All the fifteen samples of this group were left intact without cavity preparation and was designated as negative control group.

The samples were subjected to 500 thermocycling (5^0 C ± 2^0C &55^0C ± 2^0C) with a 30 s dwell time)

2. Microleakage Test:
All the specimens (Group1, 2and 3) were coated two layers with nail varnish within a distance of 1mm to the margin of restoration. The specimens of Group 4 (teeth without cavity preparation) were completely coated with two layers of nail varnish. All the specimens were immersed in 2% methylene blue solution at room temperature for 24 hours, and then each sample was washed with 20 ml distilled water. The nail varnish was scrapped off from all the specimens. The specimens were air dried and were cut bucco-lingually right from the middle of the restoration with the help of diamond disc.

Finally, the marginal microleakage was examined at occlusal margins and cervical margins of cavities using a stereomicroscope at 40X magnification, and were photographed with a camera which was attached to the stereomicroscope under magnification.

3. Scoring Criteria:
Taking in to consideration the degree of dye penetration the samples were scored into four grades:[5]
Score 0: No microleakage found
Score 1: Dye penetration by one-third of the cavity depth
Score 2: Dye penetration by two-thirds of the cavity depth
Score 3: Dye penetration by more than two-thirds of the cavity depth
Score 4: Dye penetration reaching the axial wall or towards the tooth pulp
Finally, the mean score of microleakage was calculated for each group. The obtained data were subjected to statistical analysis.

Statistical Analysis
The data was analysed by SPSS (21.0 version).Owing to the ordinal nature of the data, non-parametric tests were used for inferential statistics. For Intergroup comparison, Kruskal Wallis test was used followed by Mann Whitney U test for pairwise post hoc comparison. For Intragroup comparison Wilcoxon sum rank test was used. Level of statistical significance was set at p-value less than 0.05.

RESULTS

Intergroup comparison revealed that overall statistically significant difference was obtained when mean micro leakage at occlusion margin was compared among all four study groups. Pairwise comparison showed that mean micro leakage was found to be significantly higher in Group 3 as compared to Group 1, 2 and 4.

Table 1A: Intergroup comparison of mean microleakage at occlusal margin using Anova

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Overall P value
					Lower Bound	Upper Bound			0.001*
Group 1	15	1.000	0.6547	0.1690	.637	1.363	.0	2.0	
Group 2	15	1.667	0.8165	0.2108	1.215	2.119	.0	3.0	
Group 3	15	4.000	0.000	.0000	4.000	4.000	4.0	4.0	
Group 4	15	.000	0.000	.0000	.000	.000	.0	.0	

Table 1B: Intergroup comparison of mean microleakage at occlusal margin using post hoc

Groups	P value
Group1 vs Group 2	0.001*
Group 1 vs Group 3	0.001*
Group 1 vs Group 4	0.001*
Group 2 vs Group 3	0.21, NS
Group 3 vs Group 4	0.001*

On comparing mean microleakage at cervical margin, overall significance difference was obtained when mean micro leakage at cervical margin was compared among four study groups. Pairwise comparison showed that mean micro leakage was found to be significantly higher in group 3 as compared to Group 1, 2 and 4 at cervical margin. Also microleakage of Group 1 was found to be significantly lesser than microleakage of Group 2 at cervical margin.

Table 2A: Intergroup comparison of mean microleakage at cervical margin using Anova

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Overall P value
					Lower Bound	Upper Bound			0.001*
Group 1	15	1.067	.7988	.2063	.624	1.509	.0	2.0	
Group 2	15	2.333	.6172	.1594	1.992	2.675	1.0	3.0	
Group 3	15	4.000	.0000	.0000	4.000	4.000	4.0	4.0	
Group 4	15	.000	.0000	.0000	.000	.000	.0	.0	

Table 2B: Intergroup comparison of mean microleakage at cervical margin using post hoc

Groups	P value
Group 1 vs Group 2	0.001*
Group 1 vs Group 3	0.001*
Group 1 vs Group 4	0.001*
Group 2 vs Group 3	0.001*
Group 3 vs Group 4	0.001*

On comparing micro leakage at Occlusal and cervical margin. In Group 1, the difference in the micro leakage at occlusal and cervical margin failed to reach the level of statistical significance. But In Group 2 mean micro leakage was found to be significantly higher at cervical margin.

Table 3: Intragroup comparison of microleakage between Cervical and Occlusal using Post hoc.

		Mean	Std. Deviation	Std. Error Mean	Mean difference	P value
Group 1	Occlusal margin	1.000	.6547	.1690	0.06± 0.88	0.774, ns
	Cervical margin	1.067	.7988	.2063		
Group 2	Occlusal margin	1.667	.8165	.2108	0.66±1 .17	0.045*
	Cervical margin	2.333	.6172	.1594		
Group 3	Occlusal margin	4.000	.0000	.0000	-	-
	Cervical margin	4.000	.0000	.0000		
Group 4	Occlusal margin	.000	.0000	.0000	-	-
	Cervical margin	.000	.0000	.0000		

DISCUSSION

Microleakage serves as a critical indicator of the effectiveness of restorative materials which is characterized by the imperceptible movement of bacteria, fluids, molecules or ions between the cavity walls and the restorative materials. The potential factors contributing to microleakage in enamel and dentin restoration margins include polymerization shrinkage, the physical properties of the restorative material, insufficient marginal adaptation of the restorative material, the curing light source and photo initiators.[6] Restoring class V cavities presents a challenge due to the majority of cervical margins being situated in dentin and cementum, resulting in weaker marginal adaptation compared to enamel surfaces, thus increasing the risk of restoration failure.[7]

In clinical practice, flowable composite resins are extensively employed and are often the preferred choice for restoring cervical lesions over traditional resin composites. Renowned for their favourable aesthetic properties, these materials are distinguished by their low viscosity, facilitating easier placement and greater self-adaptability compared to stiffer alternatives. Additionally, flowable materials may serve as stress-breakers during application, further enhancing their utility in restorative procedures.[8]

G-aenial Universal flow comprises of high-molecular bis-GMA resin and a pre-polymerized filler identified as factors capable of diminishing shrinkage in dental composites. Specifically, in the formulation of G-aenial Universal Flow, silicon dioxide (with filler particle size exceeding 16 nm) and strontium glass (filler particle size above 200 nm) were employed to attain a semi-liquid consistency rich in filler content.[9]

3M ESPE Filtek Supreme Flowable is composed of various resins,

including Procrylat, BisGMA and TEGDMA. Its fillers encompass diverse types and sizes. The average cluster particle size falls within the range of 0.6 to 10 µm. These components collectively contribute to its flowable nature and overall performance as a restorative dental material.[10]

Taking in to consideration the degree of dye penetration the samples were scored into four grades according to the scoring criteria advocated by Fathpur k et al.[5] Same criteria was also used to assess the microleakage by Kumar A et al[11] and Sameer p et al.[12]Finally, the mean score of microleakage was calculated for each group.

Among the experimental groups, the least microleakage was exhibited by Group1; restored with GC G-aenial Universal flow composite which might be due to advanced ultra-fine strontium glass fillers, treated with silane surface technology and averaging a size of 200 nm. This formulation enhances the bond between the filler particles and the matrix, resulting in reduced polymerization shrinkage. Findings similar to the present study has been demonstrated by Sooraparaju SG et al[13] evaluating the microleakage in class V restorations found that GC G-aenial Universal flow showed the least microleakage attributing to its high flexibility, pre-polymerised fillers, low volumetric shrinkage of G-aenial Universal flow helps preserve tooth structure by maintaining margins, thereby minimizing both microleakage and cracks.[13]

Intragroup comparison revealed that microleakage was more at cervical margin as compared to occlusal margin in both GC G-aenial Universal flow and 3M Filtek Supreme Flow. However, the difference was not statistically significant in G-aenial Universal flow. The increased microleakage observed at cervical margins in Class V cavities can be attributed to the characteristic junction between the crown and root. Here, the enamel thickness decreases while dentin or cementum becomes more prominent. This complex anatomy poses difficulties in achieving optimal bonding and sealing conditions, thus leading to heightened levels of microleakage. This is in accordance with a study conducted by Gupta SK et al[14] (2012) evaluating the microleakage in class V cavities restored with various glass ionomer cements (conventional glass ionomer, RMGIC, Nano filled RMGI) and also stated that microleakage was more at cervical margins than occlusal margins.[14]

Microleakage is predominantly observed when the gingival margin of a restoration is positioned below the cementoenamel junction. This is primarily because bonding to dentin is less effective compared to enamel, owing to its intricate pattern and lower mineral content. This phenomenon may be attributed to the variance in bonding capabilities between enamel (occlusal) and dentin (cervical).[15]

The study has a few limitations, the main limitation is that the forces affecting the class V cavities were not simulated in the present study which may also cause microleakage. Future studies are required to compare the microleakage in in vivo environment.

CONCLUSION

Within the limitations of the study, none of the materials was free from microleakage. Among the two restorative materials used, GC G-aenial Universal flow composite had comparatively less microleakage as compared to 3M Filtek supreme flowable composite. In addition, GC Gaenial Universal flow composite exhibited significantly less microleakage around the cervical margins. Therefore, it can be concluded that GC G-aenial Universal flow composite may offer optimal performance in Class V restorations.

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