ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 6, Issue – 3, May - 2023, Page No. : 144 – 150

Cervical Microleakage in Class II Restorations- An In -Vitro Study

[1]Dr. Shirin Sunil Darure, Post graduate student Department of Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

[2]Dr. Anantha Krishna. S, Professor and HOD Department of Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

[3]Dr. Pradeep P.R., Principal and Professor Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

[4]Dr. Vijay Shankar L.V., Reader Department of Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

[5]Dr. Dipin Tom Jose, Post graduate student Department of Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

[6]Dr. Vinayak Jagdish Rao, Post graduate student Department of Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

Corresponding Author: Dr. Shirin Sunil Darure, Post graduate student Department of Conservative dentistry and Endodontics M.R. Ambedkar dental college and hospital Bangalore.

Citation of this Article: Dr. Shirin Sunil Darure, Dr. Anantha Krishna. S, Dr. Pradeep P.R., Dr. Vijay Shankar L.V., Dr. Dipin Tom Jose, Dr. Vinayak Jagdish Rao, "Cervical Microleakage in Class II Restorations- An In -Vitro Study", IJDSIR- May - 2023, Volume – 6, Issue - 3, P. No. 144 – 150.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: The purpose of this In-vitro study was to determine the effect of different placement techniques on gingival microleakage of giomer and composite restorations.

Materials and methods: 32 Class II preparations were created in 16 extracted molar teeth with cervical margins 1mm below the CEJ. The teeth were divided into 4 groups of 4 teeth each.

Group 1: Teeth were restored with Snow-plow technique using Beautifil II and Beautiful flow.

Group 2: Teeth were restored with Horizontal increment technique using Beautifil II.

Group 3: Teeth were restored with Snowplow technique using nano filled flowable composite and Nanohybrid composite.

Group 4: Teeth were restored with Horizontal increment technique using Nanohybrid composite.

After thermocycling & immersion in 2% methylene blue, the teeth were sectioned and dye penetration was evaluated under a stereo micro scope at 25x magnification.

Inferential statistics: Kruskal wallis test followed by Mann Whitney post hoc test will be used to compare the cervical micro leakage scores between different study groups. The level of significance will be set at P<0.05.

Results: According to the comparison, snowplow restorations showed least micro leakage followed by horizontal increment technique.

Conclusion: Microleakage was clinically significantly lower in snowplow restorations compared to the horizontal increment technique, which has lower microleakage. Our future scope is snowplow restorations can provide the best marginal seal clinically.

Keywords: Horizontal Increment, Buccolingual, Restorations

Introduction

The placement of restorative material in teeth is not an easy task and it poses many challenges.[1]

Marginal discoloration, secondary caries, restoration failure and pulpitis are the results of insufficient sealing. Hence, the interface between the restoration and dental hard tissue is an area of clinical concern. One of the weakest aspects of class II composite resin restorations is microleakage at the gingival margin of mesial and distal cavity boxes.[2]

The success of any restoration material depends on marginal integrity.[1] The marginal ingress of oral fluids and bacteria between the tooth – restoration interface is termed as microleakage or marginal leakage. The ability to maintain an unfailing margin improves the durability of a restoration to a large extend.[3]

The placement techniques proved to be important for longevity of these materials.[1] Failure associated with these restorations is invariably due to the use of improper technique and microleakage at the gingival margin.

Figure 1:

Materials and methods Procedure

All the required armamentarium and the restorative materials for the study were procured.

Step 1: Sixteen intact extracted molars devoid of caries, restoration, and cracks were chosen for the study. Standardized class II box only cavities were prepared on either of the proximal surfaces with rounded internal line angles and a Cavo surface margin at 90° to the tooth surface.

Step 2: The dimensions of the cavities were as follows: - buccolingual width = 3 mm, mesiodistal width = 2 mm, and gingival floor = 1 mm below the cementoenamel junction. Cavity preparations were performed using a diamond dome-shaped fissure bur and cooled in water a high-speed air turbine handpiece.

Step 3: Self etch adhesive was applied to the cavity walls and cured for 20 sec.

Step 4: Teeth were restored.

Figure 2:

Group I

Group II

Group III

Group IV

Restorative materials used

Group I: Teeth were restored with Snow-plow technique using Beautifil II and Beautifil flow (Shofu).

Group II: Teeth were restored with Horizontal increment technique using Beautifil II (Shofu).

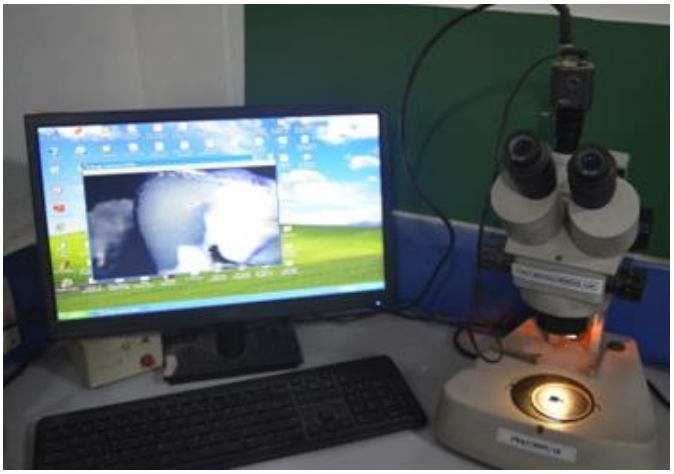
Group III: Teeth were restored with Snowplow technique using nano filled flowable composite and Nanohybrid composite (Filtek 3M).

Group IV: Teeth were restored with Horizontal increment technique using Nanohybrid composite (Filtek 3M).

Figure 3:

- Step 5: The restored teeth were subjected to 500 thermocycles of between 5°C and 55°C in water baths, with a 30-second dwell time.
- Step 6: The Samples were then immersed in a 2% methylene blue solution for 24 hours at 37°C.
- Step 7: Each tooth then was sectioned mesiodistally with diamond disc, and the extent of micro leakage was scored using the international standard organization (ISO) micro leakage scoring system.
- Step 8: Sectioned restorations were examined under a stereo microscope (Wuzhou New Found Instrument Co. Ltd. China Model: XTL 3400E) at 25× magnification.

Figure 4:



Cervical dye penetration score

- Score 0: No dye penetration
- Score 1: Dye penetration into ½ of the cervical wall
- Score 2: Dye penetration into all the cervical wall
- Score 3: Dye penetration into cervical and axial walls

Figure 5:

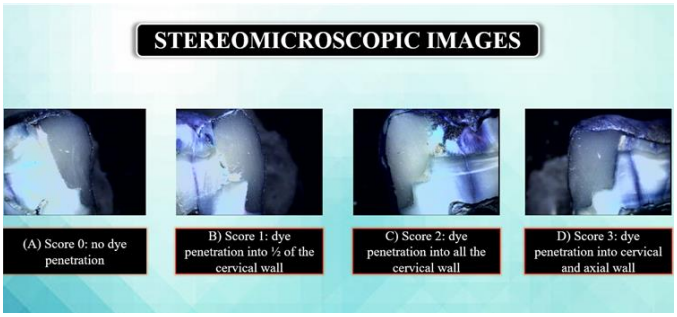


Table 1:

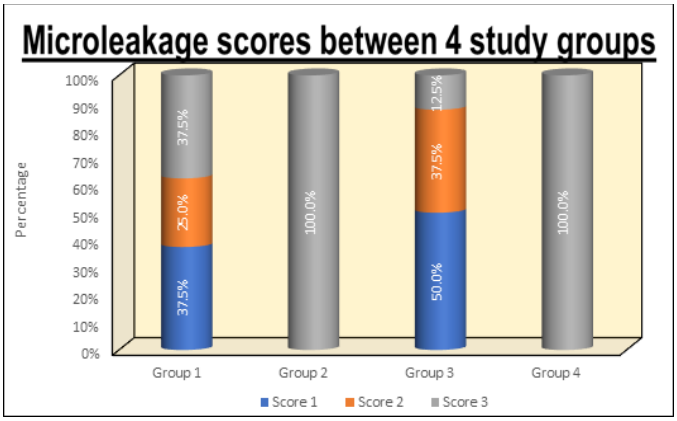
	Micro Leakage Scores			
Sl	Group 1	Group 2	Group 3	Group 4
1	Score 3	Score 3	Score 1	Score 3
2	Score 3	Score 3	Score 2	Score 3
3	Score 2	Score 3	Score 1	Score 3
4	Score 3	Score 3	Score 3	Score 3
5	Score 1	Score 3	Score 1	Score 3
6	Score 1	Score 3	Score 2	Score 3
7	Score 1	Score 3	Score 1	Score 3
8	Score 2	Score 3	Score 2	Score 3

Table 2:

Comparison of Micro leakage scores between 4 study groups using Kruskal Wallis Test

Micro leakage score	Group 1		Group 2		Group 3		Group 4		KH Value	P-Value
	n	%	n	%	N	%	n	%		
Score 1	3	37.5%	0	0.0%	4	50.0%	0	0.0%	18.555	<0.001*
Score 2	2	25.0%	0	0.0%	3	37.5%	0	0.0%		
Score 3	3	37.5%	8	100.0%	1	12.5%	8	100.0%		

Graph 1:



Statistical analysis

Kruskal Wallis test followed by Mann Whitney post hoc test was used to compare the cervical micro-leakage scores between different study groups.

The level of significance [P-Value] was set at $P<0.05$

Results

Multiple pairwise comparison between groups showed that group 3 demonstrated significantly lesser micro leakage scores as compared to Group 2 & 4 at P=0.001, which was followed by Group 1 exhibiting with lesser micro leakage scores as compared to Group 2 & 4 at P=0.01. However, no significant difference was noted between Group 1 & 3 [P=0.40] and also between Group 2 & 4 [P=1.00]

According to the comparison, snowplow restorations showed least microleakage followed by horizontal increment technique.

Discussion

The success of any restoration material depends on marginal integrity. Polymerization shrinkage results in micro leakage.[1]

In majority of clinical situations, the relative lack of adaptation may possibly occur fairly due to polymerization contraction and excessive temperatures inside the oral cavity.[1]

Microleakage involves many factors, such as dimensional changes in materials due to polymerization shrinkage, thermal contraction, absorption of water, mechanical stress and dimensional changes in tooth structure.[4]

All such kinds of spaces usually permit the infiltration of microorganisms, fluids, and other elements from the intraoral atmosphere along the tooth/restoration junction, which may result in postoperative sensitivity, marginal deterioration, recurrent caries, and pulp injury.[5]

Monomer molecules are converted into a polymer network and hence, exchanges van der Waals spaces into covalent bond spaces, forming tightening stresses in the resin composite leading to microleakage.[6]

Thermocycling is the in vitro process of subjecting the restoration on the tooth to temperature extremes compatible with the oral cavity. This simulates introduction of hot and cold extremes in the oral cavity and shows the relationship between coefficient of thermal expansion between the tooth and restorative material.[7] In this study the restored teeth were subjected to 500 thermocycles of between 5°C and 55°C in water baths, with a 30-second dwell time. Some authors reported the absence of any influence of thermocycling on micro leakage[8] while others show an increase in microleakage at the cementum dentin restoration interface after thermal stress.[9]

The properties of the Beautifil II are closer to the tooth structure and fluoride uptake is from the pre-reacted giomer calcium fillers. This may be explained by the fact that beauty bond employs an interesting chemical approach for maximizing the union (mechanic) and bonding (chemical) to tooth substrates.[10]

Beautibond contains a monomer of carboxylic acid that promotes bonding to dentin and phosphonic acid to generate bonding to enamel.[10]

In the present study Group 1 (Teeth were restored with Snow-plow technique using Beautifil II and Beautifil flow) and Group 3 (Teeth were restored with Snowplow technique using nano filled flowable composite and Nanohybrid composite) showed least microleakage scores as compared to group 2 and 4. In snowplow technique, a small amount of flowable composite can be found in such areas of the cavity where the high-viscosity resin composite does not completely adapt to the cavity wall, which may lead to voids. As in this

procedure both flowable and restorative composites are co-cured, the remaining flowable composite will absorb the volumetric changes and can stretch or flow to allow stress relaxation.[11]

The use of an elastic resin layer between the composite resin and adhesive system has been proposed as an alternative to creating an adhesive interface without the presence of gaps.[12,13] This intermediary layer is able minimize the shrinkage stress generated during polymerization shrinkage and promote more effective sealing to the tooth structure due to its lower modulus of elasticity and consequently, is effective in reducing gaps between restoration and tooth, thus reducing leakage.[14,15]

In addition low viscosity resins have lower amount of filler and higher proportion of diluent monomers in their formulation, which offer lower viscosity, resulting in better adaptation to the internal wall cavity, easier insertion and greater elasticity compared to conventional composites.[16] The low modulus of elasticity might imply that the material support and dispelling of tension generated by thermal stresses and chewing act as a modulator of stress between conventional composites and the inner wall of the tooth.[14,17,18]

On this basis, it is assumed that co-curing of flowable and restorative composites would also result in less polymerization shrinkage and subsequently less micro leak age.

Because of higher resin content, the flowable composites demonstrate up to three times greater polymerization shrink age than do standard hybrid composite formula tions.[10]

Conclusion

Microleakage was clinically significantly lower in snowplow restorations compared to the horizontal increment technique, which has lower microleakage. Our future scope is snowplow restorations can provide the best marginal seal clinically.

References

1. Nanda BD, Sharma P, Moudgil M, Sharma V, Gupta AK, Gupta D. In vitro Evaluation and Com parison of Microleakage of Two Restorative Composite Resins in Class II Situations using Confocal Laser Scanning Microscopy. J Contemp Dent Pract. 2018 Sep 1; 19 (9):1100-1104. PMID: 30287711.

2. Patil BS, Kamatagi L, Saojii H, Chabbra N, Mutsaddi S. Cervical Microleakage in Giomer Restor ations: An In Vitro Study. J Contemp Dent Pract. 2020 Feb 1;21(2):161-165. PMID: 32381821.

3. An in-vitro comparative evaluation of microleakage between giomer, compomer, composite and resin-modified GIC. Original Article a: Author Details: Rini Rajendran, Mukundan Vijayan*Volume: 9, Issue 2 a: Year: 2021 Article Page: 105-111

4. Staninec M, Mochizuki A, Tanizaki K, et al. Interfacial space, marginal leakage and enamel cracks around composite resins. Oper Dent 1986;11(1):14–24.

5. Poskus LT, Placido E, Cardoso PE. Influence of adhesive system and placement technique on micro leakage of resin-based composite restorations. J Adhes Dent 2004 Autumn;6(3):227-232.

6. Van Ende A, De Munck J, Van Landuyt KL, Poi Tevin A, Peumans M, Van Meer Beek B. Bulk-filling of high C-factor posterior cavities: Effect on adhesion to cavity-bottom dentin. Dent Mater 2013 Mar;29(3):269-277.

7. Crim GA, Swartz ML, Phillips RW. Comparison of four thermo cycling techniques. J Prosthet Dent. 1985; 53 (1): 50–3. doi:10.1016/0022-3913(85)90064-2.

8. Doerr CL, Hilton TJ, Hermes Ch CB. Effect of thermo cycling on the microleakage of conventional and

resin modified glass ionomer. Am J Dent 1996;9(1):19–21.

9. Yap AU. Effects of storage, thermal and load cycling on a new reinforced glass-ionomer cement. J Oral Rehabil 1997;25(1):40–44. DOI: 10.1046/j.1365-2842.1998. 00192.x

10. Chuang SF, Liu JK, Chao CC, et al. Effect of flowable composite lining and operator experience on microleakage and internal voids in class II composite restorations. J Prosthet Dent 2001;85(2):177–183. DOI: 10.1067/mpr.2001.113780.

11. Alster D, Feilzer AJ, de Gee AJ, et al. The dependence of shrinkage stress reduction of poro city concentration in thin resin layers. J Dent Res 1992;71(9):1619–1622. DOI: 10.1177/ 0022 0345 9207 100 91401.

12. Behle C. Flowable composites: properties and applications. Pract Periodontics Aesthet Dent 1998; 10: 347–51.

13. Unterbrink GL, Liebenberg WH. Flowable resin com posites as “filled adhesives”: literature review and clinical recommendations. Quintessence Int 1999; 30: 249–57.

14. Estafan D, Estafan A, Leinfelder KF. Cavity wall adaptation of resin-based composites lined with flowable composites. Am J Dent 2000; 13: 192–4

15. Leevailoj C, Cochran MA, Matis BA, Moore BK, Platt JA. Microleakage of posterior packable resin com posites with and without flowable liners. Oper Dent a. 2001; 26: 302–7

16. Payne JH 4th. The marginal seal of class II restorations: flowable composite resin compared to injectable glass ionomer. J Clin Pediatr Dent 1999; 23: 123–30.

17. Braga RR, Hilton TJ, Ferracane JL. Contraction stress of flowable composite materials and their efficacy as stress-relieving layers. J Am Dent Assoc 2003; 134: 721–8.

18. Kleverlaan CJ, Feilzer AJ. Polymerization shrink age and contraction stress of dental resin com posites. Dent Mater 2005; 21: 1150–7.