



EVALUATION OF MICROLEAKAGE OF DENTAL COMPOSITES USING BONDING AGENTS WITH DIFFERENT PLACEMENT TECHNIQUES: AN INVITRO STUDY

Anil K Tomer¹, Pudu Tirupathi², Sushma Kumari³, Midhun Ramachandran⁴, Ashvin G John⁵, Artika Gupta⁶, Vanita Verma⁷

¹Professor and Head, Department of Conservative dentistry & Endodontics D.J College of Dental Sciences and Research, Modinagar, Ghaziabad

^{2,3,4,5,6,7}Post Graduate Student, Department of Conservative Dentistry & Endodontics D.J College of Dental Sciences and Research, Modinagar, Ghaziabad

Conflicts of Interest: Nil

Corresponding author: Pudu Tirupathi

Abstract:

Aim: To evaluate the microleakage of bonding agents namely fusion denprovest bond 5 and fusion denprovest bond 7 using composite material with three different placement techniques.

Materials and Methods: 30 extracted human premolars were taken & divided into 3 groups depending upon application of bonding techniques followed by composite restoration. Specimens were subjected to thermal cycling at 60C, 370C, 540C and again at 370C & then placed in 10 ml each of freshly prepared 2% silver methylene blue alkaline solution for 24 hours in darkness, washed & placed under sun light for 24 hours. The sectioned specimens were then observed under stereomicroscope to detect microleakage.

Results: On comparing the mean microleakage scores among the three groups, maximum microleakage scores have been obtained when no bonding agent was used, while least microleakage scores were obtained with double coat of bonding agent.

Conclusion: The present study suggests that the placement of bonding agent technique before composite restoration can be effective to limit the microleakage at the tooth restoration interface.

Introduction

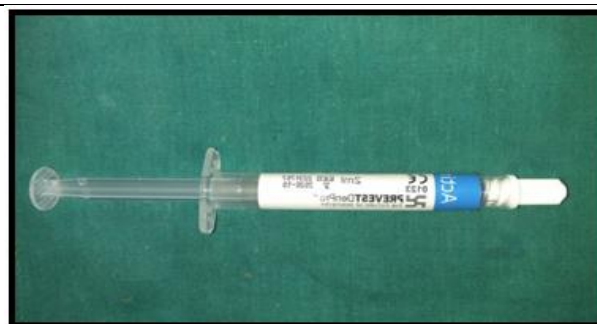
The rapid progress of adhesive dentistry over the past decade has been attributed to the significant advances in dentin bonding technology. As we enter the new millennium, it is important for us to examine the past¹. Perfect adaptation is hard to accomplish because of inconsistent physical properties between tooth structure and restorative materials. The hidden leakage is called microleakage².

Microleakage may be defined as the clinically undetectable passage of bacterial fluids, molecules or ions between a cavity wall and the restorative material applied to it. This invitro study has been undertaken to investigate the degree of dye penetration as an estimation of microleakage of composites with bonding agents placed under different techniques³.

MATERIALS AND METHODS

- Etchant 37% phosphoric acid gel

(ACTINO GEL, PREVEST DEN PRO)



- Adhesive System** BOND 5 FUSION (prevest Den pro)
BOND 7 FUSION (prevest Den pro)



Restorative Materials

Fusion (prevest Den pro), Magma NT(prevest Den pro)



Sample collection and Storage: Thirty noncarious human premolars were collected. Collected teeth were divided into 3 groups 10 teeth in each group. These samples were stored in distilled water for further use.

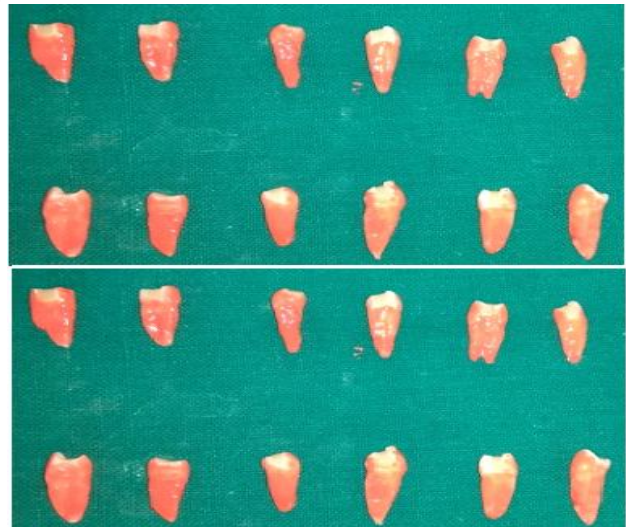
Cavity Preparation: Class II cavities were prepared with dimension 2.5 mm depth occlusally, 2mm width occlusally, 3.5mm depth gingivally, and a 3mm wide gingival seat using high speed handpiece with continuous water cooling. The teeth were subsequently stored in distilled water.



- Group A:** Without application of bonding agent (Subgroups I, II)
- Group B:** Application of single layer of bonding agent (Subgroups III, IV)
- Group C:** Application of double layer or bonding agent (Subgroups V, VI)

SUBGROUP I	Prepared cavities were acid etched with etching gel (37% phosphoric acid) for 20 seconds, washed in distilled water & gently dried. Fusion composite was placed & light cured for 40 sec.
SUBGROUP II	Acid etching for 20 seconds washed & gently dried. Two increments of Magma NT was placed into the cavity and light cured for 40 seconds each.
SUBGROUP III	Acid etching, a single coat of bond 5 bonding agent was applied, gently air dried for 2 to 5 seconds and then light cured for 10 seconds. Fusion composite was placed & then light cured for 40 seconds.
SUBGROUP IV	Acid etching, single coat of fusion 7 bonding agent was applied, light cured for 20 seconds. Magma NT composite was placed & light cured for 40 seconds.
SUBGROUP V	Acid etching, two coats of bond 5 bonding agent was applied one after other, air dried for 2-5 seconds and then light cured for 10 seconds, restored with fusion composite and light cured for 40 seconds.
SUBGROUP VI	Acid etching, two coats of fusion 7 bonding agent was applied, light cured for 20 seconds. Magma NT composite was placed & light cured for 40 seconds.

All the specimens were subjected to thermal cycling at 6 C, 27 C, 54 C and again at 37 C completing one cycle with a 30 second dwell time. Nail varnish was applied over all the thermally cycled tooth specimens except 1mm around the restoration. Green stick compounds was used to seal the apex completely. Each group of samples was placed in 10 ml each of 2% methylene blue solution for 24 hours in darkness. The teeth were retrieved, washed thoroughly in distilled water, stored in developing solution and exposed to sun light for 24 hours. The extent of dye penetration was determined.



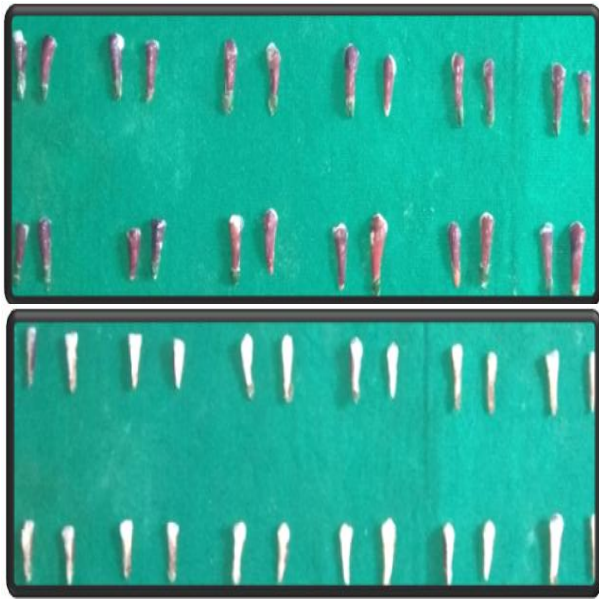
Samples after applying the Nail Varnish



Samples after applying Green stick compound at the apex



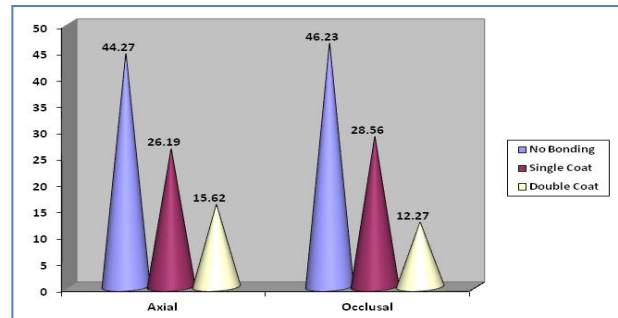
Some of the sectioned samples



Microleakage for each group was evaluated by stereomicroscope 4X magnification and recorded using a parametric scale that give a qualitative measurement of sealing effectiveness of restorative material. The data collected was tabulated accordingly and was statistically analysed using Kruskal Walls and Chi-Square tests.

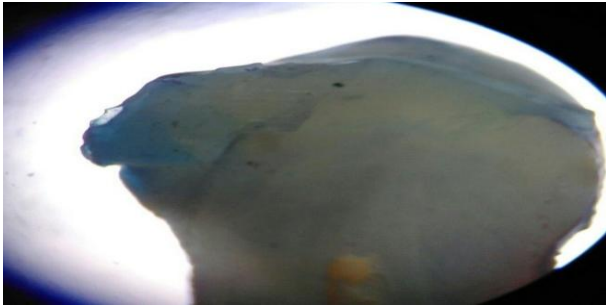
The mean microleakage scores among the individual 3 groups were calculated. On comparing the mean microleakage scores among the three groups, maximum microleakage scores have been obtained when no bonding agent was used, while least microleakage scores were obtained with double coat of bonding agent.

BONDING AGENT	Score (Axial)					Total	Mean Rank
	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4		
No Bonding	0	0	0	3	7	10	44.27
Single Coat	0	1	5	2	2	10	26.19
Double Coat	2	4	3	1	0	10	15.62
Total number of teeth presenting with the microleakage scores along the axial wall							

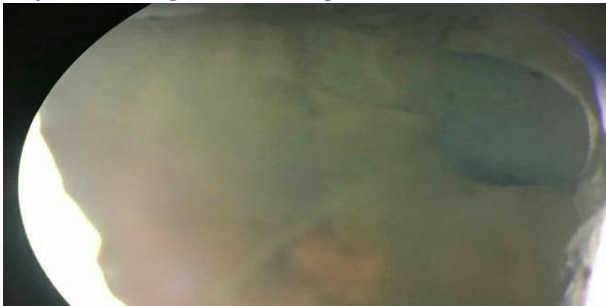


Graph representing the comparison in the mean microleakage scores between the groups with no bonding agents, single coat of bonding agent and double coat of bonding agent





Sample showing microleakage score IV



Sample showing microleakage score 0

DISCUSSION:

One of the main factors associated with marginal shrinkage and gap formation is the resin composite shrinkage at the tooth-restoration interface. This polymerization shrinkage causes building up of significant stress in the surrounding tooth structure which may be a major causative factor in bond failure. Factors affecting the integrity of the tooth-restoration interface⁴.

- Polymerization shrinkage and cavity configuration factor.
- Hygroscopic expansion.
- Light polymerization concepts and units.
- Thermal cycling and occlusal stresses.
- Bonding agent & its placement.

The stress build up due to polymerisation can cause adhesive or cohesive failure and interfacial gap formation and can eventually lead to deformation of residual tooth structure. Light cured composites develop higher stress than self cured composites, and the use of higher energy curing lights further worsens the situation⁵.

The penetration of these newer adhesives into a chemically conditioned dentin creates a mechanical interlocking based on the formation of a hybrid layer and resin tags penetrating into opened dentin tubules (Tay FR et al., Sano H et al.,) . Maintaining a moist dentinal surface is of crucial importance in enhancing bond strength in vitro. Moisture prevents collagen fibrils from collapsing into demineralized dentinal surfaces after acid etching, thus allowing the

adhesive monomers to penetrate into dentin, forming a hybrid layer⁶. This technique is commonly known as wet bonding technique & has been considered a paramount mechanism in adhesive dentistry. Quantifying the amount of moisture that should be left after acid etching is, however, problematic. Moreover, differing amounts of moisture may be required with specific solvents contained in each adhesive system; over wetting and over drying phenomena may occur and lead to the formation of an altered hybrid layer known as Hybridoid layer (Simone Deliperi)⁷ . In this study, particular attention was paid to preserving moist dentin surface prior to the start of bonding procedure. The excess water was removed using an air syringe; this method is particular technique sensitive.

This study used thermocycling to mimic intra-oral temperature variations and subjecting the restorations on the tooth to temperature extremes compatible with oral cavity . Wahab et al., found that thermocycling significantly increased the microleakage of Class V composite restorations. Only when the initial bond is known, thermal stressing of the restoration interface is of value.

A more uniform hybrid resin layer can result from doubling the number of coats. This procedure can promote the formation of a stress absorbing resin layer which is able to reduce microleakage⁸.

Conclusion:

All three groups i.e. group A,B,C (No bonding agent, Single layer of bonding agent. Double layer of bonding agent) tested showed microleakage at tooth restoration interface. Highly significant difference was found in the degree of microleakage scores between the group A & C i.e. no application of bonding agent & application of double layer of bonding agent. Significant difference was found in group A & B i.e. with no application of bonding agent & application of single layer of bonding agent. No significant difference was found in group B & C i.e. application of single layer of bonding agent and application of double layer of bonding agent. Though group C showed least microleakage among three groups.

References:

1. DenizAG, et al.Effect of Multiple Consecutive Adhesive Coatings or Microleakage of Class V Cavities. *Eur J Dent.*2009;3(3):178-84.

2. Thomas P.etal. The nanolekage phenomenon: influence of moist vs. dry bonding. *J Adhes Dent.* 2002;4:24-30.
3. Cenci M, Demacro F, de Carvalho R. Class II composite resin restoration with two polymerization techniques: *JOD.*2005;33(7):603-10.
4. Alavi AA, Klanimanesh N.Microleakage of direct & indirect composite restorations with three denting bonding agents. *Operative Dentistry.* 2002;27:19-
5. Buonocore MG. A simple method of increasing the adhesion of acylic filling materials to enamel surfaces. *J D Res.*1955;36:6.
6. Gallego AV, Teixeira Cl. Freire PLA. Microleakage Study of Three Adhesive Systems. *Braz Dent J.*2004;15(3):194-98.
7. Kanca J. Improving bond strength through acid etching of dentin and bonding to wet dentin surfaces. *J Am Dent Assoc* 1992;123:35-43.
8. Spencer P, Wang Y. Adhesive phase separation at the dentin interface under wet bonding conditions. *J Biomed Mater Res* 2002;62:447 -56.