Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/14496
DOI URL: http://dx.doi.org/10.21474/IJAR01/14496

RESEARCH ARTICLE

COMPARATIVE EVALUATION OF MICROLEAKAGE OF NEWER GENERATION OF DENTIN BONDING AGENTS IN CLASS V CAVITY: A DYE PENETRATION STUDY

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Manuscript Info

Manuscript History
Received: 25 January 2022
Final Accepted: 28 February 2022
Published: March 2022

Abstract

Aims: This study aims to evaluate the microleakage (ML) of the newer generations bonding agents in Class V Cavity.

Materials and Methods: Thirty six mandibular premolars were randomly divided into three groups: Group I (n = 12)-bonded with GlumaBond5, Group II (n = 12) with G-Bond and Group III (n = 12) with Single Bond Universal Adhesive. Class V box cavity was prepared on the buccal surface and restored with composite resin with recommended each group's specific bonding protocol for each adhesive. ML testing were conducted, Rhodamine B and stereomicroscope was used to measure microleakage and data analyzed. Kruskal–Wallis analysis was done to statistically differentiate the ML between the three experimental groups. Intergroup comparison was made using the Mann–Whitney U test and the level of significance was set at $p<0.05$.

Results : Single Bond Universal Adhesive showed maximum resistance to microleakage followed by GlumaBond5 and G- Bond and this difference is statistically significant($p<0.05$). Mann–Whitney U test shows statistically significant difference between Group II and Group III. ($p<0.05$).

Conclusions: Within this study's limitation, composite resin bonded with Single Bond Universal Adhesive showed maximumresistance to ML followed by GlumaBond5 and G-Bond.

Introduction:-

In the beginning of the era of restorative dentistry, retention and stabilization of restoration often required the removal of sound tooth structure to provide large undercuts to make auxiliary retention aids. This problem was greatly solved with the introduction of Composite material and newer bonding systems in adhesive dentistry.[1]

Resin-based composites obtain their retention, most notably by micromechanical adhesion to the structure of the tooth. The implementation of the etch and rinse method was the most productive technique to achieve sufficient resin composite bonding to the enamel. However, rinsing and drying of the tooth, makes the procedure tedious and technically sensitivetoo.The recent trend in adhesive products is to simplify the process into two steps or even one steps to make it user friendly and time saving[2]

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Currently the 7th generation dentin bonding agents combine an etchant, primer, and adhesive in one container compared to the total‐etch or etch and rinse systems, where separate etchant, primer, and adhesive monomers are utilized. They are called as self‐etching or all in one adhesive require no mixing and thus are time‐saving.

Further, modification has been achieved by introducing the "8th generation dentin bonding agent, which can be used in total etch, selective etch and self etch mode . This is a new simple dose delivery system in which the solvent evaporation does not take place so as to ensure an immediate stick effect which guarantees that the bond will not be blown out of the cavity while air drying. This has resulted in a superior marginal integrity and protection against dentinal sensitivities[2].

The longevity of a restoration requires a good marginal seal, strength of material, biocompatibility, resistance to fracture etc., Microleakage has been recognized as the major clinical problem with composite restorations.Thus, this study was aimed to determine and compare the microleakage of the 5th , 7th , and 8th generation dentin bonding agents.This manuscript is designed according to CRIS guidelines.

Materials And Methods:-

This study protocol has been approved by Scientific Review Committee(SRC).Thirty Six mandibular premolar teeth were extracted for orthodontic or periodontal reasons were used in the study. Teeth were randomly assigned to three experimental group. Teeth were cleaned of debris using ultrasonic scaler and stored in 0.1% Thymol solution till use . Class V cavities (3 mm × 2 mm × 1.5 mm) were prepared on the buccalsurfaces of teeth, with a high-speed airotor, 1 mm above CEJ using no.2 diamond point.Dimensions were standardized using Williams graduated periodontal probe . The prepared cavity was then be rinsed thoroughly with air/water spray and dried. Application of bonding agent Bonding agents wasdone in all the experimental groups according to the manufacturer's instructionsand cured for 20 sec using Bluephase curing light.

Group I :Sample teeth in this group were bonded with GlumaBond5 . First, the37 % phosphoric acid etchant was applied thoroughly on the prepared cavity for 10-15sec, rinsed for 20sec and blot dried. An even layer of bonding agent was applied generously and thoroughly with the help of an applicator tip on the entire surface for 10 sec.The bond was allowed to dwell for 10-15 sec.Then with help of gentle drying for 5 sec the excess solvent was allowed to evaporate, Making sure no excess remained.The bond was then cured for 10 sec.After curing the surface should show a uniform glossy appearance.

Group II: Sample teeth in this group were bonded with G-BOND (7th generation, self-etching, light-cured dental adhesive) which is supplied in an easy squeeze bottle. With an applicator tip, one coat of the bonding agent was applied on the prepared cavity, left undisturbed for 20 sec, dried with air for 5 sec , and then light cured for another 10 sec.

Group III Sample teeth in this group was bonded with Single Bond Universal Adhesive (8th generation) which was applied by rubbing using an applicator tip for 20sec then gently air dried for 5 sec and light cured for 10sec.

All the Class V preparations was restored with a nanohybrid composite restorative (3M ESPE Filtek^{TM}Z250XT) in two increments and light cured for 20 secs and then finished using a 10 fluted carbide bur (SS white) and polished using the shofu composite polishing kit.

The prepared samples was subjected to thermocycling in water baths for 500 times between 5° and 55° with a dwell time of 30 s in each bath and a transfer time of 30 s to simulate the oral conditions. After thermocycling, the apices of teeth was sealed with sticky wax. All tooth surfaces were triple coated with finger nail varnish, except a 0.5–1.0 mm window around the restoration margins. The teeth was immersed in 1% Rhodamine B for 24 h after which they were rinsed with water and air-dried.

All the samples were longitudinally sectioned in a buccolingual direction using a diamond disc at slow speed in a micromotor straight handpiece. The microleakage was assessed by viewing all the groups under a stereomicroscope at a magnification of × 40, and the scoring criteria for the microleakage assessment was followed according to Stainee and Mark Holtz

SCORE 0	no dye penetration
SCORE 1	dye penetration along occlusal but less than half way to axial wall depth
SCORE 2	dye penetration along occlusal wall but more than halfway to axial wall depth,
SCORE 3	dye penetration along occlusal wall , up to and along axial wall

Statistical analysis

The statistical difference among the three experimental groups was evaluated by Kruskal-Wallis test (non-parametric ANOVA). Also, Mann-Whitney 'U' test used for pairwise comparison.

Results:-

Fig 1 and Table 1 presents mean microleakage score of GlumaBond5 ,G Bond and Single Bond Universal adhesives as 2.5, 2.6 and 1.5 respectively. Kruskal- Wallis test demonstrates as statistically significant difference between three groups at $p=0.03$ ($p<0.05$).

Mann-Whitney U test (Table no 2) for intergroup comparisons shows no statistically significant difference between Group I vs Group III and Group I vs Group II. However Group II (G Bond) and Group III(Single Bond Universal) shows a statistically significant difference ($p<0.05$).

Discussion:-

To ensurelong-term clinical success, one of theprimary purposes of the enamel and dentin adhesives is to minimize the marginal gap at the tooth-restoration interface, as ML is one of the essential parameters used to study the formation of the gap.[6,7]

In our invitro study, newer generations of bonding agents i.e. 8th generation produced minimum microleakage in Class V cavity. These findings are in accordance with study done by R. Somani et al .

Gluma Bond5 show score 2 microleakage in 50% of samples (6/12) and score 3 microleakage in 50% samples (6/12). G bond show score 2 microleakage in 33.3 % samples (4/12) and score 3 microleakage in 66.6% samples (8/12). Single Bond Universal Adhesive show score 0 microleakage in 33.3% samples (4/12) , score 2 microleakage 41.6% samples (5/12) and score 3 microleakage in 25% samples (3/12). None of the samples show score 1 microleakage.

Statistical significant difference was found in Group II (G-Bond) and Group III (Single Bond Universal Adhesives).These is because of acid esters, when mixed with water, produced a favorable lower pH value of 1.4 as incomparison to unfavorable higher pH value of 1.8 ofthe 7th generation dentin bonding agents. The lower pH favors complete removal of smear layer andthe hydroxyapatite is dissolved (demineralized), creating a deeper retentive pattern on the tooth surface.[8]

The maximum microleakage was found in 7th generation dentin bondingagent(G-Bond), which is HEMA-free, in comparison with the 5th generation dentin bonding agent (GlumaBond5) and 8th generation dentin bonding agent (Single Bond Universal Adhesive) could be contributed to the absence of HEMA. As stated by Pashley et al. the hydrophilicity of HEMA makes it an excellent adhesion promoting monomer and by enhancing wetting of dentin it significantly improves bond strength, thereby reducing microleakage.

7th and 8th generation don't have HEMA, the water content was increased in 7th generation has been increased in an effort to improve its bonding efficacy and reducemicroleakage; however, bondingefficacy got reduced as in the absence of HEMA[9]. No significant difference was found between Group I (GlumaBond 5) and Group III (Single Bond Universal Adhesive).

According to Shruti Attavar et al the ML was higher in the nanocomposite , followed by micro-hybrid resin, and the least is seen in nanohybrid resin,that is why in this study Filtek^{TM} Z250 XT (3M ESPE),A Nano Hybrid Universal Restorative Material was used.

Rhodamine B dye was the dye chosen. Rhodamine B dye has a significant deeper dye penetration activity. The advantages are smaller particle size , water solubility, diffusibilityand hard tissue reactivity. Dye penetration was evaluated using stereomicroscope.

The current research was carried out under in vitro conditions and used to restore natural extracted teeth, and thermocycling was used as part of the test procedure. For the early evaluation of dental products, in vitro studies are very relevant.

However, all the possible factors that differentfrom patient to patient are only considered in a clinical trial. Masticatory forces, food types, oral temperature, moisture variability, and the presence of salivary enzymes and bacterial by-products are some of the variables. Therefore, to confirm their in vitro findings, further studies are needed to assess these products' substantial clinical value through clinical long-term follow-up.

Conclusion:-

Within the limitation of this study, it concludes that the Single Bond Universal Adhesive system showed maximum resistance to Microleakage compared to the resin bonded with G-Bondand GlumaBond5 bonding agents.

Table no 1:- Comparison of Microleakage between the study groups.

Group	Samples	Mean(SD)	Range	Median(Q1-Q3)	Kruskal- Wallis Test
Group I	12	2.5(0.522)	2-3	2.5	P=0.03
GroupII	12	2.6(0.492)	2-3	3	
Group III	12	1.5(1.240)	0-3	2	

Table no 2:-

Mann-Whitney U-test		
Group I versus Group II	Group I versus Group III	Group II versus Group III
0.4	0.06	0.01

Fig 1:-

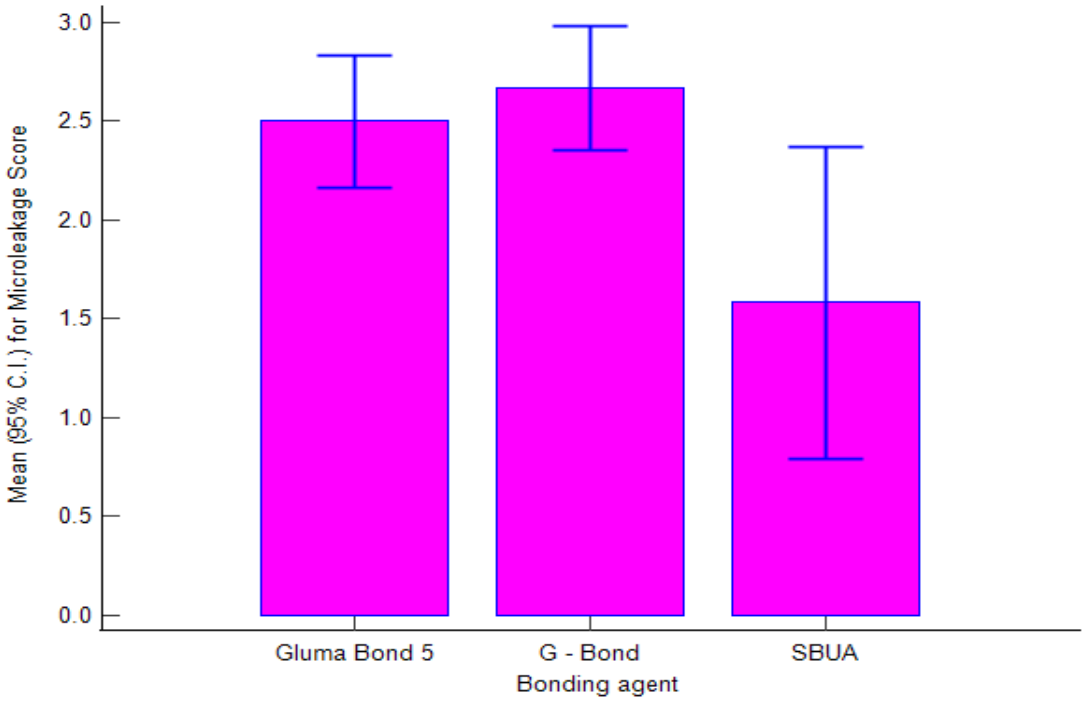

Fig 2:- Scores of microleakage.

Score 0 Score 2 Score 3

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