

Comparative Evaluation of Marginal Microleakage in Class V Restorations Using Conventional Restorative Materials and Zirconomer - An in Vitro Stereomicroscopic Analysis.

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ABSTRACT

Background: This aim of this study compared the marginal microleakage of Class V cavities restored with composite, GIC, Zirconomer and Amalgam. **Methods:** Tested materials were grouped as follows: Gp1: Brilliant™ NG (Duo Shade Nanohybrid Composite), Gp2: GIC; GC Universal Restorative, Gp3: Zirconomer; Shofu INC. (Zirconia Reinforced Glass Ionomer) and Gp4: Amalgam High Copper. The apical foramina were sealed with sticky wax and two coats of nail varnish was applied on the entire sample except on the restoration and 1mm area beyond the margins of restoration. All restorations were polished with an abrasive finishing kit. All specimens were thermocycled followed by immersion in 0.2% basic fuchsin dye for 24 hours and then rinsed with running water. Teeth were then sectioned in Bucco lingual plane and the dye penetration at the enamel and cementum margins was scored. Microleakage was then studied under Stereomicroscope. Depth of dye penetration at occlusal and gingival margins was analysed according to a 0-3 scale scoring system. **Results:** On applying Kruskal Wallis test, a statistical significant difference was seen among all the restorative materials on account of microleakage at gingival and occlusal margins ($p < 0.05$) and Turkey multiple Comparison Test, no significant difference was observed between Composite and GIC in the microleakage for both occlusal and gingival margins. Within the limitations of the study. **Conclusion:** It was concluded that Zirconomer exhibits minimum marginal leakage and GIC exhibits maximum marginal leakage.

Keywords: Microleakage, Zirconomer.

INTRODUCTION

Dentistry had always thrived to achieve biocompatible restorations that do not compromise the pulp and also maintain the dental seal. Cervical lesions is a common occurrence due to in-adequate brushing in gingival recession cases, corrosive food and drink consumption and occlusal stress due to habits of bruxism and clenching. Their prevalence is common in molars and premolars.^[1]

In Class V cavities, restoration is more challenging because isolation of the operating site may be difficult in cervical areas due to the exudation of gingival fluid which is impaired by many factors

like absence or less enamel gingivally and characteristics of dentine. Etiology of Cervical lesions varies from caries to abrasion, abfraction, erosion which usually have little or no enamel at cervical margins and their incidence is more because of habits. Choosing the best treatment strategy for restoring these lesions is necessary to achieve adequate strength and to restore aesthetics. However, the importance of perfect seal for success and longevity of Class V restorations has still eluded dentist.^[2,3]

Numerous restorative materials are being used in dentistry to achieve adequate strength and restore esthetics. Dental Amalgam is versatile material with self-sealing property, but is unesthetic. Other restorative materials like Composite require conservative tooth preparation, but exhibit polymerization shrinkage resulting in microleakage which can lead to marginal staining and secondary caries and if not treated on time causes pulpal

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pathosis. In an effort to reduce the side effects caused by polymerization shrinkage; GIC which bonds to the tooth structure, has limited curing shrinkage and has thermal properties similar to dental tissues showed promise, however its strength is less than desirable. Its inconvenient setting characteristics, fragility and a less-than-ideal appearance have limited the acceptance of these materials.^[4,5] Zirconomer, is a high strength restorative material which has been reinforced with zirconia and ceramic fillers has the properties similar to GIC as well as amalgam.

According to Nakabayashi and Pashley, microleakage is defined as the passage of fluids and substances through minimal gaps on the interface restoration teeth. Clinically microleakage is indicative of failure of restoration as it reduces bonding effectiveness, increases secondary caries and later causes postoperative sensitivity.^[3,6]

The aim of the study is to compare marginal microleakage in Class V restorations with: Brilliant™ NG (Duo Shade Nanohybrid Composite), GIC; GC Universal Restorative, Zirconomer; Shofu INC. (Zirconia Reinforced Glass Ionomer) and Amalgam High Copper.

Aim and Objective

The aim of this study is to determine which restorative material will give least microleakage.

MATERIALS AND METHODS

The present in vitro study was conducted in the Department of Conservative Dentistry and Endodontics, Swami Devi Dyal Hospital and Dental College, Barwala.

Sample collection-

Non carious freshly extracted forty teeth were collected, cleaned with slurry of pumice and stored in distill water. All these samples were mounted on wax model. A standardized Class V cavity was prepared in each tooth using No. 245 and 169 L tungsten carbide burs in a high speed air rotor with water spray.

Grouping of Samples-

GROUP 1- 10 Class V cavities were restored with Amalgam

GROUP 2- 10 Class V cavities were restored with Composite

GROUP 3- 10 Class V cavities were restored with GIC

GROUP 4- 10 Class V cavities were restored with Zirconomer

Finishing and polishing of samples-

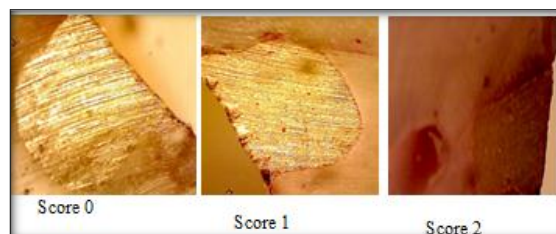
The finishing and polishing of all restorations were achieved with the sequential use of finishing and polishing burs, Diamond or Aluminum oxide discs, rubber cups, wheels and pastes. Proximal margins were finished with Sof-Lex discs (3M ESPE, St. Paul, MN, USA).

Thermocycling-

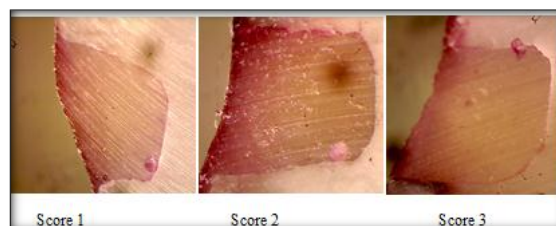
The teeth were stored in isotonic saline solution at 37°C water bath for 24 h. The samples were subjected to thermocycling in customized thermocycling device i.e. 500 thermal cycles at 5°C, 37°C and 55°C in water with a dwell time of 30 seconds and transfer time of 15 seconds.

Apices of all the teeth were sealed with sticky wax and two coats of Nail varnish were applied on the entire sample surface except for the restoration and 1mm area beyond the margins of restoration to limit dye penetration to cavity margins. Further the samples were soaked in freshly prepared with 0.2% basic fucine dye for 24 hours. The teeth were removed from the staining solutions and washed under running water for 5 minutes and dried at ambient temperature for 24 hours to allow the dyes to fix. All the samples were then sectioned in Bucco-Lingual dimension with a water cooled diamond disc. All the sections were seen under Stereomicroscope. Depth of dye penetration at occlusal and gingival margins was analysed according to a 0-3 scale scoring system.

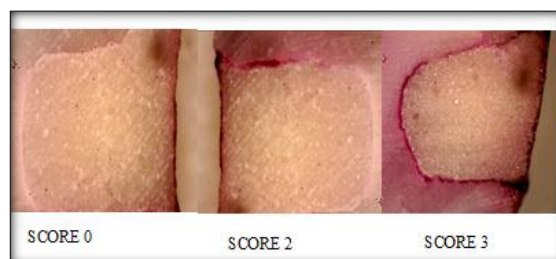
| Score | |
|-------|---|
| 0 | Without evidence of infiltration in the tooth /restoration interface |
| 1 | Infiltration of dye upto 1/3rd of walls of restoration |
| 2 | Infiltration of dye in more than 1/3rd of walls of restoration without reaching axio-cervical or axio-occlusal angles |
| 3 | Infiltration of dye reaching axio-cervical or axio-occlusal angles and going towards pulp |



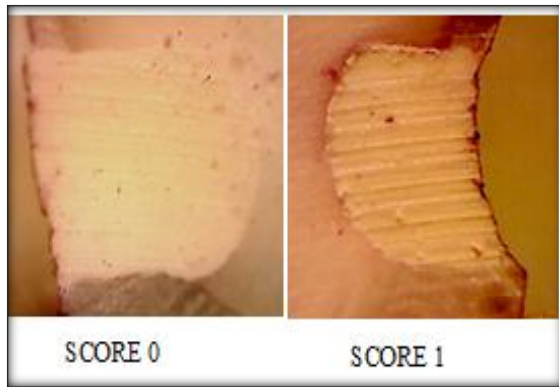
Group 1: Amalgam



Group 2: Composite



Group 3: Glass Ionomer Cement



Group 4: Zirconomer

| Occlusally | Mean difference | Q | p < 0.05 |
|-------------------------|-----------------|--------|----------|
| Amalgam vs Composite | -0.9000 | 2.937 | No |
| Amalgam vs GIC | -1.200 | 3.916 | Yes |
| Amalgam vs Zirconomer | 0.5000 | 1.632 | No |
| Composite vs GIC | -0.3000 | 0.9791 | No |
| Composite vs Zirconomer | 1.400 | 4.569 | Yes |
| GIC vs Zirconomer | 1.700 | 5.548 | Yes |

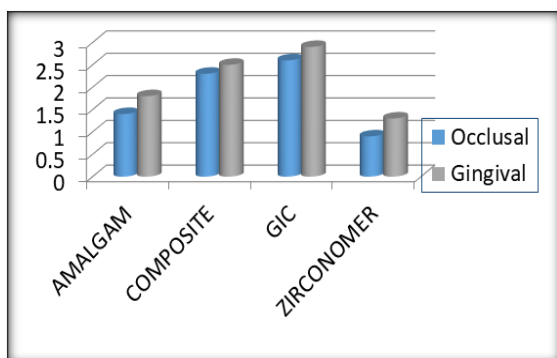
| Gingivally | Mean difference | q | p < 0.05 |
|-------------------------|-----------------|--------|----------|
| Amalgam vs Composite | -0.5000 | 1.489 | No |
| Amalgam vs GIC | -0.8000 | 2.382 | No |
| Amalgam vs Zirconomer | 0.5000 | 1.489 | No |
| Composite vs GIC | -0.3000 | 0.8933 | No |
| Composite vs Zirconomer | 1.000 | 2.978 | No |
| GIC vs Zirconomer | 1.300 | 3.871 | Yes |

RESULTS

| Groups | Dye leakage at occlusal margins | | | | Dye leakage at gingival margins | | | |
|------------|---------------------------------|---|---|---|---------------------------------|---|---|---|
| | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 |
| Amalgam | 4 | 1 | 2 | 3 | 3 | 2 | 2 | 3 |
| Composite | 0 | 3 | 1 | 6 | 1 | 2 | 3 | 4 |
| GIC | 0 | 1 | 2 | 7 | 0 | 1 | 3 | 6 |
| Zirconomer | 3 | 5 | 2 | 0 | 4 | 3 | 2 | 1 |

Mean Scores of Different Restorative Materials

- On applying KRUSKAL WALLIS TEST to compare occlusal and gingival scores of 4 different restorations
- A statistical significant difference was seen among all the restorative materials on account of microleakage at gingival and occlusal margins p<0.05 level.
 - Group 4 showed significantly least microleakage as compared to group 1, 2 and 3 at both occlusal and gingival margin



- On applying TURKEY MULTIPLE COMPARISON TEST, Significance was considered when P value is <0.05
- No significant difference was observed between Composite and GIC in the microleakage for both occlusal and gingival margins.
 - A significant difference between rest of groups except for Composite and GIC at gingival margins (P<0.05).
 - Statistically significant difference of leakage scores at gingival margins than occlusal margins.

DISCUSSION

One of the goals of ideal restoration is to prevent microleakage. In spite of all the achieved progress of the restorative dentistry, microleakage is still a challenge. Thus there is a constant search for material and technique that ensures a minimum leakage potential.^[7] The present in-vitro study was done to investigate microleakage in Class V restorations under Stereomicroscope and dye leakage methodology was used as it is most frequent method used now a days. Order of microleakage scores according to Kruskal Wallis test at both enamel and gingival margins (p<0.05) is Zirconomer < Amalgam < Composite < GIC. Basic fuschin was used because of greater microleakage marker capacity and deeper dye penetration. Results of the present study showed that less microleakage in Group 4 and Group1 when compared with Group 2 and Group 3. Similar study was conducted by Parolia et al (2014), in which 5% silorane composite and 35% GIC showed dye penetration upto 1/3rd of cavity. These results are in concurrence with those of Alptekin T et al concluded that resin restorations showed more microleakage than amalgam restorations. Similar study was conducted by Patel et al (2015), in which contradictory results were found to the present study. They concluded that Zirconomer showed more microleakage than Amalgam and Composite. Composite is used as it fulfilled the esthetic demands and required minimum cavity design. But main problem is polymerisation shrinkage and its bonding systems which will lead to marginal staining, poor marginal seal and recurrent caries which affect longevity of restoration.^[8,9] Glass Ionomer Cement is favourable restorative material due to their ease of use and unique biocompatibility among direct restoratives but bond failure and strength is their main problem.^[10] Amalgam though its improved strength, self-sealing property and durability cause minimal microleakage but esthetic demands, specific depth and cavity design are the main problems which limits its use as an ideal restorative material in Class V cavities.^[7,11]

With the decline of popularity of amalgam in recent years and drawback of composite there is a need of an equally strong and bondable material with ease of placement. Zirconomer, a white amalgam a new class of glass ionomer restorative material exhibiting strength and durability of amalgam along with bondable and fluoride releasing properties of GIC and at the same time no mercury is used. It contains Zirconia fillers which provides high strength.^[11]

In our study, significant difference was found in Group 4 and Group 3 i.e. Zirconomer showed minimum leakage and GIC showed maximum leakage to dye penetration. Zirconomer has a dual nature i.e. chemical bonding and high strength while GIC has less strength and can fracture easily under load leading to formation of microcracks causing leakage. Thus, GIC is contraindicated as permanent restorative material.

Our study also showed that, greater leakage was observed in gingival margins when compared to occlusal margins. It is because gingival margins are located in dentin/cementum which is less mineralized than that of enamel. Occlusally, it contains more enamel thus relatively impermeable to dye.^[12] These results are in concurrence with those of Cenci et al (2004) where in occlusal margins less leakage was observed with adhesive materials and more leakage in gingival margins with Panavia 21 EX. Also, study by Silva et al (2006) found that amalgam and composite exhibits more leakage at gingival margins than at occlusal margins. Further studies with larger sample size are required to come to a definite conclusion.

CONCLUSION

Out of all the restorative materials used in this study Zirconomer showed minimum microleakage and GIC showed maximum microleakage.

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