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An Invitro evaluation of microleakage in Class V Cavities restored with Chemically cured GIC, Light cured GIC, Nanofilled Resin Modified GIC and Cention N

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ABSTRACT

Aim: Invitro evaluation of microleakage in Class V Cavities restored with Chemically cured GIC, Light cured GIC, Nanofilled Resin Modified GIC and Cention N using Stereomicroscopic analysis.

Materials and Methods: One-Hundred extracted human permanent mandibular 1st and 2nd molar teeth were collected. Class V cavity preparations were done in all the teeth. All the specimens were then divided into 5 groups, with 20 teeth per each group. In Group A: Chemically cured GIC, Group B: Light cured GIC, Group C: Nanofilled Resin Modified GIC, Group D: Cention N, were used as restorative materials. Group E: Control Group in which the prepared cavities were not restored. Dye penetration test was done using Methylene blue dye and the microleakage was measured using Stereomicroscope. Statistical analysis was done by One-Way ANOVA and Post Hoc-Tukey test and the P-value was < 0.0001 and is highly significant.

Results: Nanofilled Resin Modified GIC and Cention N showed optimum tooth-restoration interface with minimal or no microleakage compared to Chemically cured GIC, Light Cured GIC and Control Group. Control Group showed maximum microleakage at tooth-restoration interface.

Conclusion: Nanofilled Resin Modified GIC and Cention N showed better marginal adaptation with least microleakage compared to Light cured GIC and Chemically cured GIC.

Keywords: Stereomicroscope, Cention N, Nanofilled Resin modified GIC, Microleakage, Class V cavity.

INTRODUCTION

Class V carious lesions have been a restorative challenge for clinicians for many years. The complex morphology of Class V cavities with margins partially on enamel and partially in dentin presents a challenging scenario for retention of restorative materials. The primary problem associated in the restoration of Class V cavities is microleakage at the gingival margins located in dentin.[1]

According to Nakabayashi[2] and pashley[2], Microleakage is defined as the passage of fluids and substances through the minimal gap in the tooth-

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restorative material interface. In theory, microleakage is defined as an indication of failure because it reduces the sealing effectiveness, compromises the restoration and increases the chances for secondary caries and post-operative sensitivity.[2]

Glass Ionomer Cement is indicated for Class V Cavities, because they bond chemically to tooth structure. The main advantage of GIC is relative use of bonding potential to enamel and dentin and fluoride ions release. The disadvantages include sensitivity to dessication and moisture contact during the early setting stages of GIC. GIC's are alternative restorative materials to dental composites for the restoration of cervical lesions because of their chemical adhesion to tooth structure, fluoride ion release, biocompatibility, low shrinkage value, reduced microleakage and acceptable aesthetics.[3,4]

Newer Glass Ionomer Cements are being introduced every day and it is important to know the physical and mechanical properties of each product before selecting the material for restoration of teeth. Recently, Nanofilled Resin Modified GIC was developed that combines the benefit of a Resin modified light cured GIC and Bonded Nanofilled technology. Nanofilled RMGI contains unique combination of two types of surface treated Nanofillers (approximately 5-25nm) and Nanoclusters (1-1.6nm). Nanofilled GIC contains fluoroaluminosilicate glass together with Nanomers and Nanoclusters in the filler loading, which is approximately 69% of weight.[1] Nanofilled Resin Modified GIC has high filler loading that may result in lower polymerization shrinkage and lower coefficient of thermal expansion, thus improving the long term bonding to tooth structure and subsequently reduced microleakage at tooth-restoration interface.[1]

Cention N is an alkasite restorative material which is a new category of restorative material like Compomer or Ormocer and it is essentially a subgroup of composite resin. It has high translucency of approximately 11% and this allows Cention N to blend in naturally with the surrounding tooth structure while covering discoloured dentin at the same time. Cention N can be used with or without an adhesive. If used with an adhesive, then the cavity is prepared according to modern principles of Minimal Invasive Dentistry, by preserving as much as natural tooth structure as possible. If used without adhesive, then retentive preparation (with undercuts) similar to that used with amalgam restoration are required and enamel margins should not be bevelled and etching with phosphoric acid is not required. The material exhibits low polymerization shrinkage and low shrinkage force, subsequently lower microleakage at tooth-restoration interface. Cention N contains partially functionalized silanes which keeps shrinkage stress to minimum, this filler acts as shrinkage stress reliever. Organic-Inorganic ratio and monomer composition of Cention N are responsible for its low volumetric shrinkage and less microleakage at tooth-restoration interface.[5]

The aim of present invitro study was to evaluate the microleakage in Class V cavities restored with Chemically cured GIC, Light cured GIC, Nanofilled Resin Modified GIC and Cention N.

MATERIALS AND METHODS

One-hundred freshly extracted human permanent mandibular 1st and 2nd molar teeth were collected from the Department of Oral and Maxillofacial Surgery at Triveni Institute of Dental Sciences Hospital and Research Centre. Bilaspur, Chhattisgarh.

Inclusion Criteria: Non Carious, non-fractured, non-restored, matured with close root apices.

Exclusion Criteria: Carious, fractured, restored, open root apex, previously endodontically treated teeth.

Tooth specimens were cleaned off superficial debris, calculus, tissue tags and were stored in 0.5% thymol at room temperature until used. Class V cavity preparations were made on the buccal surfaces of each tooth using No: 810 cylindrical diamond bur (Diatech dental, Coltene Whadent AGA Altstätten Switzerland) under air water cooling. The bur was replaced for every four cavity preparations. The Class V cavities were made with mesio-distal dimension of 3mm and buccolingual dimension of 2mm. The depth of all the prepared cavities were made 1.5mm. The gingival margins of the prepared cavities were placed in dentin and occlusal margins

in the enamel. All the specimens were then randomly divided into five groups with 20 specimens per each group according to the type of restorative material used.

In Group A: Chemically cured GIC, Group B: Light cured GIC, Group C: Nanofilled Resin Modified GIC, Group D: Cention N, were used as restorative materials. In Group E: Control Group in which no restorative material was placed into the prepared cavities. (Figure No:1)

Fig 1: Restorative materials used.

In group A, The Class V prepared cavity walls were first dried with blotting paper and conditioned for 20 seconds with GC dentin conditioner (10% Polyacrylic acid, GC Corporation, Japan). GIC Fuji II cement was mixed according to manufacturer's instructions and was placed into the prepared cavities. Immediately after placement of restorative material into the prepared cavities, a transparent mylar matrix (Clear Thru, Premium Dental Products, Norristown, PA, USA) was adapted over GIC Fuji II restorations during initial setting for 2 min and then the matrix was removed. The unfinished restorations were immediately coated with GC FUJI Varnish (GC Corp) according to the manufacturer's instructions and excess restorative material was removed with BP Knife (Magnia marketing, Kanpur, India). After the varnish was dried, the teeth were stored in distilled water for 24 hours at 37°C of temperature.

In Group B: The prepared Class V cavity walls were first dried with blotting paper and conditioned for 20 seconds with GC dentin conditioner (10% Polyacrylic acid, GC Corporation, Japan,). Fuji II LC cement was mixed according to manufacturer's instructions and was placed into the prepared cavities. Immediately after the placement of restorative material, a transparent mylar matrix (Clear Thru: Premium Dental Products, Norristown, PA USA) was adapted over the Light cure GIC and cured with LED curing unit (QTH light curing unit, Dentsply) for 20 seconds. The matrix was then removed and the unfinished restorations were immediately coated with GC Fuji varnish (GC Corp) according to the manufacturer's instructions and the excess material was removed with the BP knife (Magnia marketing, Kanpur, India). Once the varnish was dried, the teeth were stored in distilled water for 24 hours at 37°C of temperature.

In Group C, the prepared Class V cavity walls were first dried with blotting paper and Ketac N100 Nano-ionomer primer was applied on the walls of prepared cavities and thinned with a stream of dry air for 10 seconds. It was light cured for 10 seconds using LED light curing unit (Dentsply). Equal amounts of two pastes of Ketac N100 Nano-ionomer cement was dispensed on paper pad and mixed with a plastic spatula for 20 seconds and placed into the prepared cavities and light cured for 20 seconds.

In Group D, the prepared Class V cavities were first air dried and were then acid etched with 37% Phosphoric acid (Prime Dental Products, Thane, Maharashtra, India) for 30sec and then gently rinsed with water to remove the etchant totally. The prepared cavities were then dried with blotting paper to remove excess moisture and the walls of the prepared cavity were conditioned with Tetric N bond for 20 seconds. Cention N was mixed according to manufacturer's instructions and was placed into the prepared cavities. Immediately after restorative material was placed, a transparent mylar matrix (Clear Thru: Premium Dental Products, Norristown, USA) was placed over Cention N restorative material for 5 min for its initial setting and was then light cured with LED curing unit (Dentsply) for 30 seconds for final setting. After polymerization, excess material was removed with fine grit diamond bur (SS White burs Inc. New Jersey, USA).

The restorations in all the specimens were finished with fine grit diamond finishing burs (SS White Burs Inc. New Jersey, USA) and polished with the disc system (Sof-Lex, 3M ESPE).

In Group E: Control Group: No restorative material was placed into the prepared cavities.

All the specimens were then stored at 100% relative humidity at 37°C of temperature for 24 hours and were subjected to 500 thermocycling at 5°C and

55°C with dwell time of 1 minute. The root apices of all the teeth were sealed with sticky wax. All the specimens were then coated with two layers of nail varnish, except over the restorations and 1mm circumference around it, with a moist cotton pellet placed over the restorations to prevent dessication. All the specimens were then placed in 2% methylene blue dye (Molychem, Mumbai, India) for 48 hours at room temperature and to prevent dye leakage through the root apices, only the coronal portions of the teeth were immersed in the dye. All the specimens were then removed from the dye, rinsed under tap water for 30 seconds and nail varnish was removed with BP blade. Subsequently, all the teeth were sectioned longitudinally in a buccolingual direction with a diamond disc (DFS, Germany) of 0.3 mm in thickness at a speed of 20,000 rpm.

The degree of marginal leakage was evaluated by the penetration of methylene blue dye from the occlusal and gingival cavosurface margins to the axial walls of the prepared cavities. Each specimen was viewed under a Stereomicroscope (M9, Wild Heerbrugg, Switzerland) at 10X magnification (Figure No:2 and Figure No:3) and scoring was done in 0-3 Scale scoring system as suggested by Silveira de Arauja.[6]

Fig 2: Group C: - Dye leakage viewed under Stereomicroscope.

Score 0 = No evidence of dye penetration.

Score 1 = Dye penetration along occlusal/gingival wall to less than half of the cavity wall.

Score 2 = Dye penetration along the occlusal/gingival wall to more than half of the cavity depth, but not extending on to the axial wall.

Score 3 = Dye penetration along the occlusal/gingival wall to the full cavity depth and extending on to the axial wall.

Fig 3: Group B: - Dye leakage viewed under Stereomicroscope.

DISCUSSION

In spite of all achieved progress in the field restorative dentistry, microleakage is still an undesired possibility and it appears to be very hard to eliminate. The chase for a perfect adhesion between tooth structure and the restorative material is in the gear level for new researches on adhesive restorative materials.[2]

Restoration of Class V cavities is always a challenge because cervical margins of such lesions is in cementum or dentin. GIC's are indicated for Class V cavities, where esthetics is not a prime concern. The properties of GIC over Composite restorative material is in its ability to bond chemically to tooth structure, release fluoride, biocompatible, lower shrinkage and reduced microleakage.[7]

The present study evaluated the microleakage of different types of Glass Ionomer cement restorations and Cention N (An alkasite restorative material essentially subgroup of composite resin.) placed in Class V cavities by using a dye penetration test. Microleakage is an important property that has been used in accessing the success of any restorative material used in dental restorations.

Thermocycling is a standard protocol in the restorative literature when bonded dental restorative materials were evaluated. Thermocycling helps in simulating invivo conditions

by subjecting dental restorative materials to cyclic exposure to hot and cold temperatures. [3]

In the present study, Nanofilled Resin Modified GIC and Cention N showed optimum tooth-restoration interface with minimal or no microleakage compared to Chemically cured GIC, Light Cured GIC and Control Group. Control Group showed maximum microleakage at tooth-restoration interface.

A novel RMGI restorative dental material, Ketac N 100(3M, ESPE) was developed incorporating the benefits of nanotechnology. Ketac N 100 is resin - modified glass ionomer, where two type of setting reactions occurs. 1) Acid-base reaction between the fluoroaluminosilicate glass and polycarboxylic acid. 2) Light-activated free radical polymerization of the methacrylate group of the polymer and HEMA(2-hydroxyethylmethaacrylate) However the actual bonding mechanism of RMGI's to tooth structure has been recently determined to be two-fold by micromechanical interlocking and chemical interaction. The basic bonding mechanism was ionic interaction between two carboxyl(COO-) groups in the cement to the calcium(Ca2+) ions in enamel and dentin and micromechanical interlocking is achieved by impregnation of partially demineralized layer on over the dentin substrate, with high molecular based polycarboxyl-based polymer. Due to the presence of resin in RMGIC, bonding of RMGIC to tooth structure is very much similar to composite resin, that is attachment of resin tags into the enamel and establishment of hybrid layer from the hydrophilic HEMA.[8]

Light-activated polymerization is accompanied by certain degree of polymerization shrinkage that takes place in the Light cured GIC, Nanofilled Resin Modified GIC and Cention N. The Nanofilled Glass ionomer cement contains fluoroaluminosilicate glass, together with nanomers and nanoclusters in the filler loading, which is approximately 69% by weight. Higher filler loading results in lower polymerization shrinkage and lower coefficient of thermal expansion, thus improving the long term bonding to the tooth structure.[8]

Cention N is a tooth coloured restorative material for direct restorations. It is self-curing restorative material, which requires optimal additional light curing. The liquid contains dimethacrylate and initiator, while the powder contains various glass fillers, initiators and pigments.[5] Due to the sole use of cross-linking methacrylate monomer in combination with a stable and efficient self-cure initiator, Cention N exhibits higher polymer network density and higher degree of polymerization to the complete depth of the restoration. Cention N contains, an Isofiller, which acts as shrinkage stress reliever, thus minimizing the shrinkage forces. The organic/inorganic ratio and the monomer composition of Cention N are also responsible for lower volumetric shrinkage leading to minimal microleakage. When the material polymerizes either in the self-cured mode or by light-curing, the monomer chains located on the filler particles and silanes begin to cross link and the forces between the individual filler particles places stress on the prepared cavity walls. This stress has been influenced by both volumetric shrinkage and modulus of elasticity of the restorative material. Due to its low elastic modulus (10Mpa), the shrinkage stress reliever within the Cention N reduces polymerization shrinkage and microleakage.[5]

Light-cured GIC showed more microleakage and loss of restorative material compared to Conventional GIC, Nanofilled Resin modified GIC and Cention N due to its hygroscopic expansion. Microleakage in conventional GIC is due to its rigid framework and elastic deformation in the initial stages of polymerization.[4]

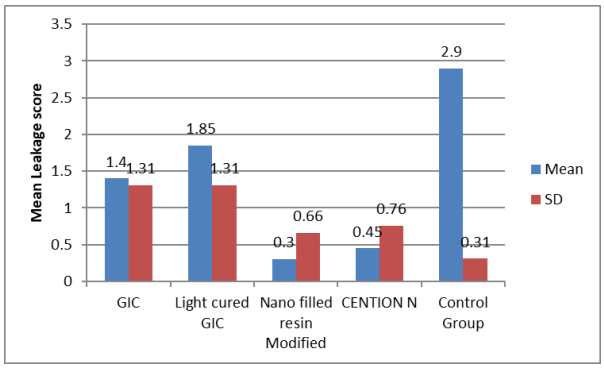
RESULTS

The results were tabulated and statistically analysed using Chi Square test, Analysis of Variance (One Way ANOVA) and Tukey's-Post Hoc test. One-Way ANOVA showed highly significant difference in the mean values of microleakage between the five groups with P-Value < 0.0001 and is considered to be highly significant. (Table:I)

Table 1: Mean microleakage scores at occlusal and gingival margins of Groups: A, B, C, D, E.

Groups Score	Dye leakage scores at occlusal margin 0	 1	 2	 3	Dye leakage scores at gingival margin 0	 1	 2	 3
A. GIC (n=20)	8(40%)	2(10%)	4(20%)	6(30%)	1(5%)	4(20%	5(25%)	10(50%
B. Light cured GIC (n=20)	5(25%)	3(15%)	2(10%)	10(50%)	2(10%)	3(15%)	7(35%)	8(40%)
C. Nanofilled Resin Modified GIC (n=20)	16(80%)	2(10%)	2(10%)	0(0%)	18(90%)	1(5%)	1(5%)	0(0%)
D. Cention N (n=20)	14(70%)	3(15%)	3(15%)	0(0%)	17(85%)	2(10%)	1(5%)	0(0%)
E. Control Group (n=20)	0(0%)	0(0%)	2(10%)	18(90%)	0(0%)	0(0%)	1(5%)	19(95%)
Chi Square value	39.66				74.74			
P value (P: Probability)	<0.0001 Highly significant				<0.0001 Highly significant			

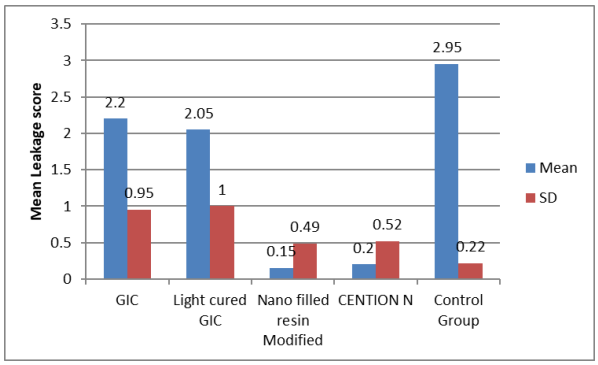
Group C in which, the prepared cavities were restored with Nanofilled Resin Modified GIC and Group D in which, the prepared cavities were restored with Cention N showed the least dye penetration compared to Group A (Chemically cured GIC), Group B (Light cured GIC), and Group E (Control group).



Graph I: Comparison of Mean dye leakage scores of all the groups at occlusal margin.

There was no statistically significant difference in the mean microleakage values between Group C (Nanofilled Resin Modified GIC) and Group D (Cention N). To find exactly which group differs from the other. Tukey's - Post Hoc test was done for inter-group comparison among the five groups and was found that, there was a statistically significant difference in the dye penetration between the groups. Group C and Group D showed significantly better marginal seal with minimal dye penetration compared to the other groups. Wilcoxon test was done to compare the occlusal mean dye leakage scores of all the groups and it showed statistically significant difference in the dye leakage between Group A with Group B, Group C, Group D and Group E. However, there was no statistically significant difference between Group C and Group D.

The gingival mean dye leakage scores showed statistically significant difference between Group A with Group C, Group D and Group E. However, there was no statistically significant difference in the dye leakage between Group A with Group B and Group C with Group D.



Graph II: Comparison of Mean dye leakage scores of all the groups at gingival margin.

CONCLUSION

Within the limitations of the present study, Nanofilled Resin Modified GIC and Cention N showed better marginal adaptation with least microleakage compared to Light cured GIC and Chemically cured GIC.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Sunil Kumar Gupta, Vidya Sarswathi, Vasudev Ballal, Shashi Rashmi Acharya. Comparative evaluation of Microleakage in Class V cavities using various Glass Ionomer Cements: An invitro study. Journal of Interdisciplinary Dentistry 2012.;2:3:164-169.

2. Danielson Guedes Pontes, Manoel Valcacio Guedes-Neto, Maria Fernanda Costa Cabral, Flavia Cohen-Carneiro. Microleakage evaluation of Class V restorations with Conventional and Resin modified Glass Ionomers. J. OHDM 2014;13:3:642-646.

3. Nesrin Eronat, Emir Yilmaz, Nazan Kara, Asli Topaloglu AK. Comparative evaluation of Microleakage of Nano-filled resin modified Glass-ionomer: An invitro analysis. European Journal of dentistry 2014:8:14450-455.

4. Amish Diwanji, Vineet Dhar, Ruchi Arora, Madhusudhana A, Ambika Singh Rathore. Comparative evaluation of microleakage of three restorative Glass Ionomer Cements: An invitro analysis. Journal of Natural science, Biology and Medicine 2014:5:2:373-377.

5. Soumita Samanta, Utpal Kumar Das, Aditya Mitra. Comparison of microleakage in Class V cavities restored with flowable composite resin, Glass Ionomer Cement and Cention N. Imperial Journal of interdisciplinary research 2017.3:8:180-183.

6. Silveira de Arauja, Inserti da silvera T, Olieri FA, Meireles SS, Piva E, Dimarco FF. Microleakage of seven adhesive systems in enamel and dentin. J Contemp Dent Practice 2006:7:26-33.

7. Shameera Asafarlal. Comparative evaluation of microleakage, surface roughness and hardness of three Glass ionomer cements: Zirconomer, Fuji IX Extra GC and Ketac Molar: An invitro study. J. Dentistry 2017:7:5:427.

8. S Abd, El Halim, D Zaki. Comparative evaluation of microleakage among three different Glass Ionomer types. J. Operative Dentistry 2011:36:1:36-42.