IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 3 Ser.5 (March. 2023), PP 30-35
www.iosrjournals.org

Comparative evaluation of microleakage two types of restorative materials in primary and permanent posterior teeth: an invitro study.

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Abstract:
objective: The aim of this study was to compare the microleakage of type IX GIC and composite resin restorations in primary and permanent posterior teeth through scanning electron microscope. Methodology: A total of 60 extracted molars (30 primary ,30 permanent posterior teeth) was considered for the study. The samples were divided in to Group IIA-(n=15) permanent posterior teeth with composite restoration and Group IIB-(n=15) permanent posterior with Glass Ionomer Cement restoration. Debris removed, teeth was cleaned, and stored in distilled water at room temperature. Class-1 cavity was prepared and restored. All the groups were analysed under scanning electron microscope for observing the microleakage in both sets of teeth. Data was collected, tabulated and statistically analysed. Result: Highest microleakage was seen in the primary posterior teeth filled with GIC at a mean of 33.9340 +1.06588 μm. The least microleakage was noted in the permanent posterior teeth filled with Composite at a mean of 17.3913 +.68513 μm, which was statistically significant at p=0.000. Conclusion: All the groups showed varying degree of microleakage. Overall, it can be concluded that amongst the restorations, GIC exhibited higher microleakage than Composites.

Key Words: *Activa pronto composite, GIC, microleakage, Scanning electron microscope.*

Date of Submission: 26-02-2023 Date of Acceptance: 10-03-2023

I. Introduction

One of the most factors affecting the clinical success of restorations is marginal leakage, which is defined as the microscopic passage of bacteria, fluids, and ions between restoration and dental tissue. [1,3] Several negative condition can be encountered as a result of microleakage, including postoperative sensitivity, marginal discoloration, impaired marginal integrity and secondary caries.[3]. There are two basic reasons for the formation of microleakage in restorations, these are moisture contamination at the time of restoration and functional force create stress on tooth. To overcome this many advances in the development of improved biomaterials for dental restorations have been rapid, and they continue to occur at a fast pace.

The more common restorative materials used are composite and GIC. [1,6] Esthetics has been prime segment of dentistry and GIC and composite are material of choice.[1] A newer composite is introduced which is highly aesthetic, moisture friendly, versatile, hydrophilic and designed to reduce the polymerization shrinkage and also features biomimicry. The material diffuses fluoride, calcium, phosphate ions that fortify the saliva and help replace essential minerals that are lost in the decay process.[2]

GIC may be considered pharmacologically therapeutic because of fluoride release over time, biocompatibility and chemical bonding to dental tissue. They also have minimal shrinkage during setting. [1,2]

The aim of this study to evaluate two different restorative materials through comparison of microleakage.

II. Methodology

The extracted 60 teeth (30 primary and 30 permanent) were collected and divided into group I (containing 30 primary posterior teeth) group II (30 permanent posterior teeth). further it was divided into two subgroups group I A (15 primary posterior teeth restored with composite), group I B (15 primary posterior teeth restored with GIC) likewise, group II A (containing 15 permanent posterior teeth restored with composite) and group II B(15 permanent posterior teeth restored with GIC) Primary molars near to exfoliation, Permanent molars extracted for periodontal reason, impaction, Caries free teeth included. Selected samples were kept in separated jar. All the crown portion of the teeth were separated from root at the level of CEJ with the help of double-sided diamond disc under continuous irrigation, followed by mounting of all the samples on wax were done. Standard class -I cavity preparation done by diamond bur (straight fissure No.- SF - 41) with a width of one- fourth of intercuspal distance and depth of 0.5mm- 1 mm below the dentino-enamel junction.

2.1 Group I A & II A

Prepared cavity of each teeth were etched using 37% orthophosphoric acid etchant (Actino gel REF-10006, DenPro Limited- Jammu-181133, India)for 30 sec. and rinsed with 3-way air-water syringe for 10 sec. Application of bond adhesive done and polymerized by Blue violet LED Unit with wave length of 420-480nm (wood pecker, 2300mw/cm^2 , 1400mAh , China) for 20 sec. Cavity were restored with Composite Resin (Pulpdent Activa Pronto-Pulpdent corporation Watertown, MA 02472 USA) as per manufacturer's guidance, and cured with Blue violet LED Unit with wave length of 420-480nm for 20 sec.

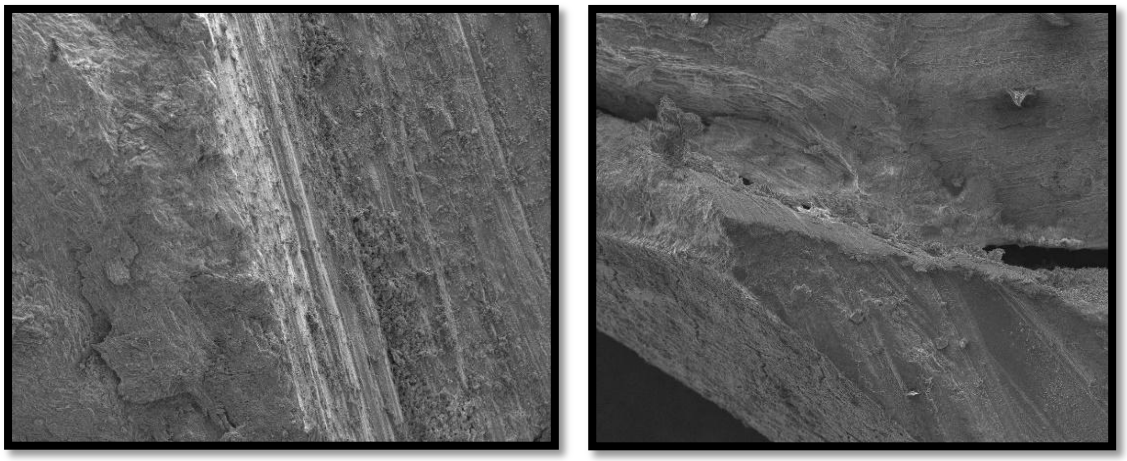
2.2 Group I B & II B

All prepared cavity were washed and dried with 3-way air-water syringe. Type -9 GIC– Gold Label – 9 – A2 (GC corporation, Tokyo, Japan.) was mixed as per manufactures guidance and cavity were restored.

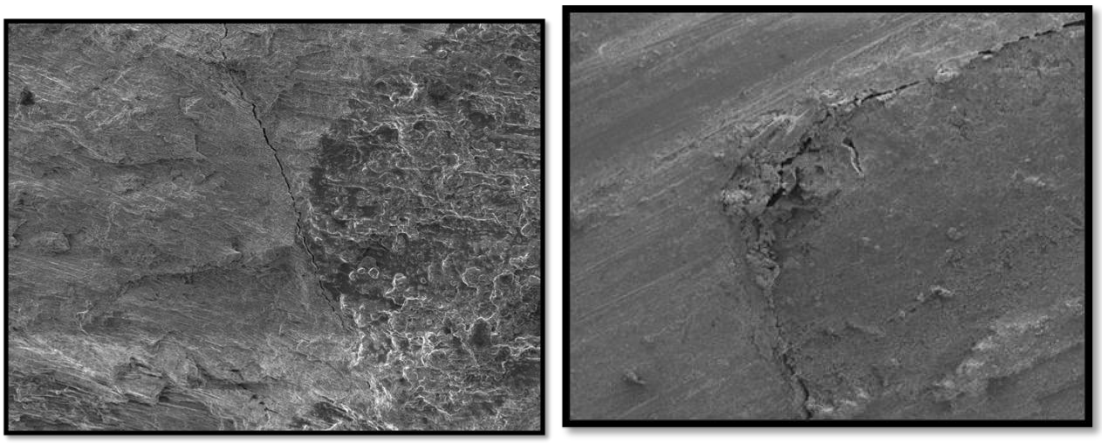
All 60 samples were subjected to thermocycling at 5^o C-55^o C with a dwell time of 50 sec. after that teeth surface were dried and sectioned buccolingually by using double ended diamond disc bur. (D.FD.355.504. 220.HP; in Germany) under continuous irrigation.

2.3 Sample preparation for SEM:

All the samples were washed and air dried. Samples are attached to aluminium stub, sputtering of prepared samples were done with 2000 E thick layer of gold under sputtering unit. Microleakage evaluation was done using SEM (JEOL-JAPAN 6390A) with a magnification of x 20,000.



(a) (b)



(c) (d)

Figure:SEM observation for microleakage in(a) Group IA –primary tooth restored with composite. (b)Group I B- primary tooth restored with GIC. (c) Group IIA –permanent tooth restored with Composite. (d)Group II B- permanent tooth restored with GIC.

III. Result

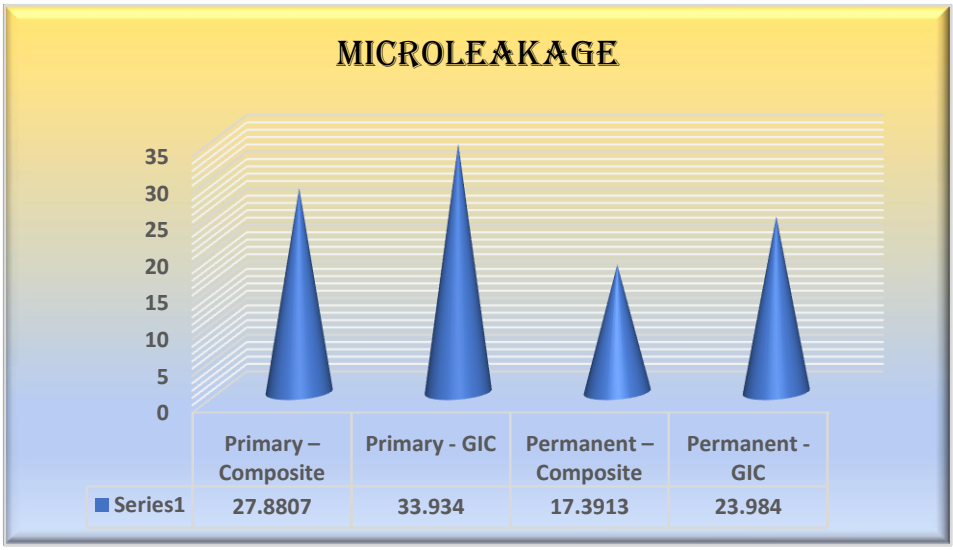
The mean for different readings between the groups was compared using One-way analysis of variance (ANOVA), and the intercomparison between each group was done using Tukey's *post hoc* analysis. Student 't' test was run to find significant differences in microleakage between Primary posterior teeth, Permanent posterior teeth, Composite and Glass Ionomer Cement restoration.

Comparative evaluation of microleakage of two types of restorative materials in primary and permanent posterior teeth by SEM analysis in both groups shows: -

Table 1: Comparative analysis of microleakage by SEM between all the study groups.

Groups	N	Mean	Std. Deviation
Group I A	15	27.8807	.89310
Group I B	15	33.9340	1.06588
Group II A	15	17.3913	.68513
Group II B	15	23.9840	1.02500
ANOVA statistic	836.743		
df	3		
P value	0.000*		

* =Significant; NS=Not Significant



Graph1: Comparative analysis of microleakage by SEM between all the study groups.

Table 2:-Comparison of microleakage in different study groups.

Pairs	Mean Difference	Sig.
Group I A versus Group I B	-6.05333*	.000*
Group I A versus Group II A	10.48933*	.000*
Group I A versus Group II B	3.89667*	.000*
Group I B versus Group II A	16.54267*	.000*
Group I B versus Group II B	9.95000*	.000*
Group II A versus Group II B	-6.59267*	.000*

* =Significant; NS=Not Significant.

SEM analysis conducted between the groups showed that the highest microleakage was seen in the Primary posterior teeth filled with GIC at a mean of 33.9340 +1.06588 μm followed by the Primary posterior teeth restored with Composite. The least microleakage was noted in the group of Permanent posterior teeth restored with Composite at a mean of 17.3913 +.68513 μm, which was statistically significant at p=0.000 as seen in Table 1 and graph 1.

Pairwise comparison done by applying Tukey's post hoc test showed significant differences between all pairs. The highest mean difference was noted between primary posterior teeth restored with GIC versus permanent posterior teeth restored with composite at 16.54267 significant at p=0.000. When primary posterior teeth were compared for microleakage between Composite and GIC restorations, GIC restoration showed greater microleakage with a mean of 33.9340 + 1.06588 μm as compared to 27.8807 + .89310 μmin the composite restoration, significant at p=0.000. Comparative evaluation of permanent posterior teeth also showed GIC to have greater microleakage mean is17.3913 than Composite restoration i.e., 23.9840. When compared for microleakage between the type of dentition for composites, primary dentition demonstrated greater microleakage with a mean of 27.8807 + .89310 μm as compared to permanent at 17.3913 + .68513 μm, significant at p=0.000. GIC restoration when checked for microleakage between dentition showed greater values for primary dentition i.e., 33.9340, than permanent 23.9840, significant at p=0.000.

Overall, it can be inferred that, Primary dentition had greater microleakage as compared to permanent dentition. Amongst the restorations, GIC exhibited higher microleakage than composites.

IV. Discussion

The demand for aesthetic restoration has existed since antiquity, but during the first half of the twentieth century, silicates were the only tooth-colored material available for cavity restoration. However, they eroded after a few years and were only replaced by tooth-colored acrylic resin in the late 1940s and early 1950s. Regrettably, they have a reduced wear resistance and shrink considerably during curing, likely to result in leakage [58]. Microleakage takes place as a result of polymerization contraction and the difference in the thermal expansion coefficients between the dental structure and restorative material, which can lead to bond failure (Wang and Chiang, 2016; Chandrasekhar et al., 2017) [8,9]. Furthermore, marginal microleakage has been found to be involved in several restorativedentistry failures because it accelerates material deterioration, resulting in a shorter restorative procedure life and irreversible damage to the dental structure integrity, marginal discoloration, secondary caries, postoperative sensitivity, pulp pathologies, and break restorations (Irie et al., 2014) [10]. There is constant advancement to newer dental restorations used in Paediatric Dentistry with the goal of inhibiting the progression of lesions and the formation of secondary caries as well as the longevity of the restoration.[10]

Several methods, such as dye penetration, air pressure, radioactive isotopes, and scanning electron microscopy, have been used to assess the microleakage of restorations (SEM). A scanning electron microscope is typically used to measure gaps that form between the restoration and the tooth surface. The specimens are prepared for SEM by mounting them on metal stubs and sputtering them with gold. Abnormalities somewhere at micro level can be seen with magnifications ranging from X 200 to X 2000. The microphotographs are made from final evaluation.[11]

Following new updates in polymer concentration or organic matrix, a new generation of bulk-filled composites has been introduced. The composites are said to have low polymerization shrinkage, which is a major advantage for reducing microleakage caused by polymerization shrinkage. ACTIVA Pronto is a dynamic, moisture-friendly, mineral-enriched composite which emits and recharges calcium, phosphate, and fluoride, providing teeth with the minerals they require to stay healthy. ACTIVA Pronto is a nanohybrid material that is universal, stackable, and shapeable, and that does not slump. It is made with a proprietary rubberized resin that is intense, resilient, and resistant to wear and fracture, even in thin areas on angled margins. ACTIVA Pronto is

a versatile, aesthetic, and highly radiopaque material that is approved for all types of cavities and load - carrying applications.[13]

SEM analysis was used in this study to assess microleakage in composite and GIC. After 24 hours of distilled water immersion, Group I B primary teeth filled with GIC (GC gold type IX) demonstrated a mean leakage of 33.9340, while Group II B permanent teeth filled with GIC (GC gold type IX) exhibited a mean leakage of 23.9840. This was consistent with the findings of Viramani et al. (2007), who determined the microhardness and microleakage of GIC in primary dentition and discovered nearly identical microleakage (GC type - IX) is a highly viscous material because of its higher powder-liquid proportion and smaller glass particle size. The microleakage behaviour was most probably caused by high viscosity, which prevented proper wetting of the tooth surface and the formation of a good seal between the tooth restoration interface(Castro and Feigl ,2002).[14]

Group II A Upon 24 hours of distilled water immersion and SEM analysis, permanent teeth filled of composite (ACTIVA Pronto) had a mean microleakage of 27.8807, while Group II B had the least microleakage, with permanent teeth filled of composite (ACTIVA Pronto) having a mean microleakage of 17.3913. According to the findings of this study,Kaushik M, Yadav M (2017) discovered that ACTIVA restorative material had less microleakage. Some other study was conducted byGhazal et al (2021) found that ACTIVA is a restorative material with both a resin network and bioactive fillers that can reduce polymerization shrinkage and thus achieve efficient sealing with less microleakage.[12]

In the accordance of present study Dr. Nirmala Bishnoi et al (2020) found a significant difference in microleakage among the three groups. ACTIVA restorative composite and Tetric N Cream bulk fill showed least microleakage. pair-wise comparison for the groups using Mann- Whitney U test showed that there was not significant difference between Group I (Activa Bioactive) and group II (Tetric N Cream) , however comparison of Group II (Tetric N Cream) and Group III (Filtek bulk fill) revealed a statistically significant difference . The results of this study in accordance with that of Cannova et al. (2014**)** who demonstrated that the marginal seal of Activa Bioactive when used without bonding agent was at par with the leading composites Filtek^{TM}Supreme Ultra (3M, ESPE/conventional), SonicFill^{TM} (Kerr/Bulk Fill), Tetric Evo Cream (Ivoclar / Bulk Fill).[17] the superior sealing of Activa restorative composite could be attributed to the ionization reaction that helps form hydroxyapatite bond to the tooth structure.[4]

Ayana et al. (2018) investigate dye microleakage at the margins of primary teeth restorations made with three GIC-based restorative materials. They concluded that polyacid-modified composite resin could be a beneficial restorative material in primary dentition.[9]

Microleakage was greater in deciduous molars than in permanent molars. This could be due to the differences in composition between primary and permanent teeth. The mechanism of GIC and composite adhesion to the tooth structure includes the chelation of polyacid carboxylic groups with calcium in the apatite of both enamel and dentin. Permanent teeth comprise more inorganic content than primary teeth, resulting in a strong bond, which may have resulted in a decrease in microleakage.[15]

According toHirayama (1990), primary teeth's peritubular dentin is 2-5 times thicker compared to that of permanent teeth. Thicker peritubular dentin means very little intertubular dentin; since the intertubular dentin seems to be the major area where bonding takes place, dentition provide less bonding than permanent dentition, resulting in more microleakage.[16]

According to the findings of the studies, composite (ACTIVA Pronto), a urethane-based resin that appears to contain no Bisphenol A, no Bis-GMA, and no BPA derivatives, could serve as an appropriate restorative material in an extremely stressful area where GIC are contraindicated because the flexural strength values are considerably higher than that specifically mentioned by IOS benchmarks and cannot only release fluoride but is also a dynamic, moisture-friendly material that responds to pH changes. As a result, it could be regarded as a dependable and promising restorative material in the field of preventive and operative dentistry. More large-scale research is needed to validate the findings of the present study.[16]

V. Conclusion

The current study was conducted to evaluate and compare the microleakage of two types of restorative materials i.e.- type IX GIC and newer hydrophilic composite in primary and permanent posterior teeth by SEM analysis. Predicated on the result of the present study, following culminations were drawn:

- Composite in permanent dentition showed less microleakage compared to primary dentition.
- GIC restoration when checked for microleakage between dentition showed greater values for primary teeth than permanent teeth.
- SEM analysis conducted between the groups showed that the highest microleakage was seen in the Primary teeth filled with GIC followed by the Primary Composite. The least microleakage was noted in the group of Permanent teeth filled with Composite.

Result of this study would be helpful in the field of pediatric preventive dentistry. It also showed that there was no complete elimination of microleakage in any of the groups. Hence, to validate this study, further in vivo research on larger sample size has to be done for a better prediction of microleakage.

Conflict of interest
Nil
Fundings
Nil

Bibliography:

[1]. American Academy of Paediatric Dentistry: Definition of a dental home, Paediatric Dent 35(6):12, 2014. [Special issue: Reference manual 2013-2014].
[2]. Anderson, R J.; Braddock, G.; Beal, J.F.; James, P.M.C.: the reduction of dental caries prevalence in English Schoolchildren J. Dent. Res.61; spec. issue. 1311 (1982).
[3]. Brown LJ, et al: Dental caries, restoration and tooth conditions in U.S. adults, 1988-1991, J Am Dent Assoc 127:1315-1325, 1996.
[4]. Activa presto: -http://www.fda. gov/Medical Devices/Products and MedicaI Procedures/Dental Products/ucm4044 72.htm.
[5]. Bhasi E, Sagmak S, Celiiko O, Akkus Z. The evaluation of microleakage and fluoride release of different types of glass ionomer cements. Niger J clin Pract 2019 ;22;961-70.
[6]. Niranjan B, Shashikiran ND, Singla S, Thakur R, Dubey A, Maran S. A comparative microleakage evaluation of three different base materials in Class I cavity in deciduous molars in sandwich technique using dye penetration and dentin surface interface by scanning electron microscope. J Indian Soc Pedod Prev Dent 2016; 34:324‑30.
[7]. Mazumdar et al SEM evaluation of gap at the resin dentin interface in Class II composite resin restoration: an in vitro study May-August 2012; Vol 10 (No.2);98-104 SEM evaluation of gap resin dentin interface.
[8]. Wang, Z., Chiang, M.Y., 2016. Correlation between polymerization shrinkage stress and C-factor depends upon cavity compliance. Dent. Mater. 32, 343–352.
[9]. Chandrasekhar, V., Rudrapati, L., Badami, V., Tummala, M., 2017. Incremental techniques in direct composite restoration. J. Conserv. Dent. 20, 386–391.
[10]. Irie, M., Tanaka, J., Maruo, Y., Nishigawa, G., 2014. Vertical and horizontal polymerization shrinkage in composite restorations. Dent. Mater. 30, 189–198.
[11]. Anusavice, Restorative Resin, Phillip's Science of Dental Material, Elsevier (2003).
[12]. Campodonico CE, Tantbirojn D, Olin PS, Versluis A. Cuspal deflection and depth of cure in resin-based composite restorations filled by using bulk, incremental and trans tooth-illumination techniques. J Am Dent Assoc 2011;142(10):1176-1182.
[13]. Czasch P, Ilie N. In vitro comparison of mechanical properties and degree of cure of bulk fill composites. Clin Oral Investig 2013;17(1):227-235.
[14]. http://www.fda.gov/Medical Devices/Products and MedicaI Procedures/Dental Products/ ucm4044 72.htm
[15]. Ranjbar Omidi et al Microleakage of an Enriched resin- modified Glass Ionomer Restorative Material in Primary Molars J Dent Tehran July, 2018; vol.15, No.4.
[16]. N Bishnoi et al, Evaluating the marginal seal of bioactive restorative materials activa bioactive and two bulk fill composites in class II restorations: an in vitro study, international journal of applied dental sciences 2020; 6(3): 98-102.

Pragya Kumari, et. al. "Comparative evaluation of microleakage two types of restorative materials in primary and permanent posterior teeth: an invitro study." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 22(3), 2023, pp. 30-35.