COMPARATIVE EVALUATION OF THE MARGINAL INTEGRITY AND MICROLEAKAGE OF A NANOFILL, NANOHYBRID AND MICROFILL COMPOSITE IN PREPARED CLASS II CAVITIES – AN *IN-VITRO* STUDY

Dissertation submitted to

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

In partial fulfillment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH IV – CONSERVATIVE DENTISTRY

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RAJAS DENTAL COLLEGE AND HOSPITAL

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This is to certify that this dissertation entitled“**COMPARATIVE EVALUATION OF THE MARGINAL INTEGRITY AND MICROLEAKAGE OF A NANOFILL, NANOHYBRID AND MICROFILLCOMPOSITE IN PREPARED CLASS II CAVITIES – AN IN VITRO STUDY**”*is a bonafide research work done by***Dr. S.Maria Antony** *under my guidance during his postgraduate study period between* ***2016- 2019.***

*This Dissertation is submitted to***THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY,***in partial fulfilment for the degree of***MASTER OF DENTAL SURGERY** *in* **CONSERVATIVE DENTISTRY AND ENDODONTICS – BRANCH IV.** *It has not been submitted partially or fully for the award of any other degree or diploma.*

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DECLARATION OF THE CANDIDATE

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

	ABBREVIATIONS
Bis-GMA	Bis-phenol A diglycidyl ether dimethacrylate
UDMA	Urethane dimethacrylate
CEJ	Cementoenamel junction
TEGDMA	Triethylene glycol dimethacrylate
PEGDMA	Poly(ethylene glycol) hydrogels
PPF	Pre-polymerized filler
LED	Light Emitting Diode
HAp	Hydroxyapatite

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Background

Polymerization shrinkage is the major drawback of resin based composites Because of polymerization shrinkage, undesirable space or gaps are frequently detected in the proximal gingival margins of class II restorations. The filler content and the resin matrix composition of compositeresin dictate the amount of volumetric shrinkage.So this *in-vitro study* was undertaken to evaluate themicroleakage and marginal adapatation of amicrofill, nanofill and nanohybrid composites in prepared class II cavities.

Materials and Methods

Standardized Class II Mesio-Occluso- Distal cavities were prepared in 90 intact human mandibular premolars with the gingival floor ending 1mm coronal to the CEJ in the mesial side and 1 mm apical to CEJ in the distal side.Restored teeth were then divided into two main groups. Group 1 for microleakage evaluation (n=45). Group 2 for marginal adaptation evaluation (n=45).Group1 was then further subdivided into Group 1a(Filtek Z350 nanofill composite), Group 1b (Herculite précis nanohybrid composite) and Group 1c (Heliomolar microfill composite).Similar grouping was done in Group 2 (Marginal adaptation). For microleakage evaluation, therestored teeth were stored in a incubator at 37°C for 24 hours followed by thermocycling. Nail varnish application was done, except for an area approximately 1 mm around the margins of the restoration. Then the specimens were stored in 0.2 % methylene blue aqueous solution for 24 hours. After which the samples were sectioned mesiodistally by using a fine grit diamond disk.Microleakage for the sectioned specimens was evaluated by using a stereomicroscope. For theevaluation of marginal

adaptation,scanning electron microscopic analysis was performed, prior and after performing the loading cycles.

Statistical analysis:

For microleakageevaluation,the data wasstatisticaly analyzed by using the Kruskal-Wallis test at 0.05 level of significance. For marginal adaptation, the data wasstatisticaly analyzed byusing ANOVA and Post-Hoc analysis by using Bonferroni Test at 0.05 level of significance.

Results:

The Results of this study indicated that lower mean microleakage scores and higher continuous margin percentages was found for Filtek Z350 Nanofill composite group followed by the Herculite précis nanohybrid composite and finally for Heliomolarmicrofill composite. For marginal adaptation , statisticaly significant values were found between all the involved groups. The results were not statisticaly significant for the microleakage group.

INTRODUCTION

The most relevant oral health problem around the globe is dental caries.Around 2.43 billion of the people that is 36% of the population is affected worldwide by dental caries to their permanent dentition (1). In India 50%–60% of the population areaffected by some form of dental caries. (2)

Dental restorative materials such as dental amalgam, composite resin, porcelain, glass ionomer cement and compomers are used commonly to replace and restore the function and the integrity of the lost tooth structure. (1) In 1950 ,Bowen used Bis-GMA resin to restore the decayed tooth structure. In 1980, posterior resin composite material was introduced (3). Now, most of the posterior direct restoration placements are by some form of composite materials (Sadowsky, 2006) (4)..In the 1990s, resin-based composites was introduced and its ability to mimic tooth structure gave resin-based composites a distinct advantage for patients and dental professionals. But the wear was an important concern associated with posterior restorations, The wear in resin-based composite has been compensated to an extent by silane application, filler loading and also by filler size. Resin-Based Composites are now available in different shades, opacities, various filler particle sizes, multiple viscosities and also by means of different delivery systems. (5)

The mean annual failure rates associated with posterior resin composite is found to bebetween 1 to 3% (Manhart et al., 2004; Heintze and Rousson, 2012)(6). Both amalgam and composites are apt for restoring class I and class II cavities but the major advantage of composites over amalgam restoration is intheir adhesive properties, minimal cavity preparation size,theability to reinforce weaker cusps and also esthetics.(7).

But marginal leakage is the most important disadvantage when class II cavities are restored with resin based composite materials. And, achieving a good seal is even more difficult when the margins are located below the cementoenamel junction (CEJ). The incapability of the restorative material to seal the interface with the tooth structure leads to microleakage and inflow of intraoral irritants and this results in the development of sensitivity, bacterial penetration and also secondary caries. (20).

In spite of the superior clinical outcomes, there are some intrinsic problems associated with composite restorations such asthe polymerization shrinkage and also lower wear resistance. Shrinkage may vary from site to site. It also depends upon the curing light intensity and the reaction rate.Direction of shrinkage is predominantly controlled by boundary conditions, i.e., the shape of the cavity and the features of the margins whichincludesbonded as well as free surfaces. Polymerization shrinkage in resin composites occurs when the free radical monomers combine with the other monomers to form polymer chains. These polymer chains interact with other chains and this interaction causes a marked increase in the viscosity of the paste. When these polymer chains are twisted with one another they form a cross-linked network. At the same time, the polymer gets rigidity as the lengthening chains interlock with one another and the bridges of covalently bonded molecules connect the chains together to form a cross-linked network (11). Hence, each individual polymer chain gets trapped within the stiffened polymer structure. At this point, the composites turn out to be a elastic solid and any further change in the dimension due to the polymerization contraction generates stresses according to Hooke’s law, where stress is equal to the elastic modulus multiplied by the strain. Thus, the increase in shrinkage, combined with an increased elastic modulus, produces increased stress within the composite. (10,11). The Polymerizing material shrinks under restricted conditions like adhesion to the cavity walland this may lead to the disruption of the bond with the tooth structure. (12) The Polymerization contraction causes stresses ranging between 2-6 MPa. These stresses can cause postoperative pain, fracture of the tooth and also the opening ofrestoration margins which can further result in microleakage and also lead to recurrent caries. Normally the polymerization contraction of the composite resins ranges between 0.2 % to 2% for the linear shrinkage and from 1.7 % to 5.7% for the volumetric shrinkage. (13)

To reduce the shrinkage stresses, different restorative techniques have been suggested. IF Neiva et al (14) stated that the oblique incremental insertion showed lesser marginal gap formation and microleakage when compared to the bulk or horizontal incremental techniques. But, none of these different restorative techniques have the ability to eliminate the micro gap formation completely. (14)

The filler content and the resin matrix composition dictate the amount of volumetric shrinkage and also the elastic modulus of the resin composite(16). The connection between the filler content and stress can be explained as the direct relationship between the filler volume fraction and the elastic modulus and it is also seen that the type of monomer and the structure will also affect stress generation (11). Hence, filler loading is one of the most crucial factors which decides the material's strength, elastic modulus, wear resistance and polymerization shrinkage. It also influences the restoration's polishability(15). Heliomolar micro filled composite (Ivoclar, Vivadent) has a filler loading of 77.8% by weight and 46% by volume of highly dispersed silicon dioxide, ytterbium trifluoride and a copolymer having 0.2-0.4µm particle size.(15) Resin technology used in Heliomolar micro filled composite is based upon bis-phenol A diglycidyl ether dimethacrylate(Bis-GMA), urethane dimethacrylate(UDMA) and decandioldimethacrylate(15). Filtek Z350 has a filler loading of 82% by weight and 68% by volume and has a unique combination of nano-sized particles and nanoclusters. The surface of the filleris coated with zirconia/silica having a median particle size of approximately 3 µ. It has Non-agglomerated/non-aggregated 20- nanometer surface-modified silica particles (16). The resin technology is based on theBis-phenol Adiglycidyl ether di -methacrylate(Bis-GMA), Urethane dimethacrylate(UDMA), Triethylene glycol dimethacrylate(TEGDMA) and Poly(ethylene glycol) hydrogels(PEGDMA)(16). Herculiteprecisnanohybrid composite (Kerr) has a filler loading of 78% by weight and it has three fillers namely pre-polymerized filler (PPF), silica nanofiller (20 – 50 nm) and also a submicron hybrid filler namely barium glass filler having a 0.4µ average size (17).

The Cyclic loading and thermocycling are the in -vitro process which stimulate and replicate the natural oral environment. The bond strength of the restorative material is greatly influenced by the intraoral environment changes and the cyclic loading. Cyclic loading is a procedure which can replicate the masticatory stresses that occur in the oral environment So subjecting a restoration and the tooth specimens to both temperature extremes and cyclic loading is an important process which determines the marginal quality(18).

Scanning electron microscope is a widely used method to evaluate the marginal adaptation of the restoration. But it has some drawbacks like during scanning electron microscopic evaluation,a vaccum atmosphere is created and because of thisvaccum procedure, crack formation can occur in the testing specimens. By using a replica method, the artificial gap formation can also be avoided (19) Stereo zoom microscopes provide a 3-dimensional or "stereo" image when looking through the microscope. It is a reliable method when used to view the gaps formed between the restoration and the tooth structure. (19)

Hence the aim of this in vitro study is to compare the marginal integrity and microleakage associated with nanofill, nanohybrid and microfill composites in prepared class II cavities by using a scanning electron microscope and stereo microscope.

AIMS AND OBJECTIVES

AIM

To compare and evaluate the marginal integrity and microleakage of nanofill,nanohybrid and microfill composites in prepared class II cavities

OBJECTIVES

1.To compare and evaluate the marginal integrity of nanofill,nanohybrid and microfill composites in prepared class II cavities by scanning electron microscope before and after performing the loading cycles .

2.To compare the microleakage of nanofill,nanohybrid and microfill composites in prepared class II cavities through dye penetration method and by evaluating the samples using stereomicroscope

REVIEW OF LITERATURE

Barry M. Owens et al in 2018 undertook original research titled “Evaluation of the marginal integrity of a bioactive restorative material” In this study, He evaluated the marginal microleakage of a bioactive composite resin, Universal nanohybrid composite resin and Resin-modified glass ionomer in standard class v preparations in extracted molars. In their study, bio-active composite resin showed greater microleakage than other restorative materials. This finding suggests that the process of micromechanical adhesion of composite resin to enamel is more efficacious than the bond achieved with composite resin or other restoratives to a dentin or cementum surface substructure. Due to its bioactive ionic matrix, bioactive composite resin reportedly accomplishes polymerization from both light- and chemical curing processes. So it is characterized as a hybrid material because its physical qualities are only comparable to those of traditional composite resins and its biologic properties are similar to those of glass ionomer systems (21)

C Shahidi et al in 2017 did a study in “In Vitro Evaluation of Marginal Adaptation of Direct Class II Composite Restorations Made of Different ‘‘Low-Shrinkage’’ Systems” This study examined the marginal adaptation of class ii mesio-occluso- distal cavities restored with various low-shrinkage direct composite restorations before and after simulated occlusal loading by scanning electron microscope . This study concluded that medium-size class II restorations made with a traditional layering approach and flowable composite resin liner or simplified filling methods presented satisfactory adaptation to proximal enamel, whereas in cervical dentin, the bulk-filling technique (SonicFill) and extended flow base (SDR flow þ Ceram-X) showed the best adaptation

Vania Stephanie Sanchez Gamarra[43] et al in 2017 did a study titled as “Marginal adaptation and microleakage of a bulk-fill composite resin photopolymerized with different techniques" This study compared the marginal adaptation and microleakage of SonicFill composite with different photopolymerization techniques. Results of this study concluded that the percentage of continuous margin values were decreased after thermocycling. Another finding of the study was cervical margin adaptation of sonic fill composite led to gap formation.

Indira Priyadarshini Bollu in 2016 undertook original research titled as "Comparative Evaluation of Microleakage Between Nano-Ionomer, Giomer and Resin Modified Glass Ionomer Cement in Class V Cavities- CLSM Study" This study evaluated microleakage in Class V cavities which were restored with Resin Modified Glass Ionomer Cement (RMGIC), Giomer and Nano-Ionomer. Results of the study showed that Nano-Ionomer and RMGIC showed significantly less leakage and better adaptation than Giomer. The Reason behind Good sealing ability of nano-ionomer could also be related to high filler loading and lower coefficient of thermal expansion which withstands the polymerization contraction stresses.

AyseGozde turk et al in 2016 did a study in "Comparison of the marginal adaptation of direct and indirect composite inlay restorations with optical coherence tomography" This Study evaluated the photonic imaging modality of optical coherence tomography (OCT) to compare the marginal adaptation of composite inlays fabricated by direct and indirect techniques. Results of this study stated that direct inlays had smaller marginal discrepancy than indirect inlays. Increased marginal discrepancy values were found in all restorations that directly in relation to cement thickness after cementation

Heintze SD in 2015 evaluated "Marginal Quality of Class II Composite Restorations Placed in Bulk Compared to an Incremental Technique: Evaluation with SEM and Stereomicroscope" Study compared the marginal quality of composite resin restorations placed in extracted molars either in bulk (4 mm) or three increments and also evaluated the influence adhesive systems such as etch and rinse and self etch in marginal adaptation of composite resin. The Author examined the quality of proximal margins by stereomicroscope and also by a dental explorer using the SQUACE (semi-quantitative evaluation of restorations) method. Results of the study concluded that regular margins were detected for those fillings placed with the etch-and-rinse system than for those placed with the self-etching system.

S. K. Garoushi et al in 2015 investigated “The effect of short fiber composite base on microleakage and load-bearing capacity of posterior restorations” In their study, They evaluated the marginal microleakage of Class II restorations made with different composite base materials and the static load-bearing capacity of direct composite onlay restorations. Results showed Restorations combining the base of short FRC and surface layer of conventional composite displayed promising performance related to microleakage and load-bearing capacity.

RollyShrivastav Agarwal in 2015 did a study titled as “Evaluation of cervical marginal and internal adaptation using newer bulk fill composites: An in vitro study”. By using 1) Sonic Fill (Kerr/Sybron Orange, CA) 2) — SDR (Dentsply, Konstanz, Germany) + Ceram X Mono 3) Tetric N Ceram Bulk Fill (IvoclarVivadent) 4) Tetric N Flo + Tetric N Ceram (IvoclarVivadent). Before and after thermal cycling, the gap-free marginal length was analyzed using SEM of epoxy resin replicas. After thermal cycling, specimens were cut longitudinally in order to investigate internal dentine adaptation by epoxy replicas under SEM (500 × magnification). Results of this study showed that The viscosity of the bulk fill restorative material influenced the proportion of gap-free marginal interface and the internal adaptation in dentine.

D. Dionysopoulo in 2014 did a research titled as “The Evaluation of Various Restoration Techniques on Internal Adaptation of Composites in Class V Cavities” This study was undertaken to evaluate the effect of different restoration techniques on the formation of internal micro gaps between materials and dentin in class V restorations using the following composites such as 1) preheating (55∘ C) conventional composite (Filtek Z250), 2) flowable composite (Filtek Flow), 3) Filtek Flow + Filtek Z250 light-cured separately, 4) Filtek Flow + Filtek Z250 light-cured simultaneously, and 5) (control): Filtek Z250 at room temperature (23∘ C). Preheated conventional composite and the combination of Filtek Flow with Filtek Z250 which was light-cured separately showed better internal adaptation than the other groups.

AA Bicalho et al in 2014 did a study “Incremental Filling Technique and Composite Material—Part II: Shrinkage and Shrinkage Stresses” in this study,shrinkage stresses were evaluated for Three composites (Filtek LS, Aelite LS Posterior, Filtek Supreme) and three filling techniques (bulk, 2.0-mm increments, and 1.0- mm increments) for restoring a molar were simulated in a two-dimensional FEA. Polymerization shrinkage was modeled using post-gel shrinkage, which was measured using the strain gauge technique. To validate the study results, Cuspal tooth deformation was evaluated in buccal and lingual surfaces. Results of the study show that Increasing the number of increments caused higher stresses in the remaining tooth structure and tooth/ restoration interface. Cuspal deformation results strengthen the finite element analyses results.

R Pecie et al in 2013 investigated “Marginal Adaptation of Direct Class II Composite Restorations with Different Cavity Liners”. Except for the control group, 1- mm thickness lining material was applied to the bottom of the cavity and polymerized before placing the resin composite Herculite XRV Ultra. (group A:

control; group B: Premise Flowable lining; group C: Herculite XRV Ultra lining; and group D: Optibond FL lining). Marginal adaptation of composite material to the tooth structure was evaluated by Scanning electron microscope before and after loading cycles(200,000 cycles).Results of the study showed The percentage of enamel fractures and the percentage of noncontinuous margins in proximal enamel were high, with no significant difference between liners.

Claudio Poggio et al in 2013 did a study in “Microleakage in Class II composite restorations with margins below the CEJ: In vitro evaluation of different restorative techniques”.This In-vitro study examined the microleakage in “deep” Class II composite restorations with gingival cavosurface margin below the CEJ (cementoenamel junction) in relation to restoration with different techniques 1: Filtek TM Supreme XTE Flowable (3MESPE) + Universal Filtek Supreme XTE (3MESPE), 2: GrandioSO Heavy Flow (Voco) + GrandioSo (Voco), 3: SDR™ (Dentsply Caulk) + Esthet-X® HD (Dentsply Caulk), 4: SonicFill (Kerr), 5: Grandio (Voco) 0.5% basic fuchsine dye solution. After thermocycling, specimens sectioned mesiodistally and these sectioned specimens are subjected to immerse in 0.5% basic fuchsine dye solution. Dye penetration into the specimens evaluated stereomicroscope (25* magnification). Based on the dye penetration scoring criteria used in this study, the prevalence of score 0 was higher in SonicFill (Kerr), Grandio (Voco). But none of the restorative products fully eliminates microleakage in dentin margins.

Suat ozcan et al in 2013 investigated “The Effect of Different Liners on the Microleakage of Class II Restorations after Thermocycling and Occlusal Loading” The study evaluated marginal adaptation of 1) Resin-modified glass ionomer liner (RMGI) + composite resin (CR), 2) flowable composite liner composite resin 3) self-adhesive flowable composite liner + composite resin, and 4) composite resin in a standardized class 2 cavities. Results showed Flowable composite and RMGI liners were useful in decreasing microleakage, but the self-adhesive flowable composite liner showed no significant advantage.

Casselli et al in 2013 investigated " Marginal adaptation of class V composite restorations submitted to thermal and mechanical cycling" In their study , They compared the marginal adaptation an etch-and-rinse [Single Bond 2 (SB)] and a self-etching adhesive [Clearfil SE Bond (CL)] in a prepared class v cavities restored with micro-hybrid composite resin. They concluded that etch and rinse adhesive had higher gaps in the dentin than the enamel. In the dentin, Self etch adhesive showed better marginal sealing than Etch and rinse adhesive.

Hamid Reza Poureslam in 2012 undertook a research titled "Marginal Microleakage of Low-shrinkage Composite Silorane in Primary Teeth: An In Vitro Study" The study examined sealing ability of novel low-shrinkage composite silorane in class V cavity of primary canines in comparison with three types of composite resin such as 1) Bonding Silorane + Silorane (3M/ESPE, St. Paul, USA) , 2) Etch + Bonding Silorane + Silorane (3M/ESPE, St. Paul, USA) , 3) Bonding (T Adper Scotch Bond Self-Etch Adhesive) + Z250 composite (3M/ESPE, St. Paul, USA) 4) Bonding (T Adper Scotch Bond Self-Etch Adhesive) + Filtek supreme (3M/ESPE, St. Paul, USA) 5) Etch microcid +Bonding (James-2) + Saremco LS (Saremco, St. Gallen, Switzerland) 6) Uni-Etch (32%) W/BAC + Bonding (one step plus OS+) + Aelite LS Bisco (Bisco Inc., Schaumburg, USA). This study concluded that etching the cavity before application of silorane composite could increase the bonding efficiency in primary teeth and silorane restorations can provide an acceptable marginal seal.

Malene schimdt et al in 2012 did a study in “marginal adaptation of low shrinkage silorane based composite- A Scanning Electron Microscopic analysis” Study compared marginal adaptation of low shrinkage composites with methacrylate-based composites to investigate whether polymerization shrinkage reduced or not.but results of this study showed polymerization shrinkage occurred in these two tested composite resins so there was no significant difference in marginal adaptation of these two composites

Usha HL et al in 2011 did a study in “Comparing microleakage and layering methods of silorane-based resin composite in class V cavities using confocal microscopy: An in vitro study” This in vitro study evaluated the effects of different layering techniques on the microleakage of silorane-based resin composite such as (Filtek™ P90 Silorane Low Shrink Restorative, 3M ESPE) using two different layering techniques – split incremental and oblique layering technique by confocal laser scanning microscope . The Study concluded that microleakage score was same in both the groups but the width of the interface was lesser in split incremental technique.

Motaz A. Ghulman in 2011 investigated “Effect of Cavity Configuration (C Factor) on the Marginal Adaptation of Low-Shrinking Composite: A Comparative Ex Vivo Study”. The Study evaluated the effect of c factor on marginal adaptation of low-shrinking composites such as Silorane based composites with their “FiltekSilorane/Silorane Adhesive Bond System” and methacrylate-based composites with their “Filtek Z250/Prompt L-Pop’’ adhesive system were used. Specimens were divided into 5 groups. In group 1, One wall is allowed for bonding. In group 2, Two walls are allowed for bonding In group 3, Three walls are allowed for bonding. In group 4, Four walls are allowed for bonding In group 5, Five walls are allowed for bonding. Results of the study explained Silorane-based resin showed good marginal adaptation,But it showed the tendency toward a high leakage score with C-factor of5.

Sarita Bhushan et al in 2010 compared the "Effect of prepolymerized composite megafiller on the marginal adaptation of composite restorations in cavities with different C-factors: An SEM study " In their study, They compared the effect of prepolymerized custom-made composite megafiller and configuration factors (C-factor) on marginal adaptation of resin composite restorations by scanning electron microscope. Marginal gap values in class 2 cavities restored with composite megafiller followed by restoration of nanofilled composite Z-350. The Study explained that measures should be taken to reduce the effect of C-factor while performing composite restorations.

Andreia A. Carvalho et al in 2010 evaluated "Marginal microleakage of class II composite resin restorations due to restorative techniques" After cavity preparation, Cavities were restored with the following techniques such as (1) Oblique incremental technique 2: flowable resin (1 mm) applied in the gingival wall + OIT; 3: OIT + three pre-cured spheres inserted in the first increment of CR; and, 4: OIT + strip of fiberglass inserted in the first increment of CR), Specimens were subjected to thermocycling and 0.5% basic fuscin dye immersion for 24hrs. Specimens were evaluated under an optic microscope for dye penetration. In this study, They concluded that the marginal microleakage values were not influenced by the different restorative techniques tested.

S Idriss in 2007 evaluated " Factors Associated with Microleakage in Class II Resin Composite Restorations". The Study compared the correlation between factors related to cavosurface marginal adaptation and microleakage in Class II cavities restored with a light- or chemical-activated resin composite. The Study concluded that the choice of material and placement technique are important factors determining microleakage.

Andrea fabianelli et al in 2007 wrote a review article about “The relevance of micro-leakage studies” In the review, Author explained Microleakage is unavoidable whilst clinical studies report substantially less pessimism about the sealing ability of dental restorations. This review of the literature explained various forms of leakage in dental restorations, distinguishing micro-leakage and nano-leakage. The phenomena, causes, and methods to reduce leakage are explained and the clinical relevance of in vitro and in vivo leakage studies evaluated.

Andre´ V. Ritter in 2006 did a study titled as “Effect of Light-Curing Method on Marginal Adaptation, Microleakage, and Microhardness of Composite Restorations” Study compared the effects of different light-curing methods such as 1)quartz-tungsten-halogen (QTH) 2)LCU (Optilux 501), 3) first-generation light-emitting diode (LED) LCU (FreeLight 1), and 4) second-generation LED LCUs on microleakage, marginal adaptation, and microhardness of composite restorations in a Slot-type preparations in bovine teeth, with gingival margins on dentin. Results concluded that the performance of the second-generation LED LCUs generally was equal to that of the QTH control, and better than that of the first-generation LED unit.

Carlos Jose Soares in 2005 did a study titled as “Marginal integrity and microleakage of direct and indirect composite inlays – SEM and stereomicroscopic evaluation” Study evaluated the microleakage of direct and indirect composite inlays through dye penetration method by stereomicroscope and scanning electron microscopy. Results of the study concluded that There were no significant differences between the direct and indirect techniques for the cervical finishing line in enamel, but for the finishing line in dentin, the indirect technique showed less microleakage than the direct technique.

Juergen Manhart et al in 2001 comparatively evaluate " Marginal quality and microleakage of adhesive class V restorations" Study evaluates the marginal quality and microleakage of different composite resin class V restorations in which half of the finish lines limited within dentin Marginal quality assessed by scanning electron microscope through epoxy replica technique. Microleakage was evaluated by stereomicroscope by dye penetration method. Results concluded that Marginal quality and sealing ability of adhesive systems to dentin, using a wet-bonding procedure was inferior compared with enamel margin

MATERIALS AND METHODS

MATERIALS USED:

1. Human Mandibular Premolars (N=90)
2. Filtek Z350 XT Nanofill Composite(3M ESPE , Sumaré, SP, Brazil)
3. HeliomolarMicrofill Composite (Ivoclar , Vivadent AG, FL Schaan, Liechtenstein)
4. HerculitePrecisNanohybrid composite (Kerr/Sybron Orange, CA))
5. Round Diamond Bur (DentsplyMaillefer, Ballaigues Switzerland)
6. 245 Carbide fissure bur (DentsplyMaillefer, Ballaigues Switzerland)
7. High speed hand piece (NSK Corporation, Japan)
8. Sectional matrix system(Palodent v3, Dentsply, Germany)
9. Composite Polishing Kit(Shofu co, Japan)
10. Light Cure Unit (Bluephase LED Unit, Ivoclar , Vivadent)
11. Diamond Disk (Horico H557F220, HopfRingleb&CoGmbH, Berlin, Germany)
12. Universal Instron Testing Machine (Zwick Testing Instrument, Zwick GmbH and Co, Ulm, Germany)
13. Incubator (Jemco, Chennai, India)
14. Polyvinyl Siloxane Impression Material (President light body, Coltene/whaledentAG,Alstatten, Switzerland)
15. Epoxy Resin (Araldite Epoxy Resin)
16. Stereomicroscope (Olympus Tokyo, Japan)
17. Scanning Electron Microscope (Zeiss DSM 962: Oberkochen, Germany)

Ninety intact, mandibular premolars extracted for orthodontic reasons were collected. Any calculus, debris or soft tissue remaining in these extracted premolars was removed by using an ultrasonic scaler. These extracted premolars were then stored in Sodium azide solution until the experiment in order to maintain dentin moisture.

The inclusion criteria for this study was

1} Teeth without any carious lesion

2) No visible tooth defect and

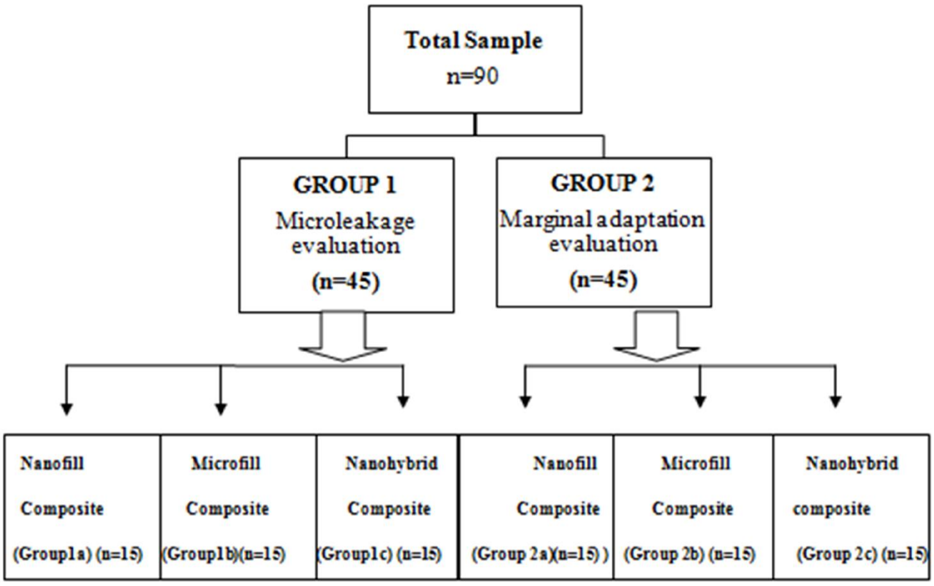
3)Teeth with complete root formation.

Cavity preparation:

"Endo jaw" was used to stabilize the teeth during Class II Mesio-Occluso-Distal (MOD) cavity preparation. The cavity outline was done by using a high-speed airotor handpiece(NSK Corporation, Japan) with No 10 size coarse grit round diamond bur with a abrasive particle size of 100µm(DentsplyMaillefer, Ballaigues Switzerland) followed by final preparation of the cavity with a fine grain tungsten carbide 245 bur . (DentsplyMaillefer, Ballaigues Switzerland). Class II MesioOccluso-Distal (MOD) cavities were then prepared by following a set of standard dimensions: The Width of the occlusal cavity dimension was maintained at 5 mm. The depth of the occlusal cavity dimension was 3.5 mm(measured from tip of the palatal cusp). The width of the proximal cavity preparation was 4mm and was having a slight divergence occlusally. The proximal cavity margins were located 1 mm mesially above the cementoenamel Junction and distally 1 mm below the cementoenamel Junction. The dimensions of the prepared cavities was then checked by using a periodontal probe (24).

GROUPING:

The 90 Prepared teeth specimens were then randomly divided into two main groups namely Group 1 forMicroleakage evaluation (n=45)and Group 2 for marginal adaptation evaluation(n-45).



Restorative procedures :

After cavity preparation, all the prepared specimens were then etched with 37% phosphoric acid for 30 seconds and rinsed for 15 seconds by using the three-way syringe. Respective bonding agents were applied to the samples according to the manufacturer’s instructions in a thin layer all over the cavity surfaces with a microbrush and rubbed for 15 seconds. After application,the preparedcavities were gently air dried and light cured for 20 seconds.To ensure a tight proximal contact, sectional matrix system(Palodent v3, Dentsply, Germany) was placed. The respective composite resin was placed into the cavity in 1-1.5 mm increments by a teflon coated composite plastic filling instrument . Each increment was then light-cured for 20 seconds by using a blue phase LED light curing unit (Ivoclar, Vivadent). The curing was initially done from the occlusal direction for 20 seconds followed by curing from the buccal and lingual directions for 10 seconds each. Finishing and polishing of the composite restorations was done by using a composite polishing kit(Shofu Co, Japan) according to the recommended sequence of sof- lex XT coarse disc and sof-lex XT fine discs.

GROUP1A:

Adperscotchbond multipurpose adhesive (3M ESPE, Sumaré, SP, Brazil) was applied according to the manufacturers instructions on to the cavity surface with a microbrush and light cured for 30 seconds. The Filtek Z350 (3M ESPE, Sumaré, SP, Brazil) nanofill composite was placed in a 1-1.5 mm by the oblique increment technique. Each increment was then light cured for 20 seconds

GROUP 1B:

Optibond (Kerr/Sybron Orange, CA) bonding agent was applied according to the manufacturers instructions on to the cavity surfaces with themicrobrush and light cured for 30 seconds. The Herculite précis Nanohybrid composite (Kerr/Sybron Orange, CA))was placed in 1-1.5 mm by the oblique increment technique. Each increment was then light cured for 20 seconds.

GROUP 1C:

Heliobond (Ivoclar, Vivadent AG, FL Schaan, Liechtenstein) bonding agent was applied according to the manufacturers instructions on to the cavity surfaces with a microbrush and light cured for 30 seconds. The HeliomolarMicrofillcomposite(Ivoclar, Vivadent AG, FL Schaan, Liechtenstein)was placed in 1-1.5 mm by the oblique increment technique and each increment was then light cured for 20 seconds.

Microleakage evaluation:

For Microleakage evaluation, all the prepared specimens were stored in an incubator at 37 ° C for 24 hours. Then, the specimens underwent artificial aging procedure by means of “Thermocycling”. In the thermocycling procedure, the specimens were exposed to alternative water baths having the temperature set at 5°C± 2 °C followed by 55°C ± 2°C and 1500 cycles were performed with a dwell time of 30 seconds and a transfer time of 15 seconds. In order to prevent dye penetration in to the dentinal tubules and lateral canals, the apices of the prepared specimens were sealed with sticky wax and coated with two layers of nail varnish, except for an area approximately 1 mm around the margins of the restoration. Then the specimens were stored in 0.2 % methylene blue aqueous solution for 24 hours. After which the samples were sectioned mesio-distally by using a fine grit diamond disk (Horico H557F220, HopfRingleb&CoGmbH, Berlin, Germany). Then the dye penetration of the samples was evaluated under a stereomicroscope(Olympus Tokyo, Japan) by using the scoring system formulated by Bohra et al:

0- No dye penetration

1- Dye penetration extending to 1/3 rd of cervical wall

2- Dye penetration extending to 2/3 rd of cervical wall

3- Dye penetration involving the whole of the cervical wall

4- Dye penetration involving the whole of the cervical wall and axial walls toward the pulp

Marginal adaptation evaluation:

After placement of the restoration and the polishing procedure, the mesial and distal proximal aspects of the MOD cavity margins was etched with 35% phosphoric acid gel mixed with three times its volume of distilled water solution.

Then the solution was applied over the restorative margins followed by gentle brushing for four seconds to enhance the visualization of the Epoxy resin replica under the Scanning electron microscope(Zeiss DSM 962: Oberkochen, Germany). The Impression of the above acid etched specimens was then taken with polyvinyl siloxane(President light body, Coltene/whaledentAG,Alstatten, Switzerland) which served for the fabrication of the Epoxy resin replicas (Araldite Epoxy Resin). These epoxy resin replicas were then evaluated under the Scanning electron microscope(Zeiss DSM 962: Oberkochen, Germany) at a magnification of 200x. Continuous margins and defective margins in the mesial and distal proximal aspects of the MOD cavities was then evaluated in percentage. Then all the specimens were subjected to 1,00,000cycles with a 50-newton eccentric occlusal load in a instron universal testing machine (Zwick Testing Instrument, Zwick GmbH and Co, Ulm, Germany). The axial force of the intender was set at 1.5 Hz frequency. After the loading phase, the epoxy resin replicas of the cyclically loaded samples was made and evaluated at a standard 200x magnification under the scanning electron microscope (Zeiss DSM 962: Oberkochen, Germany)

The results of the restorative margin adaptation before and after the loading phase was expressed as percentages of the continuous margins. Defective margin sections likeunderfilling and overfilling of margins were combined together and accounted for as non-continuous margins. The approximal enamel adaptation refers tothe mesial, full enamel restoration margin adaptation. The cervical dentin adaptation refers to cervical dentin adaptation on the distal preparation side.

COLOUR PLATES

1.INTRODUCTION

Fig 1.1 90 Human single rooted mandibular premolars

Herculite précis Kerr composite Heliomolar microfill composite Filek Z350 nanofill composite

Fig 1.2: Herculite précis nanohybrid composite, Heliomolar microfill composite and Filek Z350 nanofill composite

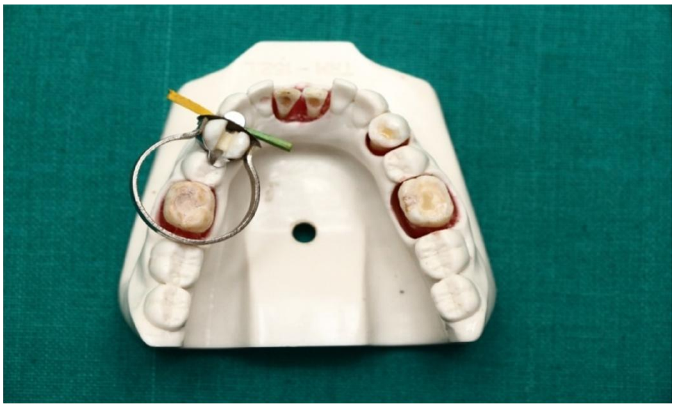


Fig 1.3 Palodent sectional matrix band application

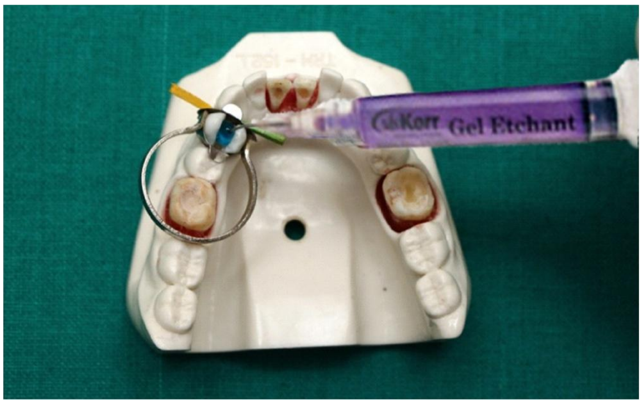


Fig 1.4 37% Phosporic acid etching gel application

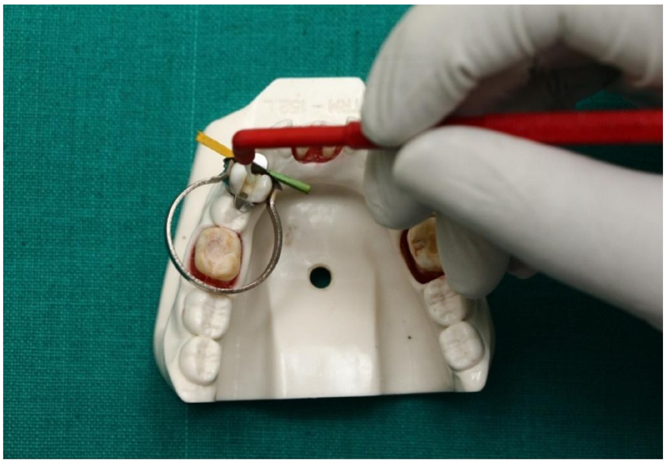


Fig 1.5 Bonding agent application

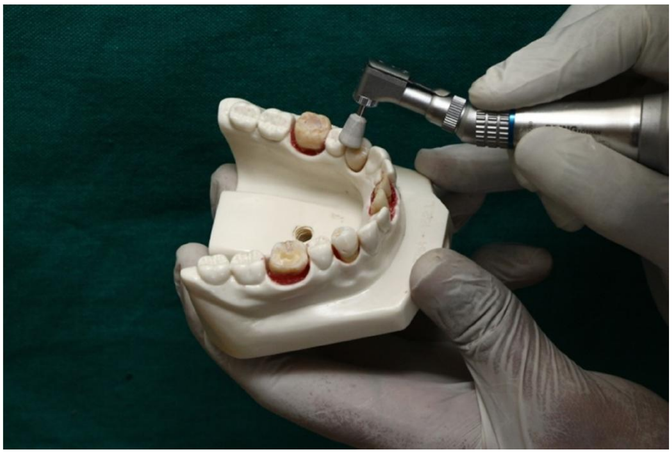


Fig 1.6 Finishing and polishing of the restoration

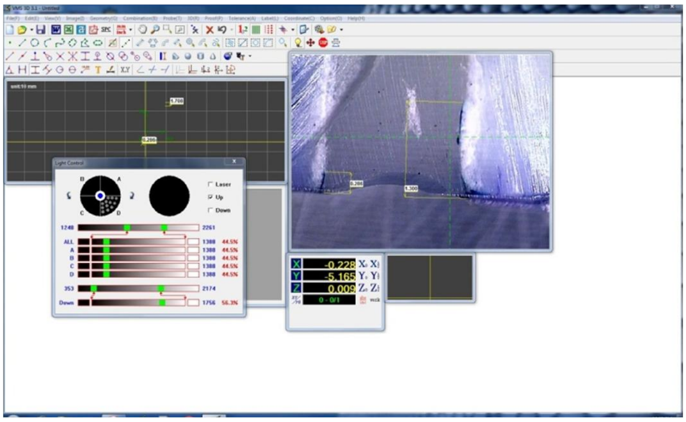
Fig 1.7: After finishing and polishing of the composite restoration

2.INCUBATION

Fig. 2.1 Incubator

Fig. 2.2 Thermocycling apparatus

3.Microleakage evaluation



☐ Laser
☑ Up
☐ Down

```
X -0.228
Y -5.165
Z 0.009
0 - 0/1
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Fig 3.1 Stereomicroscopic image evaluation of dye penetration

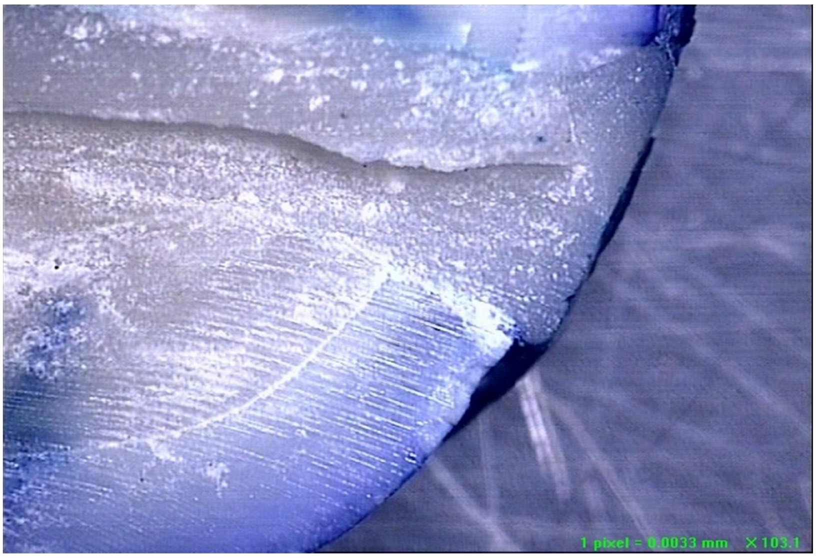

Fig. 3.2 Stereomicroscopic image of score 0

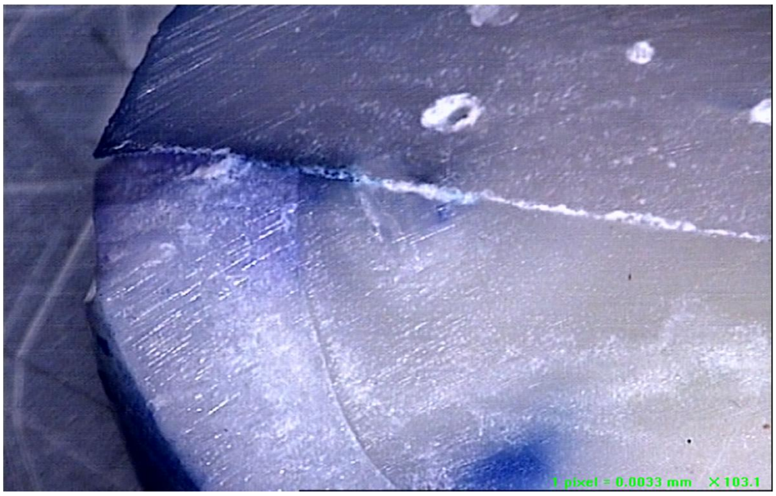

Fig. 3.3 Stereomicroscopic image of score 1

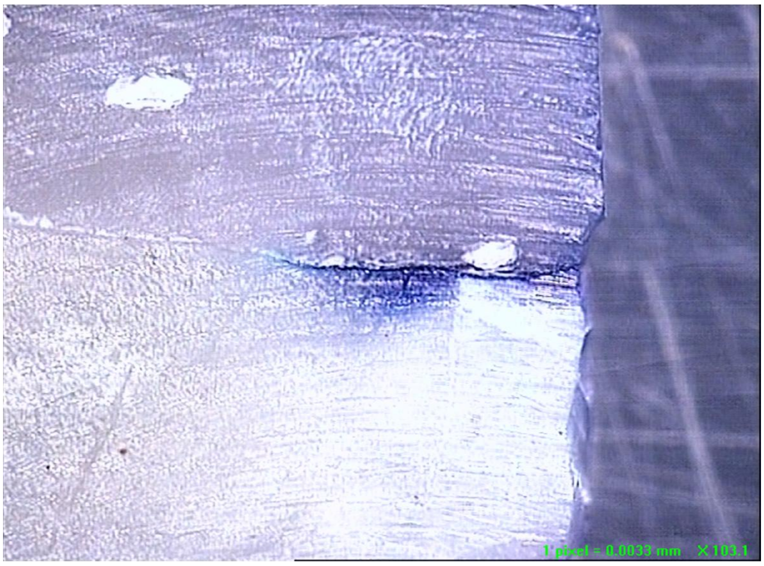

Fig. 3.4 Stereomicroscopic image of score 2

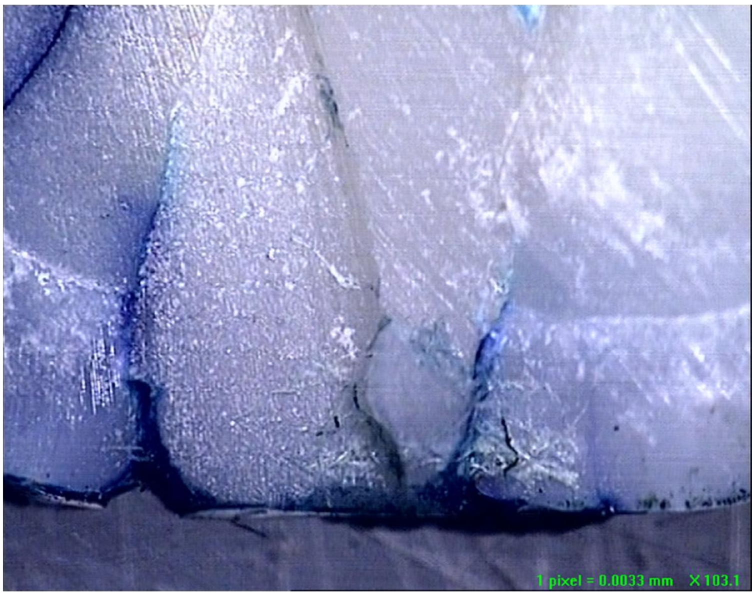

Fig. 3.4 Stereomicroscopic image of score 2 and 3

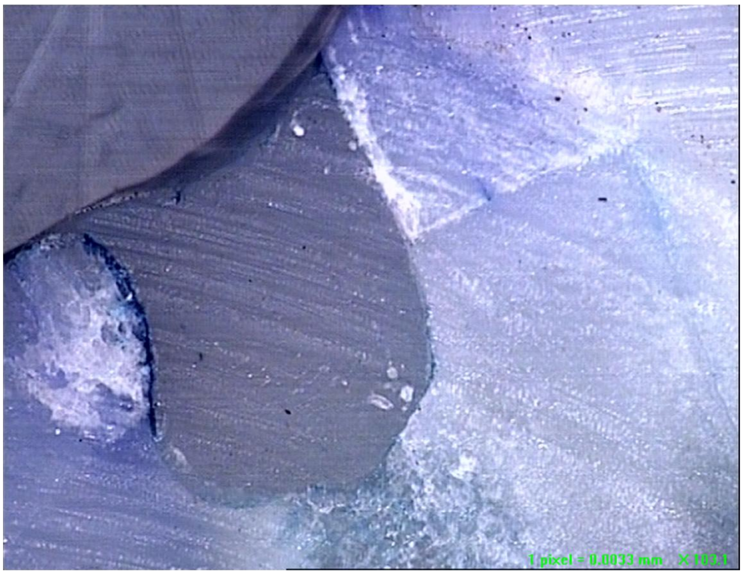

Fig. 3.5 Stereomicroscopic image of score 3

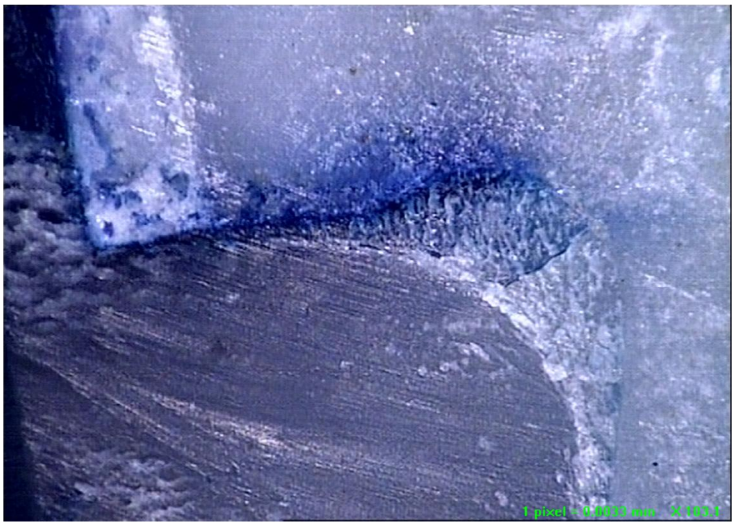

Fig. 3.6 Stereomicroscopic image of score 4

4. Mechanical loading procedure

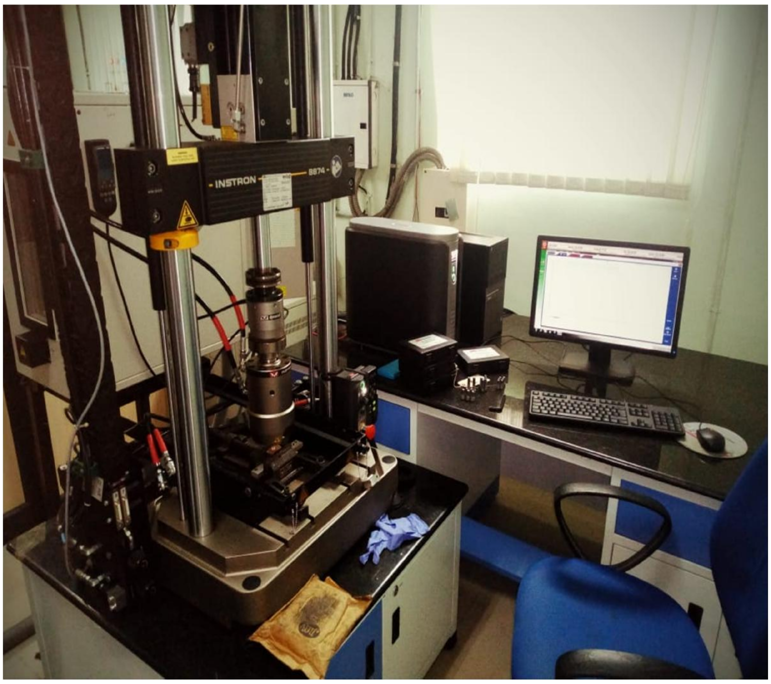

Fig 4.1 Instron universal testing machine

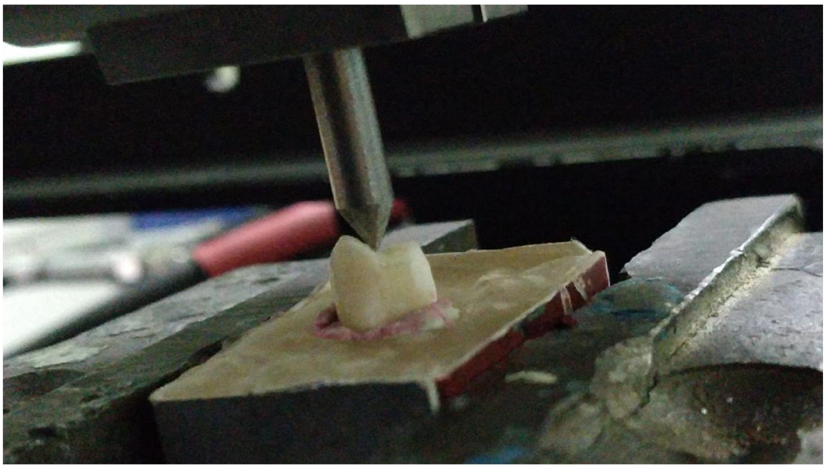

Fig 4.2 Pointed intender facing acrylic molded restored tooth root covered by polyvinyl siloxane impression

5.MARGINAL ADAPTATION EVALUATION

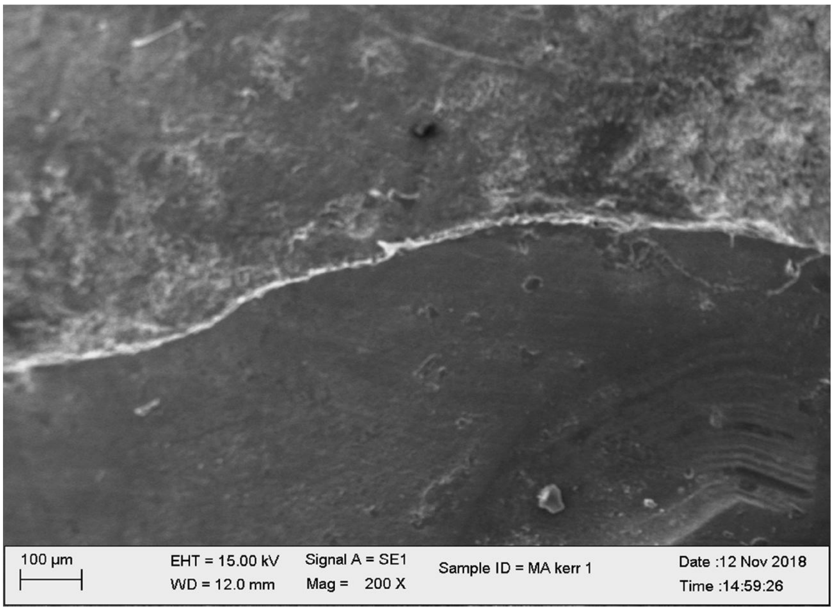

Fig 5.1: Preloading continuous margin images

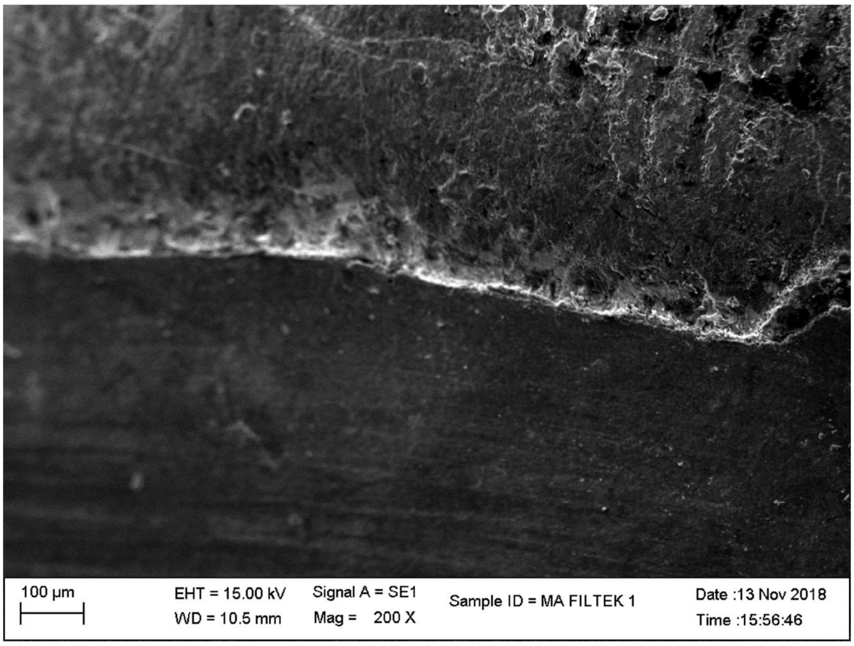

Fig 5.2: Preloading continuous margin images

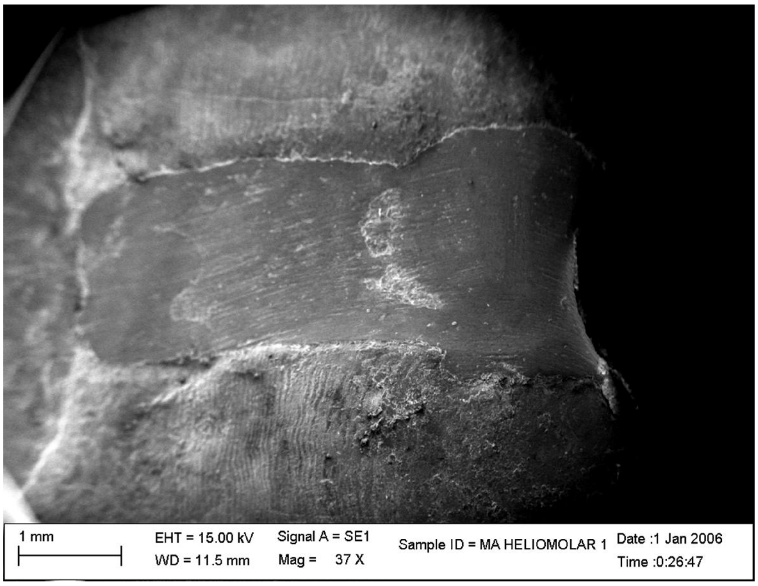

Fig 5.2:Preloading total tooth restorative interface images

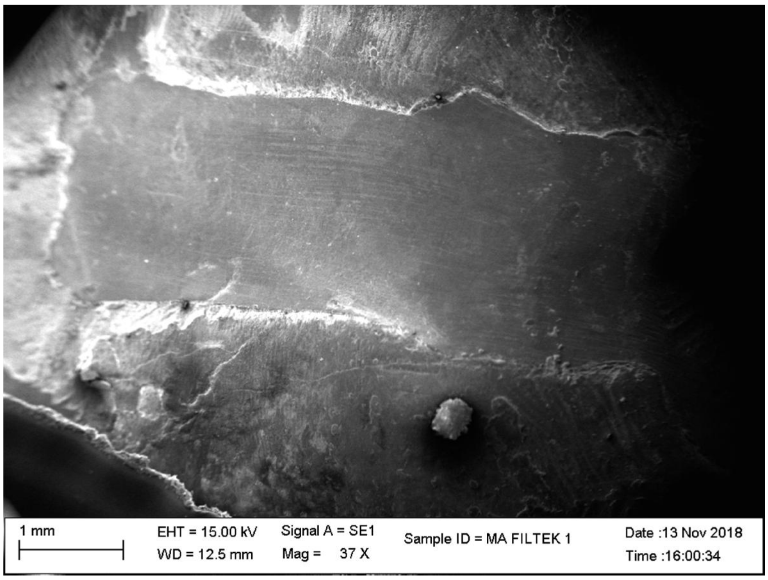

Fig 5.2:Preloading total tooth restorative interface images

POSTLOADING DEFECTIVE MARGIN IMAGES

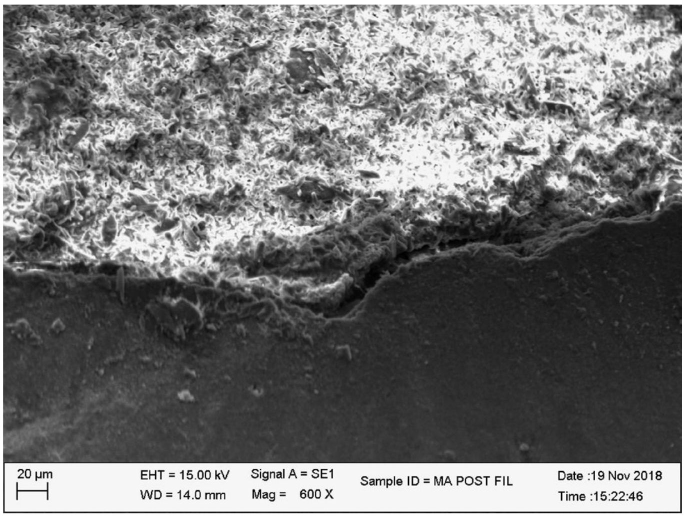

Fig 5. 3 Postloading defective margin images

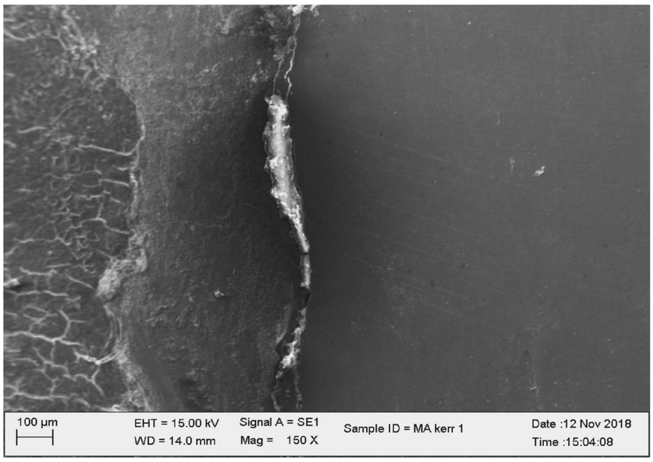

Fig 5. 3 Postloading defective margin images

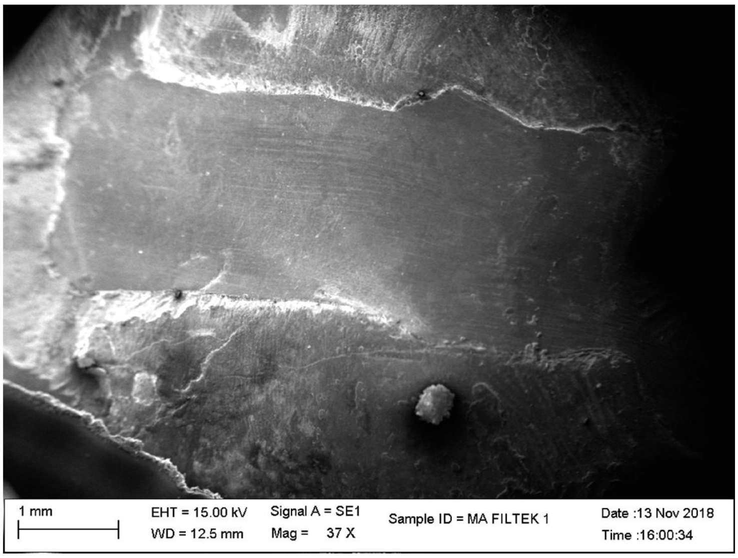

Fig 5.4 Postloading total tooth restorative interface images

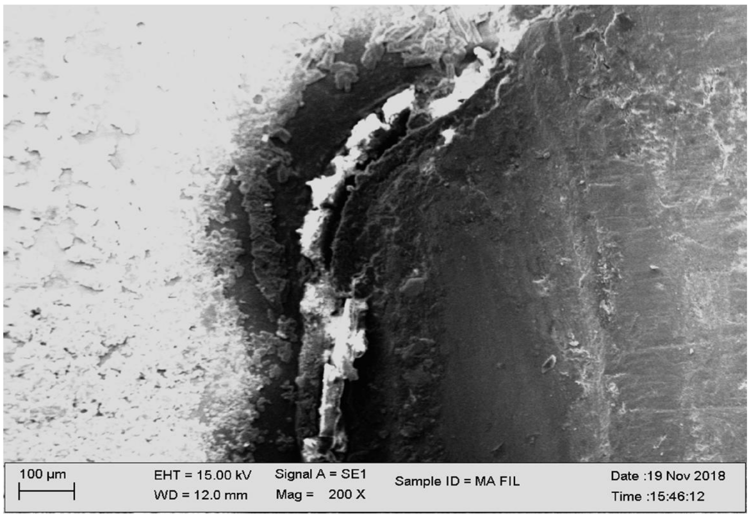

Fig 5.5 Postloading defective margin images

RESULTS

MICROLEAKAGE RESULTS

Table 1

Above CEJ group (mesial side) **Below CEJ (distal side)**

Score	Group 1a (Filtek Z350)	GroupIIa (Kerr)	Group IIIa (Heliomolar)	Group Ib (Filtek Z350)	Group IIb (Kerr)	Group IIIb (Heliomolar)
0	7	9	5	6	7	8
1	8	2	7	6	4	3
2	0	0	3	3	2	1
3	0	2	0	0	1	2
4	0	2	0	0	1	1
Mean	0.53	1.06	0.86	0.8	1.00	1.00

Dye penetration rating using the Grade scale for the Mesial side(above Cemento Enamel Junction) and Distal side (Below Cemento Enamel junction) has been tabulated in Table 1.Mean microleakage scores for Group Ia and Group Ib is 0.53 and 0.8 respectively.The meanmicroleakage scores of Group IIa and Group IIb is 1.06 and 1.00 respectively. The meanmicroleakage scores for Group IIIa and Group IIIb is 0.86 and 1.00 respectively. Filtek Z350 showed less microleakage than Kerr and Heliomolar among all the groups.

All the three groups were compared by using theKruskal-Wallis test. There was no significant difference for the Above Cementoenamel junction group (Group 1)and Below the Cemento Enamel Junction group (Group II) with the P-Values being 0.56 and 0.981 respectively. When Group Ia and Group Ib, Group IIa and Group IIb, GroupIIIa and Group IIIb were compared, the results were statistically insignificant. (P>0.05).

MARGINAL ADAPTATION RESULTS:

In this study mesial side enamel adaptation and the distal side dentin adaptation was taken to analysis marginal adaptation.

IN GROUP 1 (FILTEK Z350 NANOFILL COMPOSITE)

After finishing and polishing of the restoration, the total tooth -restorative interface of the Mesial and distal proximal cavities was evaluated by using a scanning electron microscope. These values were then tabulated in table 2. In both the mesial side enamel and the distal side dentin adaptation, The scanning electron microscopic analysis was performed to evaluate the defective areas. Table 3 depicts the defective margins after finishing and polishing in the mesial and distal proximal cavities which were restored with Filtek Z350 nanofill composite.

Table 2

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	13.3	2.6
2.	13.1	2.8
3.	13	2.8
4.	12.4	2.6
5.	13	2.5
6.	13.2	2.2
7.	13.4	2.8
8.	13.4	2.4
9.	13.4	2.7
10.	13.7	2.4
11.	14.4	2.3
12.	14.1	2.8
13.	13,6	2.8
14.	13.4	2.8
15.	13.6	2.6
Mean	13.4	2.61

Table 3

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	1.95	1.25
2.	1.97	1.05
3.	2.25	0.88
4.	2.19	0.86
5.	1.95	0.9
6.	2.03	0.98
7.	2.29	0.8
8.	1.94	1.15
9.	2	1.2
10.	2	0.75
11.	2	0.82
12.	1.85	0.83
13.	1.84	0.94
14.	1.9	1.01
15.	1.91	0.80
MEAN	2.004	0.94

FORMULA:

Total length of continuous margin can be measured by= Total tooth-restorative interface length - Defective Margin length

Mesial enamel adaptation Side:

Mean continuous margin length of mesial side (enamel adaptation)

= 13.4-2.00= 11.4 mm

Distal dentin adaptation side:

Mean continuous margin length of Distal side (Dentin adaptation)

= 2.61 mm -0.94 mm = 1.67mm

Preloading values forFiltek Z350 Nanofill Composite:

Percentage of Mesial Side Enamel adaptation forFiltek Z350 = 85.07 %

Percentage of distal dentin adaptation forFiltek Z350 Nanofill composite = 63.98%

IN GROUP 2(HERCULITE PRECIS KERR NANOHYBRID)

Similarly in Group 2, After finishing and polishing of the restoration, epoxy resin replicas were made. The total tooth-restorative interface of the mesial and distal proximal cavities was evaluated by using a scanning electron microscope. Those values were tabulated in table 4. Table 5 depicts the defective margins after finishing and polishing inthe mesial and distal proximal cavities restored with HerculitePrecis Kerr Nanohybrid composite.

Table 4

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	11.56	1.74
2.	11.70	1.80
3.	10.28	1.73
4.	11.13	1.63
5.	11.63	1.74
6.	11.83	1.84
7.	11.63	1.95
8.	12.04	2.03
9.	11.35	1.93
10.	12.24	2.06
11.	11.59	1.77
12.	11.8	1.83
13.	11.57	1.92
14.	11.85	2.02
15.	11.56	1.73
MEAN	11.58	1.84

Table 5

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	1.72	0.40
2.	1.62	0.52
3.	1.87	0.62
4.	1.87	0.50
5.	1.8	0.50
6.	2.02	0.42
7.	2.19	0.43
8.	2	0.48
9.	1.85	0.49
10.	1.88	0.50
11.	1.94	0.41
12.	1.98	0.47
13.	2.33	0.49
14.	2.17	0.54
15.	1.92	0.51
MEAN	1.944	0.48

Mesial Side (enamel adaptation):

Total continuous margin length of mesial side (enamel adaptation)

= 11.58mm-1.944mm= 9.64 mm

Distal Side (dentin adaptation):

Total continuous margin length of the Distal side (Dentin adaptation)

= 1.84 mm -0.48 mm = 1.36 mm

Preloading values of Herculite Précis Kerr Nanohybrid composite:

Percentage of continuous margin on mesial side (Enamel adaptation) = 83.24 %

Percentage of continuous margin on distal side (Dentin adaptation) = 73.91=74%

In Group 3 (HeliomolarMicrofill composite)

Similarly in Group 3, After finishing and polishing of the restoration, Epoxy resin replicas were made. Total tooth-restorative interface of mesial and distal proximal cavities was evaluated by using a scanning electron microscope. These values were then tabulated in table 6. Table 7 depicts the defective margins after finishing and polishing on the mesial and distal proximal cavities restored with HeliomolarMicrofill composite.

Table 6

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	11.46	1.833
2.	11.19	1.80
3.	11.4	1.84
4.	11.47	1.77
5.	11.47	1.78
6.	11.32	1.62
7.	11.3	1.82
8.	11.47	1.6
9.	11.56	1.73
10.	11.44	1.88
11.	11.5	1.89
12.	11.37	1.9
13.	11.52	1.95
14.	11.36	1.93
15.	11.65	1.83
MEAN	11.43	1.81

Table 7

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	2.85	0.60
2.	3.16	0.50
3.	2.49	0.52
4.	2.55	0.58
5.	2.58	0.80
6.	2.31	0.75
7.	2.59	0.73
8.	2.77	0.78
9.	2.99	0.82
10.	2.94	0.81
11.	2.79	0.82
12.	2.96	0.60
13.	2.29	0.63
14.	2.4	0.64
15.	2.39	0.70
MEAN	2.67	0.685

Mesial Side (enamel adaptation):

Total continuous margin length of mesial side (enamel adaptation)

= 11.43mm-2.67mm= 8.76 mm

Distal Side (dentin adaptation):

Total continuous margin length of Distal side (Dentin adaptation)

= 1.81 mm -0.69 mm = 1.12 mm

Preloading values of Hercules Précis Kerr Nanohybrid composite:

Percentage of continuous margin on mesial side (Enamel adaptation) = 77 %

Percentage of continuous margin on distal side (Dentin adaptation) = 61.8%=62%

POSTLOADING

After 1,50,000 mechanical loading cycles, Epoxy resin replicas of the specimens were made. These epoxy replicas were then evaluated under a scanning electron microscope for marginal adaptation. Table 8 shows mesial and distal proximal cavity defective margin values forFiltek Z350 nanofill composite restored specimens after 1,50,000 cycles of mechanical loading.

Table 8

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	2.37	1.30
2.	2.26	1.05
3.	2.35	0.91
4.	2.39	0.92
5.	2.3	0.90
6.	2.21	1.00
7.	2.38	0.80
8.	2.17	1.35
9.	2.22	1.40
10.	2.31	0.94
11.	2.28	1.00
12.	2.17	1.02
13.	2.17	1.00
14.	2.17	1.00
15.	2.36	1.08
MEAN	2.27	1.04

Mesial Side (enamel adaptation):

Total continuous margin length of mesial side (enamel adaptation)

= 13.4mm-2.27mm=11.13mm

Distal Side (dentin adaptation):

Total continuous margin length of Distal side (Dentin adaptation)

= 2.61 mm- 1.04 mm = 1.57 mm

Postloading values of HerculitFiltek Z350 Nanofill composite:

Percentage of continuous margin on mesial side (Enamel adaptation) = 83.05 %

Percentage of continuous margin on distal side (Dentin adaptation) = 60.15%

In Group 2 (Herculite Precis Kerr Nanohybrid Composite)

Table 9 shows the mesial and distal proximal cavity defective margin values for Herculite Precis Kerr Nanohybrid Composite composite restored specimens evaluated under scanning electron microscope after 1,50,000 cycles of mechanical loading by the InstronUniversal Testing Machine.

Table 9

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	2.64	0.90
2.	2.59	0.92
3.	2.76	0.82
4.	2.9	1.02
5.	2.76	0.84
6.	2.84	1.04
7.	2.6	0.85
8.	2.8	0.89
9.	2.82	0.88
10.	2.87	1.04
11.	2.23	1.00
12.	3.02	1.02
13.	2.94	0.92
14.	2.69	0.94
15.	2.8	0.96
MEAN	2.75	0.936

Mesial Side (enamel adaptation):

Total continuous margin length of mesial side (enamel adaptation)

= 11.58mm-2.75mm= 8.83 mm

Distal Side (dentin adaptation):

Total continuous margin length of Distal side (Dentin adaptation)

= 1.84 mm -0.93 mm = 0.91 mm

Post loading values of Herculite Précis Kerr Nanohybrid filled cavities

Percentage of continuous margin on mesial side (Enamel adaptation) =76.25 %

Percentage of continuous margin on distal side (Dentin adaptation) = 50.27%

IN GROUP 3 (HeliomolarMicrofill Composite)

Table 10 shows the mesial and the distal proximal cavity defective margin values forHeliomolarMicrofill Composite Compositecomposite restored specimens evaluated under scanning electron microscope after 1,50,000 cycles of mechanical loading by Universal Instron Testing Machine

Table 10

Sample	Mesial enamel adaptation (mm)	Distal dentin adaptation (mm)
1.	3.71	1.15
2.	3.67	1.25
3.	3.56	1.2
4.	3.34	1.18
5.	3.7	1.28
6.	3.42	1.30
7.	3.6	1.02
8.	3.63	1
9.	3.99	1.08
10.	3.75	1.43
11.	3.41	1.00
12.	3.54	1.00
13.	3.54	1.20
14.	3.56	1.30
15.	3.48	1.40
MEAN	3.59	1.19

Mesial Side (enamel adaptation):

Total continuous margin length of mesial side (enamel adaptation)

= 11.43mm-3.59mm= 7.84 mm

Distal Side (dentin adaptation):

Total continuous margin length of Distal side (Dentin adaptation)

= 1.81 mm -1.19 mm = .62 mm

Post loading values of Heliomolarmicrofillcomposite :

Percentage of continuous margin on mesial side (Enamel adaptation) =68.59 %

Percentage of continuous margin on distal side (Dentin adaptation) = 34.25%

ENAMEL MARGIN ADAPTATION(MESIAL SIDE):

Preloading percentages for the proximal enamel adaptation for Filtek Z350, HerculitePrecis Kerr and Heliomolar composite were 85.07%, 83.24%, and 77%. After loading, the Percentage of continuous margin decreased to 83.05%, 76.25%, and 68.59%. Filtek Z350 Nanofill composite shows higher percentages of post loading enamel adaptation followed by Kerr nanohybrid and HeliomolarMicrofil composite.

DENTIN MARGIN ADAPTATION(DISTAL SIDE):

The preloading percentages for the proximal dentin margin adaptation for Filtek Z350, HerculitePrecis Kerr and Heliomolar composite was 63.98%,74%, and 62.4%. After loading, the Percentage of continuous margin decreased to 60.15%, 50.27%, and 34.25%. Filtek Z350 Nanofill composite shows higher percentages of post loading dentin margin adaptation followed by Kerr nanohybrid and HeliomolarMicrofil composite.

Table 11

Groups	Filket Z350	Kerr	Heliomolar
Enamel preloading	85.07%	83.24%	77%
Enamel afterloading	83.05%	76.25%	68.59%
Dentin preloading	63.98%	74%	62.4%
Dentin afterloading	60.15%	50.27%	34.25%

Statistical analysis:

The data collected were compiled using MS-Office Excel and was subjected to Statistical analysis using IBM corp. SPSS (Statistical package for social sciences) Statistics for windows, version 20.0 (Armonk, NY) Statistical significance was set at $P < 0.05$. Descriptive and inferential statistics was used to analyze the data. Normality of the data was assessed and it was found to be normal so, Independent t test was used to compare the pre and post values and Oneway ANOVA TEST(Analysis of Variance) was used for within group comparison

Mean and standard deviation of enamel and cervical dentin adaptation of Filtek Z350 nanofill composite, Herculit précis Kerr nanohybrid composite and Heliomolarmicrofill composite before (Preloading) and after(Post loading) cyclic loading is tabulated in Table 12

Table 12

GROUPS	No of samples	Mean	Std. Deviation
Filtek Z350 nanofill Enamel Adaptation Preloading	15	11.3953	.54857
Herculit précis nanohybrid Enamel Adaptation Preloading	15	9.6400	.31050
Heliomolarmicrofill Enamel adaptation –Preloading	15	8.7613	.31934
Filtek Z350 nanofill Enamel adaptation Post loading	15	11.1260	.50973
Herculit précis nanohybrid Enamel adaptation Postloading	15	8.8333	.30281
Heliomolarmicrofill Enamel adaptation Postloading	15	7.8387	.19091
Filtek Z350 Cervical Dentin adaptation Preloading	15	1.6486	.25845
Herculit précis Kerr nanohybrid Cervical dentin adaptation Preloading	15	1.3627	.14320
Heliomolarmicrofill Cervical dentin adaptation Preloading	15	1.1262	.17175
Filtek Z350 Cervical Dentin adaptation Post loading	15	1.5620	.28313
Herculit précis Kerr nanohybrid Cervical dentin adaptation Postloading	15	.9120	.14996
Heliomolarmicrofill Cervical dentin adaptation Postloading	15	.6255	.18664

Table 13 depicts the comparison of preloading and post loading marginal adaptation values forFiltek Z350 nanofill, Herculiteprecis Kerr nanohybrid, Heliomolarmicrofill composite by using the Paired t test .

In Filtek Z350 nanofill composite enamel adaptation (Mesial side) group, Pre and post loading values were compared by using the paired t-test.The results were found to be statistically significant with lesser values for the post-loading group. Where as in the Herculite Précis Kerr enamel Adaptation group, Pre and post loading values when compared by paired t-test, the results were also found to be statistically significant with lesser values for the post-loading group. Where as in the Heliomolar microfill composite enamel adaptation group, Pre and post loading values were compared by paired t-test, results were found to be statistically significant with lesser values for the post-loading group. In the Filtek Z350 Composite cervical dentin adaptation group, Pre and post loading values were compared by paired t-test, the results were found to be statistically significant with lesser values for the post-loading group. In the Herculite Précis Kerr cervical dentin adaptation group, Pre and post loading values were compared by using the paired t-test, the results were found to be statistically significant with lesser values for the post loading group. In the HeliomolarMicrofill Composite cervical dentin group, Pre and post loading values was also compared by paired t-test,the results were found to be statistically significant with lesser values for the post-loading group.

Groups	*P – value*
Filtek Z350 enamel Adaptation Preloading – Filtek Z350 enamel Adaptation Postloading	.001
Herculit Précis Kerr enamel Adaptation Preloading – Herculit Précis Kerr Enamel Adaptation Postloading	.000
HeliomolarMicrofill Composite enamel Adaptation Preloading – HeliomolarMicrofill Composite enamel Adaptation Postloading	.000
Filtek Z350 Composite cervical dentin adaptation Preloading - Filtek Z350 cervical dentin adaptation Postloading -	.002
Herculit Précis Kerr cervical dentin adaptation Preloading – Herculit Précis Kerr cervical dentin adaptation Postloading	.000
HeliomolarMicrofill Composite cervical dentin adaptation Preloading – HeliomolarMicrofill Composite cervical dentin adaptation Postloading	.000

Table 14 depicts the inter-group comparison done with ANOVA and the post-hoc analysis by using the Bonferroni Test .

Multiple Comparisons

Bonferroni Test

Dependent Variable	(I) Groups	(J) Groups	Mean Difference (I-J)	Sig.
Preloading Mesial enamel adoptation	Filtek	Kerr	1.86533*	.000
		Heliomolar	2.74400*	.000
	Kerr	Filtek	-1.86533*	.000
		Heliomolar	.87867*	.000
	Heliomolar	Filtek	-2.74400*	.000
		Kerr	-.87867*	.000
Preloading Distal dentin adoptation	Filtek	Kerr	.29600*	.000
		Heliomolar	.53247*	.000
	Kerr	Filtek	-.29600*	.000
		Heliomolar	.23647*	.005
	Heliomolar	Filtek	-.53247*	.000
		Kerr	-.23647*	.005
Postloading mesial enamel adoptation	Filtek	Kerr	2.45267*	.000
		Heliomolar	3.44733*	.000
	Kerr	Filtek	-2.45267*	.000
		Heliomolar	.99467*	.000
	Heliomolar	Filtek	-3.44733*	.000
		Kerr	-.99467*	.000
Postloading distal dentin adoptation	Filtek	Kerr	.65000*	.000
		Heliomolar	.93647*	.000
	Kerr	Filtek	-.65000*	.000
		Heliomolar	.28647*	.002
	Heliomolar	Filtek	-.93647*	.000
		Kerr	-.28647*	.002

When the Filtek Z350 nanofill composite group is compared with the Herculite précis Kerr nanohybrid composite group during pre and post loading enamel adaptation. The results were statistically significant with greater values for the Filtek Z350 nanofill composite group. So Filtek Z350 nanofill composite group is better than theHerculite précis Kerr nanohybrid composite group for both pre and post loading enamel adaptation.

When Filtek Z350 nanofill composite group was compared with Heliomolarmicrofill composite group for pre and post loading enamel adaptation.The results were statistically significant with greater values for Filtek Z350 nanofill composite group. So Filtek Z350 nanofill composite group is better when compared toHeliomolarmicrofill composite group in both pre and post loading enamel adaptation.

When Herculite précis Kerr nanohybrid composite group was compared with the Heliomolarmicrofill composite group during pre and post loading enamel adaptation, The results were statistically significant with greater values forthe Herculite précis Kerr nanohybrid composite group. So Herculite précis Kerr nanohybridgroup is better than Heliomolarmicrofill composite group in both pre and post loading enamel adaptation.

When Filtek Z350 nanofill composite group is compared with Herculite précis Kerr nanohybrid composite group in pre and post loading cervical dentin adaptation, Results were statistically significant with greater values for Filtek Z350 nanofill composite group. So Filtek Z350 nanofill composite group is better than Herculite précis Kerr nanohybrid group for both pre and post loading cervical dentin adaptation.

When Filtek Z350 nanofill composite group is compared with Heliomolarmicrofill composite group for pre and post loading cervical dentin adaptation, Theresults were statistically significant with greater values for Filtek Z350 nanofill composite group. So Filtek Z350 nanofill composite group is better than Heliomolarmicrofill group in both pre and post loading cervical dentin adaptation.

When Herculite précis Kerr nanohybrid composite group is compared with Heliomolarmicrofill composite group for pre and post loading cervical dentin adaptation, The results were statistically significant with greater values for Herculite précis Kerr nanohybrid composite group. So Herculite précis Kerr nanohybrid composite group is better than Heliomolarmicrofill group in both pre and post loading cervical dentin adaptation.

DISCUSSION

The search for an ideal esthetic restorative material started with the era of direct filling gold restorations(21). In dentistry, several restorative materials have been tried and used but currently the use of composites has gained in prominence because of it's percieved advantages like micro-mechanical bonding to the tooth structure, higher fracture resistance than other comparable restorative materials and also in having the core advantage of being a resin-based restorative. It successfully and satisfactorily meets the functional and the esthetic demand of the patient.(21) In dentistryone of the significant development is enamel bonding and the development of adhesive dentistry. Enamel has a hard solid crystalline structure- hydroxyapatite (HAp) which has strong intermolecular forces, high-energy surface, besides water and organic material. Acid etching dissolves the hydroxyapatite crystals and also creates micropores in which the adhesive resins are absorbed and are able to create resin-micro tags. These resin tags are the ones which facilitate micromechanical adhesion. On the other side, dentin , being heterogeneous in nature, has less mineral content andalso has a higher water content than enamel (2). When compared to enamel, dentin hashigher smear layer production and also more fluid content inside the dentinal tubules. The permeability of the occlusal, proximal, coronal and root dentin also plays a significant role in bonding. (3) Formation of the smear layer and the presence of dentinal fluid in dentin can also affect the resin tag formation.(3) Because of these factors, bonding to dentin is always a challenging task. So in this study, in order to evaluate the adaptation of restorative material to both enamel as well as dentin, Class II MOD cavities was prepared.(3)

Undesirable space or gaps which are commonly anticipated and frequently noticedat the proximal gingival margins of class II restorations (3,31).So the abilty of the restorative material to seal the proximal gingival margin interface determines clinical success.

In composites, during the polymerization process, monomers create a covalent bond and the space between the two groups of atoms is decreased and there is also a decrease in free volume, both of which translates into volumetric shrinkage..This volumetric shrinkage creates stresses around the tooth and restoration interface. The extent of this shrinkage relies upon the volume fraction of the non-shrinking filler, the size of the monomer which is the concentration of functional methacrylates per monomer and also the extent of the polymerization reaction(6). Overall, volumetric shrinkage reliesupon the filler volume fraction, the composition and the degree of conversion of the resin matrix.(5)Nowadays,widely used dental composites are based upon the methacrylate resin chemistry. During the polymerization process of methacrylate-based composites, monomer molecules were located nearer to each other during the polymerization process, which results in polymerization shrinkage. (4)This polymerization contraction stress create a powerful force which results in cuspal deflection and can cause the separation of the restoration from the tooth resulting in marginal microleakage (4). This microleakage leads to hypersensitivity, recurrent caries and also which leads to pulpal pathosis and its sequelae.(4)So this study was undertaken to compare and evaluate three commonly used composite restorative materials having three different sizes of fillers and their effect on the marginal integrity and also themicroleakage which occurs.

Microleakage of the restorative materials is one of the important key parameters used to detect the causes that result in bond failure along the tooth-restoration interface (30). Going et al proposed that leakage of fluid will occur between the filling and the prepared tooth surface. Kidd in the year of 1976 stated that microleakageis the clinically undetectable passage of bacteria, fluids, molecules, or ions between a cavity wall and the restorative material applied to it (30) In1971 Brannstrom and Nyborg explained the possible cause of pulpal inflammation by demonstrating the occurrence of microbial leakage around dental restorations, proving that its prevention could eliminate the associated inflammation.(30)

Replicating the oral temperature changes is the most important factor to determine and validate the In-vitro microleakage evaluation associated with dental restorative materials Thermocycling is a widely used method for this purpose.Thermocycling is defined as the in vitro process of subjecting a restoration and tooth to temperature extremes which conform to those found in the oral cavity (30). In 1966 ,Peterson demonstrated that microleakage of composite resin restorative material increased with an increased number of cycles during thermocycling process (30). In 1991 Mandras et alfound that there was no variation in microleakageanalyasis of composites thermocycled at 250 and 1000 cycles.(30,27)

In this study, thermocycling temperatures was set at 5ºC-55ºC± 2ºC with a dwell time of 30s of 1500 cycles. These temperature changes with its dwell time seem to be tolerated by the oral tissues and is suitable for clinical conditions (36). If the dwell times exceeds the real clinical environments, it may hide the thermal isolation characteristics of the resin composites, causing fatigue to this material (36). In1997 Geurtsen et al stated that thermocycling with a 30 s dwell time enhances the chance to cause themicroleakage especially in the cavities where margins are located at cementoenamel junction. Another important factor which influences microleakage is the linear coefficient of thermal expansion. It is defined as the change in length per unit length of material when its temperature is raised or lowered 1ºC. This factor is based on the presence and quantity of the inorganic fillers present in resin composite.

A great difference in the linear coefficient of thermal expansion between the tooth and restorative material will change the dimensions of the adhesive interface with temperature change (36). Hence in this study, the thermocycling process of restored specimens was carried out to evaluate microleakage

Several methods are used to detect microleakage.One such method is the organic dye method. Other commonly used methods are the radioisotope method, acetate peel technique, microcomputed tomography, confocal laser scanning microscopy and optical coherence tomography. Among this, organic dyemethod is the most accurate method to detectmarginal leakage in *In-Vitro*.The review of published literature demonstrates that there has been wide variations in the choice of dye used either as solutions or particle suspension of different particle size. The concentration of dyes used also ranges between 0.5% and 10% while the time of the immersion of specimen in the dye varied from between 4 h and 72 h or more.Christen and Mitchell (1966) found that different concentration of dyes can vary in penetration time between 5 min and over 1 h. They suggest that 0.5% basic fuchsin as the standard dye in all *in-vitro*leakage studies So in this study, 0.5% Basic fuchsin aqueous dye as a solution was used. Before the immersion of the samples in 0.5% basic fuchsin aqueous dye, the surface of the restored specimens was coated with two layers of nail varnish except for 1 mm away from the margins of the restoration because nail varnish application prevents the unwanted dye penetration into the dentinal tubules and in those areas where the restoration is not placed. In this study, After subjecting the specimens to dye penetration, the samples were sectioned mesiodistally by using a fine grit diamond disc. Then these sectioned samples were evaluated for marginal microleakage under a stereomicroscope (28). Chen et al did a comparative study on the micro-CT method against the section method regarding the assessment of marginal microleakage of sealants, and they concluded that the best images were obtained from stereomicroscope. (29)

The second parameter evaluated in this study was the marginal adaptation. Good adaptability of the restoration to the tooth structure is considered to deliver better clinical performance Marginal adaptability is the ultimate test to evaluate the quality of dental composites. While marginal gap formed at the tooth-restoration interface can cause postoperative sensitivity, marginal staining, recurrent caries and also the development of pulp pathology[32,33].Marginal adaptation can be explained as the interfacial distance between the eluted restoration and the tooth structure. Attaining a good marginal adaptation relieson the quality of the composite restorations and the adhesive system used. Site of gap formation serves as a reservoir for the growth of bacteria on the composite resin surfaces which leads to secondary caries and pulp damage [34]. The factors are responsible for gap formation commonly are polymerization contraction of the composite resin and also the temperature variations(35). Hence ,in this study marginal adaptation was taken as another parameter.

To evaluate the marginal adaptation in in-vitro, occlusal loading is necessary to replicate and to reproduce the oral masticatory forces. This in- vitro procedure creates stresses on the restoration. The impact of these occlusal forces on the restored specimens can result in tooth deflection and also cause vertical tooth deformations, resulting in tensile flexure stresses and shear stresses along the margins of the restorations.(36)So in this study, to replicate masticatory forces, occlusal loading was carried out by the universal testing machine and 1,00,000 cycles was performed to recreate the intraoral masticatory forces that a restoration undergoes over a period of six months (36). After cyclic loading, polyvinylsiloxane impression of cyclically loaded samples was taken and epoxy resin replicas were made. Epoxy replicas of the cyclically loaded samples were evaluated under a scanning electron microscope for marginal adaptation.

The scanning electron microscope is the most accurate technique for the evaluation of the marginal adaptation. Greater magnification and depth of focus of scanning electron microscope offers clear visualization and observation of the tooth restorative interface.When the etch and rinse adhesive procedure is used, the examiner canget clear visualization of the marginal adaptation of composite resin to enamel and dentin with better micro-retention (37) So in this study , the resin-dentin margin was directly analyzed under a low vaccum scanning electron microscope. On the other side, the scanning electron microscope has a disadvantage of crack formation in testing specimens due to the vacuum procedure utilized during Scanning Electron Microscope. This can be overcome by using an epoxy resin replica technique, so the artificial gap formation can be avoided(19)

In this study, Filtek Z350 Nanofill composite showed a lesser mean microleakage score and higher values in continuous marginal adaptation analysis after performing loading cycles. Filtek Z350 has a filler loading of 82% by weight and 68% by volume. It has a unique combination of nano-sized particles and nanoclusters. Filler surfaces were coated with zirconia/silica with a median particle size of approximately 3μ (38). The results in this study may be attributed to filler particle sizes of the nanofiller composite which ranges from 0.005 to 0.01μm and which is below the wavelength range for visible light (0.02-2μm) These very small particles of nanofiller composites do not react with the visible light and don't produce scattering which results in the significant absorption of light and leads to improvement in the modulus of elasticity, the depth of cure and also improved esthetics(38). F.Yalcin et al in 2016did a comparative study to evaluate the effect of polishing systems on the microleakage of a nanofill, nanohybrid and microhybrid composite resin. They proposed that microleakage was seento be higher in the nanohybrid composite resin, while the least micro-leakage was in nanofill composite resin. (39)

Filler molecule size of the nanofilled composite is 20–70 nm. They possess high mechanical strength similar to the hybrid material, a high wear resistance, and can be easily polished..Mishra et al in 2018 stated that the micro filled composites have nearly 37%–40% volume of filler loading while the nanofilled resins posses 60% volume filler loading, making the nanofilled resins as strong as the hybrid and micro hybrid resins(41). Hence these nanocomposites possess superior hardness, flexural strength, modulus of elasticity, decreased polymerization shrinkage and they also have excellent handling properties.

In herculite précis kerr nanohybrid composite consists of the hybrid filler particles of various sizes with filler load of 75–85% by weight. It was designed to get the benefits of both macro filled and micro filled fillers. Resins with hybrid fillers reduce the thermal expansion and also it has a higher mechanical strength. However, it has higher polymerization shrinkage due to a larger volume of diluent monomer which controls the viscosity of the resin.(41)

In heliomolar microfill composite contain microfilled fillers colloidal silica with a particle size of 0.4 µm. Heliomolarmicrofill composite filler loading is lower than in conventional (only 40–45% by weight). Therefore, it is contraindicated for loadbearing situations and has poor wear resistance.So the final restoration is difficult to polish adequately leaving rough surfaces, and therefore this type of resin is plaque retentive. (41)

In this study, nanofill composites showed higher marginal adaptation than nanohybrid and microfillcomposite . This may due to the increased filler volume loading of the nanofill composite. The increased filler volume loading of 82% by weight (68% by volume) of Filtek Z350 nanofill composite, the amount of contraction stresses are low during the polymerization process. It results in reduced polymerization shrinkage. In conventional hybrid composites have large filler particle size. So mechanical properties and wear resistance were high but polishing was difficult because of large particle size which may create more roughness.so it acts as plaque retentive site. To overcome the drawbacks of the conventional hybrid composite, Nanofill composites were introduced with smaller filler particle size and higher filler volume loading. So both mechanical, as well as polishability can be achieved. Good surface finishing and polishing reduce the formation of micro gaps between the tooth-restorative interface and provides better marginal adaptation in nanofill composites.

In this study, higher filler loading and smaller filler particle size of nanofill composite show lesser microleakage and better marginal adaptation than nanohybrid and microfill composite.

CONCLUSION

Conclusion:

Within the limitations of the present study, it can be concluded that Nanofill composites shows lesser microleakage score and higher marginal adaptation than nanohybrid and microfill composite.Difference in results lies in the smaller filler particle size and higher filler volume loading in nanofill composite.This smaller filler particle size and higher filler volume loading in nanofill composite reduces the amount of contraction stresses during the polymerization process which results in reduced polymerization shrinkage.So in nanofill composites both mechanical properties as well as polishability can be achieved. Good surface finishing and polishing reduce the formation of microgaps between tooth restorative interface and provides better marginal adaptation in nanofill composites.

SUMMARY

Background

This *In-vitro* study is done to evaluate the marginal integrity and microleakage associated with nanofill, nanohybrid and microfill composites in prepared class II cavities by using a scanning electron microscope and stereo microscope.
Ninety intact human mandibular premolars were collected. “Endo jaw”was used to create adjacent teeth contact while making class II mesio-occluso- distal cavities .Class II Mesio-Occluso- Distal cavities were prepared by using high speed hand piece . Initial cavity out line was done by using No10 size round bur.Final cavity preaparation done by using 245 bur. Class II MesioOccluso-Distal (MOD) cavities were prepared by following a set of standard dimensions: The Width of occlusal cavity dimensions was 5 mm. Depth of the occlusal cavity dimensions was 3.5 mm (Measured from tip of the palatal cusp) .Width of the proximal cavity preparation was 4mm with a slight divergence occlusaly. Proximal cavity margins were located mesialy 1 mm above the cemento-enamel Junction and distally 1 mm below the cemento-enamel Junction. The Dimensions of the prepared cavities was checked by using a periodontal probe

Restored teeth were divided into two main groups. Group 1 was microleakage divided into two main groups. Group 1 was microleakageevaluation(n=45). Group 2 was marginal adaptation evaluation(n=45). Group1 was subdivided into three subgroups .15 specimens were allocated for each subgroup.Group 1a (Filtek Z350 nanofill composite), Group 1b (Herculite précis kernanohybrid composite) and Group 1c (Heliomolarmicrofill composite). Similar grouping was done for Group 2 (Marginal adaptation).After cavity prepration, all the prepared specimens were etched with 35% phosporic acid. Respective bonding agents were applied according to manufacturer instructions. To ensure tight proximal contact, Sectional matrix systemwas placed . Respective composite resin was applied into the cavity in 1-1.5 mm increments. Each increments was light cured for 20 seconds by a blue phase LED light curing unit.

For Microleakage evaluation, all the prepared specimens were incubated at 37 ° C for 24 hours and thermocycledat alternative water baths, 5°C± 2 °C followed by 55°C ± 2°C .1500thermocycles were performed with a dwell time of 30 seconds and a transfer time of 15 seconds. After thermocycling, Nail varnish was applied on to the prepared specimens except for an area of above 1 mm around the margins of the restoration .specimens were stored in 0.2 % methylene blue aqueous solution for 24 hours. Specimens were sectioned mesiodistally by using diamond disc and viewed under stereomicroscope fordye penetration on restorative tooth interface.

For marginal adaptation , specimens were subjected to 1,00,000cycles with a 50 newton eccentric occlusal load in Universal Instron Testing Machine. Impressions of MOD cavities were taken with polyvinyl siloxane impression material followed epoxy resin replicas were made before and after performing mechanical loading cycles. Continuous margins of the restoration in epoxy replicas were viewed under the Scanning Electron Microscope.Pecentages of continuous margins were calculated by ratio between continuous margin and total interface length .

For microleakage evaluation, datas were stasticaly analyzed by using Kruskal-Wallis test at the 0.05 level of significance. For marginal adaptation, datas were stasticaly analyzed by ANOVAand Post-Hoc analysis using Bonferroni Testat the 0.05 level of significance. Results of this study showed that lower mean microleakage scores and higher continuous margin percentages were found in Filtek Z350 Nanofill composite group followed by Herculite précis nanohybrid composite and Heliomolarmicrofill composite. In marginal adaptation , statistical significant values were found between all the groups. Results were not statisticaly significant in microleakage group.

Within the limitations of the present study, it can be concluded that Nanofill composites shows lesser microleakage score and higher marginal adaptation than nanohybrid and microfillcomposite.Difference in results lies in the smaller filler particle size and higher filler volume loading in nanofillcomposite.This smaller filler particle size and higher filler volume loading in nanofill composite reduces the amount of contraction stresses during the polymerization process which results in reduced polymerization shrinkage.Soin nanofill composites both mechanical properties as well as polishability can be achieved. Good surface finishing and polishing reduce the formation of microgaps between tooth restorative interface and provides better marginal adaptation in nanofill composites.

BIBLIOGRAPHY

1) KhushbuYadav. Dental Caries: A Review. Asian Journal of Biomedical and Pharmaceutical Sciences 2016; 53(6): 01-07.
2) Naseem Shah. Oral and dental diseases: Causes, prevention and treatment strategies: Burden of disease, National Commission on Macroeconomics and Health. 2005;9(9): 275-98
3) LezizeÇebnemTürkün.Clinical evaluation of different posterior resin composite materials: A 7-year report. Quintessence International. 2003 ; 34(3):418-426.

   Rajat Sharma. Restoring fractured anterior tooth using direct composite restoration : A case report. University J Dent Scie 2015; 1(1):1-2
4) N.B. Cramer et al..Recent Advances and Developments in Composite Dental Restorative Materials. J Dent Res 2011;90(4):402-416.
5) J.O. Burgess.Posterior resin-based composite: review of the literature. Pediatric Dentistry 2002;24(5):465-79.
6) N.J.M. Opdam. Longevity of Posterior Composite Restorations: A Systematic Review and Meta-analysis. J Dent Res 2014; 93(10): 943–949.
7) Flávio F. Demarco. Longevity of posterior composite restorations: Not only a matter of materials.Dent Mater. 2012 ;28(1):87-101
8) KatrinHeck.Clinicalevaluation of the bulk fill composite QuiXfil in molar class I and II cavities: 10-year results of a RCT.Dent Mater. 2018;34(6):e138-e147
9) Versluis A, Tantbirojn D. Do dental composite always shrink toward the light? J Dent Res 1998;77(6): 1435-1445.
10) Cornelis J. Kleverlaan . Polymerization shrinkage and contraction stress of dental resin composites . Dental Materials 2005; 21(12): 1150–1157

11) JL Ferracane. Placing Dental Composites— A Stressful Experience. Operative Dentistry 2008; 33(3): 247-257

12) C. L.Davidson et al.Relaxation of Polymerization Contraction Stresses by Flow in Dental Composites . J Dent Res 1984;63(2):146-148

13) Abdul-HaqSuliman et al. Polymerization shrinkage of composite resins: Comparison with tooth deformation.Journal of Prosthetic Dentistry 1994; 71(1): 7-12.

14) I F Neiva etal.An In Vitro Study of the Effect of Restorative Technique on Marginal Leakage in Posterior Composites. Operative dentistry 1998; 23: 282-289

15) H Lu and YK Lee. Properties of a Dental Resin Composite with a Spherical Inorganic Filler. Operative Dentistry, 2006; 31(6): 734-740

16) Filtek Z250 XT Nano Hybrid Universal Restorative technical data sheet.3M ESPE

17) Herculite Précis Where legacy & advanced technology meet. KERR brouchure

18) Kristi J et al.Thermocycling and dwell times in microleakage evaluation for bonded restorations Dent Mater1995;(11):47-51.

19) R Pecieetal.Marginal Adaptation of Direct Class II Composite Restorations with Different Cavity Liners. Operative Dentistry, 2013; 38(6): 210-220

20) Ishikiriama et al. Role of Additional Retention on Marginal Adaptation and Sealing of Large Resin Composite Class II Restorations. Operative Dentistry, 2007;32(6): 564-570.

21) Arvind k Alexander et al.Comparative evaluation of different surface treatments on repair shear bond strength of three nanohybrid composites. An *In-Vitro* study. CEJ 2018 ;3(1):22-26.

22) NS Kimmes et al .Adhesive Bond Strengths to Enamel and Dentin Using Recommended and Extended Treatment Times .Operative Dentistry, 2010;35(1): 112-119

23) YH Bagis et al. Comparing Microleakage and the Layering Methods of Silorane-based Resin Composite in Wide Class II MOD Cavities. Operative Dentistry, 2009; 34(5):578-585

24) PoonamBogra et al. Comparative evaluation of microleakage in class II cavities restored with Ceram X and Filtek P-90: An in vitro study. Contemporary Clinical Dentistry 2012;3(1):9-14

25) AkshayLangalia et al.Polymerization Shrinkage of Composite Resins: A Review . Journal of Medical and Dental Science Research 2015;2(10): 23-27

26) JL Ferracane .Placing Dental Composites— A Stressful Experience. Operative Dentistry, 2008;33(3): 247-257

27) M.S. Gale et al .Thermal cycling procedures for laboratory testing of dental restorations . Journal of Dentistry 1999;27: 89–99

28) Pazinatto et al . Effect of the number of thermocycles on microleakage of resin composite restorations.PesquiOdontol Bras 2003;17(4):337-41

29) X Chen et al. Validation of micro-CT against the section method regarding the assessment of marginal leakage of sealants. Australian Dental Association 2012.

30) A H Alani et al. Detection of Microleakage around Dental Restorations: A Review. Operative dentistry I997;(22): 173-185

31) Idriss et al.Marginal adaptation of class II resin composite restoration using incremental and bulk placement techniques an SEM study. J. Oral Rehabil 2003;30: 1000-1007

32) Shortalet al.,Microlekage, marginal adptation of composite resin restoration. Br. Dent. J 1982;153:223-27,

33) Yap et al. Marginal gap formation of composites in dentine: Effect of water storage. J. Oral Rehabil 2003; 30: 236-42,

34) Scheibenbogen et al.One year clinical evaluation of composite and ceramic inlays in posterior teeth.J.Prosth. Dent 1998;80:410-16

35) Souza et al. Effect of the curing method and composite volume on marginal and internal adaptation of composite restoratives. Operative Dentistry2011;36:231-8.

36) Mandras, R.S et al Retief, D.H. and Russell, C.M, The effect of thermal and occlusal stresses on the microlekage of the scotch bond to dentinal bonding system.Dent. Mat 1991;7: 63-67,

37) oyde et al..The use of SEM in clinical dental research. Br. Dent. J 1969;127: 313-22,

38) Mohamed El-Nawawy et al. Marginal Adaptation of Nanofilled, Packable and Hybrid Dental Composite Resins Stored in Artificial Saliva. .American Journal of Biomedical Engineering 2012; 2(3): 105-114

39) SomyaGoviletal.A comparative evaluation of micro-leakage of different tooth colored restorative materials. An in-vitro study..IJCPHR 2016; 1(1):10-14

40) T. Naveen et al .Marginal adaptation of composite resin with different dentin bonding agents in Class V restorations .Drug Invention Today 2018;10(9)

41) Preeti Mishra et al. Evaluation of marginal sealing ability of self-adhesive flowable composite resin in Class II composite restoration: An in vitro study. Journal of Conservative Dentistry 2018;21(4):363-368

ANNEXURE

Estd : 1987

INSTITUTIONAL ETHICS COMMITTEE AND REVIEW BOARD

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DCI Recognition No: DE-3(44)-93/2246
Dated 09-11-1993

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The Tamil Nadu Dr. M.G.R. Medical University, Chennai

This ethical committee has undergone the research protocol submitted by ***Dr.S.Maria Antony*** *Post Graduate Student,* ***Department of conservative dentistry and endodontics*** *under the title" COMPARATIVE EVALUATION OF THE MARGINAL INTEGRITY AND MICROLEAKAGE OF A NANOFILL, NANOHYBRID AND MICROFILL COMPOSITE IN PREPARED CLASS II CAVITIES – AN IN-VITRO STUDY " under the guidance of* ***Dr.A.Arvind Kumar*** *for consideration of approval to proceed with the study.*

This committee has discussed about the material being involved with the study, the qualification of the investigator, the present norms and recommendation from the Clinical Research scientific body and comes to a conclusion that this research protocol fulfills the specific requirements and the committee authorizes the proposal.

Dr. ANISHA CYNTHIA SATHIASEKAR MDS
CHAIR PERSON
Ethical Committee

CERTIFICATE -II

This is to certify that this dissertation work titled " **Comparative evaluation of marginal adaptation and microleakage of nanofill, nanohybrid and microfill composites in prepared class II cavities-An *In-vitro* study** " of the candidate **Dr.S.Maria Antony** with registration number **241617201** for the award of **Master of Dental Surgery** in the branch of **Conservative Dentistry and Endodontics -Branch - IV .** I personally verified the urukund.com website for the purpose of plagiarism check .I found that the uploaded thesis file contains from introduction and conclusion pages and result shows 7 percentage of plagiarism in the dissertation.

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