COMPARATIVE EVALUATION OF MARGINAL ADAPTATION OF SELF ADHERING FLOWABLE COMPOSITE TO BULK FILL FLOWABLE COMPOSITE : AN IN VITRO STUDY.

DISSERTATION

Submitted to

BABU BANARASI DAS UNIVERSITY, LUCKNOW, UTTAR PRADESH

In the partial fulfilment of the requirement for the degree

of

MASTER OF DENTAL SURGERY

In the subject of

CONSERVATIVE DENTISTRY & ENDODONTICS

Submitted by

DR. SATYAM KASHYAP

Under the guidance of

DR. (Prof.) PRAVEEN SINGH SAMANT

DEPARTMENT OF CONSERVATIVE DENTISTRY & ENDODONTICS

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW

Batch: 2021-24 **Enrolment No.: 12103222929**

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"Comparative evaluation of marginal adaptation of self-adhering flowable composite to bulk fill flowable composite: An Invitro Study"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. Praveen Singh Samant**, Professor & Head, Department of Conservative Dentistry & Endodontics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Satyam

Signature of the Candidate

Date: 19/02/24

Place: BBDCODS

Dr. Satyam Kashyap

CERTIFICATE BY THE GUIDE/CO-GUIDE

This is to certify that the dissertation entitled **"Comparative evaluation of marginal adaptation of self-adhering flowable composite to bulk fill flowable composite: An Invitro Study"** is a bonafide work done by **Dr. Satyam Kashyap**, under our direct supervision & guidance in partial fulfilment of the requirement for the degree of **Master of Dental Surgery (M.D.S.)** in the speciality of Conservative Dentistry and Endodontics.

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ENDORSEMENT BY THE HEAD OF THE INSTITUTE

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"The most important function of education at any level is to develop the personality of the individual and the significance of his life to himself and to others."

At the very start, I bow my head to the **Almighty GOD***, who blessed me with his worthy blessings, bestowed me with his kind grace, provided me with necessary strength,*

courage and good health to reach this stage and made it possible to bring out this manuscript.

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.

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I beg forgiveness from those, whose names I have inadvertently missed but they should find solace that their knowledge has been extended to others by way of this thesis.

Dr. Satyam Kashyap

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ABSTRACT

ABSTRACT

Despite the improvement of restorative materials and techniques in the recent decades, the postoperative sensitivity with composite restorations remains a challenge for the dentist. Poor marginal adaptation may produce marginal discoloration, postoperative sensitivity, and secondary caries that would decrease the longevity of composite restorations. The possibility of marginal failure in composite resin restorations is related mainly to the quality of bond between the dental substrate and the resin and also to stress generated within the restoration due to polymerization shrinkage.

The discovery of a new category of composites termed as "self-adhering", in the recent past has revolutionized the phase of adhesive dentistry. This self-adhering flowable composite material combines an all-in-one bonding system, eliminating the need for a separate etching and adhesive application.

Class II cavities were prepared on the distal surface of 50 human mandibular premolars, with the dimensions of 4 mm buccolingual width, 2 mm mesiodistal depth with the gingival margin at the cementoenamel junction (CEJ). No bevels are placed at any of the cavosurface margins; however, all margins were smoothened using an enamel hatchet. Then, the teeth were randomly divided into 5 groups of 10 samples each.

Group I (n=10)- Vertise flow with etchant and bond.
Group II (n=10)-Vertise flow without etchant and bond
Group III (n=10)-DMG Constric with etchant and bond.
Group IV (n=10)-DMG Constric without etchant and bond.
Group V (n=10)-SDR Flow(positive control group)

After the completion of restoration, the specimen were sent further for SEM investigation. The teeth samples will undergo sagittal sectioning. An area of 1cm X 1cm of the restoration will be subjected under SEM to evaluate the marginal adaptation of the restoration. The results were then analysed using Analysis of Variance (ANOVA) and unpaired t-test. There was a significant difference in the marginal adaptation among the five experimental groups.

The result concluded that vertise flow with etchant and bond showed the best marginal adaptation.
However further *in-vivo* studies are required to further test the marginal adaptations of the chosen materials.

INTRODUCTION

INTRODUCTION

Dental restorative materials are required to fulfil basic prerequisites including similarity to tooth structures in their mechanical, physical, and esthetic properties. Although dental restorative materials differ significantly in their characteristics, they are all, once placed as restorations, subjected to the harsh conditions of the oral cavity. After placement, dental restorative materials are in constant interaction with the surrounding tissues. Although dental restorative materials are fabricated to be as durable and inert as possible, restorations may deteriorate, degrade or fail, and during these processes, constituents of these materials may be released into the oral cavity. Not only are these materials expected to maintain their integrity in such harsh conditions, but also to preserve these features during function for prolonged periods. As most restorative materials have a long lifespan, their functionality may alter their basic properties, including those related to biocompatibility. Restorative materials in function need to endure chewing forces, aqueous conditions, numerous microorganisms, fluctuations in pH, food products, temperature swings, and active enzymes.[1] If only clinical characteristics are of concern, the highest priorities for an ideal direct restorative material most certainly would be properties like coefficient of thermal expansion which should be close to enamel and dentin, another important property be crack tolerance (i.e., fracture resistance), simple delivery systems, (i.e., ease of clinical use), and good clinical performance (i.e., 10- to 20-year longevity).
Acceptance and performance of new restorative systems are driven by a wide range of concerns such as performance, economics, patient expectations, cost-effectiveness, health care systems, global challenges in manufacture and service delivery, and now environmental concerns. [2]

Composite materials were introduced to the profession in 1955 by *Dr Raphael Bowen*. It is interesting to note that the discovery of the concept of acid-etching enamel by *Dr Michael Buonocore* occurred almost at the same time. The initial composite resin materials were superior to their predecessors (silicate and PMMA) in terms of physical properties, colour stability, solubility and clinical performance. However, these initial materials were not suitable for use in posterior teeth and had problems resulting from polymerization shrinkage even though the amount of that shrinkage was substantially less than the shrinkage of PMMA materials.[3]

Composite resin materials have evolved constantly over the past 50 years and contemporary composite resin materials are vastly superior to the original material in both clinical performance and esthetic potential. They make it possible to attain outstanding aesthetics and satisfy patients increasing needs in terms of dentition repair, both functionally and anatomically.[3]Four primary components make up dental resin composite materials:

- an organic polymer matrix (dispersed medium)

- an inorganic filler (dispersed phase) such as tins and fillers

- a coupling phase that binds the matrix to the filler particles (silanes);

-polymerization process activators and inhibitors.[4]

Their qualities often exceed the total properties of their constituent parts, and their structure is non-homogeneous.[5]

Inadequate marginal adaptation can result in secondary caries, postoperative sensitivity, and marginal discoloration, all of which shorten the lifespan of a composite restoration. The marginal failure in a composite resin restoration is mostly associated with strength of the bond between resin and the dental substrate, as well as the stress that polymerization shrinkage causes inside the restoration.[6]

The polymer matrix of dental composites is the primary cause of shrinkage.[4] The postoperative sensitivity with composite restorations continues to be a difficulty for restorative dentists, even with advancements in restorative materials and techniques over the past few decades.[6]

The resin matrix makes up roughly 20–40 percent weight. It is made up primarily of dimethacrylate monomeric compounds, such as urethane dimethacrylate (UDMA), triethylene glycol dymethacrylate (TEGDMA), bisphenol-A glycidyl dymethacrylate (Bis-GMA), and ethoxylated bisphenol-A glycidyl dymethacrylate (Bis-EMA).[7]

Current resin composite materials contain these monomers in a variety of combinations and amounts that produce distinct copolymer systems.

These days, minimally invasive dentistry and conservative techniques necessitate the use of adhesive resin restorations, which work effectively in moderate- to small-sized preparations.Despite the potential greatness of flowable resin restorations, the decision was not as credible in the past due to the material's mechanical flaws.[8]

The use of nanotechnology to flowable resin composites has been a breakthrough that has the potential to improve these materials' clinical performance. Because of their easy placement and adaption to the inner cavity walls, their mechanical qualities improved to the point where they could compete with some standard viscosity resin. Promoting a more straightforward and user-friendly technique for employing flowable resin composite in conservative cavity preparations, however, may have significant clinical implications.[9]

Previously generation flowables were used only as liners due to their low elastic modulus. The second-generation flowables developed since 2000 promised increased mechanical properties and are proposed for use in bulk restorations. The development of self-adhering flowable composite (SAFC), which combines the benefits of restorative and adhesive material technologies in a single application process, represents an ambitious advancement (eighth generation).[10]

When dealing with patients who are difficult to work with or who have several carious defects, the SAFC promises fewer steps, a lower probability of application errors, and the shortest chair time feasible. This could be very beneficial when applying quadrant dentistry.[11]

The next development that doctors have been waiting for is the creation of a self-adhesive restorative composite, since adhesives used today are frequently thought to be technique-sensitive.[12]

One of the main goals of the dentistry industry's current research and development activities is the simplification of clinical adhesive procedures.[12]

To create a long-lasting bond, however, the hydrophobic–hydrophilic mismatch between dental composite and tooth substrate must be addressed. The development of composite cements that stick together has led to the development of a new class of self-adhesive (restorative) composites (SACs) that are bonded to tooth enamel and dentin without a separate adhesive

Vertise flow(Kerr) is a flowable self adhering composite with matrix composition of GPDM,HEMA and MEHQ,the filler type is Prepolymerized particles, Ba glass, colloidal SiO_2, YbF_3, ZnO and the diameter of filler is 1 micro metre for Ba glass; nanoscale SiO_2 and YbF_3.

Surefil SDR Flow (Dentsply) Flowable, fluoride ion release, up to 4 mm thickness, low shrinkage stress with matrix content of Polymerization modulator, dimethacrylaye resins (<10% wt), UDMA (<25% wt) and filler type Ba-B-F-Al silicate glass (<50% wt),[a] SiO_2, amorphous (<5% wt),[a] Sr–Al silicate glass (<50% wt),[a] TiO_2 (<1% wt).

An indicator characterizing the properties of restorative materials, with particular importance for preventing secondary caries, is the integrity and durability of marginal sealing. Thermocycling and ageing with SEM marginal analysis and marginal adaptation are still closer to the clinical situation, allowing us to compare these important for the clinic characteristics of different restorative materials.

The present study aimed to evaluate and correlate marginal adaptation in Class-II cavities restored with self-adhering flowable composite and bulk-fill flowable composite.

AIM AND OBJECTIVES

Aim & Objectives

AIM

The aim of this study was to comparatively evaluate the marginal adaptation of Self Adhering flowable composite with bulk fill flowable composite, with and without an etchant and bonding agent.

OBJECTIVES

1- To comparatively evaluate the marginal adaptation of Self adhering flowable composite to bulk fill flowable composite with the help of Stereo-electron microscope (SEM).

2- To evaluate the marginal adaptation of Vertise flow (Kerr manufacture) to SDR Flow (Dentsply) with etchant and bonding agent.

3- To evaluate the marginal adaptation of Vertise flow (Kerr manufacture) to SDR Flow (Dentsply) without etchant and bonding agent.

4- To evaluate the marginal adaptation of Constric (DMG) to SDR flow (Dentsply) with etchant and bonding agent.

5- To evaluate the marginal adaptation of Constric (DMG) to SDR flow (Dentsply) without etchant and bonding agent.

6- To evaluate the marginal adaptation of Vertise flow (Kerr) to Constric (DMG) with etchant and bonding agent.

7- To evaluate the marginal adaptation of Vertise flow (Kerr) to Constric (DMG) without etchant and bonding agent

REVIEW OF LITERATURE

Review of Literature

1- **AM Neme, BB Maxson, FE Pink (2002)** evaluated the effect of low-viscosity liners Heliomolar HB, Prodigy Condensable, Surefil and Tetric Condense on microleakage in Class II packable composite restorations and found that all materials, either separately or in combination with a flowable liner, had greater leakage scores at the cervical margin compared to the occlusal margin [13]

2- **Olmez A ,Oztas N,Bodur H (2004**) compared the effect of two flowable resin composite, Filtek Flow and Tetric Flow with and without their packable composite on the marginal microleakage and internal voids in Class II composite restorations with the margins below the cementoenamel junction (CEJ) and stated that the use of flowable resin composites along with their packable composites provided a reduction in marginal microleakage and internal voids.[14]

3- **Korkmaz Y, Ozel E, Attar N (2007)** performed a study to determine the influence of four flowable composite linings on marginal microleakage and internal voids in Class II composite restorations with the margins above the cementoenamel junction. **They restored class II cavity with packable along with their flowable composite resin in one group and packable composite solely in another group and suggested** that flowable resin composites under packable composites provided a significantly different reduction in microleakage compared to restorations without flowable liners.[15]

4- **Yazici R, Celik C, Dayangac B (2008)** conducted a study to assess the influence of different light curing units and modes on microleakage of flowable composite resins. Eighty Class V cavities were prepared in buccal and lingual surfaces of 40 extracted human premolars. These teeth were randomly assigned into 2 groups with 20 teeth in each of the groups. Group I was restored with Esthet-X Flow and Group II was restored using Grandio Flow**.** Each group was randomly divided into four subgroups, first group was polymerized with conventional Halogen light, the rest of them were polymerized with different curing modes of Light Emitting Diode (LED). The second subgroup was polymerised with fast curing; third subgroup : pulse curing and fourth subgroup: step curing mode of LED. No statistically significant differences were observed between curing units for Esthet-X Flow samples. For Grandio Flow samples, only step-curing mode of LED caused statistically higher leakage scores than halogen and other curing modes of LED.[16]

5- **Sadeghi M, Lynch D (2009**) investigated the effects of a thin layer of flowable composite on microleakage occurring in Class II packable and nanofilled composite restorations that extend apical to the cemento-enamel junction (CEJ). They chose Filtek P60 for packable and Universal Filtek Supreme XT for nanofilled composite with and without their respective flowable liners, Dyract Flow and Flowable Filtek Supreme XT and found a significant reduction in the microleakage occurring under both types of composite materials at the gingival floors.[17]

6- **Leila B, Mashaallah K, Ehsan N (2012)** performed a study to compare the microleakage of two self etched adhesives and one bottle adhesive used in pit and fissure sealant with or without saliva contamination and they concluded that the best technique of sealant therapy in saliva contaminated condition is the use of acid etching and bonding agent.[18]

7- **Rengo C, Goracci C, Juloski J (2012)** conducted a study to evaluate the influence of preliminary phosphoric acid etching on the microleakage of a self-adhering flowable composite with a self-etch adhesive and with an etch and rinse three step system. Vertise flow and Optibond flowable were evaluated for their interfacial sealing ability and they concluded that The early sealing ability of the self-adhering flowable composite and the self-etch adhesive in Class V restorations did not significantly benefit from selective enamel etching. Preliminary phosphoric acid etching of dentine negatively affected the quality of the seal when using the adhesive-free flowable composite.[19]

8- **Bektas O, Eren D, Akin E G, Akin H (2013)** evaluated the dentin bond strength and microleakage of a self-adhering flowable resin, Revolution Formula 2 flow and Vertise Flow with or without adhesive resin. They came into conclusion that self adhering flowable composite resin combined with adhesive resin provided a stronger dentin bond strength and better marginal seal.[20]

9- **Jankovic O,Radman K(2013)** conducted a study to evaluate the marginal seal using dye method of class V cavities restored with self-etching flowable composite material Vertise Flow and flowable composite Tetric Flow polymerized with different light-curing techniques. In their Vertise Flow, self-etching flowable composite showed better marginal seal than flowable composite resin Tetric Flow. Smaller microcracks with Vertise Flow were also confirmed after applying all three light-curing polymerization techniques.[21]

10- **Alessandro V, Mariam M (2013)** conducted a study to assess the bonding and sealing ability of a self adhering flowable composite and they concluded that vertise flow resulted in lower bond strength on either dental substrate, better marginal sealing ability was observed in comparison with all-in-one adhesive systems.[22]

11- **Ruben N, Caroline S (2014)** evaluated the bonding performance of a self adhering flowable composite to indirect restorative materials. The materials they took was ceromer, leucite ceramic,zirconia ceramic and metal ceramic alloy. The SAFC used in this study was Vertise flow and Filtek Z350 XT as flowable composite. They concluded that The self-adhering composite provided lower bond strength only to zirconia ceramic. Comparing with the control group, Dyad Flow showed lower bond strength to the ceromer and zirconia ceramic.[23]

12- **He Yuan,Mingyang L, Bin G(2015)** carried out a study to evaluate the microtensile bond strength and marginal sealing ability of a self adhering flowable composite between dentin and composite interface, the study concluded that the individual usage of self adhering flowable composite showed the lowest bond strength, the same marginal sealing ability was observed as that of combining self etching and etch and rinse adhesive with flowable composite.[24]

13- **Gayatri C, Rambabu T, Sajjan G (2018)** carried out a study to evaluate the marginal adaptation of self-adhering flowable composite (Dyad flow) in comparison to the conventional flowable composite (Tetric N-flow) under scanning electron microscope and resulted that the marginal adaptation of the self-adhering flowable was better than that of the conventional flowable composite.[25]

14- **Anitakumari R, Jyothi S (2018)** carried out a study to evaluate the shear bond strength (SBS) of self-adhering flowable composites on the dentinal surface prepared with carbide and diamond burs. The material used for this study were Vertise flow, DMG Constric and Tetric N flow respectively. It was concluded that the SBS of Tetric-N Flow was higher than that of the experimental groups of Constic and Dyad-flow. Dentinal surface preparation with carbide bur resulted in higher SBS for Tetric N Flow and Dyad-flow but not for Constic.[26]

15- **Omar O, Eman A, Amira F (2018)** conducted a study to evaluate the clinical performance of self adhering flowable composite to conventional flowable composite. Vertise flow and Filtek Z350XT flowable was taken into consideration in this study. It was concluded that the self adhering flowable composite showed clinical performance similar to conventional flowable composite after 6 month of clinical service.[27]

16- **Jordehi Y, Shahabi S, Akbari A (2019)** conducted a study to compare the marginal seal of self-adhering flowable composite; Vertise Flow with three universal bonding systems; Clearfil S3 Bond Universal, G-Premio Bond, and Single Bond Universal. using the self-etch technique at enamel and dentin margins. They found that self-adhering composite exhibited significantly less marginal microleakage when compared to G-Premio Bond.[28]

17- **Rahmanifard M, Khodadai E, Khafri S (2019)** performed a study to compare microleakage in occlusal and gingival margins of the cavities filled with self adhering flowable composite; Vertise Flow and conventional flowable composite; Single Bond 2, Clearfil SE Bond, and Universal Scotch Bond, using dye penetration method and suggested that vertise flow is a useful material with adequate marginal seal.[29]

18- **Buse A, Iffet Y,Ceren D (2019)** conducted a study to evaluate and compare the 1year clinical performances of self adhering flowable composite and a commercially available self etch adhesive system in occlusal restorations of primary second molars and the clinical assessment of self-adhering flowable composite exhibited good clinical results after 1 year.[30]

19- **Fatma D, Esra E, Filiz Y (2020)** conducted a study to evaluate the long term clinical performance of self adhering flowable composite compared to conventional flowable composite used with an etch and rinse adhesive system. The study compared Vertise flow with Luxaflow and they concluded that both materials used for the restoration of Class-I cavities demonstrated clinically acceptable performance at the end of 5-years. The self-adhering flowable composite exhibited a clinical performance similar to the conventional flowable applied with an etch&rinse adhesive.[31]

20- **Aleksander M, Agata T (2020)** carried out a comparative study using Vertise flow SAFC and a traditional flowable composite Premise Flow. Vertise flow was applied without the use of an etching agent or a bonding agent. Premise flow was used without the etching agent but with the use of Optibond.. In group III Premise flowable material was applied after etching and treatment of the hard tooth tissues using a fifth-generation OptiBond. It was concluded from their study that Vertise Flow used without an etching agent or a bonding system presented the weakest results with respect to marginal adaptation and smoothness among those evaluated in this study. The intensity of degradation continued over time until the final clinical observation which was 24 months. The results confirmed that the highest marginal adaptation was achieved with the Premise flowable material after etching and treatment of the hard tooth tissues using a fifth-generation OptiBond Solo Plus bonding system.[32]

21- **Fatma D, Ece M (2021)** carried out a clinical trial to compare a self-adhesive flowable resin composite, a highly filled flowable resin composite used in combination with a universal adhesive applied in self-etch mode, and a conventional flowable resin composite used in combination with a universal adhesive applied using two different application modes in the occlusal cavities. SAFC (DMG constric) , highly filled flowable (G-aenial universal flow GC) with universal adhesive was applied in self etch mode and conventional flowable (Tetric N flow Ivoclar) in combination with a universal adhesive (Tetric N-Bond Universal, Ivoclar Vivadent) applied in etch & rinse mode and the study concluded that the self-adhering flowable resin composite exhibited inferior marginal adaptation compared to the highly filled flowable and conventional flowable resin composites.[33]

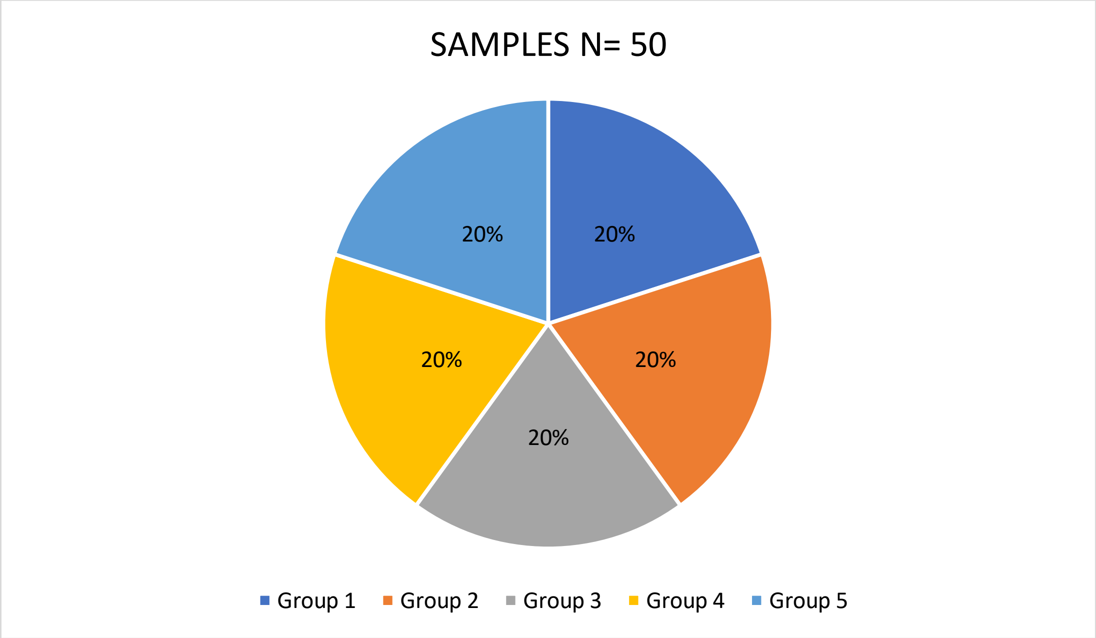
22- **Ekta V, Sanjyot M, Lotika B (2022**) conducted a study to evaluate and compare the microleakage of Universal Flo composite resin (G-aenial) using etch and rinse adhesive system ER-2 steps (Adper Single Bond 2), self-etch adhesive system SE-1 step (G-Bond), and self-adhesive flowable composite resin (Constic) in Class V cavities using a confocal laser scanning microscope. The conclusion was that none of the adhesive systems tested were free from microleakage. However, less microleakage was observed in the total etch and rinse system, especially Adper Single Bond 2 (ER-2 steps), than the self-etch adhesive system SE-1 step and self-adhesive flowable composite resin.[34]

MATERIALS AND METHODOLOG Y

MATERIALS AND METHODS

The present in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, Lucknow Freshly extracted teeth belonging to the age group of 12-25 years reporting to the Out Patient Department of Babu Banarasi Das College of Dental Sciences were collected and sourced for this study. All teeth were first cleaned under running water and then stored in 5.2% sodium hypochlorite solution for 10 minutes.

Before the cavity preparation the teeth were rewashed with running water and a toothbrush. After two hours the teeth were cleaned using an ultrasonic scaler.



Graph A- Sample Distribution

Inclusion criteria:

- Human permanent mandibular premolars freshly extracted, from patients of age group 12-25 years and teeth had been extracted for orthodontic reasons.
- Teeth with fully formed with mature roots.

Exclusion Criteria:

- Teeth with any abfraction, attrition, abrasion and erosion.
- Teeth with resorption or any dystrophic calcification in the pulp space.
- Teeth with restorations and endodontic treatment.
- Teeth with fracture or craze lines.

- Teeth with developmental malformations.
- Teeth with fluorosis, tetracycline stain or any stains due to endogenous conditions.
- Teeth with caries

MATERIALS USED

TABLE A: MATERIALS USED

Table A.1: For sample preparation

1.	Airotor	NSK, Japan
2.	Diamond points	SS White
3.	Finishing diamond points	Shofu, Japan
4.	Ultrasonic scaler and tips	Coltene, Switzerland
5.	Straight Probe	SS White, New Jersey
6.	Tweezer	SS White, New Jersey
7.	Sodium hypochlorite 3.5%	Pyrax, India
8.	Distilled Water	Waldent, India
9.	Kidney tray	IndiaMart
10	Magnifying loupes and light	Zumax Medical Co. Ltd, China

Table A.2: For restoration

1.	Composite filling instruments	GDC, India
	Heidman filling spatula	
	Goldstein flexi thin	
	Paddle condensor	
	Freedman duckhead instrument	
	Beavertail Ball burnisher	
2.	Vertise Flow	Kerr, USA
3.	Constric	DMG, Germany
4.	SDR Flow	Dentsply. India
5.	Etchant (37% phosphoric acid)	Orikam, India
6.	Applicator tips	Green Guava, India

7.	Bonding agent (Pro Bond)	SS White
8.	Shofu polishing kit	Shofu, Japan
9.	Curing light	Woodpecker, USA
10	Composite Dispenser	Cortisen, China

Table A.3 : For evaluation

1.	Stereo electron microscope	JEOL, Japan

METHODOLOGY

SAMPLE PREPARATION

Class II cavities are prepared on the distal surface of 50 human mandibular premolars, with the dimensions of 4 mm buccolingual width, 2 mm mesiodistal depth and the gingival margin of the cavity was placed at the cementoenamel junction (CEJ). No bevels are placed at any of the cavosurface margins; however, all margins were smoothened using an enamel hatchet.

Then, the teeth were then randomly divided into 5 groups of 10 samples each.

Group I (n=10)- Vertise flow with etchant and bond.
Group II (n=10)-Vertise flow without etchant and bond
Group III (n=10)-DMG Constric with etchant and bond.
Group IV (n=10)-DMG Constric without etchant and bond.
Group V (n=10)-SDR Flow(positive control group)

Restorative Procedure.

Group I

The cavities were total etched with 37% phosphoric acid gel for 15 sec thereafter rinsed with water and air dried. Two coats of Pro Bond were then applied onto the cavity surface, gently air dried and light cured for 10sec using a LED curing light at an intensity of 1000 mW/cm^{2}. Then the cavity were lined with Vertise flow in a uniform thickness of 1mm and then light cured for 20sec.

Group II

The cavities in this group were neither etched nor any bonding agent was applied. Vertise flow was placed directly onto the cavity as a liner in a uniform thickness of 1mm and was light cured for 20sec.

Group III

The cavities were total etched with 37% phosphoric acid gel for 15 sec thereafter rinsed with water and air dried. Two coats of Pro Bond were applied onto the cavity surface, gently air dried and light cured for 10sec using a LED curing light at an intensity of 1000 mW/cm^{2}. The the cavity was then lined with DMG constric in a uniform thickness of 1mm and was light cured for 20sec.

Group IV

The cavities in this group were neither etched nor any bonding agent was applied. DMG constric are placed in a uniform thickness of 1mm was placed as a liner and was light cured for 20sec.

Group V

The cavities were total etched with 37% phosphoric acid gel for 15 sec thereafter rinsed with water and then air dried. Two coats of Pro Bond were applied onto the cavity surface, gently air dried and light cured for 10sec using a LED curing light at an intensity of 1000 mW/cm^{2}. The cavities were then lined with SDR flow in a uniform thickness of 1mm and light cured for 20sec.

For seven days, all samples were kept in distilled water at 37°C. 500 thermal cycles were then run, with a dwell duration of 30 s in each bath and a transfer time of 15 s, between 5°C and 55°C.
Following restoration, the specimens were sent for additional SEM analysis. Sections of the dental samples will be made sagittally. To assess the restoration's marginal adaptation, a 1 cm by 1 cm section of the restoration will be examined under a scanning electron microscope.

The SEM images of the tooth-restoration interface were captured at 200 × 15 magnification and renamed/coded by another colleague not involved in the study; to keep the principal investigator blinded, for the micromorphological evaluation of the tooth restoration interface according to the criteria by Blunck and Zaslansky, mentioned as below[25]

- MQ1-Margin not or hardly visible; No or slight marginal irregularities; No gap
- MQ2-No gap but severe marginal irregularities
- MQ3-Gap visible (hairline crack up to 2 µm); No marginal irregularities
- MQ4-Severe gap (>2 µm); slight and severe marginal irregularities.

The term "marginal irregularities" refers to porosities within the adhesive layer, marginal restoration fracture, and/or a bulge within the adhesive layer.

Figure 1:Ultrasonic scaler

Figure 2:Distilled Water

Figure 3:Normal Saline

Figure 4:Airotor

Figure 5:Diamond Points

Figure 6:Finishing Diamond Points

PLATE I

Figure 7:Micromotor and Unit

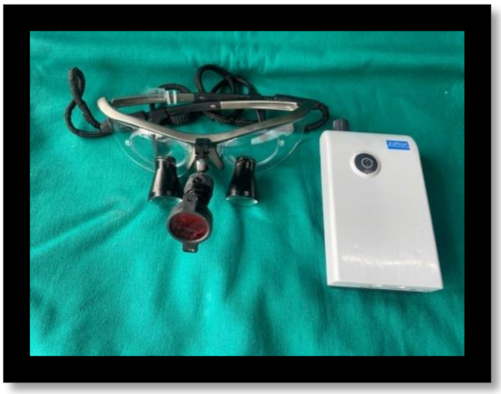


Figure 8: Zumax Loupes

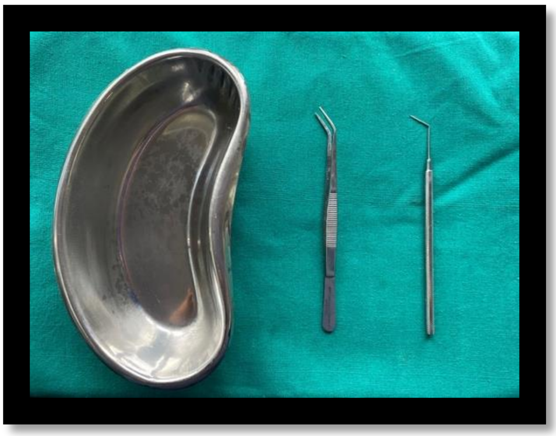


Figure 9: Kidney Tray, Tweezer and Straight Probe

Figure 10:Sodium Hypochlorite

Figure 11:Etchant,Bonding Agent, Applicator Tip

PLATE II

Figure 12:Collected Sample

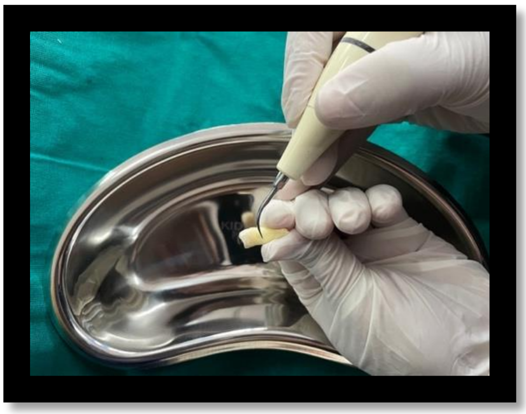


Figure 13:Scaling of samples

Figure 14: Samples Obtained

PLATE III

Figure 15:Group 1 Samples

Figure16: Group 2 samples

Figure 17 :Group 3 samples

Figure 18: Group 4 samples

Figure 19:Group 5 samples

PLATE IV

Figure 20: Vertise flow

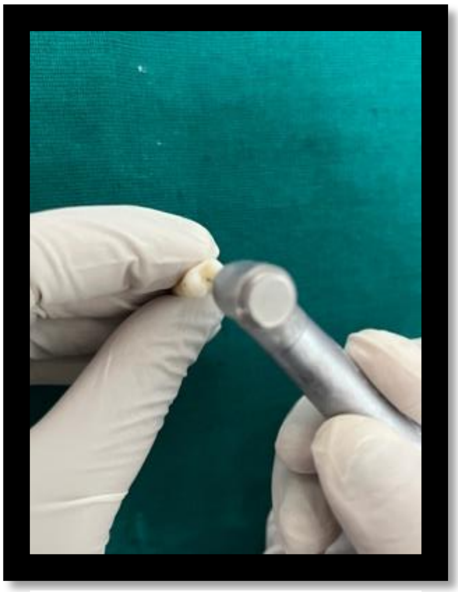


Figure 21:Cavity preparation

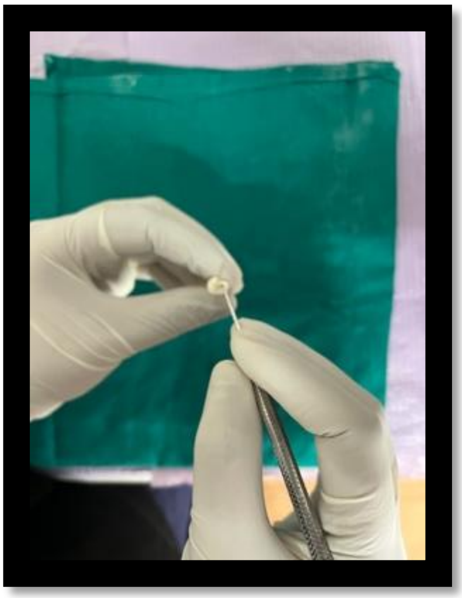


Figure 22: Occlusal cavity preparation.

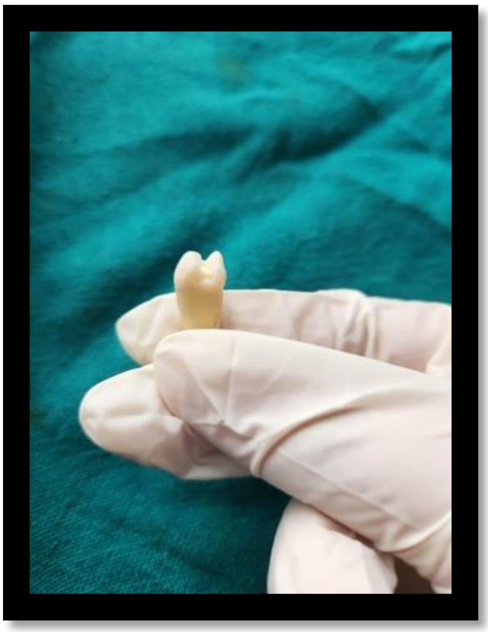


Figure 23: Proximal cavity prepared

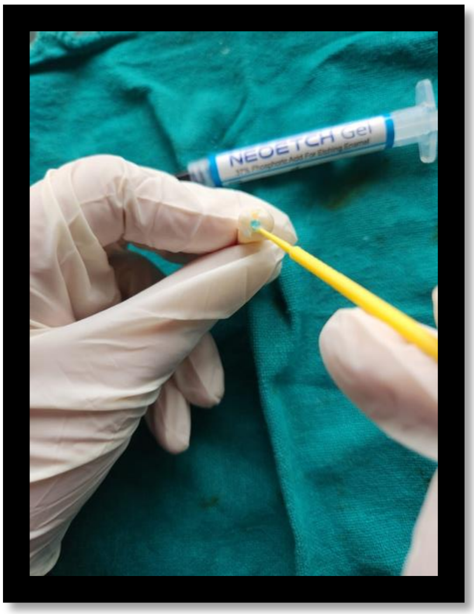


Figure 24:Etching

PLATE V

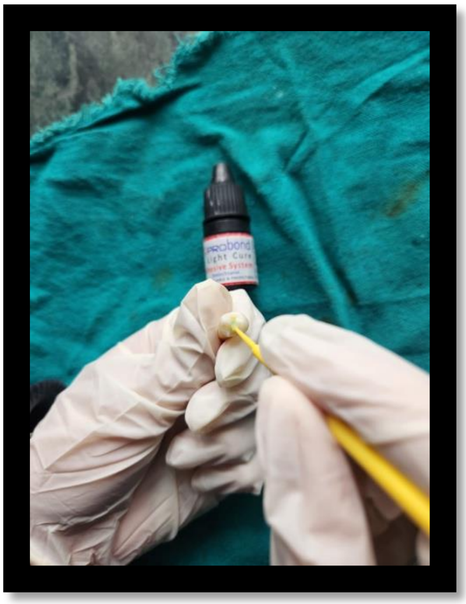


Figure 25: Bonding agent application

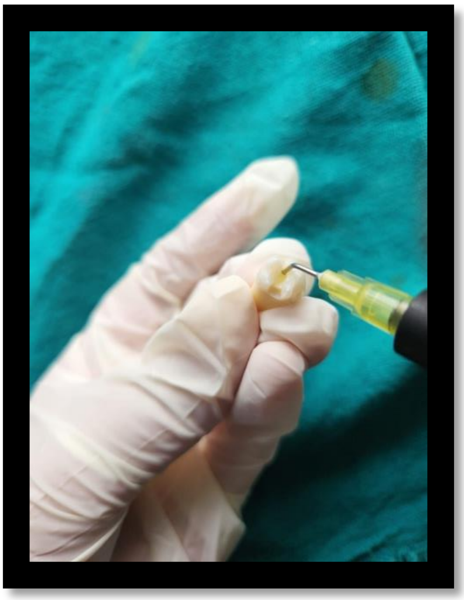


Figure 26: Restoration

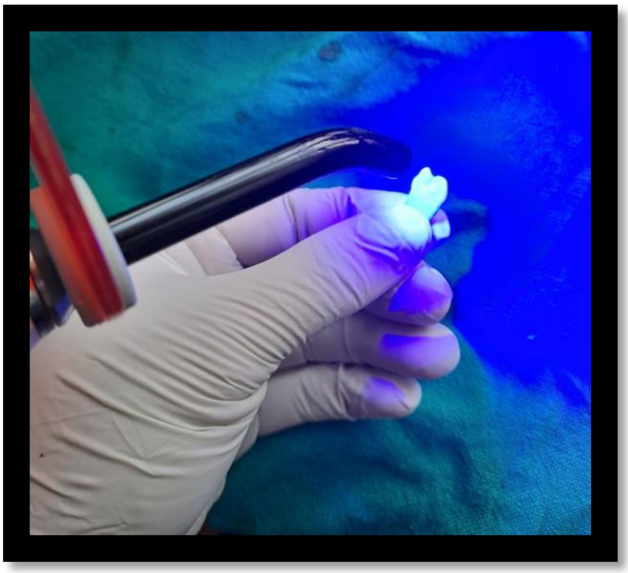


Figure 27: Curing of restoration

PLATE VI

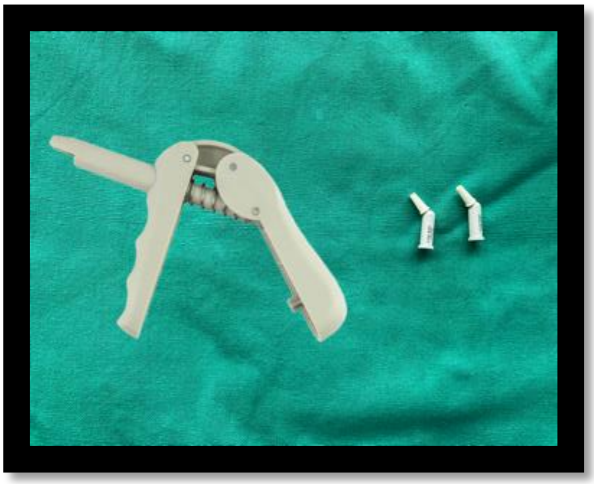


Figure 28: SDR flow

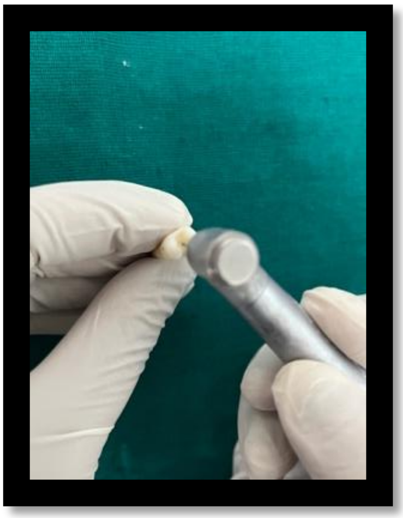


Figure 29: Cavity preparation

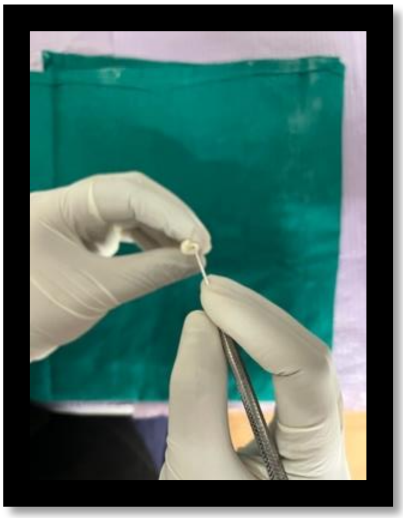


Figure 30: Occlusal cavity preparation.

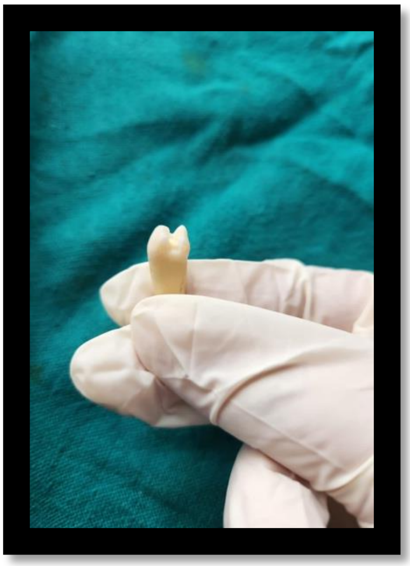


Figure 31: Proximal cavity prepared

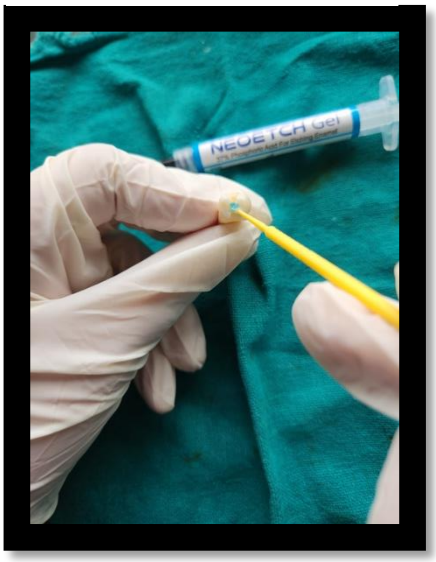


Figure 32:Etching

PLATE VII

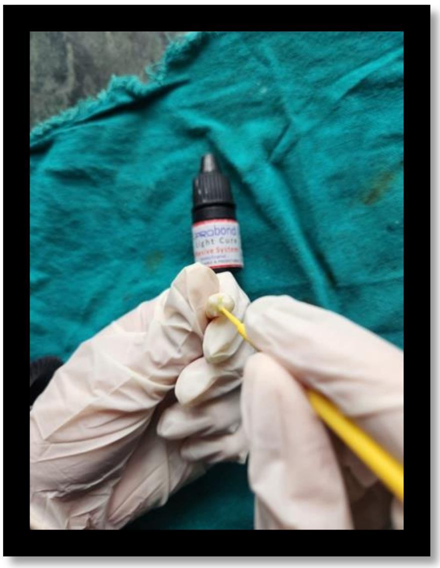


Figure 33: Bonding agent application

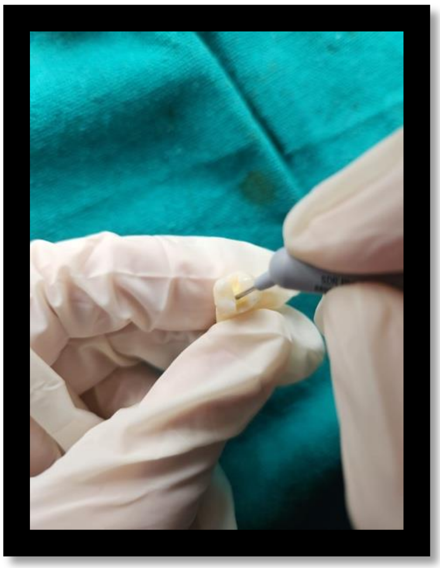


Figure 34: Restoration

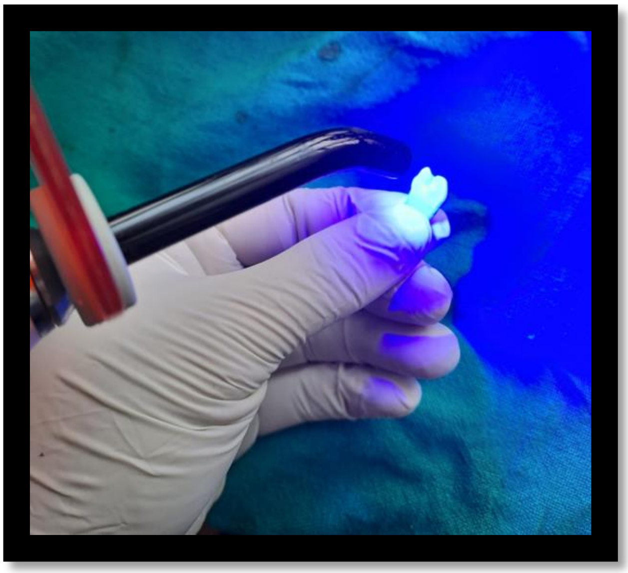


Figure 35: Curing of restoration

PLATE VIII

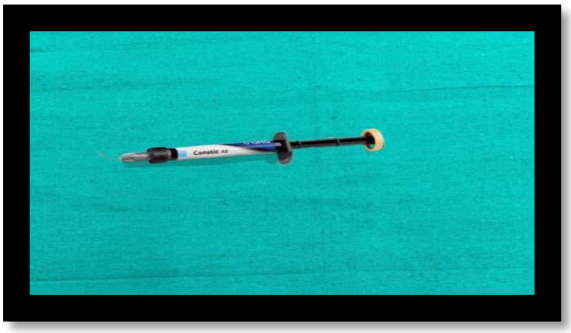


Figure 36: DMG Constric

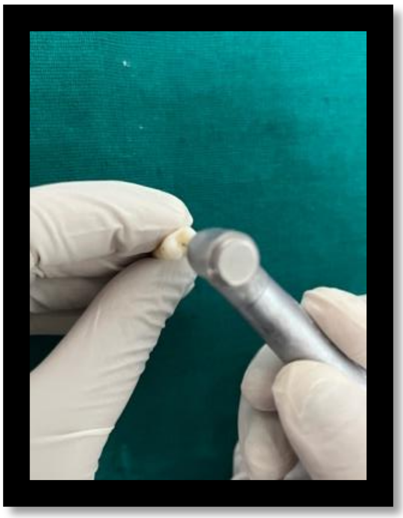


Figure 37: Cavity preparation

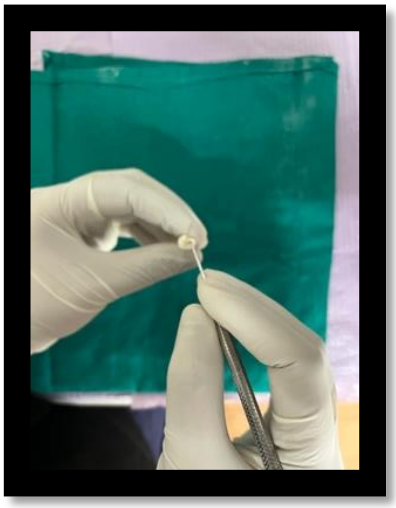


Figure 38: Occlusal cavity preparation.

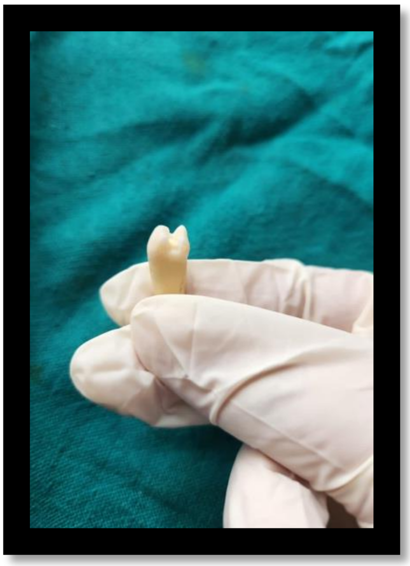


Figure 39: Proximal cavity prepared

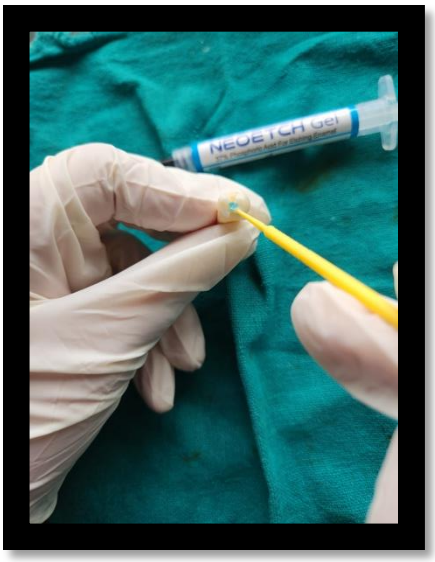


Figure 40:Etching

PLATE IX

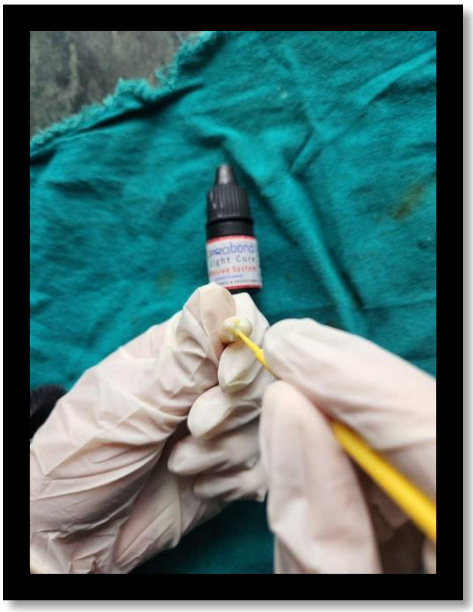


Figure 41: Bonding agent application

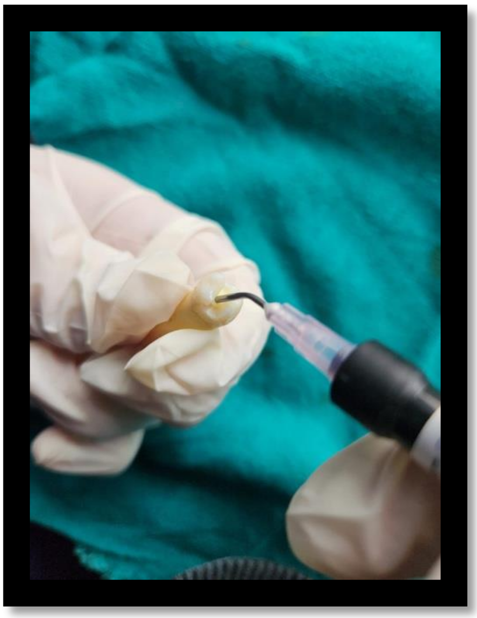


Figure 42: Restoration

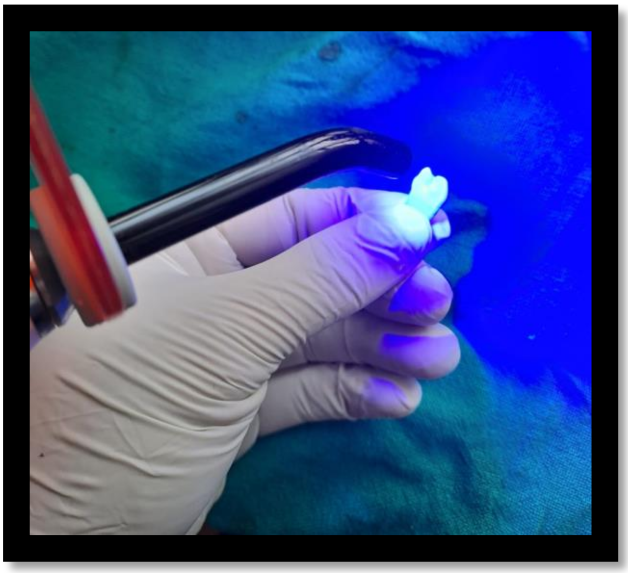


Figure 43: Curing

PLATE X

Figure 44: Composite filling instrument

Figure 45: Curing light

PLATE XI

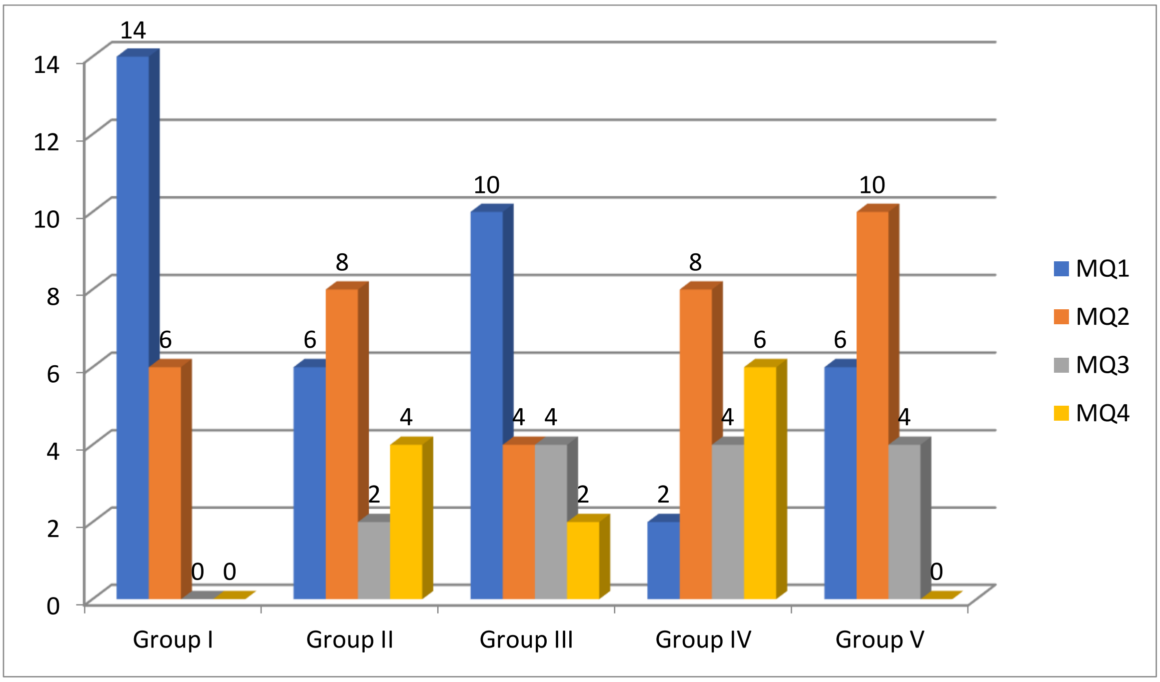
RESULTS

RESULTS

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group I	Count	7	3	0	0	10	**0.035**
	% within group	36.8 %	16.7%	0.0%	0.0%	20.0%	
	% total	14.0 %	6.0%	0.0%	0.0%	20.0%	
Group II	Count	3	4	1	2	10	
	% within group	15.8 %	22.2%	14.3 %	33.3%	20.0%	
	% total	6.0%	8.0%	2.0%	4.0%	20.0%	
Group III	Count	5	2	2	1	10	
	% within group	26.3 %	11.1%	28.6 %	16.7%	20.0%	
	% total	10.0 %	4.0%	4.0%	2.0%	20.0%	
Group IV	Count	1	4	2	3	10	
	% within group	5.3%	22.2%	28.6 %	50.0%	20.0%	
	% total	2.0%	8.0%	4.0%	6.0%	20.0%	
Group V	Count	3	5	2	0	10	
	% within group	15.8 %	27.8%	28.6 %	0.0%	20.0%	
	% total	6.0%	10.0%	4.0%	0.0%	20.0%	

Table 1: Results of all groups

The tables shows the distribution of marginal adaptation among the various groups of the study. The results shows that there was statistically significant difference among the groups ($p<0.05$) with the sequence of best marginal adaptation as follows Group I> Group III > Group V > Group II > Group II.



Graph 1: comparision of result of different groups

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group I	Count	7	3	0	0	10	**0.042**
	% within group	70.0 %	42.9 %	0.0 %	0.0%	50.0%	
	% total	35.0 %	15.0 %	0.0 %	0.0%	50.0%	
Group II	Count	3	4	1	2	10	
	% within group	30.0 %	57.1 %	100.0%	100.0 %	50.0%	
	% total	15.0 %	20.0 %	5.0 %	10.0%	50.0%	

Table 2: Comparison between Group 1 and Group 2

The above table shows the comparison of Group I and Group II and the results show statistically significant difference among the two groups ($p<0.05$).

		MQ1	MQ 2	MQ 3	MQ4	TOTAL	P-VALUE
Group I	Count	7	3	0	0	10	0.211
	% within group	58.3 %	60.0 %	0.0 %	0.0%	50.0%	
	% total	35.0 %	15.0 %	0.0 %	0.0%	50.0%	
Group III	Count	5	2	2	1	10	
	% within group	41.7 %	40.0 %	100.0%	100.0%	50.0%	
	% total	25.0 %	10.0 %	10.0 %	5.0%	50.0%	

Table 3: Comparison between Group 1 and Group 3

The above table shows the comparison of Group I and Group III and the results show statistically non-significant difference among the two groups ($p>0.05$).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group I	Count	7	3	0	0	10	**0.003**
	% within group	87.5%	42.9%	0.0%	0.0%	50.0%	
	% total	35.0%	15.0%	0.0%	0.0%	50.0%	
Group IV	Count	1	4	2	3	10	
	% within group	12.5%	57.1%	100.0%	100.0%	50.0%	
	% total	5.0%	20.0%	10.0%	15.0%	50.0%	

Table 4: Comparison between Group 1 and Group 4

The above table shows the comparison of Group I and Group IV and the results show statistically significant difference among the two groups ($p<0.05$).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group I	Count	7	3	0	0	10	0.054
	% within group	70.0%	37.5%	0.0%	0	50.0%	
	% total	35.0%	15.0%	0.0%	0	50.0%	
Group V	Count	3	5	2	0	10	
	% within group	30.0%	62.5%	100.0%	0	50.0%	
	% total	15.0%	25.0%	10.0%	0	50.0%	

Table 5: Comparison between Group 1 and Group 5

The above table shows the comparison of Group I and Group V and the results show statistically non-significant difference among the two groups (p>0.05).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group II	Count	3	4	1	2	10	0.499
	% within group	37.5 %	66.7 %	33.3 %	66.7%	50.0%	
	% total	15.0 %	20.0 %	5.0 %	10.0%	50.0%	
Group III	Count	5	2	2	1	10	
	% within group	62.5 %	33.3 %	66.7 %	33.3%	50.0%	
	% total	25.0 %	10.0 %	10.0 %	5.0%	50.0%	

Table 6: Comparison between Group 2 and Group 3

The above table shows the comparison of Group II and Group III and the results show statistically non-significant difference among the two groups ($p>0.05$)

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group II	Count	3	4	1	2	10	0.285
	% within group	75.0%	50.0%	33.3%	40.0%	50.0%	
	% total	15.0%	20.0%	5.0%	10.0%	50.0%	
Group IV	Count	1	4	2	3	10	
	% within group	25.0%	50.0%	66.7%	60.0%	50.0%	
	% total	5.0%	20.0%	10.0%	15.0%	50.0%	

Table 7: comparison of Group II and Group IV

The above table shows the comparison of Group II and Group IV and the results show statistically non-significant difference among the two groups ($p>0.05$).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group II	Count	3	4	1	2	10	0.658
	% within group	50.0 %	44.4 %	33.3 %	100.0%	50.0%	
	% total	15.0 %	20.0 %	5.0 %	10.0%	50.0%	
Group V	Count	3	5	2	0	10	
	% within group	50.0 %	55.6 %	66.7 %	0.0%	50.0%	
	% total	15.0 %	25.0 %	10.0 %	0.0%	50.0%	

Table 8: the comparison of Group II and Group V

The above table shows the comparison of Group II and Group V and the results show statistically non-significant difference among the two groups ($p>0.05$).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group III	Count	5	2	2	1	10	1.000
	% within group	83.3 %	33.3 %	50.0 %	25.0%	50.0%	
	% total	25.0 %	10.0 %	10.0 %	5.0%	50.0%	
Group IV	Count	1	4	2	3	10	
	% within group	16.7 %	66.7 %	50.0 %	75.0%	50.0%	
	% total	5.0%	20.0 %	10.0 %	15.0%	50.0%	

Table 9: Comparison of Group III and Group IV

The above table shows the comparison of Group III and Group IV and the results show statistically non-significant difference among the two groups ($p>0.05$).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group III	Count	5	2	2	1	10	0.779
	% within group	62.5 %	28.6 %	50.0 %	100.0%	50.0%	
	% total	25.0 %	10.0 %	10.0 %	5.0%	50.0%	
Group V	Count	3	5	2	0	10	
	% within group	37.5 %	71.4 %	50.0 %	0.0%	50.0%	
	% total	15.0 %	25.0 %	10.0 %	0.0%	50.0%	

Table 10: comparison of Group III and Group V

The above table shows the comparison of Group III and Group V and the results show statistically non-significant difference among the two groups ($p>0.05$).

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group IV	Count	1	4	2	3	10	0.085
	% within group	25.0 %	44.4 %	50.0 %	100.0%	50.0%	
	% total	5.0%	20.0 %	10.0 %	15.0%	50.0%	
Group V	Count	3	5	2	0	10	
	% within group	75.0 %	55.6 %	50.0 %	0.0%	50.0%	
	% total	15.0 %	25.0 %	10.0 %	0.0%	50.0%	

Table 11: comparison of Group IV and Group V

The above table shows the comparison of Group IV and Group V and the results show statistically non-significant difference among the two groups (p>0.05).

	P-VALUE
GROUP 1- GROUP 2	0.042
GROUP 1- GROUP 3	0.211
GROUP 1- GROUP 4	0.003
GROUP 1 - GROUP 5	0.054
GROUP 2- GROUP 3	0.499
GROUP 2 - GROUP 4	0.285
GROUP 2 - GROUP 5	0.658
GROUP 3- GROUP 4	1.000
GROUP 3- GROUP 5	0.779
GROUP 4- GROUP 5	0.085

Table 12: P Value

DISCUSSION

DISCUSSION

The postoperative sensitivity with composite restorations remains a challenge in restorative dentistry, despite many improvement in restorative materials as well as techniques in the recent decades.[1] One of the main reasons for marginal discoloration, postoperative sensitivity, and secondary caries is poor marginal adaptation which also decrease the longevity of composite restorations.[1]

The possibility of marginal failure in composite resin restorations is related mainly to the quality of the bond between the dental substrate and the resin along with the stress generated within the restoration due to polymerization shrinkage.[6]

The main factors that determine shrinkage stress and consequently, gap formation in composite restorations are degree of polymerization shrinkage, elastic modulus, and viscosity of the composite.[35]

Flowable composite resins have been reported to improve the marginal adaptation of restorations in relation to their rheological properties. Due to their relative flexibility and low modulus of elasticity, when employed as an intermediate layer, these liners help relieve stresses during polymerization shrinkage of the composite restorations thus providing better adaptation.[17] The high wettability of flowable composites on the tooth surface ensures penetration into every irregularity and their ability to form layers of minimum thickness, eliminating air inclusion, or entrapment, hence these are recommended as initial increments that serve as cavity liners in proximal boxes of Class II restoration.[3]

Traditional, etch-and-rinse adhesive approach pioneered by Buonocore is still regarded as the “gold standard.[36] However, the use of self-etch adhesives (SEAs) allows for a simpler, less time-consuming, and less technique-sensitive clinical procedure.[36] Immediate postoperative sensitivity reported by patients’ after direct composite resin restorations is a perplexing condition experienced by most dentists.[37] The increase in cavity depth is directly proportional to the dentinal tubule permeability and significantly predisposes the dentin to postoperative sensitivity.[38]

The discovery of a new category of composites termed as “self-adhering”, in the recent past has revolutionized the phase of adhesive dentistry. This self-adhering flowable composite material combines an all-in-one bonding system, eliminating the need for a separate etching and adhesive application.[4] There is a dearth of literature, with regard to the adaptability of this self-adhering flowable composite to tooth substrates. Regarding the use of self-etching systems in deep dentin cavities, close to pulp tissue.[36] They potentially reduce sensitivity by providing simultaneous infiltration of the adhesive to the depth of demineralization and dissolving the smear layer without exposing dentinal tubules.

Owing to the novelty of this material and considering, the importance of understanding its sealing ability, in the present study, marginal adaptation of self-adhering flowable composite; Dyad flow (which is available as “Vertise flow” in western countries introduced in the year 2009) was evaluated in comparison to the conventional flowable composite (Tetric N-flow) under scanning electron microscope (SEM) has been carried out.

In the present study, the marginal adapatation of the Group I (Vertise flow with etchant and bond.) has been found to be better than Group II (Vertise flow without the etchant and bond). The result is in agreement with the study conducted by Mann S et al who compared the marginal adaption of Self etched composite system with conventional etch and bond systems. Standard class V cavity (3 mm mesiodistal width, 3 mm occlusogingival height and 1.5 mm axial depth) was prepared on the buccal surface of freshly extracted sound human teeth. Occlusal and gingival margins of the cavities were located in enamel and cementum/dentin, respectively. Teeth were randomly assigned into the three groups (n=10) and restored with different composite materials following the manufacturer's instructions: group I was restored with nanohybrid resin composite using total-etch bonding agent; group II was restored with nanohybrid resin composite using self-etch technique; group III was restored with flowable composite (Dyad Flow), respectively. After finishing and polishing, the teeth were coated with nail varnish and immersed in rhodamine B dye and sectioned longitudinally. Dye penetration was examined under stereomicroscope and scored separately for occlusal and gingival margins on a 0–3 ordinal scale.

The Statistical analysis showed that the specimens restored with the total-etch adhesive systems revealed reduced leakage at the coronal margin as compared to those in which Vertise flow was used without etchant and bond application.

This finding was interpreted in relation to the higher viscosity of Vertise flow than that of a bonding agent in etch-and-rinse system, which might have led to limited penetration into the network of collagen fibers and within the dentin tubules exposed by phosphoric acid etching.[19] The areas of dentin that had been deeply demineralized yet incompletely infiltrated by the resin were revealed by silver nitrate deposits and have been considered responsible for a defective interfacial seal.[19] (Group I vs Group II)

The findings of the present study are in contradiction to the findings of C Rengo et al who compared the microleakage of phosphoric acid etched flowable composite resins with the self-etching self-adhering flowable composite resin. The authors reported no significant difference among the materials at the enamel interface

In the present study the marginal adaptation of the Group I,II,III and IV were not significantly different from the Group V (SDR Flow –Bulk Fill Flowable

Composite) The results are in agreement with the study conducted by Gayatri et al on 44 extracted human maxillary premolars which were divided into two groups of 22 teeth each and restored accordingly: Group I – Gingival floor lined with Tetric N-Flow and restored with Tetric N-Ceram; Group II – Gingival floor lined with Dyad flow herculite Precis. After thermal cycling, the sectioned tooth-restoration interfaces were evaluated for the marginal adaptation under SEM at ×200 magnification. There was no statistically significant difference between the study groups regarding the marginal adaptation. The marginal adaptation of the self-adhering flowable composite was found to be comparable to that of the conventional bulk fill flowable composites

Further similar findings has been reported by Osama et al who conducted the study to assess the clinical performance of Self adhering flowable composite compared to conventional flowable composite in occlusal cavities. A total of 18 patients with conservative occlusal cavities received randomly two types of restorations in a split-mouth design. Vertise Flow or Filtek Z350XT Flowable was applied according to the manufacturer's instructions. All restorations were evaluated at baseline and after 24 months, respectively, by two blinded assessors using modified USPHS criteria. Marginal adaptation results revealed that all the restorations in both the groups scored good at baseline. After 24 months, three restorations scored good in the Filtek™ Z350XT Flowable group and four in Vertise™ Flow restorations; there was no statistically significant difference between both materials after 24 months (P = 0.6780).

In the present study results of the Vertise Flow material was comparable with the results of other Flowable composite materials like SDR Flow and DMG Constric . The findings are in contradiction to the findings of Aleksander Maj, et al who conducted a Comparative Clinical Study of the Self-Adhering Flowable

Composite Resin Vertise Flow and the Traditional Flowable Composite Resin Premise Flowable. The study involved 37 patients with 64 fillings. They were distributed into three groups: 22 fillings in Group I, 22 fillings in Group II and 20 fillings in Group III. In Group I (G I), Vertise Flow material was applied without the use of an etching agent or a bonding system; in Group II (G II), Premise flowable material was applied without the use of an etching agent, but with the use of the OptiBond All-In-One seventh-generation bonding system; in Group III (G III), Premise flowable material was applied after etching and treatment of the hard tooth tissues using a fifth-generation OptiBond Solo Plus bonding system. Then, at appropriate time intervals (0, i.e., right after filling and after 6, 12 and 24 months), the fillings were subjected to clinical evaluation, conducted according to the Ryge scale criteria with the use of registration by means of a fluorescent high-intensity visible light beam produced by a camera (Vista Proof). The quality of fillings performed with the use of comparable materials was subjected to clinical evaluation using the Ryge scale of fillings after 6, 12, and 24 months; the examination showed significant differences between the tested materials. The Vertise Flow material used without an etching agent or a bonding system (G I) presented the weakest results with respect to marginal adaptation among those evaluated in this study

Dentsply's Smart Dentin Replacement (SDR) is a flowable composite introduced in the year 2009 designed to be bulk fill, up to 4 mm layers, and marketed to be used in posterior primary teeth due to ease of placement and possible reduced chair time. It is urethane dimethacrylate (UDMA) based with a 68% filler load. According to reports and good results in vitro, has less polymerisation shrinkage and contraction stress.[39]

In the present study none of the materials were able to provide 100% marginal integrity This finding could be attributed to the placement of the cavity margins in dentin, which can be probably be explained by the fact that bonding to dentin is difficult because of its high organic content, tubular structure, and its lower surface energy.

Although in vitro testing of restorations is an important initial screening for the restorative materials, these results cannot be extrapolated in correlating with the clinical performance of restorations. The simulation of temperature changes, other factors such as masticatory forces and pH fluctuations were not considered in this study. Hence, future research regarding in vitro, ex vivo studies, and randomized clinical trials are recommended while overcoming the above limitations in the present study

CONCLUSION

CONCLUSION

The present study was conducted to comparatively evaluate the marginal adaptation of self-Adhering flowable composite with a bulk fill flowable composite. 50 freshly extracted teeth belonging to the age group of 12-25 years will be collected and sourced for this study. Standarized Class II cavities (MO/DO) will be prepared with Turbine diamond point tip. After cavity preparation the teeth will be divided randomly with 10 (n=10) cavities per studied material. These teeth will be restored with different resin composites.

Group I (n=10)- Vertise flow with etchant and bond.

Group II (n=10)-Vertise flow without etchant and bond

Group III (n=10)-DMG Constric with etchant and bond.

Group IV (n=10)-DMG Constric without etchant and bond.

Group V (n=10)-SDR Flow(positive control group)

After the completion of restoration, the specimen were sent further for SEM investigation. The teeth samples will be sectioned sagittally. An area of 1cm X 1cm of the restoration will be subjected under SEM to evaluate the marginal adaptation of the restoration.

The results of the present study can be concluded as under

a. The sequence of best marginal adaptation as follows Group I> Group III > Group V > Group II > Group II.
b. Group I and Group II showed statistically significant difference among the two groups ($p<0.05$).
c. Group I and Group III showed statistically non-significant difference among the two groups

d. Group I and Group IV showed statistically significant difference among the two groups

e. Group I and Group V showed statistically non-significant difference among the two groups

f. Group II and Group III showed statistically non-significant difference among the two groups

g. Group II and Group IV showed statistically non-significant difference among the two groups

h. Group II and Group V showed statistically non-significant difference among the two groups

i. Group III and Group IV showed statistically non-significant difference among the two groups

j. Group IV and Group IV showed statistically non-significant difference among the two groups

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REFERNCES

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ANNEXURES

ANNEXURE 1

BABU BANARASI DAS UNIVERSITY

BBD COLLEGE OF DENTAL SCIENCES, LUCKNOW

BBD UNIVERSITY

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Comparative Evaluation Of Marginal Adaptation Of Self Adhering Flowable Composite With Bulk Fill Flowable Composite: An In Vitro Study"** submitted by **Dr Satyam Kashyap** Postgraduate student in the **Department of Conservative Dentistry and Endodontics** for the Thesis Dissertation as part of MDS Curriculum for the academic year 2021-2024 with the accompanying proforma was reviewed by the Institutional Research Committee in its meeting held on **14th July, 2023** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Dr. Puneet Ahuja
Chairperson

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
Babu Banarasi Das University
Ayodhya Road, Lucknow-226028

Dr. Mona Sharma
Co-Chairperson

ANNEXURE 2

BABU BANARASI DAS UNIVERSITY
BBD COLLEGE OF DENTAL SCIENCES, LUCKNOW

BBD UNIVERSITY

BBDCODS/IEC/01/2023 Dated: 17th July, 2023

Communication of the Decision of the Xth Institutional Ethics Sub-Committee Meeting

IEC Code: 01

Title of the Project: Comparative Evaluation Of Marginal Adaptation Of Self Adhering Flowable Composite With Bulk Fill Flowable Composite: An In Vitro Study.

Principal Investigator: Dr Satyam Kashyap **Department:** Conservative Dentistry and Endodontics

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol for Thesis Dissertation

Dear Dr Satyam Kashyap,

The Institutional Ethics Sub-Committee meeting comprising following members was held on 14th July, 2023.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry
2.	Dr. Praveen Singh Samant Member	Prof. & Head, Department of Conservative Dentistry & Endodontics
3.	Dr. Jiji George Member	Prof. & Head, Department of Oral Pathology & Microbilogy
4.	Dr. Amrit Tandan Member	Professor, Department of Prosthodontics and Crown & Bridge
5.	Dr. Rana Pratap Maurya Member	Reader, Department of Orthodontics & Dentofacial Orthopaedics

The submitted documents of the current MDS Project Protocol is exempted for review in the meeting.

Decision: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala 17/07/

Prof. Dr. Puneet Ahuja
Principal
BBD College of Dental Sciences
BBD University, Lucknow

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Dr. Lakshmi Bal
Member-Secretar
Institutional Ethics Sub-Committee (IEC
BBD College of Dental Science
BBD University, Luckno

Member-Secretary
Institutional Ethic Commi
BBD College of Dental Scie
BBD Universi
Faizabad Road, Lucknow-22

ANNEXURE 3

SAMPLE SIZE CALCULATION

Sample size = $2\ SD^2\ (Z_{\alpha/2} + Z_{\beta})^2/d^2$

SD – Standard deviation = From previous studies or pilot study

$Za/2 = Z_{0.05/2} = Z0.025 = 1.96$ (From *Z* table) at type 1 error of 5%

Z□□= $Z_{0.20} = 0.84$ (From *Z* table) at 80% power

d = effect size = difference between mean values

So now formula will be

Sample size = $2\ SD^2\ (1.96+0.84)^2/d^2$

$= 2\ (1.6)^2\ (1.96+0.84)^2/\ (1.44)^2$

= 19.35 ~20

As the sample size calculation formula is for 2 groups, for each group the sample size will be 10.

In our study there are 5 groups, so the total sample size will remain 50

ANNEXURE 4

दूरभाष / Telephone 0522 - 2742903, 2742902
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ई-मेल / E-mail registrar@bsip.res.in
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1946

बीरबल साहनी पुराविज्ञान संस्थान
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(भारत सरकार के विज्ञान एवं प्रौद्योगिकी विभाग का एक स्वायत्तशासी संस्थान)
(AN AUTONOMOUS INSTITUTE UNDER DEPARTMENT OF SCIENCE & TECHNOLOGY, GOVERNMENT OF INDIA)

Speed Post

संख्या
No. BSIP/SA(SEM)/2022-23/ C- 735

दिनांक
Dated 07.12.2022

Prof. Dr. Puneet Ahuja
Principal
BBD College of Dental Sciences
BBD University
Lucknow

विषय / Subject: **Utilization of SEM Facility in BSIP**

महोदय / महोदया / Dear Sir/Madam,

With reference to your Letter No. Nil dated November 02, 2022 requesting therein to provide SEM Facility. I am directed to inform you that the above facilities can be provided to Dr. Satyam Kashyap MDS 2nd year student **on payment basis** on the following rates:

विश्वविद्यालय / **Paid Research Scholars of Universities/ PG Colleges:**

a)	Sample Processing and mounting	Rs. 250 per sample
b)	Gold Palladium coating	Rs. 300 per stub
c)	Sample examination and photography	Rs. 300 per exposure

*विश्वविद्यालय / स्नातकोत्तर विद्यालय के अदत्त शोध अध्येता / ****Unpaid Research Scholars of Universities/ PG Colleges:**

a)	Sample Processing and mounting	Rs. 250 per sample
b)	Gold Palladium coating	Rs. 150 per stub
c)	Sample examination and photography	Rs. 100 per exposure
	एकल स्पेक्ट्रमी के ई डी ए एक्स प्रभार / **EDAX charges for single spectrum**	Rs. 1000 per spectrum
	क्रांतिक बिंदु शुष्कन / **CPD (Critical point drying)**	Rs. 500 per sample

**The rates of Unpaid Research Scholar will be applicable subject to production of Certificate from the concerned Head of the Department.

Note: GST @ 18% will be charged extra as per the Government of India Norms from time to time.

He may utilize the SEM Facility on December 05, 2022. GST NO. 09AAATB6882H2ZF

He may bring one CD-R of 700 MB for Loading images.

भवदीय / Yours faithfully,

07/12/2022

(संदीप कुमार शिवहरे / Sandeep Kumar Shivhare)
कुलसचिव / Registrar

प्रतिलिपि / Copy to: Convener, Electron Microscopy Committee, BSIP Lucknow the time to be allotted keeping in view Institute requirements.

ANNEXURE 5

GROUP 1

S.NO.	RESULT
1	MQ1
2	MQ1
3	MQ 2
4	MQ1
5	MQ2
6	MQ1
7	MQ1
8	MQ1
9	MQ 2
10	MQ1

GROUP 2

S.NO.	RESULT
1	MQ1
2	MQ2
3	MQ4
4	MQ3
5	MQ1
6	MQ4
7	MQ2
8	MQ2
9	MQ1
10	MQ2

GROUP 3

SNO	RESULT
1	MQ1
2	MQ4
3	MQ1
4	MQ1
5	MQ3
6	MQ2
7	MQ1
8	MQ3
9	MQ1
10	MQ2

GROUP 4

SNO	RESULT
1	MQ3
2	MQ1
3	MQ3
4	MQ2
5	MQ2
6	MQ4
7	MQ2
8	MQ4
9	MQ2
10	MQ4

GROUP 5

SNO	
1	MQ1
2	MQ2
3	MQ2
4	MQ1
5	MQ2
6	MQ1
7	MQ2
8	MQ3
9	MQ2
10	MQ3

ANNEXURE 6

DrillBit

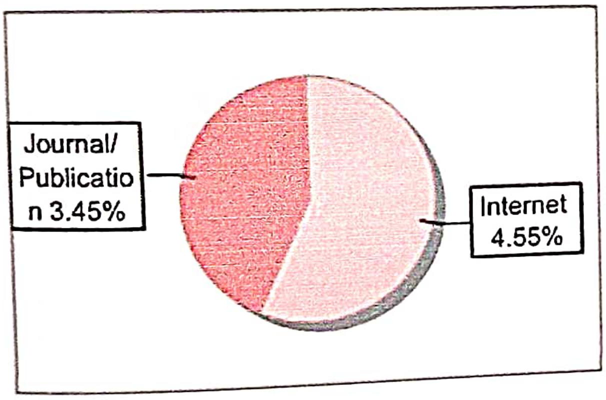
The Report is Generated by DrillBit Plagiarism Detection Software

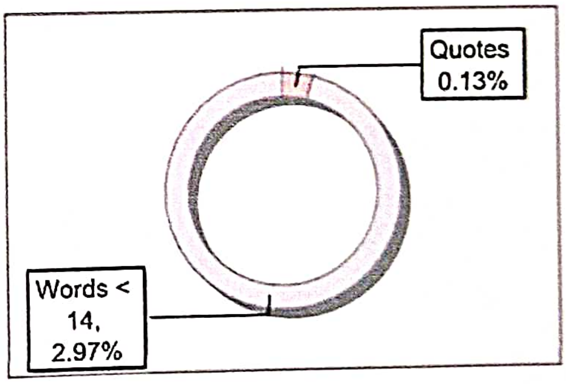
Submission Information

Author Name	SATYAM KASHYAP
Title	COMPARATIVE EVALUATION OF MARGINAL ADAPTATION OF SELF ADHERING FLOWABLE COMPOSITE TO BULK FILL FLOWABLE COMPOSITE : AN IN VITRO STUDY.
Paper/Submission ID	1413144
Submitted By	amarpal.singh056@bbdu.ac.in
Submission Date	2024-02-08 16:05:41
Total Pages	35
Document type	Dissertation

Result Information

Similarity **8 %**





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Database Selection

Language	English
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Internet or Web	Yes
Institution Repository	Yes