CLINICAL EVALUATION OF A SELF ADHERING FLOWABLE COMPOSITE AND CONVENTIONAL FLOWABLE COMPOSITE IN CONSERVATIVE CLASS I RESTORATIONS

DISSERTATION

Submitted to the

BABU BANARASI DAS UNIVERSITY, LUCKNOW, UTTAR PRADESH

In the partial fulfillment of the requirement for the degree

of

MASTER OF DENTAL SURGERY

In the subject of

CONSERVATIVE DENTISTRY & ENDODONTICS

Submitted by

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Under the guidance of

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DEPARTMENT OF CONSERVATIVE DENTISTRY & ENDODONTICS

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"Clinical evaluation of a self adhering flowable composite and conventional flowable composite in conservative class I restorations."**is a bonafied, & genuine research work carried out by me under the guidance of **DR.AKANKSHA BHATT,** Reader, Department of Conservative Dentistry & Endodontics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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Place:Lucknow

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CERTIFICATE BY THE GUIDE

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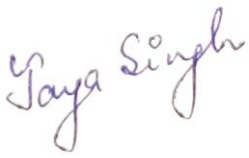

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This is to certify that this dissertation entitled **"Clinical evaluation of a self adhering flowable composite and conventional flowable composite in conservative class I restorations."**is a bonafide work done by **Dr. Vandana Shukla**, under the direct supervision & guidance of **Dr.Akanksha Bhatt,** Reader, Department of Conservative Dentistry & Endodontics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University,Lucknow, Uttar Pradesh.

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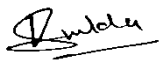

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"The most important function of education at any level is to develop the personality of the individual and the significance of his life to himself and to others."

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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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.

Above all I bow my head in gratitude tothe almighty and ever loving ***GOD*** *for bestowing his blessings on me,& rest my work on his feet.*

OM NAMAH SHIVAAY

Dr.VandanaShukla

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LIST OF ABBREVIATIONS

Abbreviation	Full form
mm	millimeter
%	percentage
o	degree
<	Less than
>	Greater than
n	Number of samples
GPDM	Glycerophosphatedimethacrylate
BisGMA	l Bisphenol A diglycydyle methacrylate
TEGDMA	Triethylene glycol dimethacrylate
nm	nanometer
UDMA	Urethane dimethacrylate
P	Probability value
µm	Micron
i.e	That is
(χ^2)	Chi - square
SD	Standard deviation
$\sum$	Sigma

ABSTRACT

Aim : The aim of this study is to evaluate and compare the clinical performance of a self adhering flowable composite resin and conventional flowable composite in conservative class 1 restorations

Materials and Method:40 restorations in patients mouth with class I cavities were selected and divided into two groups, group A Dyad flow Group B filtek Z 350 XT with universal etchant and ingle bond universal, all these materials were applied according to the manufracturer's instructions. All the restorations of both the groups were evaluated at baseline,3 months and 6 months bytwo calibrated assesors using the modified united states public health service criteria measuring (postoperative hypersensitivity, retention analysis colour match , marginal adaptations , marginal discolouration).

Results: Chi – square test was used to compare between both the groups after follow up periods. A two-tailed (α=2) $P< 0.05$ was considered statistically significant

Conclusion: self adhering flowable composite has shown clinical performance similar to conventional flowable composite however self adhering flowable composite materials showed 5% higher efficacy in hypersensitivity, color match, marginal discoloration and marginal adaptation at both 3 and 6 months as compared to conventional flowable composite.ater 6 months follow up.

Keywords: self adhering; flowable; conventional composite; clinical evaluation

INTRODUCTION

Conventional resin composites are the most common materials that has been utilised in the management of conservative Class I cavities. Resin-based composites were introduced as a tooth-colored alternative to amalgam restorations.[1]The most common disadvantage of composite was postoperative sensitivity due to gap formation as a result of polymerization shrinkage especially at the gingival cavosurface margin.[2,3,]But, these composite having a high modulus of elasticity, low flowability, low tendency for the stress relaxation, and difficulty to place in conservative tooth preparations.[4]

Inspite of the improvement in the restorative materials and techniques in the recent years, the postoperative sensitivity with composite restorations remains a challenge for the restorative dentist. The Poor marginal adaptation that may produce marginal discoloration, postoperative sensitivity, and secondary caries which could decrease the longevity of composite restorations. In composite resin restorations there is possibility of marginal failure which 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.[1]

The flowable composite materials are the modified restorative resin composites, which contains a low filler content (weight: 60-70%; volume: 46–65%) as compare to their hybrid analogs (weight:70–80%; volume: 60–75%)[5].

Reduced filler loading in flowable compositesdue which it leads to have enhanced flow and reduced elastic modulus [5]. Thus, this material can act as a stress-breaker.[10] Nevertheless, due to its lower filler content they have higher polymerization shrinkage and have inferior mechanical properties. Stress due to shrinkage results in cracked enamel rods, marginal gaps and open margins. And because of these marginal gaps Microleakage occurs around resin composite restorations [7].

Flowable composites givesexcellent handling characteristics using a syringe delivery system which overcomes some of the obstacles encountered during the placement of resin composite in small-to-moderate-sized cavities, especially in inaccessible areas.[8] Minimally invasive Class I restorations are being used widely because they have

pleasing esthetics and conservation of sound tooth structure. However flowable composites are widely used in dentistry , and their clinical applications have been restricted to some extent by their mechanical shortcomingsfound, especially in early generation flowable composites.[9]

Introduction of nanotechnology [1986] to flowable composites enhanced their mechanical properties, allowing them to attain or overcome some regular viscosity resins. Its fluidity provided better adaptation to the inner walls and cervical region, besides an easier clinical placement so they may become a material of universal indication. However, the bonding procedures during application of flowable composite in conservative Class I cavities need further simplification.[10]

The discovery of a new category of composites termed as "self-adhering", in the recent past has revolutionized the phase of adhesive dentistry. Self-adhering flowable composite (SAFC) combines the merits of both adhesive and restorative material technologies (8th generation) in a single product, bringing new horizons, and ambitions to restorative procedures This self-adhering flowable composite material combines an all-in-one bonding system, eliminating the need for a separate etching and adhesive application. Recently, an innovative resin-based material, combining the properties of self-adhesion and flowability, was developed (Dyad Flow, Kerr, Orange, CA, USA), introducing a new category of restorative materials defined as "self-adhering composite resins" which eliminates the need for a separate bonding application step.[1]

Self Adhering Flowable Composite provides the least possible chair time, allowing fewer steps, providing less chance for errors, and providing shorter treatment sessions for the patient with multiple restorations accomplished in the same visit, this is of great value, especially for uncooperative or mutilated patients.[11]

It provides the significant step forward in adhesive dentistry, because they combine adhesive and composite in one material. They allow bonding directly to tooth structure as a part of minimally invasive therapy but also simplify otherwise very complex restorative procedure because special preparation of enamel and dentin prior to the application of material in the cavity is not required.[1,2]

Clinical comparision of conventional composite and self adhering composite system will definitely help the clinicians to choose the better one among these two in different aspects, that decides its success criteria. Hence the present clinical study is designed to compare the different clinical criteria of self adhering and conventional flowable composite resin.[4]

AIM AND OBJECTIVES

AIM

The aim of this study is to evaluate and compare the clinical performance of a self adhering flowable composite resin and conventional flowable composite in conservative class 1 restorations

OBJECTIVES

1. To evaluate the clinical performance of a self adhering flowable composite resin.
2. To evaluate the clinical performance of conventional flowable composite.
3. To compare and evaluate clinical performance between self adhering flowable composite resin and conventional flowable composite resin.

REVIEW OF LITERATURE

1. **Shafiei. F ,Memarpour. M (2009)[12]** Compared the effects of repeated use of two one-bottle adhesives with that of two all in one adhesive s (with acetone solvent) on bond strength to dentin and concluded that repeated use (60 times) of the all-in-one adhesive led to a decline in the dentin bond strength, and to avoid this problem it would be advisable to have containers with smaller amounts of adhesive or perhaps those with only a single dose.

2. **Nagpal R, Manuja N Tyagi SP , Singh U P (2011)[13]** Conducted an In vitro study to evaluate and compare the microleakage of self -etch adhesive s placed under different clinical technique s and to analyze the resin dentin interfacial ultrastructure under scanning electron microscope and concluded that in enamel, prior phosphoric acid etching reduces microleakage of self etch adhesives while in dentin , hydrophobic resin coating over one step self etch adhesives decreases the microleakage.

3. **Vanajasan P.P , Dhakshinamoorthy M , Rao C V S (2011)[14]** Conducted a study to evaluate the factors that affect the bond strength of one step and two step self etch adhesives by using meta anslysis and concluded that two step adhesives system showed a superior in vitro performance in comparison to one step self etch system. Nevertheless, certain factors such as dentin origin, site and area of bonding affect the bond strength of adhesives.

4. **Bektas. O. O, Eren D , Akin E G, Akin H (2013)[11]** Evaluated dentin bond strength and microleakage of self adhering flowable resin with or without adhesive resin and observed that self adhering flowable composite resin combined with adhesive resin provided stronger dentin bond strength and better marginal seal than when it was used individually.

5. **Goracci C ,Margvelashvili M , Giovannetti A , vichi A , Ferrari M(2013)[15]:** Conducted a study to assess the shear bond strength (SBS) to enamel and the distribution of failure modes of brackets bonded using a new self-adhering

flowable resin composite (Vertise Flow, VF), with or without preliminary phosphoric acid etching (PAE) and concluded that VF achieved early bracket SBSs similar to E&R. Following thermocycling, VF and PAE/VF manifested a significant decrease in SBS

6. **Tuloglo. N , Tunc S E , Ozer S, Bayrak S (2014)[16]** Evaluated the shear bond strength of conventional and self adhering flowable composite resin on the dentin surface of primary and permanent teeth and also evaluated the effect of the application of an adhesive system under self adhering flowable resin composite on shear bond strength and the study shows that self adhering flowable resin composite was found to have lower bond strength values than conventional flowable resin composite for both primary and permanent dentin.

7. **Erdemir U etal (2014)[17]** : Compare the effects of of different surface treatment techniques on the surface roughness and shear Bond strength of a new self adhering flowable composite reason for or used with lithium disilicate reinforced CAD cam ceramic material and concluded that self adhering flowable composite resin used as repair composite resin exhibited very low Bond strength irrespective of of surface pretreatment used.

8. **Naga AAE , Yousef M , Ramadan R, Bhagat S F Alshawwa L (2015)[18]** Evaluated the performance of self adhesive flowable composite and to self etching adhesive system when subjected to cyclic loading in preventing the nanoleakage of class V Restoration and concluded that under the test condition the self adhesive flowable composite provided better sealing ability aging of two tested adhesive systems as a function of cyclic loading increased microlekage.

9. **Imam S R, Ramazani N, Fayazi M R (2015)[19]** Compared the marginal microleakage of fissure sealants and self adhering flowable composites in permanent teeth and concluded that microleakage was less using self adhering flowable composite compared to conventional fissure sealant ; therefore , self adhering flowable composite can be used as a suitable fissure sealant in permanent teeth .

10. **Altunsoy M , Tanriver M , Ok E, Kucukyilmaz (2015)[20]** : Compared the shear bond strength of a self-adhering flowable composite (Vertise Flow; Kerr, Orange, CA) and a flowable composite to mineral trioxide aggregate (MTA), Biodentine (Septodent, Saint-Maur-des-Fosses Cedex, France), and calcium-enriched mixture Concluded that MTA and CEM exhibited higher SBS than Biodentine; therefore, they could be preferred under flowable composites.

11. **Tyagi N, Chaman C, Tyagi S P, Singh U P, Sharma (2016)[21]** Evaluated the bond strength of MTA with three different types of adhesive systems self adhering flowable composite , etch and rinse adhesive system and self etch adhesive system and concluded that in a single visit after 45 minutes self adhering flowable composite can be used successfully as a final restorative material in place of conventional flowable composite without using any alternative adhesive system over MTA.

12. **Paul N , Zeinoun T , Majzoub Z , Corbani Karim Nammour S (2016)[22]** Conducted the study to investigate the shear Bond strength of self adhering flowable composite to dentin after mixing it with Er: YAG laser radiation at different energy densities and concluded that Er: YAG dentin irradiation may enhance share bond strength of self adhering flowable composite resin when it is used at the appropriate low level of energy density.

13. **Sabbagh J, Dagher S, Osta E N, Souhaid P (2017)[23]** Compared the clinical performances of self adhering resin composite and a conventional flowable composite with a self etch-bonding system on permanent molars , the influence of using rubber dam versus cotton roll isolation was also investigated and concluded the result that all patient attended the two year recall for all the major variables there was no significant difference between the rubber dam and the cotton after two years of restoration with the premise flowable or what is floor the percentage of restoration scored Alpha decreased significantly over time with premise flowable and what is flow for marginal adaptation and surface texture as well as marginal discoloration while it did not vary significantly for colour matching after

two years what is low floor showed a similar behaviour to the premise flowable used with the self adhesive resin systems.

14. **Ghavam M. Soleimanpour M, Heashemikamngar , Ebrahimi H ,Kharazifard M J (2017)[24]** Conducted study to assess the micro shear bond strength of a repairing self adhesive flowable composite to ceramic after mechanical chemical and laser treatment of the ceramic surfaces and concluded that the what is flow provide relatively good bond strength to ceramic even with no surface treatment.

15. **Hamdy TM (2017)[25]** Evaluated the interfacial microscopic examination and the chemical analysis at the resin dentin interface of self adhering flowable resin composite versus total etch resin composite using an agent and bonding agent and concluded the result regarding marginal gap distance and silver anatomic %means values, teeth restorated with self adhering resin composite showed significantly higher mean values than the multistep etch and rinse resin composite group.

16. **Doozaneh M, Koohpeima F, Firouzmandi M, Abbassiyan F (2017)[26]**Compared the shear bond strength of self adhering flowable composite and resin modified glass ionomer to mineral trioxide aggregate and calcium enriched mixture cement and concluded that the bond strength of a self adhering flowable composite resin and calcium enrichced mixture cement was higher than resin modified glass ionomer which was improved after the additional application of adhesive.

17. **Baltacioglu I.H et al (2017)[27]**: Evaluated the internal adaptation of two different self-adhering flowable composite resin materials used as liners under Class II restorations using microcomputed tomography (micro-CT) analysis and concluded that the performance of self-adhering composites was similar to that of universal flowable composites in terms of marginal microleakage.

18. **Krishnegowda S C ,jaganath B M , Rudranaik S,Kurup N B Madanan S , Manjula CG(2017)[28]:** Evaluated the marginal integrity of self-adhesive flowable composite resins when compared with conventional total etch composite resins

and they concludes that the self-adhesive flowable composite has superior marginal adaptability when compared with total etch-based resin system.

19. **Harsha P P , Dhruv K V (2017)[29]:** Conducted a Comparative evaluation of marginal microleakage of conventional fissure sealants and self-adhering flowable composites as fissure sealant in permanent teeth-an in vitro study.and concluded that Microleakage was less using self-adhering flowable composite compared to conventional fissure sealant; therefore, self-adhering flowable composite can be used as a suitable fissure sealant in permanent teeth.

20. **Mishra. P Jaiswal S, Nikhil V , Gupta S , Jha P, Raj Shalya (2018)[1]** Evaluated marginal sealing ability of self adhesive flowable composite resin when usd as a liner in class II composite restoration with or without aging for 6 months and found that margins of the cavity in cementum can be better sealed by placing self adhesive liner and is not affected by aging.

21. **Shaalan O. O. , Abou-Auf E, zoghby A F E (2018)[4]**Evaluated self adhering flowable composite resin versus conventional flowable composite in conservative class I cavities, and concluded that self adhering flowable composite has shown same clinical properties as conventional flowable composite in 6 months follow-up.

22. **Rangappa. A. Srinivasulu J, Rangaswamy V, Eregowda S, Lakshminarasimhaiah V, Lingareddy U** (**2018)[30]** Evaluated the shear bond strength of self adhering flowable composite s on the dentinal surface prepared with carbide and diamond burs and concluded that shear bond strength of Tetric-N Flow was higher than that of the experimental groups of constic and Dyad flow, dentinal surface prepared with the carbide bur result ed in higher shear bond strength for Tetric N Flow and Dyad flow but not for Constic.

23. **Wadhwa S , Nayak U A, Kappadi D , Prajapati D, Sharma R pawar A(2018)[31]** Evaluated the use of self adhering flowable composite as a fissure

sealant and compare it with a resin based pit and fissure sealant and concluded that dyad flow can be used as an alternative to the conventional fissure sealant.

24. **Gayatri C, Rambabu T, Sowjanya L B (2018)**[32]Evaluated the marginal adaptation of self adhering flowable composite versus conventional flowable composite under scanning electron microscope and concluded that there was no significant difference between the study group regaeding marginal adaptation when used as a liner in class II restorations.

25. **C. Rengo etal (2018)**[33] Compared the influence of preliminary phosphoric acid etching on the microleakage of a self adhering flowable composite and self etch adhesive used in combination with the proprietary flowable composite and concluded that the early sealing ability of the self adhering flowable composite and self etch adhesive in class V restorations did not benefit from the selective enamel etching. Preliminary phosphoric acid etching of dentin negatively affected the quality of the seal when using the adhesive free flowable composite.

26. **Maede Rahmanifard , Khodadadi , Kharif S , Ezoji F (2019)**[34]**:** Compared microleakage in occlusal and gingival margins between cavities filled with self-adhesive flowable and conventional flowable composites using dye penetration. Composite restorations were bonded with self-etch, total etch and universal adhesives and Concluded that Vertise Flow is a useful material with adequate marginal seal.

27. **Serin B A , Yaziciohlu I , Deveci c, Dogan M C (2019)**[35] : Evaluated and compared the 1 year clinical performances of a self-adhering flowable composite and a commercially available self-etch adhesive/composite system in occlusal restorations of primary second molars.Then concluded that clinical assessment of self-adhering flowable composite exhibited good clinical results with predominating alpha scores after 1 year. Advantage of the application convenience for children is promising for self-adhered flowable composite materials in pediatric use.

28. **Simge Durmuşlar, Ayşegül Ölmez (2019)[36]:** Compared the microtensile bond strengths and fracture modes of flowable composites on primary dentin with application of different adhesive strategies concluded that The self-adhering flowable composite Vertise™ Flow had the lowest and G-aenial Universal Flo® had the highest microtensile bond values.

29. **Maj A Trzcionka A, Twardawa H, tanasiewicz M(2020)[37]** : Compared a self-adhesive, light-curing composite material called Vertise Flow and a traditional flow material called Premise flowable used in combination with dedicated bonding systems. In order to standardize the clinical environment, the stability of oral hygiene (analyzed with the oral hygiene index and the approximal plaque index) was taken into consideration concluded that The used preparation scheme and bonding system have an impact on the final quality of the composite filling. There is a need to carry out a qualitative clinical evaluation of dental restorative materials under uniform conditions using evaluation scales.

30. **Vichi A, Goracci C, Ferrar M (2020)[3]:** Evaluated over a 6-month follow-up period the clinical outcome of restorations performed with a new self-adhering flowable composite resin. And concluded that all the evaluated restorations remained in place and in acceptable conditions over the 6-month follow-up period. No post-operative sensitivity was recorded at any evaluation.

MATERIALS AND METHODOLOGY

The present in-vivo study was conducted in the Department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University Lucknow .

Collection of Samples

20 patients indicated for composite restoration was selected from the OPD of Department of Conservative Dentistry and Endodontics Babu Banarasi Das College Of Dental Sciences , Lucknow . and explained about the procedure and then written consent was taken along with the signature .

Eligibility Criteria

Inclusion criteria

1. Caries on pits and fissure on occlusal surface of premolars and molars
2. Caries on facial and lingual surface of premolars and molars
3. Caries on lingual surface of maxillary incisors.

Exclusion Criteria

1. Grossly carious teeth
2. Severe periodontal infection
3. Endodontically treated tooth
4. Periapical or pulpal pathogy
5. Tooth hypersensitivity

ARMAMENTARIUM:

FOR CAVITY PREPARATION

Mouth mirror[API ,India]

Explorer [API India]

Twizer [API ,India]

Williams probe [API , India]

Rubber dam [GDC ,]

Airotor handpeice [NSK, Japan]

Straight bur [Dentsply Maillefer, Switzerland]

Enamel hatchet [API ,India]

FOR RESTORATION PROCEDURE

Light curing unit[Dentmark R&D impex India]

Dyad flow [Kerr,CA,USA]

Filtek Z 350 [3M ESPE]

Bonding agent [Ivoclar vivadent]

Etchant gel [Ivoclar vivadent]

Applicator tip[Ivoclar vivadent]

FOR POLISHING AND FINISHING

Finishing and polishing kit[sofu super snap,India]

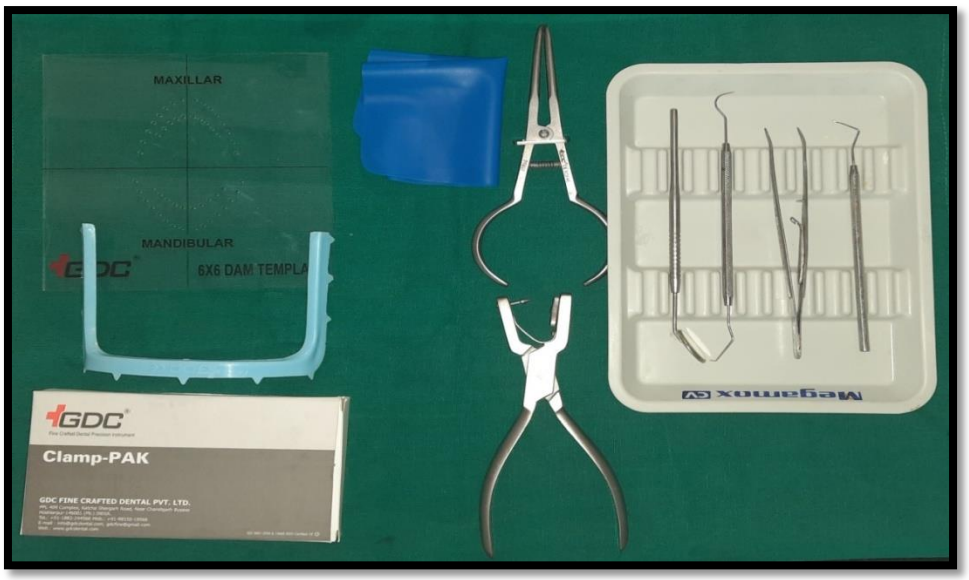


Figure No. 1: Rubber dam kit and diagnostic instruments

Figure No.2: Restorative materials and instruments

DYAD ™FLOW

Dyad™ Flow, the first self-adhering composite powered by OptiBond™, greatly simplifies the direct restorative procedures by incorporating a bonding agent into a flowable. So, no need to bond separately. Fewer steps saves you time. And Dyad Flow shares the same characteristic inherent in self-etch materials: it reduces the chance of post-operative sensitivity.

COMPOSITION

Matrix:-

Glycerol diphosphate methacrylate adhesive monomer [GDMA]

Urethane dimethacrylate [UDMA],

Bis phenol A diglycydyle methacrylate[Bis GMA]

And other methacrylate co-monomers,

Photo initiator

Fillers :-

70%by weight .

Ytterbium Fluoride

Barium aluminosilicate glass,

Prepolymerized fillers, and colloidal silica

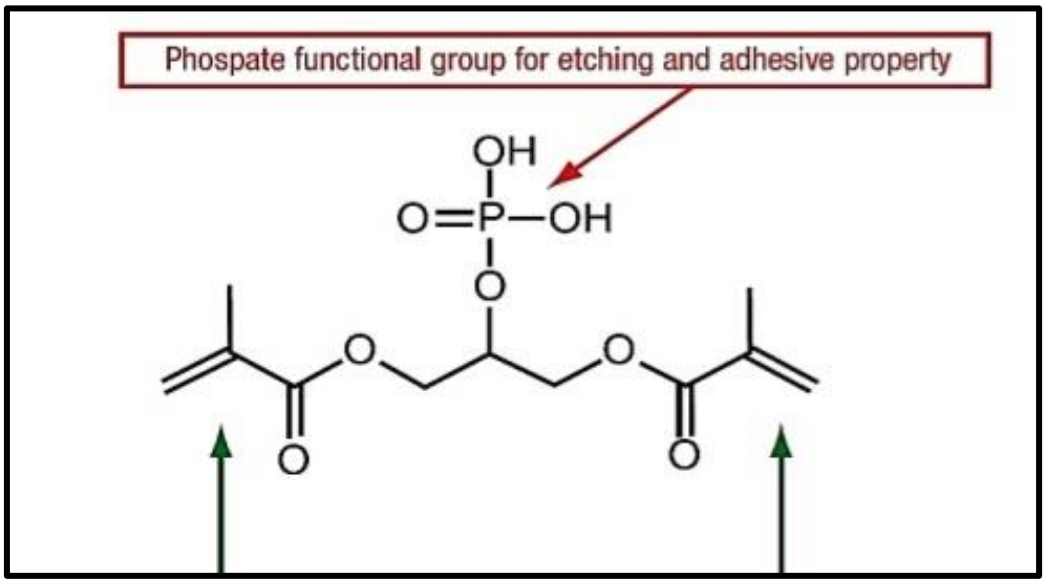


Figure No. 3: Two methacrylate groups for copolymerization/crosslinking with other methacrylate co-monomers.

MECHANISM

DYAD FLOW which is based on the adhesive technology that uses a functional monomer (glycerophosphate dimethacrylate [GPDM]) to etch enamel and dentin, and a hydrophilic monomer (e.g., hydroxyethyl methacrylate) to enhance wetting and resin infiltration into dentin substrate. This resin bonds in a dual manner; chemically between the functional monomer and the hydroxyapatite of tooth structure and micromechanically between the polymerized resin of SAFC and collagen fibers and smear layer of dentin

A functional monomer such as 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) can form stable complexes of calcium–phosphate. GPDM is another functional monomer that has the advantage of having two polymerizable groups that can react with other monomers in adhesive systems and resin composite; this improved quality of the polymer network and enhanced mechanical properties.[12] However, GPDM revealed hydrophilicity, and greater demineralization of dentin than bonding to calcium of hydroxyapatite, producing unstable complex of di-calcium phosphate dehydrate deposited on hydroxyapatite surface that will dissolve gradually in aqueous environment thus deteriorating the interfacial integrity.

3M FiltekTM Z350 Flowable composite

In 2002, 3M ESPE launched FiltekTM Supreme Universal Restorative. This was the first product that utilized nanotechnology to provide the esthetics of a microfill and the strength of a hybrid. All of the filler particles in this novel composite are surface-modified, bonded nanofillers. Incorporation of this filler technology into a flowable restorative was realized in 2005, with the introduction of 3M Filtek^{TM} Z350 Flowable Restorative.

Composition

Filtek Z350 XT flowable restorative contains Bisphenol A diglycydyle methacrylate[Bis GMA], Triethylene glycol dimethacrylate [TEGDMA] and Procrylat resins. The fillers area combination of ytterbium trifluoride filler with a range of particle sizes from 0.1 to 5.0 microns, a non agglomerated/non-aggregated surface-modified 20 nm silica filler, a non-agglomerated/ non-aggregated surface modified 75 nm silica filler, and a surface-modified aggregated zirconia/silica cluster filler

(comprised of 20 nm silica and 4 to 11 nm zirconia particles). The aggregate has an average cluster particle size of 0.6 to 10 microns. The inorganic filler loading is approximately 65% by weight (46% by volume).

The formulation improvements of Filtek Z350 XT flowable restorative take advantage of the advancements made in filler processing and resins since the introduction of Filtek Z350 flowable restorative. The formulation was modified to improve properties, such as shrinkage, fluorescence and polish retention.

MECHANISM

Filtek Supreme restorative was formulated using both engineered nanoparticle and nanocluster fillers. The nanocluster filler particles consist of loosely bound aggregates of engineered nanofiller particles. The addition of engineered nanoparticles to formulations containing nanoclusters reduces the interstitial spacing of the filler particles leading to higher filler loadings. The filled matrix (resin plus engineered nanoparticles) is harder and more wear resistant than resin alone. The increased filler loading results in better physical properties and wear resistance.

METHODOLOGY

Total 40 restorations were taken for an in vivo study and they were randomly allocated to one of the two groups (n=20) .

GROUP A- Self adhering flowable composite resin

GROUP B- Conventional flowable composite resin

A complete examination, diagnosis (including caries risk assessment), treatment plan and informed consent were finalized and obtained before the patient was scheduled for operative appointments (emergencies expected). A brief review of the patient's record (including medical history), treatment plan radiographs were recorded.

Local anaesthesia was administered for more comfortable and uninterrupted procedure that may resulted in reduction in salivation. These effects of local anaesthesia contribute to better operative dentistry, especially when placing bonded restorations.

Then shade selection was done. The shade of the tooth was determined before teeth were subjected to any prolonged drying, as dehydrated teeth become lighter in a shade

as a result of decrease in translucency secondary to water loss from the naturally porus tooth structure. Rubber dam was placed for complete isolation. Preoperative assessment of the occlusion was made. This assessment identifies not only the occlusal contact of the tooth to be restored but also the occlusal contacts on adjacent tooth.

CAVITY PREPARATION

Same Cavity preparation was done for both the groups' i.e Group A and Group B

Depending upon the type and location of the caries, cavity preparations were done accordingly.

A small to moderate lesion were restored with modified design which is not having an uniform depth, cavitywere more rounded as smaller cutting instruments wereused.

Patients were administered local anaesthesia as required; teeth were isolated using rubber dam.

Straight bur in a high speed hand piece with copious amount of water wereused to make conservative class I cavity preparations, with facio lingual width not extending more than ¼ of the intercuspal distance.

Undermined marginal ridges [enamel] were left in extensive preparation and to strengthen by composite bonding.

RESTORATIVE TECHNIQUE

Placement of the Self Adhering Flowable Composite Resin[GROUP A]

1.Brushed the layer with moderate pressure for 15-20 seconds to obtain a thin layer (0.5nm)

2.Light cured for 20 Seconds

3. Placement of additional increaments of self adhering flowable composite in 2mm or less.

4. Againlight cure for 20 Seconds.

Placement of conventional flowable composite resin [GROUP B]

1. The cavities were total-etched with 37% phosphoric acid gel for 15 seconds
2. Rinsed with water for 10 seconds, and air dried for 2 seconds.
3. Two coats of bonding agents were applied onto the cavity surface, gently air dried
4. Light-cured for 10 seconds, using a LED curing light.
5. Then, cavity was lined with conventional flowable composite filtek Z 350 with uniform thickness of 2 mm which was judged using a William's graduated periodontal probe.
6. The remaining cavity was restored in increments of 2 mm.
7. Each increment was light-cured for 20 seconds.

Finishing and Polishing of the Self dhering Composite:-

The occlusal surface was shaped with a round or oval carbide finishing bur or similarly shape finishing diamond burs. Polishing was accomplished with appropriate polishing discs, cups, points or both after the occlusion correction.

Figure no 4 : Pre-operative

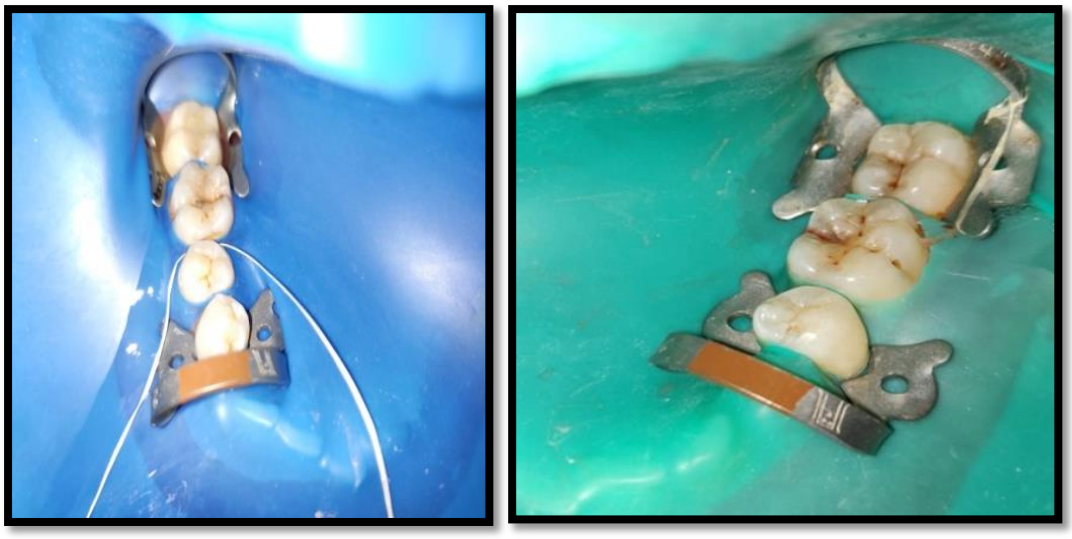


Figure No. 5 : Rubber Dam Isolation

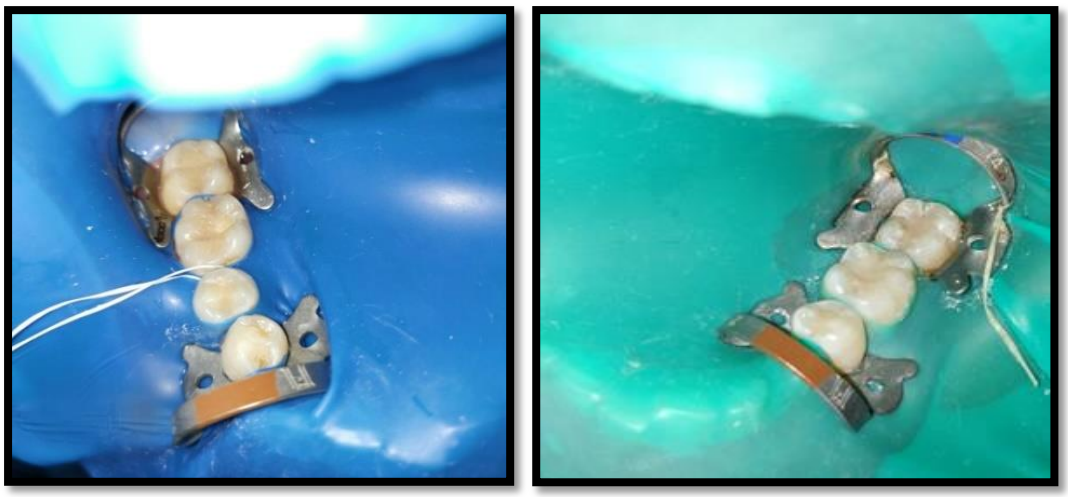


Figure No. 6 : Postoperative (Right Dyad Flow, Left Filtek Z350)

Figure No 7 : Evaluation at baseline

Figure No. 8 : Evaluation at 3 Months

Figure No. 9 : Evaluation at 6 Months

OBSERVATIONS AND RESULTS

Statistical analysis

Discrete (categorical) data were summarised in number (n) and percentage (%) and compared by chi-square (χ^2) test. A two-tailed (α=2) $P< 0.05$ was considered statistically significant. Analysis was performed on SPSS software (Windows version 22.0).

Chi-square test

The statistical inference of the last three chapters has concentrated on statistics such as the mean and the proportion. These summary statistics have been used to obtain interval estimates and test hypotheses concerning population parameters. This chapter changes the approach to inferential statistics somewhat by examining whole distributions, and the relationship between two distributions. In doing this, the data is not summarized into a single measure such as the mean, standard deviation or proportion. The whole distribution of the variable is examined, and inferences concerning the nature of the distribution are obtained.

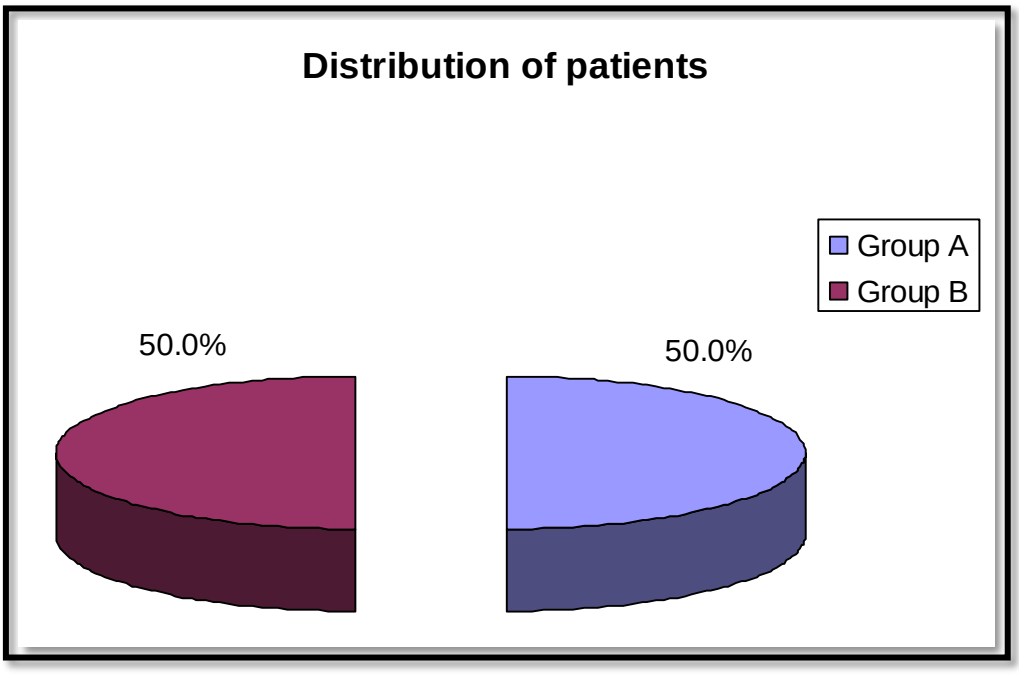
Observations and Results

The present study deals with clinical evaluation of a self adhering flowable composite and conventional flowable composite in conservative Class I restorations. Total 40 cases (restorations) were selected and randomized equally into two groups (group A and group B)and treated with self adhering flowable composite resin (*Group A, n=20*) or conventional flowable composite resin (*Group B, n=20*) (Table 1 and Fig. 1).

The outcome measures of the study were hypersensitivity, retention analysis, color match, marginal discoloration and marginal adaptation assessed using modified United States Public Health Service (USPHS) criteria for evaluation of dental restoration (Table 2). All the outcome measures were assessed post treatment on three follow up periods (baseline, 3 months and 6 months).

Table 1: Group allocation and distribution of patients in two groups

Treatment	Group name	Total patients (n=40) (%)
Self adhering flowable composite resin	Group A	20 (50.0)
Conventional flowable composite resin	Group B	20 (50.0)



Graph 1. Pie charts showing distribution of patients in two groups.

Table 2: Modified United States Public Health Service (USPHS) criteria for evaluation of dental restoration

Clinical parameters	**Score**	**Characteristics**	**Method**
Hypersensitivity	0 1	No hypersensitivity Sensitivity present	Ask the patients
Retention Analysis	0 1	No loss of restoration Loss of restoration	Visual inspection and explorer
Color Match	0 1 2	Matches tooth Acceptable mismatch Unacceptable mismatch	Visual inspection
Marginal Discoloration	0 1 2	No discoloration between tooth structure and restorative material Non penetrating marginal discoloration which can be polished Discoloration has penetrated margin in pulpal direction	Visual inspection
Marginal Adaptation	0 1 2	Closely adapted, no detectable margin Detectable marginal discrepancy clinically acceptable Marginal crevice, clinically unacceptable	Visual inspection and explorer

Outcome Measures

I. Hypersensitivity

The post treatment hypersensitivity score (0/1) of two groups (Group A and Group B) over the follow up periods (baseline, 3 months and 6 months) is summarized in Table 3 and also shown in Fig. 2a to 2c, respectively.

At baseline, the hypersensitivity score was 0 in all 20 (100.0%) cases of both groups indicating 100.0% cases with absent of hypersensitivity or 0.0% with presence of hypersensitivity. Comparing the frequency (%) of hypersensitivity score (0/1) of two groups at baseline, χ^2 test showed similar (P> 0.05) frequency of hypersensitivity score (absence of hypersensitivity/presence of hypersensitivity) between two groups (χ^2=0.00, P = 1.000) at baseline (Table 3 and Fig. 2a).

In contrast, at 3 months, the hypersensitivity score was 0 in 18 (90.0%) cases and score 1 in 2 (10.0%) cases of Group A whereas in Group B, the hypersensitivity score was 0 in 17 (85.0%) cases and score 1 in 3 (15.0%) cases. Thus, at 3 months, in Group A, the hypersensitivity was absent in 18 (90.0%) cases and present in 2 (10.0%) cases whereas in Group B, it was absent in 17 (85.0%) cases and present in 3 (15.0%) cases. Comparing the frequency (%) of hypersensitivity score (0/1) of two groups at 3 months, χ^2 test further showed similar (P> 0.05) frequency of hypersensitivity score (absence of hypersensitivity/presence of hypersensitivity) between two groups at 3 months (χ^2=0.23, P = 0.633) though the absence of hypersensitivity was 5.0% higher in Group A as compared to Group B (Table 3 and Fig. 2b).

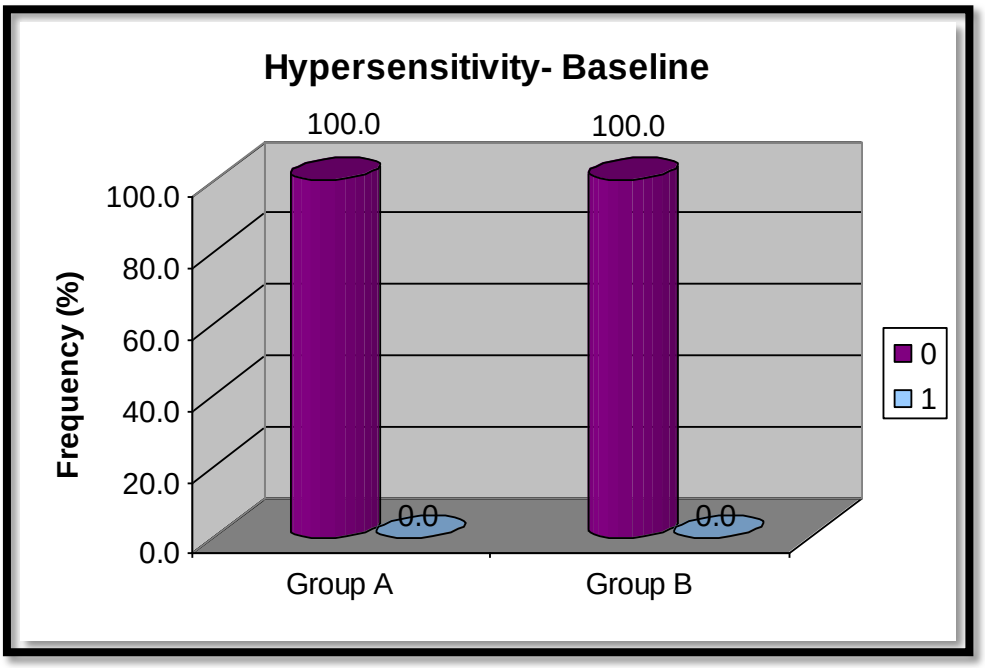
Conversely, at 6 months, the hypersensitivity score was 0 in 19 (95.0%) cases and score 1 in 1 (5.0%) case of Group A whereas in Group B, the hypersensitivity score was 0 in 18 (90.0%) cases and score 1 in 2 (10.0%) cases. Thus, at 6 months, in Group A, the hypersensitivity was absent in 19 (95.0%) cases and present in 1 (5.0%) case whereas in Group B, it was absent in 18 (90.0%) cases and present in 2 (10.0%) cases. Comparing the frequency (%) of hypersensitivity score (0/1) of two groups at 6 months, χ^2 test further showed similar (P> 0.05) frequency of hypersensitivity score (absence of hypersensitivity/presence of hypersensitivity) between two groups at 6

months (χ^2=0.36, *P* = 0.548) though the absence of hypersensitivity was again 5.0% higher in Group A as compared to Group B (Table 3 and Fig. 2c).

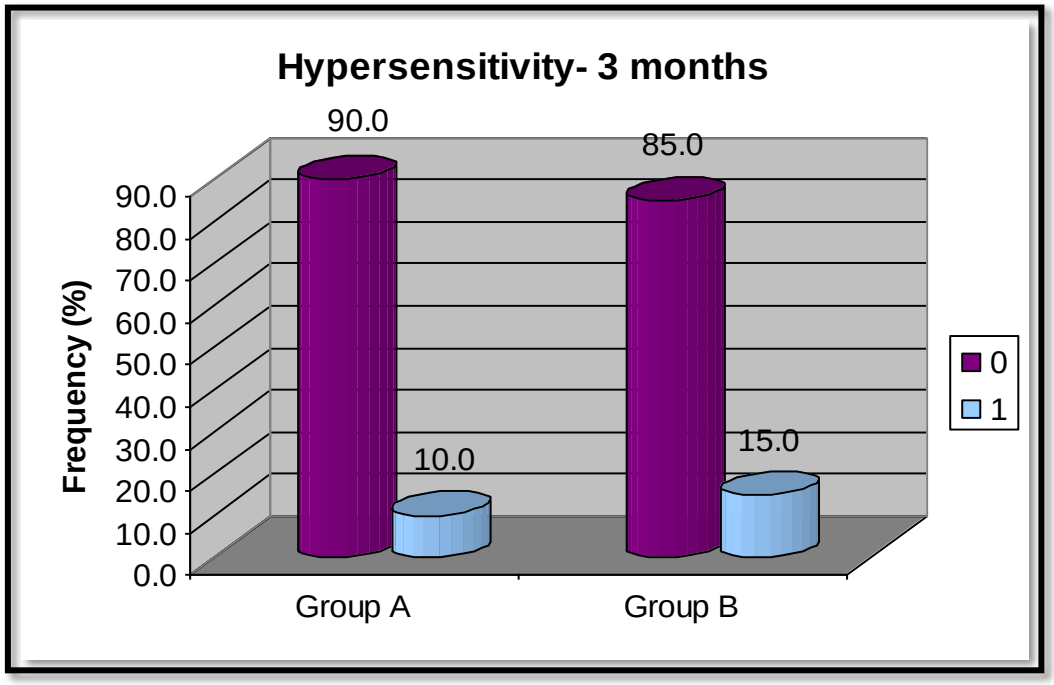
Table 3: Frequency distribution of post treatment hypersensitivity of two groups over the follow up periods

Follow up period	Score	Group A (n=20) (%)	Group B (n=20) (%)	χ^2 value	*P* value
Baseline	0	20 (100.0)	20 (100.0)	0.00	1.000
	1	0 (0.0)	0 (0.0)		
3 months	0	18 (90.0)	17 (85.0)	0.23	0.633
	1	2 (10.0)	3 (15.0)		
6 months	0	19 (95.0)	18 (90.0)	0.36	0.548
	1	1 (5.0)	2 (10.0)		

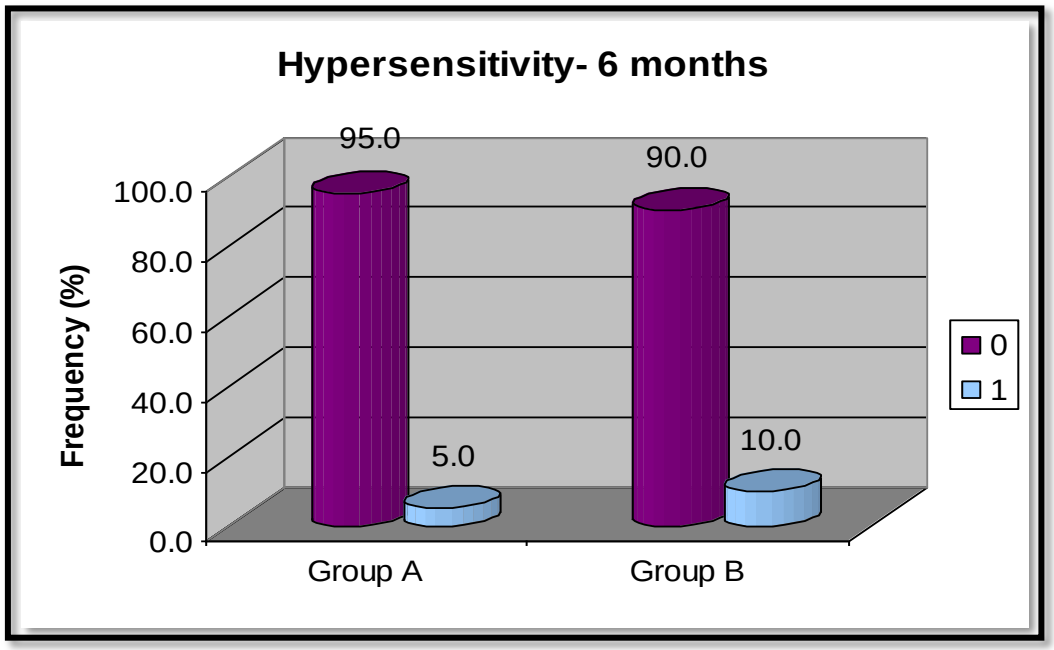
Frequency distribution of post treatment hypersensitivity of two groups were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).



(a)



(b)



(c)

Graphs 2. Bar graph showing frequency distribution of post treatment hypersensitivity score of two groups at (a) baseline, (b) 3 months and (c) 6 months.

II. Retention Analysis

The post treatment retention analysis score (0/1) of two groups (Group A and Group B) over the follow up periods (baseline, 3 months and 6 months) is summarised in Table 4 and also shown in Fig. 3a to 3c, respectively.

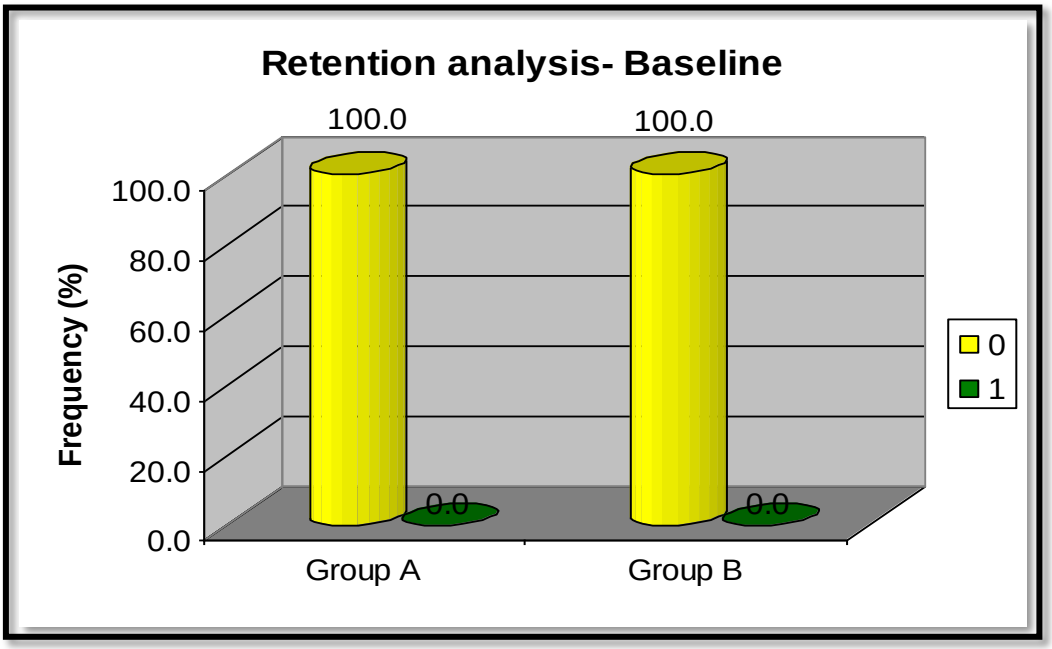
At baseline, the retention analysis score was 0 in all 20 (100.0%) cases of both groups, suggesting 100.0% cases with no loss of restoration or 0.0% with loss of restoration. Comparing the frequency (%) of retention analysis score (0/1) of two groups at baseline, χ^2 test showed similar (P> 0.05) frequency of retention analysis score (no loss of restoration/loss of restoration) between two groups at baseline (χ^2=0.00, P = 1.000) (Table 4 and Fig. 3a).

In contrast, at both 3 and 6 months, the retention analysis score of 17 (85.0%) cases was 0 and 3 (15.0%) cases was 1 in both groups indicating 85.0% cases with no loss of restoration and 15% with loss of restoration. Comparing the frequency (%) of retention analysis score (0/1) of two groups at both periods, χ^2 test further showed similar (P> 0.05) frequency of retention analysis score (no loss of restoration/loss of restoration) between two groups at both periods (χ^2=0.00, P = 1.000) (Table 4 and Fig. 3b-3c).

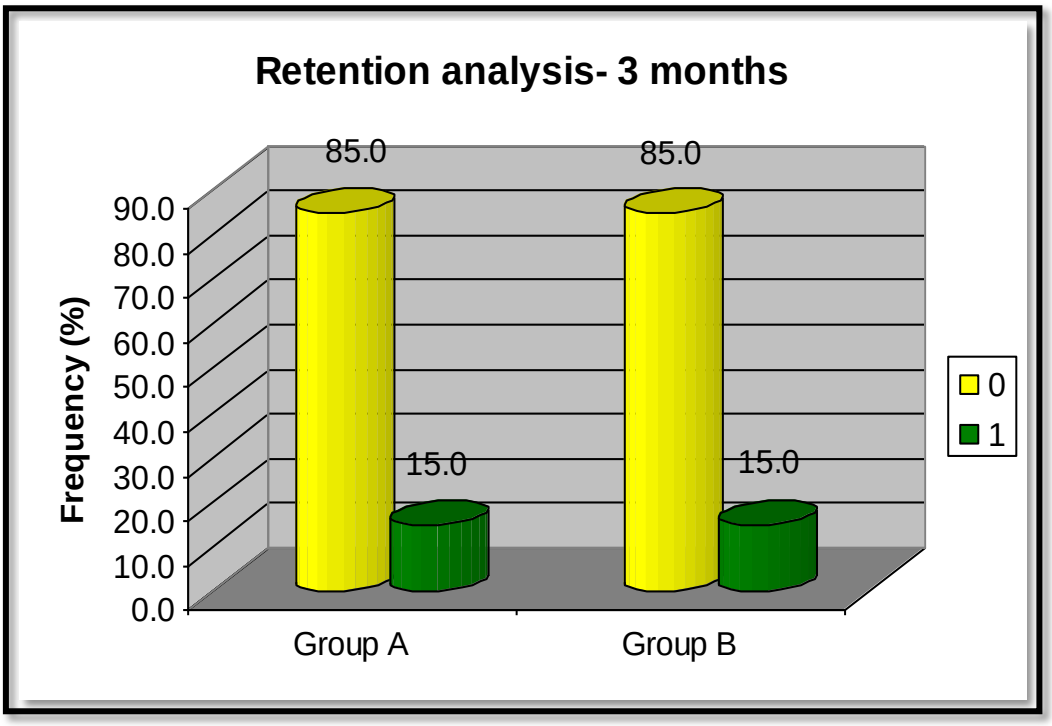
Table 4: Frequency distribution of post treatment retention analysis of two groups over the follow up periods

Follow up period	Score	Group A (n=20) (%)	Group B (n=20) (%)	χ^2 value	*P* value
Baseline	0	20 (100.0)	20 (100.0)	0.00	1.000
	1	0 (0.0)	0 (0.0)		
3 months	0	17 (85.0)	17 (85.0)	0.00	1.000
	1	3 (15.0)	3 (15.0)		
6 months	0	17 (85.0)	17 (85.0)	0.00	1.000
	1	3 (15.0)	3 (15.0)		

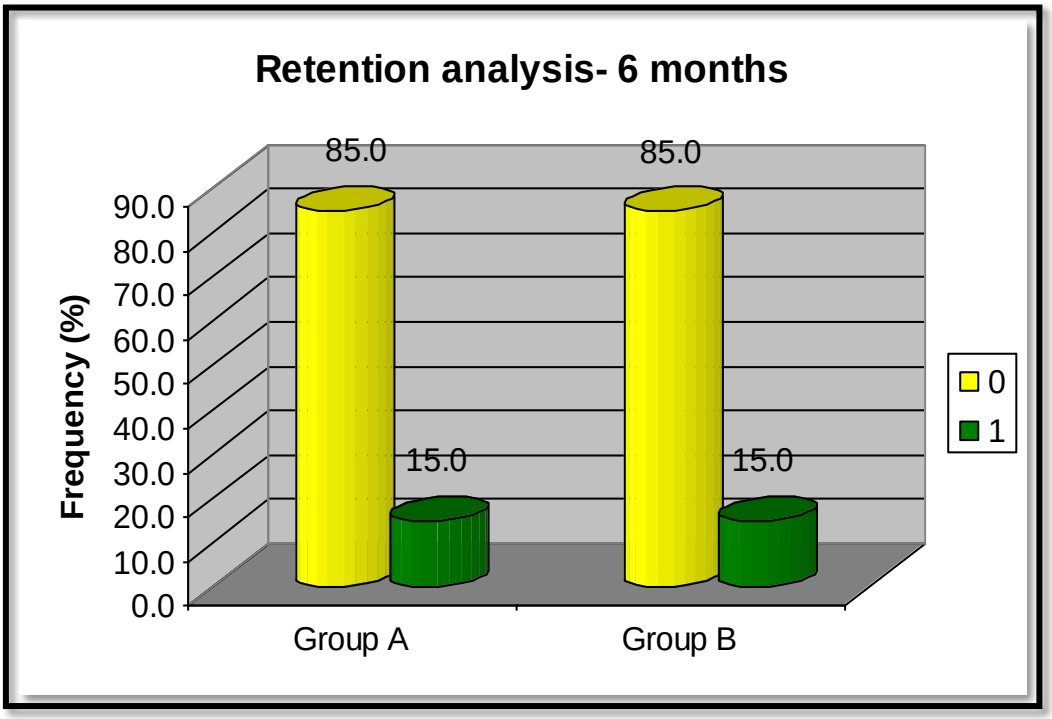
Frequency distribution of post treatment retention analysis of two groups were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).


Retention analysis- Baseline
100.0
100.0
100.0
80.0
60.0
40.0
20.0
0.0
Frequency (%)
0.0
0.0
Group A
Group B
0
1

(a)


Retention analysis- 3 months
85.0
85.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Frequency (%)
15.0
15.0
Group A
Group B
0
1

(b)



(c)

Graphs 3. Bar graph showing frequency distribution of post treatment retention analysis score of two groups at (a) baseline, (b) 3 months and (c) 6 months.

III. Color Match

The post treatment color match score (0/1/2) of two groups (Group A and Group B) over the follow up periods (baseline, 3 months and 6 months) is summarised in Table 5 and also shown in Fig. 4a to 4c, respectively.

At baseline, the color match score was 0 in all 20 (100.0%) cases of both groups, suggesting 100.0% cases with matches tooth. Comparing the frequency (%) of color match score (0/1/2) of two groups at baseline, χ^2 test showed similar (P> 0.05) frequency of color match score (matches tooth/acceptable mismatch/unacceptable mismatch) between two groups at baseline (χ^2=0.00, P = 1.000) (Table 5 and Fig. 4a).

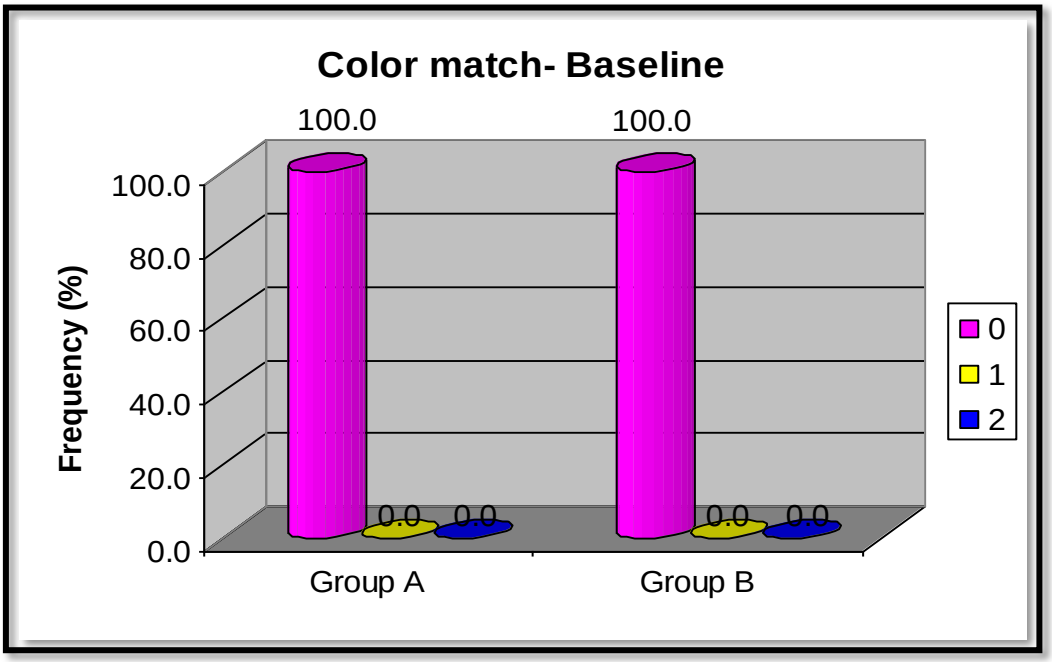
In contrast, at both 3 and 6 months, the color match of 17 (85.0%) cases have 0 score, 1 (5.0%) case had 1 score and 2 (10.0%) cases with 2 score in Group A whereas in Group B, 16 (80.0%) cases have 0 score, 3 (15.0%) cases with 1 score and 1 (5.0%) case with 2 score thus indicating 85.0% cases with matches tooth, 5.0% with

acceptable mismatch and 10.0% with unacceptable mismatch in Group A whereas 80.0% cases with matches tooth, 15.0% with acceptable mismatch and 5.0% with unacceptable mismatch in Group B. Comparing the frequency (%) of color match score (0/1/2) of two groups at both periods, χ^2 test further showed similar (P> 0.05) frequency of color match score (matches tooth/ acceptable mismatch/unacceptable mismatch) between two groups at both periods (χ^2=1.36, P = 0.506) though the matches tooth was 5.0% higher in Group A as compared to Group B at both periods (Table 5 and Fig. 4b-4c).

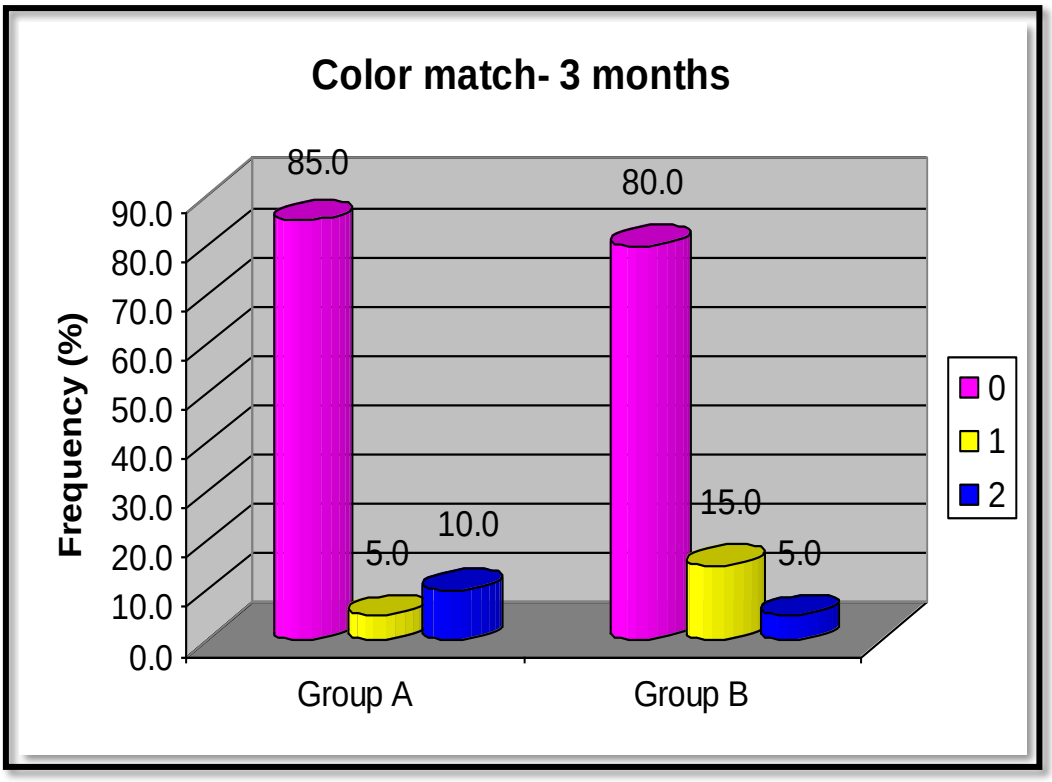
Table 5: Frequency distribution of post treatment color match of two groups over the follow up periods

Follow up period	Score	Group A (n=20) (%)	Group B (n=20) (%)	χ^2 value	*P* value
Baseline	0	20 (100.0)	20 (100.0)	0.00	1.000
	1	0 (0.0)	0 (0.0)		
	2	0 (0.0)	0 (0.0)		
3 months	0	17 (85.0)	16 (80.0)	1.36	0.506
	1	1 (5.0)	3 (15.0)		
	2	2 (10.0)	1 (5.0)		
6 months	0	17 (85.0)	16 (80.0)	1.36	0.506
	1	1 (5.0)	3 (15.0)		
	2	2 (10.0)	1 (5.0)		

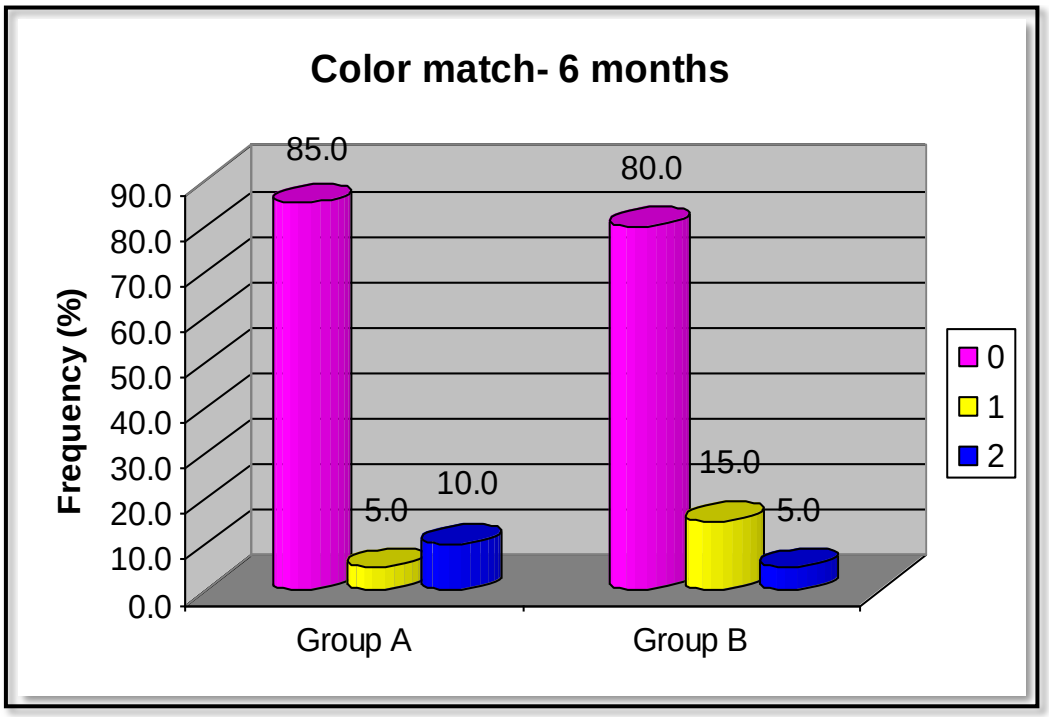
Frequency distribution of post treatment color match of two groups were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).


Color match- Baseline
Frequency (%)
100.0
80.0
60.0
40.0
20.0
0.0
100.0
100.0
0.0
0.0
0.0
0.0
Group A
Group B
0
1
2

(a)


Color match- 3 months
Frequency (%)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
85.0
5.0
10.0
80.0
15.0
5.0
Group A
Group B
0
1
2

(b)



cGraphs 4. Bar graph showing frequency distribution of post treatment color match score of two groups at (a) baseline, (b) 3 months and (c) 6 months.

IV. Marginal Discoloration

The post treatment marginal discoloration score (0/1/2) of two groups (Group A and Group B) over the follow up periods (baseline, 3 months and 6 months) is summarised in Table 6 and also shown in Fig. 5a to 5c, respectively.

At baseline, the marginal discoloration score was 0 in all 20 (100.0%) cases of both groups, suggesting 100.0% cases with no discoloration between tooth structure and restorative material. Comparing the frequency (%) of marginal discoloration score (0/1/2) of two groups at baseline, χ^2 test showed similar (P> 0.05) frequency of marginal discoloration score (no discoloration between tooth structure and restorative material/non penetrating marginal discoloration which can be polished/discoloration has penetrated margin in pulpal direction) between two groups at baseline (χ^2=0.00, P = 1.000) (Table 6 and Fig. 5a).

In contrast, at both 3 and 6 months, the marginal discoloration of 18 (90.0%) cases have 0 score, 1 (5.0%) case had 1 score and 1 (5.0%) case with 2 score in Group A whereas in Group B, 17 (85.0%) cases have 0 score, 2 (10.0%) cases with 1 score and

1 (5.0%) case with 2 score thus indicating 90.0% cases with no discoloration between tooth structure and restorative material, 5.0% with non penetrating marginal discoloration which can be polished and 5.0% with discoloration has penetrated margin in pulpal direction in Group A whereas 85.0% cases with no discoloration between tooth structure and restorative material, 10.0% with non penetrating marginal discoloration which can be polished and 5.0% with discoloration has penetrated margin in pulpal direction in Group B. Comparing the frequency (%) of marginal discoloration score (0/1/2) of two groups at both periods, χ^2 test further showed similar (P> 0.05) frequency of marginal discoloration score (no discoloration between tooth structure and restorative material/non penetrating marginal discoloration which can be polished/discoloration has penetrated margin in pulpal direction) between two groups at both periods (χ^2=0.36, P = 0.834) though the no discoloration between tooth structure and restorative material was 5.0% higher in Group A as compared to Group B at both periods (Table 6 and Fig. 5b-5c)

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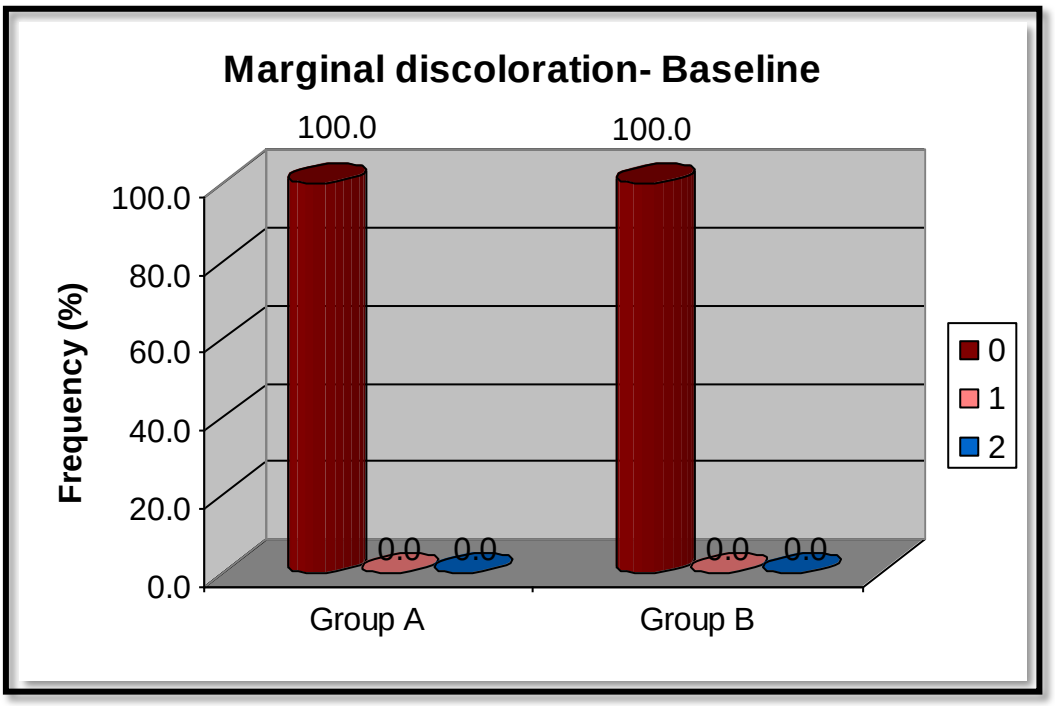
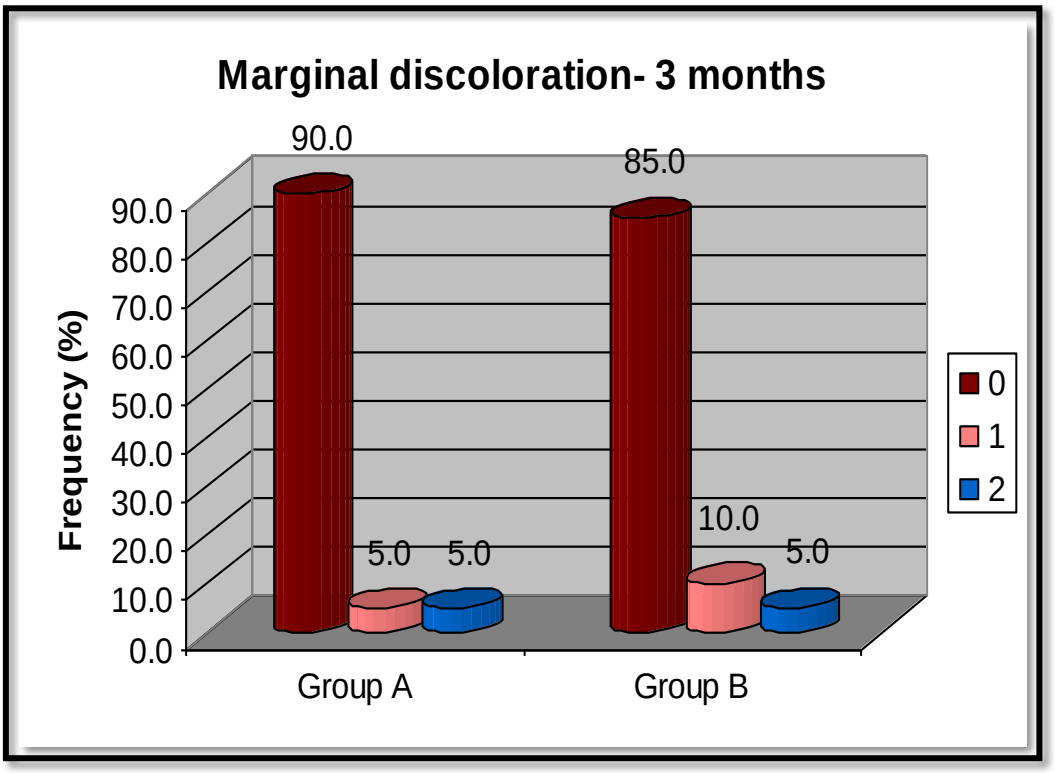
Table 6: Frequency distribution of post treatment marginal discoloration of two groups over the follow up periods

Follow up period	Score	Group A (n=20) (%)	Group B (n=20) (%)	χ^2 value	*P* value
Baseline	0	20 (100.0)	20 (100.0)	0.00	1.000
	1	0 (0.0)	0 (0.0)		
	2	0 (0.0)	0 (0.0)		
3 months	0	18 (90.0)	17 (85.0)	0.36	0.834
	1	1 (5.0)	2 (10.0)		
	2	1 (5.0)	1 (5.0)		
6 months	0	18 (90.0)	17 (85.0)	0.36	0.834
	1	1 (5.0)	2 (10.0)		
	2	1 (5.0)	1 (5.0)		

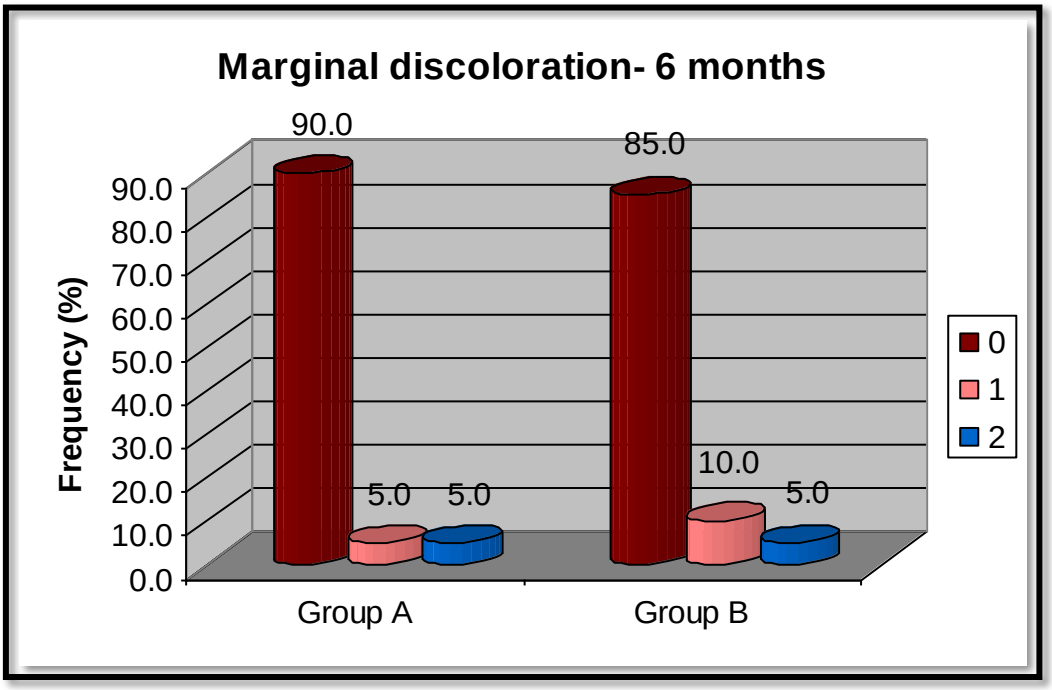
Frequency distribution of post treatment marginal discoloration of two groups were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value)


Marginal discoloration- Baseline
100.0
100.0
100.0
80.0
60.0
40.0
20.0
0.0
Frequency (%)
0.0
0.0
0.0
0.0
Group A
Group B
0
1
2

(a)


Marginal discoloration- 3 months
90.0
85.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Frequency (%)
5.0
5.0
10.0
5.0
Group A
Group B
0
1
2

b



©

Graphs 5. Bar graph showing frequency distribution of post treatment marginal discoloration score of two groups at (a) baseline, (b) 3 months and (c) 6 months.

V. Marginal Adaptation

The post treatment marginal adaptation score (0/1/2) of two groups (Group A and Group B) over the follow up periods (baseline, 3 months and 6 months) is summarised in Table 7 and also shown in Fig. 6a to 6c, respectively.

At baseline, the marginal adaptation score was 0 in all 20 (100.0%) cases of both groups, indicating 100.0% cases with closely adapted, no detectable margin. Comparing the frequency (%) of marginal adaptation score (0/1/2) of two groups at baseline, χ^2 test showed similar (P> 0.05) frequency of marginal adaptation score (closely adapted, no detectable margin/detectable marginal discrepancy clinically acceptable/marginal crevice, clinically unacceptable) between two groups at baseline (χ^2=0.00, P = 1.000) (Table 7 and Fig. 6a).

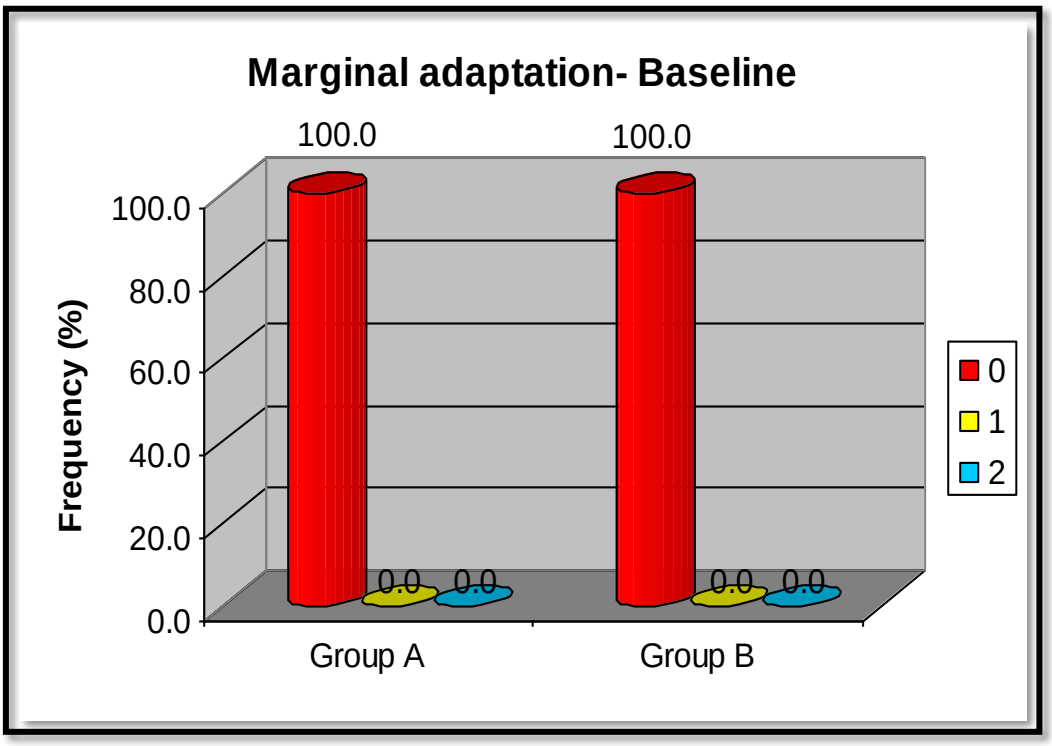
In contrast, at both 3 and 6 months, the marginal adaptation of 19 (95.0%) cases have 0 score, 1 (5.0%) case had 1 score and 0 (0.0%) case with 2 score in Group A whereas in Group B, 18 (90.0%) cases have 0 score, 2 (10.0%) cases with 1 score and 0 (0.0%) case with 2 score thus suggesting 95.0% cases with closely adapted, no detectable

margin, 5.0% with detectable marginal discrepancy clinically acceptable and 0.0% with marginal crevice, clinically unacceptable in Group A whereas 90.0% cases with closely adapted, no detectable margin, 10.0% with detectable marginal discrepancy clinically acceptable and 0.0% with marginal crevice, clinically unacceptable in Group B. Comparing the frequency (%) of marginal adaptation score (0/1/2) of two groups at both periods, χ^2 test further showed similar ($P > 0.05$) frequency of marginal adaptation score (closely adapted, no detectable margin/detectable marginal discrepancy clinically acceptable/marginal crevice, clinically unacceptable) between two groups at both periods ($\chi^2=0.36$, $P = 0.548$) though the closely adapted, no detectable margin was 5.0% higher in Group A as compared to Group B at both periods (Table 7 and Fig. 6b-6c).

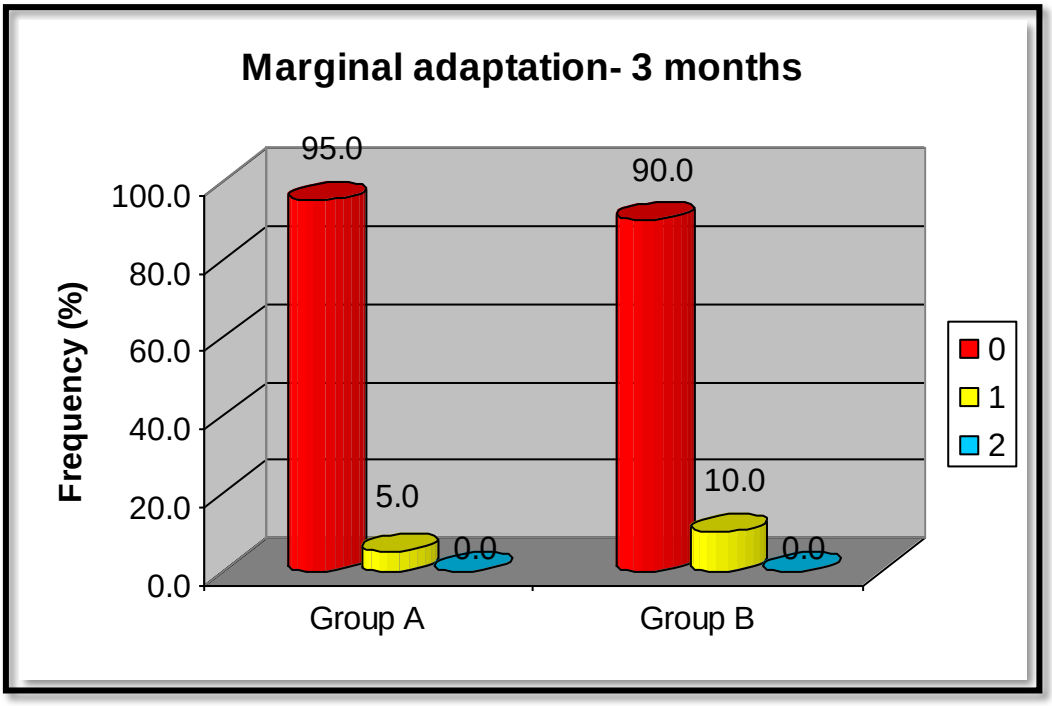
Table 7: Frequency distribution of post treatment marginal adaptation of two groups over the follow up periods

Follow up period	Score	Group A (n=20) (%)	Group B (n=20) (%)	χ^2 value	*P* value
Baseline	0	20 (100.0)	20 (100.0)	0.00	1.000
	1	0 (0.0)	0 (0.0)		
	2	0 (0.0)	0 (0.0)		
3 months	0	19 (95.0)	18 (90.0)	0.36	0.548
	1	1 (5.0)	2 (10.0)		
	2	0 (0.0)	0 (0.0)		
6 months	0	19 (95.0)	18 (90.0)	0.36	0.548
	1	1 (5.0)	2 (10.0)		
	2	0 (0.0)	0 (0.0)		

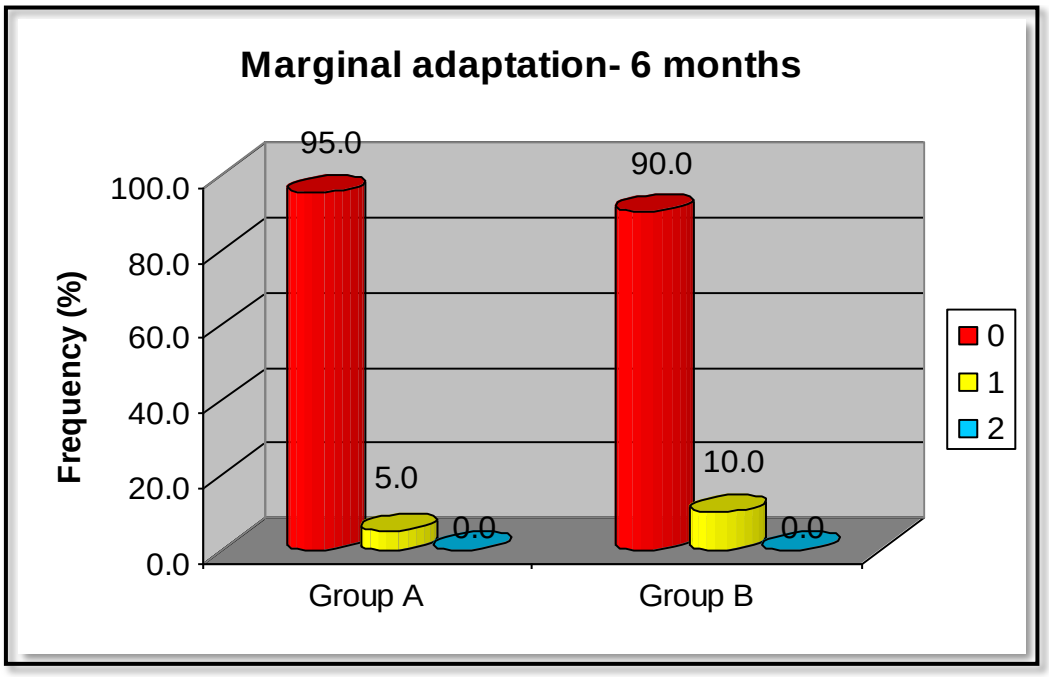
Frequency distribution of post treatment marginal adaptation of two groups were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).


Marginal adaptation- Baseline
100.0
100.0
100.0
80.0
60.0
40.0
20.0
0.0
Frequency (%)
0.0
0.0
0.0
0.0
Group A
Group B
0
1
2

(a)


Marginal adaptation- 3 months
95.0
90.0
100.0
80.0
60.0
40.0
20.0
0.0
Frequency (%)
5.0
10.0
0.0
0.0
Group A
Group B
0
1
2

(b)



C

Graph6. Bar graph showing frequency distribution of post treatment marginal adaptation score of two groups at (a) baseline, (b) 3 months and (c) 6 months

DISCUSSION

The study was conducted in department of Conservative Dentistry and Endodontics, Babu Banarasi Das College of Dental Sciences, Lucknow.

The aim of the study was to evaluate the clinical performance of a self adhering flowable composite resin and conventional flowable composite in conservative Class 1 restorations.

This is an in vivo as the clinical performance and characteristics of a self adhering flowable composite and conventional flowable composite are difficult to enhance under in vitro conditions. The possibility to evaluate clinical performance, and are considered as a predictor of the possible clinical performance of both the composites. As the purpose of this study was to compare the clinical performance of a self adhering flowable composite resin and conventional flowable composite in conservative class 1 restorations in same oral environment and was only possible in vivo study.

In the study class I cavity was taken i.e pits and fissure caries on occlusal surface of premolars and molars, caries on facial and lingual surface of premolars and molars, caries on lingual surface of maxillary incisors. Patients were informed about the whole process, and an informed consent was obtained from each of them. Class I cavities were undertaken for the study as Class I cavity is the most common among the individuals. Mustafa Demirci et al 2010 stated that Molars and premolar shows the highest caries rates among the young individuals irrespective of gender.[14] Class I cavities were under taken as it is the commonest among all.

The occurrence of dental caries, especially along the pits and fissures on occlusal surfaces of primary and permanent teeth, has been a major cause for concern. Ingenuity in this effort against fissure caries continues, with new materials and technologies being tested each year. When Buonocore in 1955 described acid etch bonding to enamel as a new technology, it was employed in the form of resin sealants for the first time in the prevention of pit and fissure caries.[38]

Conventional resin composites are the standard materials used in the restoration of conservative Class I cavities. The advent of resin-based composites served as a viable tooth-colored alternative to amalgam restorations. However, the most common shortcoming of composite was postoperative sensitivity due to gap formation as a result of polymerization shrinkage especially at the gingival cavosurface margin. However, these materials have a high modulus of elasticity, low flowability , low tendency for stress relaxation, and difficulty to be placed in conservative tooth preparations.[1,4]

To overcome these problems Self adhering flowable composite was introduced in the adhesive dentistry . Bektas OO Eren D et al 2013 stated that the main advantage is that eliminates the need for separate steps for bonding procedure. Due to its self adhesion and flowability properties it provides least possible chair time, less chance for errors , short treatment sessions for patient with multiple restoration done in same visit. [1,11]

Dyad™ Flow, the first self-adhering composite powered by OptiBond™, greatly simplifies direct restorative procedures by incorporating a bonding agent into a flowable. So, no need to bond separately. And Dyad Flow shares the same characteristic inherent in self-etch materials: it reduces the chance of post-op sensitivity.[1,4,37]

However, Glycerophosphate dimethacrylate is hydrophilic, and greater demineralization of dentin than bonding to calcium of hydroxyapatite, producing unstable complex of di-calcium phosphate dehydrate deposited on hydroxyapatite surface that will dissolve gradually in aqueous environment thus deteriorating the interfacial integrity.[39]

The inclusion of the bonding in its formulation, self-adhering resin composites eliminates the additional steps of etching/priming/bonding, otherwise necessary to bond a resin composite to dentin and enamel. In the treatment of patients, showing a difficult behavior mostly in young patients, the use of this category of materials may be very useful. The formulation of self adhering composites involves an adhesive component, which may have some adverse effects on the physical behavior of the

composite. A recent in vitro study by Yong-jie Wei a,b, Nick Silikas , Zhen-ting Zhang, David C.Watts in 2011 has compared the hygroscopic absorption characteristics of various resin based materials. Self-adhering was the least dimensionally stable overall, due to the inclusion of hydrophilic monomers [5]
Regarding the use of flowable composite in posterior restorations are limited and did not present conclusive evidence in the available data in the literature. Moreover, the large variability of products in this category that may lead to different experimental results.[5]

Low filler load in the flowable composite of the initial generation impaired the wear resistance of restorations during the function. Due to their inferior mechanical properties, the flowable composite was not recommended as restorative materials, especially in cavities with high-stress occlusal function.[40] In the small class I cavities, it is expected that there is no heavy occlusal load, because most functional tensions are absorbed by the remaining tooth structure. A systematic review was conducted regarding the use of flowable composites in minimally invasive cavities and non-carious cervical lesions. Despite limited data in literature about the flowable composite, but the best available evidence in the database recommends using the flowable composite in the conservative minimally invasive cavities.[9]

Result of this study showed showed similar efficacy of two restorative materials in conservative Class I restorations though self adhering flowable composite materials showed 5% higher efficacy in hypersensitivity, color match, marginal discoloration and marginal adaptation at both 3 and 6 months as compared to conventional flowable composite. Similar results were obtained by omar osama shalan ,eman abou-Auf, Amira Farid EI Zoghby 2018 in their study they evaluated clinical performance of self adhering flowable composite with conventional floable composite[4] .Another study by preeti Mishra et alevaluated the marginal sealing ability of self adhering flowable composite and marginal sealing ability was better of self adhering flowable composite when used as liner and decreases the micro leakage.[1]

In contrast,Anithakumari Rangappa et al 2018 evaluated the shear bond strength of self adhering flowable composite ,when compared with conventional flowable the self

adhering flowable composite could not achieve the comparable bond strength as traditional flowable composite [41].

Another study by Aleksander Maj et al,2018 evaluating the clinical performance of self adhering flowable composite , in their study self adhering flowable composite when used without etching agent or a bonding system showed the weakest results in marginal adaptation [37].

FOLLOW UP AND EVALUATION

After 3 and 6 months, all restorations were evaluated with no dropouts; the retention rate was 100%. In the current study, self adhering flowable composite has shown clinical performance similar to conventional flowable composite after 3 and 6 months of clinical study ; therefore, the null hypothesis was accepted.

Clinical data available in the literature about clinical performance of self adhering flowable composite were limited. [3] A study by Çelik EU etal.2015 evaluated the performance of the material in non-carious cervical lesions; and it has shown loss of retention after 6 months only, with a failure rate of 66%, the clinical performance of self adhering flowable composite was found to be unacceptable clinically after 6 months of clinical service.[26] The inferior bonding performance of the material was due to lack of macro-mechanical retention and insufficient micro-mechanical retention between the restoration and tooth structure due to limited etching ability of self adhering flowable composite and inadequate removal of the smear layer.[41]

Another study of Kucukyilmaz E, Savas S.2015[8] they evaluated the clinical performance of self adhering flowable composite as pit and fissure sealant; it was the least retentive material, despite preceeding it with acid etching, this may be attributed to its diminished flowability.[8]

Attar N et al, Yalcin Cakir F et al 2014 and Sabbagh J et al 2017 in their studies they evaluated self adhering flowable composite in minimally invasive Class I cavities.[23,42] The results have shown that self adhering flowable composite performed similar to conventional flowable composite when used in conservative Class I

cavities, which was in agreement with the outcome of this research. In small-sized cavities, the use of a flowable composite as a stand-alone restoration has been recommended.[7,43] In Class I cavity preparations even in minimally invasive designs, the presence of macro mechanical retention enhanced the overall clinical performance of self adhering flowable composite , unlike when used as pit and fissure sealant or in non-carious cervical lesions, this may be the reason for the performance of self adhering flowable composite in minimally invasive Class I cavities.[23]

Hypersensitivity, marginal discolouration , retention, color match, and marginal adaptation of both flowable materials have shown (0 score) for all restorations at baseline ,with no statistically significant difference between both groups.

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After 3 months, there was marginal discoloration in 2 restorations using DYAD FLOW Group A, which can be due to the functional monomer (10-MDP) formed stable complexes of calcium–phosphate salts with enhanced hydrolytic stability over time according to Wang R et al.2017 [39] In Filtek Z350XT flowable group B restorations group A, 18 restorations scored 0(zero) after 3months.

For postoperative hypersensitivity at base line. No sensitivity was recorded for Dyad-Flow (Group A) restorations at baseline and after 3 months sensitivity was recorded in two restorations. Acc to Vichi A etal, 2010 and Çelik EU et al 2015 they stated that Dyad Flow dissolved the smear layer and did not remove it; thus, dentinal tubules were kept sealed[3,41]. For postoperative hypersensitivity, at baseline in Filtek Z350XT flowable, 20 restorations (scored zero),at 3 months follow up hypersensitivity was recorded in 3 restorations. Similar study was performed by Vichi et al they stated that no post hypersensitivity was recorded at any evaluation .similar study was performed by Serin A S et al 2019 they evaluated the clinical performances of self adhering flowable composite and concluded with the result that no post-operative sensitivity was observed at any evaluation[35]. The results of postoperative hypersensitivity evaluation revealed no statistically significant differences between restorative materials at baseline (P = 1.000) 3 months (p = 0.633) after 6 months (P = 0.548).[6,7]

However, Glycerophosphate dimethacrylate is hydrophilic, and greater demineralization of dentin than bonding to calcium of hydroxyapatite, producing unstable complex of di-calcium phosphate dehydrate deposited on hydroxyapatite surface that will dissolve gradually in aqueous environment thus deteriorating the interfacial integrity.[44]

For Retention Analysis , at baseline in Filtek Z350XT flowable, 20 restorations (scored zero),at 3 months follow up loss of retention was recorded in 3 restorations and**.** No loss of retention was recorded for Dyad-Flow restorations at baseline and loss of Retention in three restoration were recorded after 3.According to Alessandro vichi,Cecilia Coracci ,Marco Ferrari 2010 in their study they stated that the higher matrix content may also contribute to increased water solubility, possibly affecting the restorations long-term performance.[3] The reduced filler load may also impair the resistance to deformation of the restorations during function. Similar study was performed by Serin A S et al 2019 to evaluate the retension analysis of self adhering flowable composite as occlusal restorative materials in primary molars and evaluated for 1 year and conclude that no lack of retension was seen in any restoration during evaluation period of 1 year.[35]

Glycerophosphate dimethacrylate which is another functional monomer that has the advantage of having two polymerizable groups which can react with other monomers in adhesive systems and resin composite; and this improves quality of the polymer network and enhanced mechanical properties. [4]

For colour match, at baseline in Filtek Z350XT flowable, 20 restorations (scored zero), at 3 months follow up acceptable mismatch was recorded in three restorations (score 1) and unacceptable mismatch was recorded in one restoration (score 2) and for DYAD FLOW group A at baseline 20 restorations (scored zero), at 3 months follow up acceptable mismatch was recorded in one restorations (score 1) and unacceptable mismatch was recorded in two restoration (score 2).

For marginal adaptation , at baseline in Filtek Z350XT flowable, 20 restorations (scored zero), at 3 months follow up clinically acceptable marginal adaptation was

recorded in two restorations (score 1) and for DYAD FLOW group A at baseline 20 restorations (scored zero), at 3 months follow up clinically acceptable discrepencies was recorded in one restorations (score 1). Wei YJ et al they reported that Vertise Flow undergoes hygroscopic expansion. C Rengo et al said that ,this might have contributed to improved marginal adaptation by offsetting resin polymerization shrinkage.[33]

After 6 months, there was marginal discoloration in 3 restorations using Filtek Z350XT flowable group B, Wang R et al they stated that the functional monomer (10-MDP) formed stable complexes of calcium–phosphate salts with enhanced hydrolytic stability over time.[39] In Dyad Flow restorations group A, 18 restorations scored 0(zero) after 6 months, clinically acceptable (1 score) in one restoration and clinically unacceptable (score 2) was observed in one restorations; there was no statistically significant difference between both materials after 3 and 6 months (P = 0.834). The functional monomer glycerophosphate dimethacrylate dissolves gradually in moisture hence affecting the interfacial integrity as mentioned earlier.[45]

For postoperative hypersensitivity, at 6 months follow up three restorations were recorded for hypersensitivity; Çelik EU 2015, Aka B, Yilmaz F. S 2019 and Vichi A, Goracci C, Ferrari M 2010 according to themthis may be attributed to microleakage due to polymerization shrinkage etching with phosphoric acid which removed the smear layer, thus opening up the dentinal tubules[3,41]; sensitivity decreased over time and completely disappeared at 6 months evaluation. Sensitivity was recorded for Dyad-Flow restorations at 6 months it was recorded in one restoration. Dyad Flow dissolved the smear layer and did not remove it; thus, dentinal tubules were kept sealed. The results of postoperative hypersensitivity evaluation revealed no statistically significant differences between restorative materials at baseline (P = 1.000) 3 months (p = 0.633) after 6 months (P = 0.548).[6,7]

For Retention Analysis, at 6 months follow up three restorations were recorded for loss of Retention. for Dyad-Flow restorations loss of Retention in three restoration were recorded after 6 months.

For colour match, at 6 months follow up acceptable mismatch was recorded in three restorations (score 1) and unacceptable mismatch was recorded in one restoration (score 2) and for DYAD FLOW group A at 6 months follow up acceptable mismatch was recorded in one restorations (score 1) and unacceptable mismatch was recorded in two restoration (score 2).

For marginal adaptation, at 6 months follow up no discrepencies were seen and for DYAD FLOW group at 6 months follow up no marginal discrepencies were seen. The results of the present study showed similar efficacy of two restorative materials in conservative Class I restorations though self adhering flowable composite materials showed 5% higher efficacy in hypersensitivity, color match, marginal discoloration and marginal adaptation at both 3 and 6 months as compared to conventional flowable composite.

CONCLUSION

Within the limitation of the current study ,clinical performance of self adhering flowable composite and conventional composite were evaluated and compared on the basis of five parameters(i.e hypersensitivity ,retention analysis , colour match , marginal discoloration and marginal adaptation) , where similar efficacy of both the two restorative materials in class I restorations was observed , though self adhering flowable composite material showed 5 % higher efficacy with four parameter – hypersensitivity , colour match , marginal discolouration and marginal adaptation after 3 & 6 months than conventional flowable composite.

so , it can be concluded that self adhering flowable composite resin can be used successfully in restoring class I cavities as it also has the advantage in its clinical handling properties and ability of reducing the chair time during dental treatment.

However, findings of this study may need further validation on large sample size and longer duration.

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ANNEXURE I

Babu Banarasi Das University
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Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the VIIth Institutional Ethics Sub-Committee

IEC Code: 21 **BBDCODS/01/2019**

Title of the Project: Clinical Evaluation of a Self Adhering Flowable Composite and Conventional Flowable Composite in Conservative Class I Restorations.

Principal Investigator: Dr. Vandana Shukla **Department:** Conservative Dentistry & Endodontics

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

Type of Submission: New, MDS Project Protocol

Dear Dr. Vandana Shukla,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 10th January 2019.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow
2.	Dr. Amrit Tandan Member	Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow
3.	Dr. Rana Pratap Maurya Member	Reader, Department of Orthodontics & Dentofacial Orthopedics, BBDCODS, Lucknow
4.	Dr. Sumalatha M.N. Member	Reader, Department of Oral Medicine & Radiology, BBDCODS, Lucknow

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.
The comments were communicated to PI thereafter it was revised.

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

Forwarded by:

Lakshmi Bala 22/01/19

(Dr. Lakshmi Bala)
Member-Secretary
IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

(Dr. Rajkumar)
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BBD City, Faizabad Road, Lucknow-226028

ANNEXURE II

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES
(FACULTY OF BBD UNIVERSITY), LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Clinical Evaluation of a Self Adhering Flowable Composite and Conventional Flowable Composite in Conservative Class I Restorations."** submitted by **Dr Vandana Shukla** Post graduate student from the **Department of Conservative Dentistry and Endodontics** as part of MDS Curriculum for the academic year 2018-2021 with the accompanying proforma was reviewed by the Institutional Research Committee present on **26th November 2018** 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. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

ANNEXURE III

Formula used for the analysis

Chi-square test

The chi-square (χ^2) test is used to compare the categorical data as

$$\chi^2 = \Sigma\Sigma \frac{(Fij - fij)^2}{fij}$$

where, Fij is the observed frequency while fij the expected frequency. The degrees of freedom (DF) is calculated as

$$DF = (r-1)\,(c-1)$$

Level of significance "*P*" is the probability signifies level of significance. The mentioned *P* in the text indicates the following:

P> 0.05- Not significant (ns)

P< 0.05- Just significant (*)

P < 0.01- Moderate significant (**)

P< 0.001- Highly significant (***)

ANNEXURE IV

MASTER CHART

Group	Sample	Hyper sensitivity			Retention Analysis			Colour Match			Marginal Discoloration			Marginal Adaptation		
		Baseline	3 months	6 months	Baseline	3 months	6 months	Baseline	3 months	6 months	Baseline	3 months	6 months	Baseline	3 months	6 months
Self Adhering Flowable Composite (Group A)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
	10	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	14	0	1	1	0	1	1	0	0	0	0	1	1	0	0	0

	15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	16	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0
	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	2	2	0	2	2	0	0	0
Conventional Flowable Composite (Group B)	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
	11	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
	14	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	17	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0
	18	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ANNEXURE V

सहमति पत्र

अध्ययन का शीर्षक .....।
अध्ययन संख्या .....।
विषय का पूरा नाम .....
जन्म तिथि / आयु .....।
विषय का पता .....।
फ़ोन नंबर और ईमेल पता ....।
योग्यता .....
व्यवसाय: छात्र / स्वयं कार्यरत / सेवा / गृहिणी / अन्य
1. मैं पुष्टि करता हूं कि मैंने प्रतिभागी सूचना दस्तावेज को पढ़ा और समझा है .....। उपरोक्त अध्ययन के लिए और प्रश्न पूछने का अवसर मिला है

या

मुझे अन्वेषक द्वारा अध्ययन की प्रकृति के बारे में समझाया गया है और मुझे प्रश्न पूछने का अवसर मिला है।
2. मैं समझता हूं कि अध्ययन में मेरी भागीदारी स्वैच्छिक है और बिना किसी ड्यूरेस् के स्वतंत्र इच्छा के साथ दी गई है और मैं बिना किसी कारण के बिना किसी भी समय वापस लेने के लिए स्वतंत्र हूं, और मेरी चिकित्सा देखभाल या कानूनी अधिकारों को प्रभावित किए बिना।
3. मैं समझता हूं कि परियोजना के प्रायोजक, प्रायोजक की ओर से काम करने वाले अन्य लोग, आचार समिति और नियामक अधिकारियों को वर्तमान अध्ययन के संबंध में मेरे स्वास्थ्य रिकॉर्ड को देखने के लिए मेरी अनुमति की आवश्यकता नहीं होगी और आगे कोई शोध हो सकता है इसके संबंध में आयोजित किया जाता है, भले ही मैं निशान से वापस लेता हूं। हालाँकि, मैं समझता हूँ कि मेरी पहचान तीसरे पक्ष को जारी किसी भी सूचना में या प्रकाशित होने पर प्रकट नहीं होगी
4. मैं इस अध्ययन से उत्पन्न किसी भी डेटा या परिणामों के उपयोग को प्रतिबंधित नहीं करने के लिए सहमत हूं, बशर्ते ऐसा उपयोग केवल वैज्ञानिक उद्देश्य के लिए हो।
5. मैं भविष्य के अनुसंधान के लिए उपरोक्त अध्ययन में भाग लेने के लिए सहमत हूं
हाँ [] नहीं [] लागू नहीं []
6. मुझे अध्ययन के बारे में समझाया गया है, और उन्हें पूरी तरह से समझा है। मैंने प्रतिभागी / स्वयंसेवक के सूचना दस्तावेज को भी पढ़ और समझ लिया है।

विषय के हस्ताक्षर / अंगूठे का निशान / कानूनी रूप से स्वीकार्य
प्रतिनिधि .....।
हस्ताक्षरकर्ता का नाम .....
अन्वेषक के नाम पर हस्ताक्षर .....
अन्वेषक का नाम ..... .डेट ....

साक्षी का हस्ताक्षर .....
साक्षी का नाम ....
विधिवत भरे हुए सहमति फॉर्म की एक हस्ताक्षरित प्रति प्राप्त की
विषय / कानूनी रूप से स्वीकार्य प्रतिनिधि के हस्ताक्षर / गांठ छाप ..... .Date .....

ANNEXURE VI

CONSENT FORM

Title of the study…….

Study Number…….

Subject's Full Name……

Date of Birth/Age…….

Address of the Subject…….

Phone No. and email address……...

Qualification……

Occupation: Student/Self employed/Service/Housewife/Other

1. I confirm that I have read and understood the Participant Information Document dated ……. for the above study and have had the opportunity to ask questions
   OR
   I have been explained the nature of the study by the investigator and had the opportunity to ask questions.

2. I understand that my participation in the study is voluntary and given with the free will without any duress and that I am free to withdraw at any time, without given any reason and without my medical care or legal rights being affected.

3. I understand that the sponser of the project, others working on the sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trail. However, I understand that my identity will not be revealed in any information released to third parties or published.

4. I agree not to restrict the use any data or results that arise from this study provided such a use is only for scientific purpose(s).

5. I agree to participate in the above study for the future research
   Yes [ ] No [ ] Not Applicable [ ]

6. I have been explained about the study, and have fully understood them. I have also read and understand the participant/volunteer's information document given to me.

Signature/Thumb impression of the subject/Legally acceptable Representative…….

Signatory's Name……..Date…….....

Signature of Investigator's Name……

Study Investigator's Name…….Date……..

Signature of the witness……

Name of witness……..Date……..

Received a signed copy of the duly filled consent form

Signature/Thump Impression of the subject/Legally acceptable representative…….Date……

ANNEXURE VII

URKUND

Urkund Analysis Result

Analysed Document:	thesis cons.docx (D110202422)
Submitted:	7/6/2021 2:58:00 PM
Submitted By:	1180322006@bbdu.ac.in
Significance:	9 %

Sources included in the report:

thesis.docx (D34209436)
https://www.researchgate.net/publication/327700691_Clinical_evaluation_of_self-adhering_flowable_composite_versus_conventional_flowable_composite_in_conservative_Class_I_cavities_Randomized_controlled_trial
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Instances where selected sources appear:

29