COMPARATIVE EVALUATION OF RETENTION AND ANTIBACTERIAL EFFICACY OF POSTERIOR HIGH STRENGTH GLASS IONOMER CEMENT AND GLASS HYBRID BULK FILL ALKASITE RESTORATIVE MATERIAL AS CONSERVATIVE ADHESIVE RESTORATION IN CHILDREN WITH MIXED DENTITION – AN IN VIVO STUDY.

By
Dr. SANJANA P. SONETA
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Under the Guidance of

Dr. SHIVAYOGI M. HUGAR$_{\text{M.D.S.}}$

DEPARTMENT OF PEDIATRICAND PREVENTIVE DENTISTRY
KAHER'S KLE VISHWANATH KATTI
INSTITUTE OF DENTAL SCIENCES,
NEHRU NAGAR, BELAGAVI -10, KARNATAKA.

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Karnataka

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Date:

Place:Belagavi **Dr.Sanjana P. Soneta**

KLE Academy of Higher Education and Research, Belagavi

Karnataka

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Guide
Dr. Shivayogi M. HugarM.D.S.
Professor and Head,
Department of Pediatric& Preventive Dentistry,
KAHER'S KLE VK Institute of Dental Sciences, Belagavi.

Date:
Place: Belagavi

CERTIFICATE BY THE CO-GUIDE

This is to certify that the dissertation entitled **"Comparative Evaluation Of Retention And Antibacterial Efficacy Of Posterior High Strength Glass Ionomer Cement And Glass Hybrid Bulk Fill Alkasite Restorative Material As Conservative Adhesive Restoration In Children With Mixed Dentition – An In Vivo Study."**is a bonafide research work done by **Dr. Sanjana P. Soneta** in partial fulfillment of the requirement for the degree of Master of Dental Surgery (M.D.S.) in Pediatric and Preventive Dentistry (Branch – VIII).

Guide
Dr. Seema Hallikerimath M.D.S.
Professor,
Department of Oral Pathology and Microbiology,
KAHER'S KLE VK Institute of Dental Sciences, Belagavi.

Date:
Place: Belagavi

Karnataka

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HOD

Dr. Shivayogi M. Hugar$_{M.D.S.}$
Professor and Head,
Department of Pediatricand Preventive Dentistry,
KAHER's KLE VKInstitute of Dental Sciences,
Nehru Nagar, Belagavi-590010.

Date:
Place: Belagavi

Principal

Dr. Alka D. Kale$_{M.D.S,\ Ph.D.}$
Principal,
KAHER's KLE VKInstitute of Dental Sciences,
Nehru Nagar, Belagavi-590010.

Date:
Place: Belagavi

KLE Academy of Higher Education and Research, Belagavi

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ABSTRACT

AIM: To compare and evaluate the retention and antibacterial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk FillAlkasite restorative material as a conservative adhesive restoration in children with mixed dentition.

METHOD: Sixty children of age 6-12 years with mixed dentition were selected fulfilling inclusion and exclusion criteria and divided into two groups: Posterior High Strength Glass Ionomer Cement(Group I) and Glass Hybrid Bulk FillAlkasite restorative material(Group II). After thorough oral prophylaxis and baseline collection of saliva, restorative treatment was carried out using the two materials. Retention of the material and Salivary *Streptococcus mutans* and *Lactobacillus species*count (CFU/ml of saliva) was estimated at 1 month, 3 months and 6 months after restorative procedure.

RESULTS: The retention rate withGlass Hybrid Bulk FillAlkasite restorative materialgroup was 100% whereas with Compomer group it was 90% at end of 6 months. Statistical significant reduction in salivary *Streptococcus mutans* colony count was seen with both the groups at all the different time intervals. Maximum reduction was noted in Glass Hybrid Bulk Fill group at 3 monthsintervals and gradual reduction was seen with Compomer group.

CONCLUSION: Among both the materials, Glass Hybrid Bulk Fill restorative material showed better retention rate as compared to Posterior High Strength Glass Ionomer Cement but it was not statistically significant. And both the materials have shown good antimicrobial activity after 6 months follow up.

KEYWORDS: Antimicrobial, Children, Conservative Adhesive Restoration,Glass Hybrid Bulk Fill restorative material,Posterior High Strength Glass Ionomer Cement.

LIST OF ABBREVIATIONS

1.	A	Alpha
2.	AAPD	American Academy of Pediatric Dentistry
3.	ART	Atraumatic Restorative Treatment
4.	B	Beta
5.	C	Charlie
6.	CAR	Conservative Adhesive Restoration
7.	Ca^{++}	Calcium Ions
8.	CO_2	Carbon dioxide
9.	CS	Compressive Strength
10.	CS	Cention N self-cure
11.	CL	Cention N Light Cure
12.	CFU	Colony Forming Unit
13.	CM	Chemomechanical
14.	DCP	Tricyclodecan- dimethanoldimethacylate
15.	DTS	Diametral Tensile Strength
16.	deft/defs	Decayed extracted filled teeth
17.	DMA	Dimethacrylate
18.	DMFT	Decayed Missing Filled Teeth
19.	ELISA	Enzyme Linked Immuno Absorbent Assay

20.	$[F]_c$	Cumulative fluoride release in time t seconds
21.	$[F]_1$	Total fluoride available
22.	F^-	Fluoride ions
23.	GIC	Glass Ionomer Cement
24.	GI	Glass Ionomer
25.	GC	General Chemicals
26.	G	GIC
27.	h/hrs	Hours
28.	H^+	Hydrogen Ion
29.	HFR	High Failure Rate
30.	IgA	Immunoglobulin A
31.	IRB	Institutional Review Board
32.	ISO	International Organization for standardization
33.	LB	Lactobacillus
34.	LED	Light Emitting Diode
35.	LC	Light cure
36.	MIC	Minimum Inhibitory Concentration
37.	MSA	Mitis Salivarius Agar
38.	MID	Minimum Intervention Dentistry
39.	MIH	Molar Incisor Hypomineralization
40.	MS	*Mutans Streptococci*
41.	mm	Millimeters
42.	No.	Number
43.	mL	Milliliters

44.	OH^-	Hydroxide ions
45.	PEG-400 DMA	Polyethylene glycol 400 dimethacrylate
46.	PRR	Preventive Resin Restoration
47.	pH	PouvoirHydrogene
48.	POS	Post-operative sensitivity
49.	RMGIC	Resin Modified Glass Ionomer Cement
50.	s	Seconds
51.	SD	Standard Deviation
52.	SIgA	Secretory Immunoglobulin A
53.	SE	Standard Error
54.	SEM	Scanning Electron Microscope
55.	SBS	Shear Bond Strength
56.	SM	*Streptococcus mutans*
57.	SOP	Standard Operating Protocol
58.	t	Time
59.	$t_{1/2}$	Time taken for fluoride release to drop by a half
60.	µL	Microlitre
61.	µm	Micrometer
62.	UTM	Universal Testing Machine
63.	USPHS	United State Public Health Service
64.	UDMA	Urethane Dimethacrylate
65.	VAS	Visual Analogue Scale
66.	WHO	World Health Organization
67.	W/w	Weight By Weight Ratio Percentage

68.	ZFR	Zero Failure Rates
69.	%	Percentage

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INTRODUCTION

"Individual curiosity, often working without practical ends in mind, has always been a driving force for innovation."

- Fedrick Seitz

Oral health is integral part to general health which in turn is essential for well-being of all human kind. Inspite of foremost progress and advances in preventive dentistry, with globalisation on the rise, there is an ever increasing rate of caries seen in children. Dental caries is most common among the spectrum of oral diseases and is still a major public health burden in developing countries, affecting 60%-90% of children. [1,2]

The paradigm around the quintessential treatment and management of carious lesions has been altering. Conventional restorative approaches, with the school of thought on the complete removal of carious tooth surface followed by placement of a restoration has been substituted by more biological and less invasive approaches, which focuses on biofilm control and its disruption to arrest caries. Also, in the time of need for a restorative treatment the focus is more on preserving the natural tooth structure. [3]

In antecedent the most accepted treatment for restoring carious teeth in children according to G.V Black's principles involved ***''Extension for Prevention''*** concept of cavity preparation. This brain wave includes removal of carious lesion by extensive preparation and also inclusion of susceptible pits and fissures which sequentially results in weakening of the overall tooth structure.[4] The gold standard

material of choice for restoration in these types of cavity preparation was amalgam due to its ease of application, proven clinical longevity (durability), good mechanical properties like compressive strength and low cost.[5] Even though amalgam was considered as the gold standard came with certain detriment related to it like esthetics, technique sensitivity, marginal leakage, extensive tooth structure removal, dentine discoloration and at the same time the toxicity of mercury for child patient has been a matter of controversy.[6]

There has been an increase concern about toxicological burden in the environment due to its content of mercury and also its issue with the patient safety has lead the current European and International authority concerned about it's operation. With keeping all this in light a gradual phasing out of amalgam was seen and inevitable, thus alternative basic filling products are long overdue.

From the evolution in caries management of G.V Black's "***Extension for Prevention***" to ***"Prevention of Extension"*** (Minimally Invasive Dentistry) - Simonsen (1985) described a minimally invasive preparation of tooth and restoration, which he named as Preventive Resin Restoration (PRR) or Conservative Adhesive Restoration (CAR) which represent an evolution in the use of biomimetic restorative materials on posterior teeth of children. This conservative tooth preparation only removes carious pit and fissures, using small burs, with tooth removal barely reaching into the dentin (without involving susceptible pits and fissures) and then restored with biomimetic restorative materials like Glass Ionomer Cement, composites, compomers etc. [4]

According to Simonsen conservative adhesive restoration is classified as [4]

Type A: Caries removal is limited to enamel

Type B: Incipient lesion in dentin that is small and confined

Type C: Characterized by need for greater exploratory preparation in dentin.

Conventional high strength posterior Glass Ionomer Cement is the basic ideal filling material of choice in the treatment of first permanent molar with conservative adhesive restoration in children due to its advantages of being aesthetically acceptable, adhesive to the tooth and release of fluoride. It is also simple, economical and does not require complicated dental equipment and can be used in small conservative restorations.

As every coin has got two sides, even Glass Ionomer Cements has certain disadvantages like poor mechanical property which is unsuitable for large posterior restorations in stress bearing areas, since its compressive strength is less compared to amalgam. The conventional Glass Ionomer Cement does not neutralize the acidic environment on tooth effectively. Studies have been conducted in the recent past to oversee the disadvantage such as secondary caries occurrence and increased salivary levels of *S. Mutans* in Glass Ionomer Cements restored tooth, which in turn affects the longevity of the restoration.[7]

Increasing needs for better tooth coloured restorative materials to replace missing tooth structure, better adaptability to the tooth contour that has equally good

physical, chemical and mechanical properties of amalgam, composite have led to evolutionary development of new filling materials.

Recently, a new basic tooth coloured filling material glass hybrid bulk fill restorative material - Cention N, has been introduced with added advantages over amalgam, Glass Ionomer Cements and Composite. The Cention N is a tooth coloured, resin based, basic bulk filling material for direct restorations. It is self-curing powder/liquid with optional additional light curing. The "Alkasite" Cention N thus redefines the basic filling, combined bulk placement, ion release, durability in a dual-curing, radiopaque, capable of releasing acid-neutralizing ions (fluoride, calcium and hydroxide), esthetic product - satisfying the demands of both dentists and patients. Cention N is intended as a good alternative for restoring deciduous and permanent teeth in a Class I, II and V tooth preparation.

It utilizes an alkaline filler (calcium fluorosilicate and isofiller), capable of releasing acid-neutralizing ions (hydroxyl ions, fluoride ion and calcium ions) which can further help to prevent demineralization of the tooth substrate. The release of ions depends on the pH value in the oral cavity. When the pH is low (acidic) due to an active plaque biofilm i.e. highly active cariogenic bacteria, Cention N releases a significantly larger number of ions than when the pH value is neutral.

This Alkasite material is a combination of Urethane dimethacrylate (UDMA), Dimethacrylate (DMA), Tricyclodecan- dimethanol dimethacylate (DCP), an aromatic aliphatic- Urethane dimethacrylate (UDMA) and Polyethylene glycol 400 dimethacrylate (PEG-400 DMA) which has a cross linking property resulting in strong mechanical properties and good long-term stability. It also contains hydroperoxide (self-curing) and Ivocerin photo initiator providing Cention N it's

additional light curing property. It does not contain Bispheno A- glycidyl methacrylate (Bis-GMA), 2- hydroxyethyl methacrylate (HEMA) or Triethylene glycol dimethacrylate (TEGDMA). It has pre-eminent mechanical strength, compressive strength than glass ionomers, good handling and better esthetics than both amalgam and glass ionomers. It is a relatively translucent material (transparency 11%) compared to other Glass Ionomer based products.

The most dominant etiological agents that are at the helm of causing human dental caries are *Streptococcus mutans* (SM) and other *Mutans streptococci* (MS). These species have been implicated as the main causative agent for dental caries and have a number of important characteristics which promote their cariogenic potential. These characteristics include the ability to colonize smooth surfaces of teeth, aggregate with *Streptococcus mutans* (SM) and other organisms.[8]

These organisms thrive by the cleavage of sucrose into a 1-3-1 linked insoluble and a 1-6-1 linked soluble glucans, and produce lactic acid, which demineralizes the enamel to form carious lesions. Restoring carious tooth remains the optimal treatment and has been thought to eliminate cariogenic organisms from the area of the restored lesion. However, few reports have established increase numbers of oral bacteria before and after restorative treatment. [8]

Research conducted in the former times have shown a correlation between salivary levels of *Mutans streptococci* and the restoration longevity. High caries activity, associated with high numbers of specific cariogenic microorganisms, may be the common factor determining the frequency of both restoration placement and restoration failure.[8] It was reported that the prevalence of *Streptococcus mutans* in dental plaque was reduced following complete restorative treatment. As teeth are

bathed in saliva and saliva may serve as a source of cariogenic organisms to susceptible sites, it is important to establish changes in numbers of salivary *Mutans streptococci* (MS) following clinically successful restorative treatment. Various attempts have been made to improve the efficacy of materials by combining properties of Glass Ionomer Cement and resin modified Glass Ionomer Cement to be used as restorative materials of choice in children.[9]

When the literature search was carried out there were no studies carried out in Indian Scenario or worldwide to evaluate and compare the retention and antimicrobial efficacy of posterior high strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as Conservative Adhesive Restoration in children with mixed dentition. So, an attempt was made to carry out this research to evaluate and compare retention and antimicrobial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite Restorative material as conservative adhesive restoration in children with mixed dentition.

AIM AND OBJECTIVES

AIM OF THE STUDY:

The aim of the study was to compare and evaluate the retention and antibacterial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a Conservative Adhesive Restoration in children with mixed dentition.

OBJECTIVES OF THE STUDY:

1. To evaluate the retention of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a Conservative Adhesive Restoration in children with mixed dentition.

2. To evaluate the retention and antibacterial of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a Conservative Adhesive Restoration in children with mixed dentition.

3. To compare the retention and antibacterial of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a Conservative Adhesive Restoration in children with mixed dentition.

RESEARCH HYPOTHESIS

NULL HYPOTHESIS:

There is no statistically significant difference in the retention and antibacterial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a Conservative Adhesive Restoration in children with mixed dentition.

ALTERNATIVE HYPOTHESIS:

There is a statistically significant difference in the retention and antibacterial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a Conservative Adhesive restoration in children with mixed dentition.

REVIEW OF LITERATURE

LITERATURE IN RELATION TO MINIMAL INTERVENTION DENTISTRY:

-

"The perpetual preservation of what remains is much more important than the meticulous replacement of what is lost". Over the past 20 years the concept of Minimally Invasive Dentistry (MID) has been promoted at both national and international level. It is method that has emerged from the concept of 'more conservative caries removal method'. It can be most accurately be described as an approach to the management of caries, which utilizes caries risk assessment and has a focus on the early prevention and interception of disease. A review article on Minimum intervention dentistry (MID) discusses the key principles and philosophy of patient care and the practical objectives which flow into individual patient care. Moving the focus away from the restoration of teeth allows the dentist to achieve maximum intervention with minimal invasive treatments modalities to be used. To promote internal healing of the dentine various bioactive materials are used.

The four core principles of Minimum intervention dentistry (MID) can be summarized by four R's namely:

(1) Recognition: to identify and assess any potential caries risk factors early, through lifestyle analysis, saliva testing and using plaque diagnostic tests;

(2) Reduction: to eliminate or minimize caries risk factors, through altering fluid balance, reducing the intake of dietary cariogenic foods and increasing the pH of the oral environment;

(3) Regeneration: to arrest and reverse incipient lesions, regenerating enamel subsurface lesions and arresting root surface lesions using appropriate topical agents including fluorides and casein phosphopeptides-amorphous calcium

(4) Repair: when cavitation is present and surgical intervention is required, as much as possible of the tooth structure is maintained by using conservative approaches to caries removal.[10]

A study was conducted using Preventive Resin Restoration (PRR) technique to evaluate the retention and caries protection of flowable resin composite and flowable compomer to conventional preventive resin technique. It integrates a preventive approach of sealant therapy for caries susceptible pits and fissures with therapeutic restoration. This preparation only removes carious pit and fissures, using small burs, with tooth removal barely reaching into the dentin; short conservative tooth preparation and restored with biomimetic restorative materials like GIC, composites etc. According to Simonsen it is classified as

Type A: Caries removal is limited to enamel

Type B: Incipient lesion in dentin that is small and confined

Type C: Characterized by need for greater exploratory preparation in dentin.

In this study 205 permanent molars with small carious cavities were selected in which 75 teeth were treated with flowable resin composite and 59 teeth were kept as control group which were filled with resin composite. The teeth were evaluated at 3, 6, 12, 18 and 24 months. It concluded that flowable resin composite and flowable compomer and similar retention when compared to conventional composites and so suggested that it can be used for preventive resin restoration.[4]

LITERATURE IN RELATION TO GLASS IONOMER CEMENT: -

The Glass Ionomer Cements were introduced by Wilson and Kent in the year of 1972 and were subsequently introduced in dentistry by 1988. These cements belong to a class of acid based cements, which are formulated by the reaction of weak polymeric acid with powdered glass of basic character. They were initially termed and popularized by the name of Glass – Ionomer but according to International Organization for standardization (ISO) they are termed as "glass polyalkenoate cement". These cements are basically composed of three key ingredients:

1. Water soluble acids
2. Basic (ion-leachable) glass
3. Water

The basic setting reaction presents itself as an aqueous solution achieved by mixing of polymeric acid and fine glass particle in a folding method. (Figure No. 1)

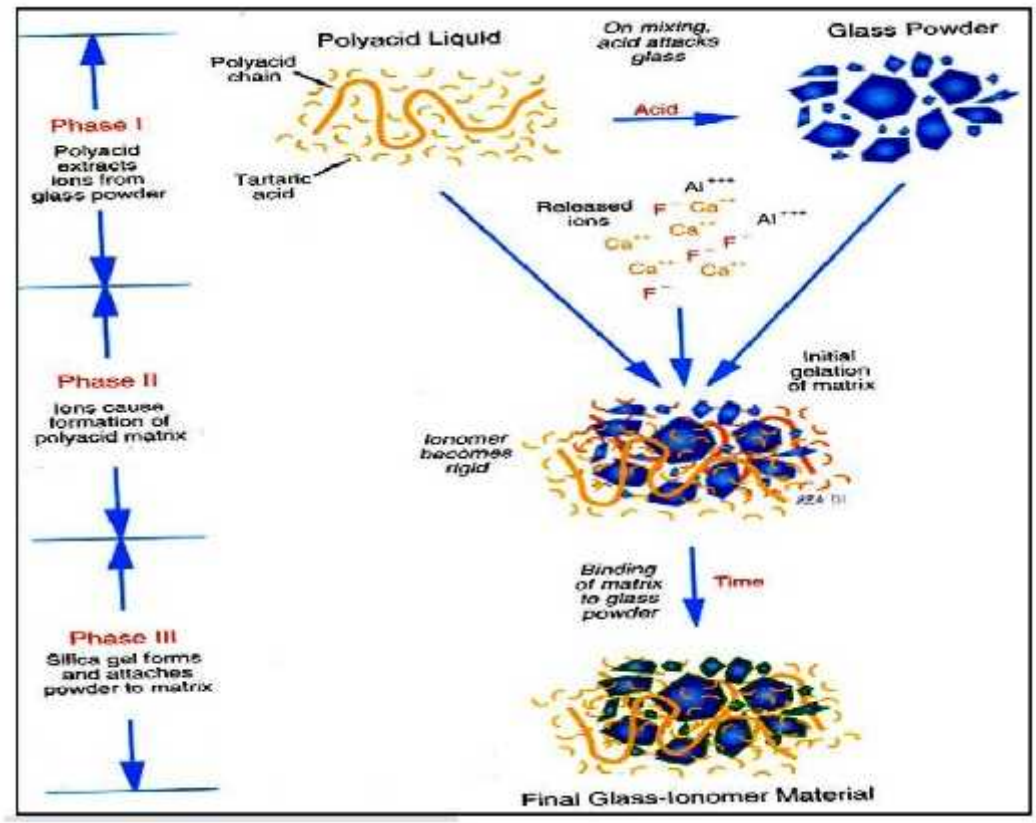


Figure No1: Figure showing setting reaction of Glass Ionomer Cement

The setting time of glass polyalkenoate cement is 2-6 mins according to the ISO standards. The main advantage of Glass Ionomer Cements is its ability to sustain for a very long time, and it's ability of an initial rapid release (early burst) and slow sustain diffusion based release of fluoride. This pattern can be easily understood by

$$[F]_c = ([F]_1 x\sqrt{t} / (t + t_{½}) + \beta . \sqrt{t}$$

Early Burst long term diffusion

Here, $[F]_c$=Cumulative fluoride release at time t seconds,

$[F]_1$= Total fluorideavailable,

t = Time

$t_{1/2}$ =Time taken for fluoride release to drop by a half[11]

Areview was done to understand the role of Glass Ionomer Cements in minimal intervention dentistry. Minimal intervention technique was a brain child of World Health organization (WHO) who aimed in providing dental treatments in low and middle income countries where unreliable or non-existent electrical supplies subsisted.

The material selected for the cause was Glass Ionomer Cements, because of its chemo mechanical bonding to the tooth structure and its sustained release of fluoride in the acidic environment. These cements were mixed in a viscous consistency and were placed in a prepared cavity by the use of hand instruments. The success rate observed was 90% in 2-3 years period when restorations were placed in class I and V cavities. Minimal invasive technique along with Glass Ionomer Cements have also gained

popularity in the treatment of minimal caries and children who are usually apprehensive with the use of airotor.[12]

A pilot study was conducted to compare the longevity of Glass Ionomer Cement with the use of two different minimally invasive method over the period of 12 months.This study was a randomized control trial with split mouth design wherein fifty pairs of permanent molars were selected. The selected molar pairs were randomly divided into two groups using sealed envelope technique. In the control group the molars treated using Atraumatic Restorative Technique (ART) while in the test group they were treated with chemo mechanical (CM) cavity preparation. Isolation was achieved and the tooth was cleaned with the wet cotton before the procedure was undertaken. In the test group gel was applied on the tooth structure for 30 seconds (s) and the carious dentine was scrapped away using hand instruments. In the control group the cavity was prepared using enamel hatchet and spoon excavators. Both the groups were restored with Type II Glass Ionomer Cement and were coated with vaseline after completion of the restoration using finger pressure for 30 sec. The restoration were clinically evaluated at baseline and after 12 months. The finding of the study revealed that a durable adhesive bond of GIC to tooth surface is seen because of the high quality of tooth/GIC interface. The results of the study showed that both the minimally invasive methods were highly appropriate for the restoration by Glass Ionomer Cements. They further highlighted that both of these methods can be used in the dental practice routinely and Glass Ionomer cements showed remarkable antibacterial activity and had the potential to remineralize the residual carious dentin.[13]

The amount of fluoride release by Glass Ionomer Cements and its contemporary play an important role in their selection for clinical application. In this regards an in vitro study was conducted to check the fluoride release from conventional and resin modified Glass Ionomer Cements. Concentrationsof the fluoride ions released were evaluated by thefluorideselective electrode potential. Total of 108 discs were prepared and were divided into Group I: Conventional Glass Ionomer Cements,Group II. Resin modified Glass Ionomer Cements. The specimen were placed in 5ml deionized water and were evaluated for fluoride ion release after 8 hrs. and 24 hrs. The result was recorded and was subjected to statistical analysis. The results of the study concluded that resin modified Glass Ionomer Cements showed statistically higher release of fluoride ions due to the availability of free ions in the resin matrix than the conventional Glass Ionomer Cements.[14]

With the use of Glass Ionomer Cements on a regular basis a major concern transpire is its effect on the surrounding tissue and organ. To be more informed about the cement an in vitro study was conducted to check the cytotoxicity of conventional and Resin Modified Glass Ionomer Cements (RMGIC).Osteoblast cell cultures and cellcultures of mouse fibroblasts specimens were prepared to evaluate cytotoxicity of experimental, conventional and resin modified Glass Ionomer Cementsthey were further divided into 4 groups group I: Conventional Glass Ionomer Cements,Group II. Resin modified Glass Ionomer Cements, group III. Positive control was presented by specimens of composite Vit-l-ecence. and negative control-group IV: waspresented by α-minimum essential medium for osteoblast-like cells and Dulbecco's Modified Eagle‘s Medium for mousefibroblast cells. Both cell cultures were exposed to 10% of eluate of each single specimen of each experimental material. 24 hoursincubation was done for theexperimentaldishes. Cell metabolism was evaluated using methyl

tetrazoliumassay. The result was recorded and was subjected to statistical analysis. The results of the study stated that Glass Ionomer Cements were formed by reaction of aqueous solution of polymeric acid with fluoraluminosilicate glass powder whereas Resin Modified Glass Ionomer Cements contained hydrophilic monomers and polymers which were responsible for the enormous cytotoxic effect. The study concluded that resin modified Glass Ionomer Cements showed more cytotoxicity of osteoblast and fibroblast than the conventional Glass Ionomer Cements.[15]

With the popularization of Glass Ionomer Cements a question often raises is about its strength to withstand posterior masticatory forces. To be more cognizant about the topic a study was conducted to compare and evaluate the shear bond strength to dentine of various Glass Ionomer Cements in primary teeth. In this, seventy two deciduous molars with intact surfaces were selected and were divided into three groups. Group A: Conventional type II GIC, Group B: Type II light cure (LC) GIC, and Group C: Type IX GIC. To simulate oral conditions thermocycling was done and after 24 hours, InstronUniversal testing Machine at crosshead speed of 0.5 mm/minute was used to determine shear bond strength until the tooth fractured. The values were calculated and were subjected to statistical analysis. The results of the study showed that the shear bond strength was highest in Group B light cure Glass Ionomer Cement due to its dual cure mechanism which in turn enhances its property to its adherance to tooth structure via ion exchange mechanism as well as micromechanical bonding. Group C type IX Glass Ionomer Cement showed a considerable shear bond strength owed to its small particle size and high powder:liquid ratio which makes it wear resistant, less moisture sensitive and increases its flexural strength than the conventional Glass Ionomer Cements.The

study concluded that light cure Glass Ionomer Cement had better shear bond strength followed by Type IX and Type II Glass Ionomer Cements.[16]

Antimicrobial property is one of the key criteria in selection of a restorative cement since recurrent caries is one of the serious problem of this era. To gauge the restorative cements on this property,a study was done to compare and evaluate antimicrobial efficacy of resin modified Glass Ionomers Cements, Compomers and Giomers. A total of 30 discs were prepared and were equally divided into three experimental groups to check for its antimicrobial efficacy. *S. mutans* were used in the study to check for antimicrobial efficacy of the test materials. Brain heart infusion agar was used for diffusion test, wells were prepared in the agar of diameter 5mm and 2mm depth with the help of agar punchers. In the wells material disc were placed and were left for 24hours to check its efficacy. The data was collected, tabulated and subjected to statistical analysis. The result of the study concluded that resin modified these Glass Ionomers Cements showed superior antibacterial and highest mean of zone of inhibition due to its ability to release free fluoride in the first phasewhen compared to Giomers and Compomer whose fluoride ion are bound in the filler particle.[17]

Although glass ionomer cements have been advantageous in most of the aspect one major disadvantage still persists is about its load bearing capacity in posterior restoration. To overcome its disadvantage many efforts have been taken to research this aspect and a relatively newer generation of cement that are the glass hybrid cements have been manufactured and popularized. In this regard a study was conducted which aimed to evaluate the survival rate of glass hybrid restoration placed under Atraumatic Restoration Treatment (ART) technique is first permanent molar

affected by Molar Incisor Hypoplasia (MIH). Sixty teeth with severe MIH associated to carious dentin lesion without pulpal involvement were selected. The carious tissue was removed with sharp excavators, the cavity was then conditioned using cavity conditioner for 10 seconds. After washing the cavity using cotton pellet soaked in water, the cavity was isolated and dried with dried cotton pellet. The cavity was then restored with glass hybrid restoration system. The treatment was evaluated at 6 and 12 months by an independent examiner using ART criteria .The data was then collected and subjected to statistical analysis .The results of the study showed that the success rate of the restorative material was 98.3% after 6 and 12 months. The results of the study showed that the restoration done using a glass hybrid restorative system performed under ART technique proved to be an effective approach to preserving first permanent molars affected by MIH, this finding was due to the materials ability to micromechanically bond to the tooth structure and also because of its protective light cure coat which reduces the surface wear and makes it a smooth finish restoration. [18]

Another in vivo study was conducted to evaluate Equia with resin modified Glass Ionomer Cement and nanohybrid composite in non-carious cervical lesion. A total of 29 patients with 87 cavitated lesion with 1-3mm of cavitation depths were selected .The patients then were equally divided into three different groups. The lesion were cleaned with prophylactic paste and rubber cups to remove deposit at the time of restorations. Isolation was achieved using cotton roll, salivary ejectors and the restoration was carried out. The subjects were recalled at the end of 1 month, 6months and 1 year for evaluation of retention, staining, marginal staining ,marginal adaption, surface roughness and post-operative sensitivity of the restoration according to the United State public health criterion (USPHS). The evaluation was carried out by a single blinded investigator. The result of the study showed that no statistical

difference was found between Equia, Glass Ionomer Cement and nanohybrid compositesand however clinically Equia showed an overall better performance than the other two materials because of its micromechanical bonding and chemical interlocking with the hydroxyapatite in the tooth structure. The mechanism propose is in two steps at first, there is formation of an ion exchange layer thereafter there is bonding which give rise to modified hybrid zone with the tooth structurewhich in turn increases the overall strength and durability of the tooth structure. [19]

LITERATURE IN RELATION TO GLASS HYBRID BULK FILL ALKASITE RESTORATIVE MATERIAL: -

In modern dental practice numerous direct filling materials are available to the dental practitioners. From dental amalgams to Glass Ionomer Cements to bulk fill composites, but still the quest of best posterior bulk fill restorative material with high strength, less microleakage and good aesthetics persists. A novel “alkasite” material which is a subgroup of composite utilizes an alkasite filler, which is capable of releasing acid neutralizing ions has been recently introduced. This novel cement is a tooth coloured direct restorative material which has the ability to release fluoride, hydroxide and calcium ions which prevents demineralization of the tooth surface, reduces plaque which in turn prevents dental caries. The ion release largely depends upon the pH of the oral cavity, when the pH is low i.e. acidic it releases significantly large number of ions (Figure No. 2). This alkasite material has a dual cure property, which makes it eligible for bothself-cure and optimal light cure. The self-cure system is made up of an initiator system consisting of copper salts, peroxide and thiocarbamide in its powder component and hydroperoxide in the liquid portion, due to this initiator it has greater temperature resistance and hence it can be stored for long

durations. This material fulfils the lacunae and disadvantage of both Glass Ionomer Cements and composites.[20]

Figure No.2: Schematic representation of low (left) and high (right) levels of calcium, fluoride and hydroxyl ion release, depending on the pH in the oral cavity

A study was conducted to compare the release of fluoride ion and to check alkalizing potential of a new bulk fill Alkasite material (self-cure and light-cure) to that of Glass Ionomer Cement. Glass Ionomer cements have been the gold standard for restoring carious tooth in pediatric dentistry. It has an advantage of fluoride release, which prevents enamel demineralization and promotes remineralization. However there are certain disadvantages related to it such as lack of flexure strength,

which makes it a weak restorative material for posterior tooth. In this study forty five specimen were selected and were disinfected in 0.1% thymol solution. The teeth were then sectioned into four parts mesiodistally and buccolingually to obtain 180 samples. The samples were randomly divided into three equal group namely GIC (G), Cention N self-cure (CS) and Cention N Light Cure (CL). These three groups were further divided into two subgroups based on its pH (Acidic pH and Neutral pH). These subgroups were further divided into three groups based on its duration (7,14 and 21 days). The results of the study showed that the acidic pH showed higher release of fluoride ion compared to the neutral pH this might be due to increase surface dissolution of the surface resistant layer in low pH condition. Also fluoride ion release from all the test material decreased with increased time duration except for the Glass Ionomer Cement group. The study concluded that Cention N (light cure) showed the highest amount of alkalizing and fluoride releasing property when compared to both the other groups.[21]

An in vitro study was done to determine the demineralization inhibition potential of Cention N. Class V cavity were prepared on thirty extracted permanent molars. A nail varnish was applied on the buccal surface within one millimeter of the prepared tooth surface. These teeth were divided into three groups, Group 1: Cention N, Group 2 : non fluoridated composited and Group 3:Resin modified Glass Ionomer Cements. The tooth were stored in artificial saliva and then they underwent 36 cycles thermocycling at 55^{O} C and 5^{O} C. The teeth were sectioned buccolingually after 2 weeks to check the enamel demineralization. The results of the study showed that Resin modified Glass Ionomer Cements showed less enamel demineralization than Cention N. HoweverCention N showed significantly less demineralization of the tooth structure than composites resin. This result might be due to Cention N property to

release ions such as fluoride, hydroxide and calcium ions which in turn prevents demineralization of the tooth surface.[22]

For a direct posterior restoration one of the chief properties is a good compressive strength which guarantee the durability of the restoration. An invitro study was conducted to compare and evaluate the compressive strength of Cention N to that of Glass Ionomer Cements. For the success of posterior restoration a restorative cement must possess good compressive strength to withstand the masticatory force. Cylindrical molds were prepared which were customized with the dimension of 6±1mm (height) × 4±1mm (diameter) were used and 10 samples each of Cention N and Glass Ionomer cement were fabricated. Universal Testing Machine (UTM) was then usedto evaluate the compressive strength of both the materials, load was applied to the samples at 0.75±0.25 per min cross speed till the samples undergo fracture. The result of the study concluded that Cention N can be considered as a suitable restorative material for restoring posterior tooth and also it proved to be a superior alternative to Glass Ionomer Cements (GIC) Type IX since it had significantly higher compressive strength. This high compressive strength is attributed to the fact that Cention N uses cross- linking methacrylate monomer in an amalgamation with efficient self-curing initiator. This facilitates high network density in the comprehensive depth of restoration.[23]

An in vitro study was conducted to compare and evaluate the mechanical property i.e. the compressive strength (CS) and diametral tensile strength (DTS) of four different restorative material. A total of 80 samples were made using a mold with the four restorative materials used for the study namely GIC (Fuji IX), ClearFil AP-X, Filtex Z350-XT, and Cention N. These groups were further divided into two sub

groups to check the compressive strength (CS) and diametral tensile strength (DTS). The test was carried out using the Instron universal testing machine that has a crosshead speed of 1.0 mm/minute and the values were recorded of each fracture samplewhich had reached the maximum load. The results of the study concluded the highest compressive strength and DTS was observed with nanohybrid composite ClearFil AP-X and it was further noted that the properties of Z350-XT and Cention N were similar to quite extent. They also further mentioned that Glass Ionomer Cement (Fuji IX) exhibited the minimum values when equated with that of the other materials.[24]

An invivo study was conducted to evaluate the mechanical properties of Cention N and to compare them with conventionally used restorative materials. In this study restorative material used for sample fabrication were Cention N, amalgam, Glass Ionomer Cement and Hybrid composite resin. Eighty samples were preparedand were divided into two equal group used to determine the compressive strength (n =40) and flexural strength (n =40).The samples were further divided into subgroups based on the restorative material to be tested and were subjected to universal Instron testing machine (UTM). The result of the study showed that the flexure and compressive strength of hybrid composite resin was highest amongst all. Cention N showed better compressive strength when compared to Glass Ionomer Cement and amalgam because of its monomer composition of Urethane Dimethacrylate (UDMA) which has a high flexure strength. The study concluded that Cention N suitable and can be used in various restorative procedure due to its aestheticsand mechanical property. [25]

Proximal areas are usually prone to moisture sensitivity which acts as a source of contamination, this increases chances of microleakage leading to restoration

failure. Mechanical strength of restorative material is of paramount importance to resist restorative failure in proximal region. To check the effectiveness of Cention N for its shear bond strength and resistance to microleakage a study was conducted to compare and evaluateCention N, Nano- Filled Composite and Ketac Molarprimary molars in terms of their microleakage and shear bond strength for restoration of primary molar teeth. Primary teeth restoration is challenging due to their thin enamel walls, its morphology, greater incidence of cervical and proximal caries. Various materials used in the past have shown microleakage and fracture restorations which leads to secondary caries. In this study sixty intact primary molars, were collected and randomly assigned in 3 groups on the basis of the restorative material and 2 subgroups on the basis for the evaluation of microleakage and shear strength. Class V cavities were prepared on the buccal surfaces of the teeth which were measuring 5 x 2 x 1.5 millimeters. The teeth were restored using Cention N, Nano- Filled Composite and Ketac Molar. Thirty samples were randomly selected from all the three groups which were used to check the dye penetration by using 0.1% Methylene blue for 24 hours. The remaining samples were used to determine the shear bond strength using Zwick Universal testing Machine at crosshead speed of 5 millimeter/ minute with 110 kilogram load cell until fracture. The results of the study showed that Cention N had better microleakage propertyand shear bond strengththan Ketac Molar and Nano-filledbecause its high polymerizing network density and its isofiller which adapts to the tooth surface very meticulously. It was also found that Cention N has a high flexure strength in the entire depth of restoration. [26]

Another study was conducted to compareand evaluatethemicroleakage around classV cavities restored with alkasite restorative material with and without bondingagent and flowable composite resin. Thirty samples were collected andclass

Vtooth preparations was carried out. They were divided into three groups Group I restored with Cention Nwithout adhesive, Group II was restored with Cention N after application ofbonding agent and Group III wasrestored with flowable composite resin. All samples were subjectedto temperature baths at 5°C and 55°C for 200 thermocycles. With the help of diamond saw the restored samples were equally cut longitudinallythrough the center and were placed in methylene blue dye for 24 hours. They were then rinsed and observed under stereomicroscope. The result of the study highlighted that the microleakage was found to be significantly higher at dentine restoration interface when compared to enamel restoration interface. The study concluded that microleakage was observed least in Group I: Cention Nwithout adhesive than the other two groups because shrinkage stress in Cention N acts as a spring owing to its low elastic modulus which brings it closer to the dentine restoration interface hence preventing microleakage.[27]

An invivo study was done to compare the microleakage in class II preparations using three different direct restorativematerials that are amalgam, Glass Ionomer Cements and Cention N. Recently extracted thirty sound mandibular first molars were selected which were submerged in 2.6% sodium hypochlorite solution and were rinsed under running water for 10 min. A standard class II cavity was prepared and was divided into 3 groups based on the restorative material used. Group I: The silver amalgam, Group II: Type II GIC and Group III: Cention N. The teeth were sectioned longitudinally to obtain two equal section and was dipped in 0.5% basic fuchsine dye for24 h. these samples were then studied under stereomicroscope. The results of the study concluded that the samples restored with Cention N showed minimal microleakage property when compared to the other two groups due to its low modulus of elasticity which prevents shrinkage during polymerization. [28]

A review article was done on Cention N which highlighted its properties compared to other restorative materials. The variety of direct filling materials available for the moderndental practitioner for posterior load bearing restorations have increase. The main concerns still persistsregarding the longevity and performance in the oral environmentand their ability to bearstress, durability, integrity of marginal sealing and aesthetics. From silver amalgam through to modern day bulk fillcomposites all have their certain disadvantages which leads to a further quest in finding the dental material which has the advantage of both. Cention N is recently introduced tooth-coloured, basic filling material forbulk placement in retentive preparations with or without theapplication of anadhesive. It is an "alkasite"restorative which is a new category of filling material, essentially a subgroup of thecomposite resin. The formulae includes a patented filler (Isofiller), which has low elastic modulus and acts as ashrinkage stress reliever which in turn reduces polymerization shrinkage and microleakage. The material is cost effective and does not require any special expertise to master it and hence can be considered as a suitable alternative for posterior restorations.[29]

An invitro study was conducted to evaluate the hardness of different restorative materials (restorative GIC, Cention N, nanohybrid composite resin and silver amalgam). The samples were prepared with the help of 5mm diameter straw cut in to 3mm in length. The molds were prepared in the cylindrical shape and restorative material were inserted into each mold. The 40 samples so prepared were divided into groups and were subjected to experimentation. Group I - Type II Glass Ionomer cement, Group II - Cention-N, Group III - nanohybrid composite, Group IV - silver amalgam. The specimen were stored in distilled water for 24 hours at 37^{o}. The samples were then randomly tested with microhardness indenter. The microhardness

indenter were used to make fine indentation in the center of the surface, mean of the microhardness were taken by Vicker's hardness tester. The result of the study showed that Cention N exhibited the highest microhardness value followed by silver amalgam,nanohybrid composite resin and Type II GIC. The study concluded that Cention N showed better microhardness properties due to its patented Isofiller hence it is more clinically suitable option for minimally invasion treatment.[30]

Plaque accumulation, surface discoloration, gingival inflammation, secondary cases are most common problems associated with surface roughness. One of the key steps during restoration is its finishing and polishing. A glossy and a smooth surface can be achieved when the restorative material has less surface disparity between the matrix and filler particle. To understand this concept in depth a study was conducted to evaluate and compare the surface roughness of Cention N and Filtek Z350 XT resin composite. In recent years, the use of resin composites in restorative dentistry has prominently amplified due to increased demand for esthetics. To achieve acceptable aesthetics a surface roughness of below 0.2 μm has been recommended which is optimal in reducing bacterial harbor and accumulation of plaque which can be accomplished by following essential finishing and polishing procedure. In this study Sixty four samples were prepared in plastic mold of 8mm diameter and 2mm thickness using Cention N and resin composite material. They were further divided into two subgroups based on the finishing and polishing material used (mylar strip group and soflex group). The results of the study showed that Filtek Z350 XT showed lower surface roughness when compared to Cention N. The study concluded that all the four groups showed clinically accepted surface roughness value < 0.2 μm. [31]

Sensitivity of the tooth after restoration is one of the most common chief complaint by patients hence, a randomized controlled trial was done to compare and evaluation postoperative sensitivity (POS) in Class I posterior restorations usingthree bulkfill restorative materials (Cention N, Equia Forte, Activa^{TM} Bioactive). Total of 144 patients having caries in permanent molars were selected and divided into three equal groups.Application of rubber dam was done to achieve appropriate isolation and preparation of Class I cavity was done using 245 no straight fissure diamond bur. The dimensions and depth of the prepared cavity was:

- 1.5 mm from central groove
- 4 mm in length mesiodistally
- 2 mm bucco palatally

After the cavity preparation the cavity were restored with the material assigned to the group. Post-operative sensitivity was assessed by cold test and air stimulus of each restored tooth at 24 hrs., 7 days, and one month using visual analogue scale (VAS). The result of the study concluded that post-operative sensitivity is seen least with Activa^{TM}bioactive restorativematerial as compared to Equia forte and Cention N at 24 hrs. however at the interval of 1week and 1 month, post- operative sensitivity was present with patients treated withEquia forte and Cention N and it was absent with Activa^{TM}bioactive restorative material. [32]

LITERATURE IN RELATION TO *STREPTOCOCCUS MUTANS AND LACTOBACILLUS SPECIES*: -

A study was conducted to evaluate the effect of restorative treatment on *Mutans streptococcus* and IgA antibodies.Children from age 4-10years with no medical history were selected for the study.Decayed, missing (extracted/ exfoliated),

filled teeth (DMFT/defs) were recorded and unstimulated salivary sample before the procedure and 1-4weeks after the procedure was subjected to microbiological investigations.Restorative procedure included of amalgam, composite resins or stainless steel crowns.The *S.mutans*count was determined and the results were subjected to statistical analysis.

The results of the study drew 3 conclusions: -

1)There was no statistical difference in pre and post restoration numbers of total oral *Streptococcus mutans.*

2)When subjected to ELISA there was no significant difference seen in IgA antibody levels to *S.mutans* pre and post treatment.

3)No significant correlation was seen between bacterial counts and IgA antibody levels.[9]

A study was conducted with objective to monitor *Streptococcus mutans* count in saliva of children aged 5-7 years over a period of 6 months with the subsequent use of Fuji IX Glass Ionomer Cement in Automatic Restorative Techniques (ART). One hundred children were selected to receive art using Fuji IX Glass Ionomer Cement. Caries status of the patient was recorded using Decayed, missing (extracted/ exfoliated), filled teeth (DMFT), saliva was collected for microbiological assessment of Streptococcus mutans count on four occasion i.e baseline 1week, 1month and 6 months. The results were recorded and were statistically analysed using non-parametric Mann Whitney rank test. The result of the study showed a significant reduction of *Streptococcus mutans* levels in saliva immediately after 1 week following the restoration. The study concluded that the ART technique was successful

in reducing the *Streptococcus mutans* count in saliva significantly from a period of 1 week post treatment, although the mean *Streptococcus mutans* count remained less than the baseline after 6 months evaluation a trend towards re-establishment of *Streptococcus mutans* to the baseline count was noticed. [33]

A study was done to compare and determine the influence of Glass Ionomers Cement and amalgam restoration on the level of *Streptococcus mutans* in interproximal plaque at periodic intervals. For this purpose seventy adult patients having two proximal carious lesions in any quadrant of the jaw were selected. Carious lesion was determined clinically and by using bitewing radiograph. One of the two carious lesion was restored with Glass Ionomers Cement and the other was restored with amalgam. Plaque samples were collected from interproximal area at baseline, 9 months and 3 months postoperatively. They were then subjected to microbiological evaluation using gram staining. The result of the study concluded that there was no statistically significant difference seen in both the restoration. The study further concluded that Glass Ionomers Cement restorations have definite advantage on the amalgam as the tunnel preparation is more conservative and fluoride release from the Glass Ionomers Cement inhibits the growth of *S. mutans* in the plaque.[34]

A study was undertaken to investigate the possibility of a relationship between restoration longevity and putative determinants of caries activity, including salivary levels of *Mutans streptococci* (MS), *Lactobacilli* and salivary flow rate. Recurrent caries has been shown to be the most common reason for the replacement of dental restorations. The study was carried out in two phases. In the first phase restoration longevity was investigated retrospectively in 70 adult patients. Based on the results a subset of the original patient population was identified characterized by a High

Failure Rate (HFR) for dental restorations. In the second phase prospective follow up study was undertaken on patients from theHigh Failure Rate (HFR) group, and the results compared were with patients found to have Zero Failure Rates (ZFR) for dental restorations in the retrospective study. The clinical examinations and saliva collections was performed. Morning saliva samples was collected and serial dilutions of saliva were prepared which were inoculated on to *Mitis Salivarius* bacitracin agar and incubated. Restoration failures in the retrospective phase of the study were evaluated. It was found that just 12% of a randomly selected patient sample accounted for 50% of all the restorative treatment experience. Thesesubjects represented a high-risk group who were particularly prone to have restorations replaced and showed an associated with *Mutans streptococci* (MS) and*Lactobacill*in their saliva .[8]

The aim of the study was to evaluate salivary level of *Streptococcus mutans* related to filled teeth with the levels related to decayed and sound teeth, to establish whether the presence of restorations may increase the risk of infection of other teeth by *Streptococcus mutans*. Salivary *Streptococcus mutans* level reflects the dental plaque level and a relationship exists between the presence of fillings and the salivary concentration of *Streptococcus mutans.*So in this study Salivary *Streptococcus mutans* detection (i.e. more than 1 x $l0^4$ CFU/ml) and counts were evaluated. *Streptococcus mutans* log count means and prevalence values of subjects with only sound teeth (Group l), with filled without decayed teeth (Group 2), with decayed without filled teeth (Group 3), were calculated. Log count means and prevalence values of Group 2 subjects were significantly lower than values of Group 3 subjects (means, 0.92 vs 1.66; prevalence, 73.17% vs 94.63%) and statistically not-different from values of Group 1 subjects (mean 0.75; prevalence, 70.06%). The risk of *Streptococcus mutans* being detected in saliva was not affected by filled teeth more than sound teeth and

showed that the reason for increase in bacterial count was mainly due to the decay. Hence concluded that treatment of a carious lesion would cause a lowering of *Streptococcus mutans* concentration to the same levels as those shown by healthy subjects.[35]

A review was done on *Streptococcus mutans*, caries and stimulation models. The review states that oral microbiota functions as a part of the host defence by acting as a barrier. There is a diversity of species found in the oral cavity which are not pathogenic unless under certain conditions. One of such species is *Streptococcus mutans*.There are 3 steps in plaque formation first salivary molecules, bacterial interaction and third step is accumulation of more bacterial species. To prevent the formation of plaque there are certain measures to take one of which can be achieved by mechanical oral hygiene procedures. A lot of time this might not be enough so an emphasis should be given on addition of antiplaque or ant microbiological agents. The review concluded that dental caries is one of the most common and costly disease in the world. Thus strategies to reduce the risk of disease are important and should be developed.[36]

MATERIALS AND METHOD

The present in vivo study was designed to evaluate the retention and antibacterial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as a conservative adhesive restoration in children with mixed dentition.

The study was conducted in the Department of Pediatric and Preventive Dentistry with the assistance from the Department of Oral Pathology and Microbiology, KLE Academy of Higher Education and Research'sKLEVK Institute of Dental Sciences, Belagavi. Ethical clearance for the study was obtained from the Institutional Review Board (IRB) of the KLE VK Institute of Dental Sciences Belagavi[Sl.No.: 1218].**(Annexure I)**

The following are the armamentarium used for the clinical procedurein the study: [Figure No.3, 4, 5, 6]

- Dental chair with illumination
- Kidney trays
- Disposable mouth mask (Ramson's Care Plus, Ramson Health Care, Bangalore)
- Disposable head cap (Ramson's Care Plus, Ramson Health Care, Bangalore)
- Disposable gloves (Rakshak, Ramya Impex Pvt. Ltd., Mumbai)
- Mouth mirror
- Straight probe
- Explorer

- Spoon Excavator
- Cotton rolls (Prabhat Surgical Cotton Pvt. Ltd., Tumkur, Karnataka, India)
- Disposable 2ml syringes (Unolok Hindustan Syringes & Medical Devices Ltd., Faridabad, India).
- Pair of tweezers.
- Airotor(NSK, 18032).
- Diamond burs (Mani diamond burs, SS Dental Supply).
- Dental hatchet
- Rubber dam kit (Hygienic Fiesta Colour Coded clamps and Dental Dam – ColteneWhaledent Inc.)
- Glass Ionomer Cement(GC Gold label H.S. Posterior Extra,Lot no: 1905201).
- Cention N(IvoclarVivadent, Leuven, Lot no: 684196).
- Articulating paper (Articulating Paper Superior, Deepashree Products G–711 MIDC Ratnagiri).
- Light curing gun. (woodpecker)

The following are the armamentariumused for the microbiological assessment in the study: [Figure No.7].

- Mitis Salivarius Agar (MSA) media with bacitracin and tellurite (Himedia Laboratories, Mumbai).
- Buffering Solution: 0.5M Phosphate Buffer (pH 7).[Spectrum reagents and chemicals Pvt Limited, Kochi India]
- Transport Medium: Thyioglycollatemedium.(0000094113,Himedia Laboratories Pvt Limited, Mumbai, India)
- Sorbitol Powder
- Petridish
- Gram Staining: Gentian violet, Iodine, Spirit, Saffronin.
- Anaerobic Jar (Himedia laboratories Pvt Limited, Mumbai, India).
- Test tubes
- Vortex Mixer (IKA Industries, India. Lot no: 06.005044).
- Platinum Loops for inoculation
- Anaerobic gaspak(LE002F, 1.5 L Himedia laboratories Pvt Limited, Mumbai, India).
- Incubator (Yorco, York Scientific Industries, IndiaLot no: 1835460).
- Hot air oven (Sterimed, India,19734)
- Light Microscope (Magnus, Olympus Korea, Lot no: 10G340).
- Stereomicroscope (Labomed SZ 790, India, Lot no: 97036).

MATERIAL & ARMAMENTARIUM USED IN THE STUDY

Figure No.3: Photograph showing clinical armamentarium used in the study.

Figure No.4: Photograph showing restorative armamentarium used in the study.

Figure No.5: Photograph showingPosterior High strength Glass Ionomer Cement (GC Gold Label) material used in the study.

Figure No.6: Photograph showing Glass Hybrid Bulk Fill Alkasite restorative material (Ivoclarvivadent)material used in the study

Figure No.7: Photograph showing armamentarium used for microbiological assessment in the study.

SOURCE OF DATA:

Patients reporting to the outpatient department of the Department of Pediatric& Preventive Dentistry at KLE Academy and Higher Education and Research'sKLE VK Institute of Dental Sciences, Belagavi who fulfilled the inclusion and exclusion criteria were selected for the study.

Written informed consent was obtained from all the parents of children participating in the study **(Annexure IIa, IIb).**Assent was obtained from all the children participating in the study **(Annexure III).**

STUDY DESIGN:

This is a two arm parallel group double blinded patient randomized controlled study with treatment provided in theDepartment of Pediatric and Preventive Dentistry. The participants were allocated to one of the groups in order to evaluate the retention and antimicrobial properties of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material.

SELECTION OF SUBJECTS:

Subjects for the study were selected according to the following inclusion and exclusion criteria.

INCLUSION CRITERIA USED IN THE STUDY:

- Children with mixed dentition (6-12 years of age)
- Maxillary or mandibular firstpermanent molars with occlusal caries (class I) involving enamel or dentin (Type 1 or Type 2Conservative adhesive restoration)
- Children having 1-2 decayed teeth.
- Children residing in Belagavi city.

EXCLUSION CRITERIA USED IN THE STUDY:

- Children with proximal carious lesions
- Children with deep carious lesion
- Children with special health care needs
- Children taking any medications that will affect the nature and volume of salivary flow.
- Children with any intra oral appliances.

SAMPLE SIZE:

Samples required for the study was selected as per the inclusion and exclusion criteria.

The sample size was calculated according to the following formula:

$$n = \frac{2S^2}{d^2} \quad (Z_{1-}\alpha/_2 + Z_{1-}\beta)^2$$

Where:

n = 30 in each group

d = 3.9897, α error = 5%, Zα =1.96,Z_{β} = 1.037

S_1= 3.5454, S_2= 5.654

$$S = \frac{S_1+S_2}{2}$$

(α = probability of type I error, Z_{β} = power of the study, S = standard deviation, d = mean difference.)

Based on the previous study where the confidence level is 85%, the probability is 0.05**.**[37]Thus the sample size derived was 26 in each group. Considering the 15% dropout, the sample size chosen was 30 in each group.

So, a total of 60 sample size wasselected and divided into two study groups of thirty each.

STUDY GROUP AND RANDOMIZATION:

All the sixty samples of the study group were equally divided into two equal groups by simple random sampling using computer allocation method to ensure standardization.

Group I(Control Group) :30 subjects allocated to Posterior High Strength Glass Ionomer Cement.

GROUP II (Experimental Group):30 subjects allocated to Glass Hybrid Bulk Fill Alkasite restorative material.

The randomly generated sequence was sealed in closed envelope. An independent Paediatric Dentist from the department was designated in the allocation of the children to the two groups. The envelope was opened during the treatment after obtaining informed consent.

METHOD OF COLLECTION OF DATA

A. SELECTION OF CASE AND RECORDING OF CASE HISTORY:

A case history was recorded in a special format prepared for this study**(Annexure IV).**Caries status was recorded using deft/ DMFT as per WHO 1997 guidelines[38]**(Annexure V).**The findings were recorded and pre-operative intra oral photographs and intra oral periapical radiographs were taken to assess the depth of the carious lesion[Figure No.8, 9]. Oral prophylaxis was done and saliva sample was collected to assess the baseline *Streptococcus mutans* countand necessary treatment was given.All the procedures of patient selection, saliva collection, restoration and post-operative assessment were carried out by a single investigator to avoid any bias.

Figure No. 8: Photograph showing pre-operative intraoral photograph and radiograph of mandibular first permanent molar with caries involving enamel in Posterior High Strength Glass Ionomer Cement. [Group I]

Figure No.9: Photograph showing pre-operative intraoral photograph and radiograph of mandibular first permanent molar with caries involving enamel in Glass Hybrid Bulk Fill Alkasite restorative material.[Group II].

B. PROCEDURE OF SALIVA COLLECTION:

Children in both the groups were asked not to eat or drink anything for two hours prior to collection of saliva. Also they were told not to use any mouthwash in that duration. Patient was seated comfortably on dental chair. The saliva was collected between 9 – 11 am.[39]Collection of the sample was carried out by suction method using sterile disposablesyringes.[40][Figure No.10]Standardized oral hygiene practices were explained to the patient and reinforced at every visit.

Figure No.10: Photograph showing collection of saliva by suction method.

Figure No.11: Photograph showing Thioglycolate transport media.

Saliva was collected for microbiological assessment of *Streptococcus mutans*count on four occasions:

- Baseline (before the intervention)[S1].
- 1month [S2].
- 3 months [S3].
- 6 months[S4].

A total of 1 ml of unstimulated saliva was collected and put into the bottle containing 1 ml ofThioglycolate Transport media[Figure No.11].The sample was transported to the Department of Oral Pathology & Microbiology, KLE Academy of Higher Education and Research'sKLEVK Institute of Dental Sciences, Belagavi. immediately after collection and processed on the same day.

The sample was inoculated on the Mitis Salivarius Agar, Methicillin Resistant Streptococcus Aureus and with potassium tellurite medium and bacitracin. The plates were incubated at 37 °C in 5-10% CO_2 jar for 48 hours.

C. PROCEDURE OF TOOTH PREPARATION FOR RECEIVING RESTORATION:

The operator and the assistant were trained by the Pediatric Dentist from the Department of Pediatric and Preventive Dentistry to perform Conservative Adhesive Restoration (CAR) using the Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite Restorative material and asked to follow Standard OperatingProtocol (SOP). After performing 10 restorations under the supervision of Pediatric Dentist Principal investigator (PI) was allowed to start the research work.

After comfortably seating the patient on the dental chair, the procedure was completely explained to the parents as well as the children by the principal investigator. The teeth selected for the study were isolated using rubber dam and fluoride free pumice prophylaxis was carried out on the concerned tooth. The tooth preparation for class I cavity was carried out to receive the restorations using high speed round diamond points according to Minimally Invasive Dentistry (MID)principles under Standard OperatingProtocol.

Teeth were equally divided into two groups and restored with Posterior High strength Glass Ionomer Cement (GC Gold Label) in Group I and Cention N (IvoclarVivadent) in Group II respectively.

In the control group (Group I) following the isolation of tooth, caries removal was done selectively depending on the depth of the carious lesion. After drying of the cavity,Posterior High Strength Glass Ionomer Cement was mixed and placed on the tooth surface using the cement carrier. The restoration was then condensed using a condenser and varnish was applied on the tooth surface. Occlusion was checked with an articulating paper for any occlusal irregularities[Figure No.12 (A-F)].

The immediate post-operative evaluation of all the restoration was done by an experienced examiner (Pediatric Dentist) in the Department of Pediatric and Preventive Dentistry and findings were recorded in a master chart.

A. Pre-operative photograph

B. Cavity prepared

C. Drying of cavity

D. Placement of the restorative material

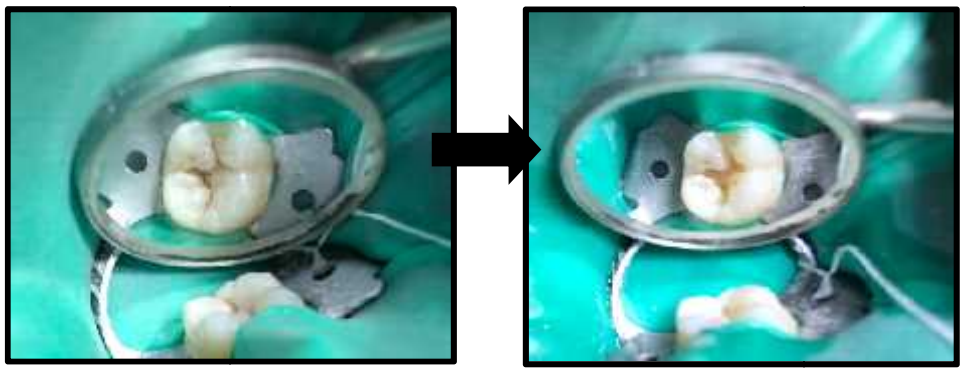
E. Carving of the restoration

F. Application of petroleum jelly

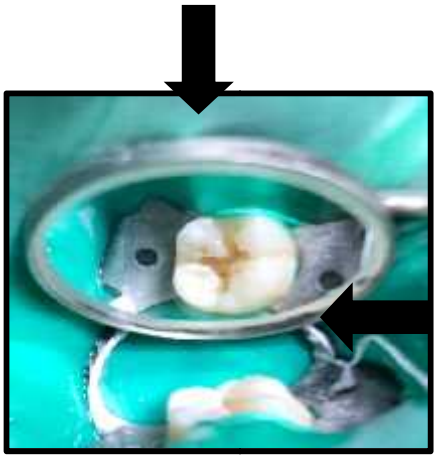
Figure No.12 (A-F): Photograph showing step by step procedure of restoration in Posterior High Strength Glass Ionomer Cement.(Group I).

In experimentalGroup (Group II) following isolationof the tooth, caries removal was done selectively depending on the depth of the carious lesion. In addition unsupported enamel was removed with a hatchet. After drying the cavity,a scoop of Cention-N powder and a drop of liquid was disposed on the mixing pad. The material was mixed and with the help of a cement carrier the restorative material was placed on the prepared cavity. Self-curing of the restorative cement for 4 mins (including the mixing and working time) was observed. Thereafter, light cure for 30s was done. [Figure No.13 (A-F)]. Occlusion was checked with an articulating paper for any occlusal irregularities.

The immediate post-operative evaluation of all the restoration was done by an experienced examiner (Pediatric Dentist) in the Department of Pediatrics and Preventive Dentistry and findings were recorded in a master chart.



A. Pre-operative photograph **B. Cavity prepared**



D. Carving of the restoration **C. Drying of**

E. Curing of Cention-N **oration**

Figure No.13 (A-F): Photograph showing step by step procedure of restoration in Glass Hybrid Bulk Fill Alkasite Restoration Group (Group II)

D. MICROBIOLOGICAL PROCEDURE:

CULTURE AND ISOLATION OF BACTERIA:

The collected salivary sample were received and processed on the same day. The saliva samples were diluted in 0.05 M Phosphate buffer (pH = 7.0) to the dilution 10^{-1} and agitated for 30 seconds on Vortex mixer [Figure No.14 (a, b, c)]. 100 µl of the dilution was inoculated each on the Mitis Salivarius Agar, Methicillin Resistant Streptococcus Aureus with potassium tellurite medium and bacitracin [Figure No.15]. The plates were incubated at 37 °C in 5-10% CO_2 jar for 48 hours. After 48 hours, the *Streptococcus mutans* colony was identified using Gram staining and sorbitol fermentation test under light microscope [Figure No.16]. The number of colony forming units (CFU) of *S.mutans* in saliva were determined using Stereomicroscope [Figure No. 17, 18].

The conversion of colonies into CFU/ml was done by:

CFU/ml = No. of colonies x Dilution factor / Volume inoculated in ml

Where,

Dilution factor = 0.1

Volume inoculated = 0.1 ml

(a) **(b)** **(c)**

Figure No.14: Photograph showing (a) Incubator, (b) Hot air oven, (c) Vortex mixer used for microbiological assessment in the study.

Figure No.15: Photograph showing inoculation of agar plate with platinum loop.

Figure No.16: Photograph showing Light Microscope used in the study.

Figure No. 17: Photograph showing Stereomicroscope used in the study.

Colonies of *S. mutans*

Colonies of *lactobacillus species*

Figure No. 18: Photograph showing the growth and colonization of *Streptococcus mutans*and *lactobacillus species*at Baseline before restoration.

Figure No.19: Photograph showingimmediate post-operative Intra oral photograph after restoration withPosterior High strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material.

After completion of treatment [Figure No.19**]**patientswere made to sit and checked for high points and given post-operative instructions.

E.POST OPERATIVE INSTRUCTIONS:

Patients were given post-operative instructions as follows:

- Not to drink or take water for thirty minutes.
- Not to eat anything for one hour and have a soft diet for next 24 hours.
- Patient were asked to report to the dental clinic if any kind of pain or sensitivity was present or patient had any kind of discomfort during mastication.
- Patient were asked to report to the dental clinic if they noticed any kind of fractured restoration.
- Patient were asked not to report to any other dental clinic for any other treatment till the research work was completed.

F. FOLLOW UP AND EVALUATION:

Patients were recalled for follow up at 1 month, 3 months, and 6 months interval. During follow up, restorations were evaluated for checking retention of the restoration as per United State Public Health Service (USPHS) Ryge criteria[41][Figure

No 20,21,22,23,24,25], for evaluation of salivary *Streptococcus mutans* level [Figure No 26,27,28,29,30,31] and evaluation of salivary *Lactobacillus species* level [Figure No 32, 33, 34, 35,36,37] to checkfor antibacterial effectiveness.

The criteria for follow up of evaluation of retention of restoration is as follows:

- Alpha (A) Restoration is intact and fully retained.
- Bravo (B) Restoration is partially retained with some portion of the restoration still intact.
- Charlie (C) Restoration is completely missing.

The summary of methodology of the study is explained as a flow diagram **(Annexure VI).**

Clinical evaluation of Posterior High strength Glass Ionomer Cement restoration at 1 month, 3 months and 6 months follow up in Posterior High Strength Glass Ionomer Cement group [Group I]

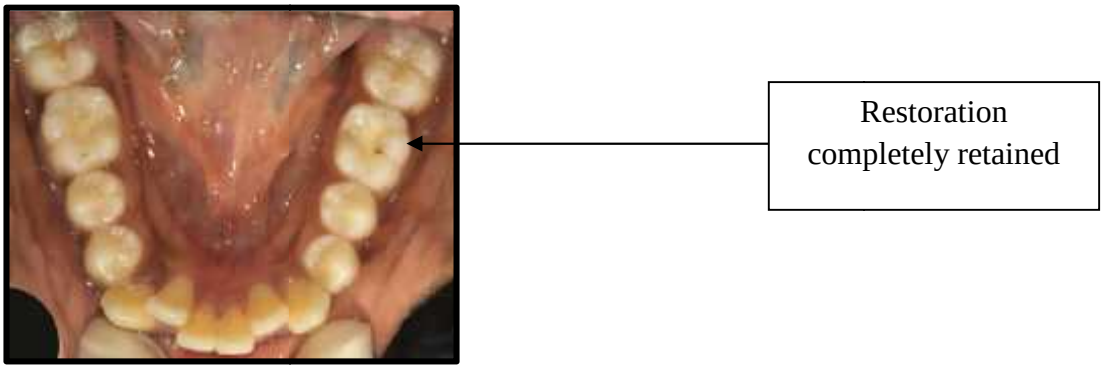


Figure No.20: Photograph showing the complete retention of Posterior High strength Glass Ionomer Cement restorationat 1 month interval.

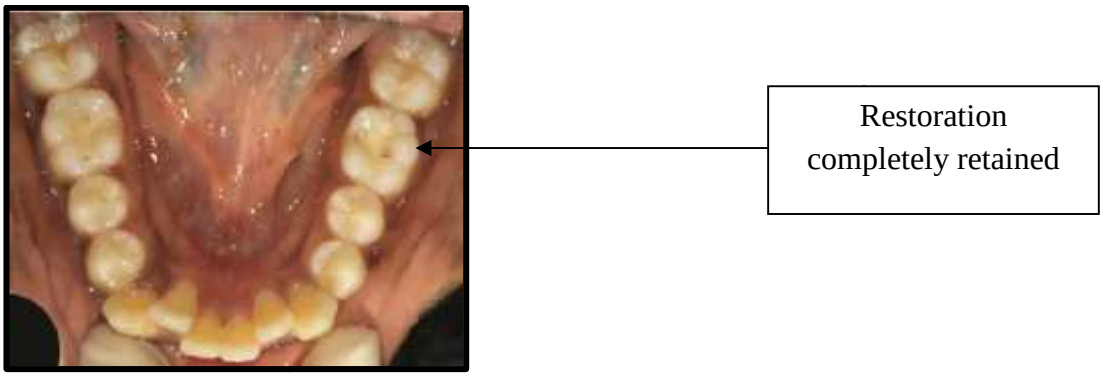


Figure No.21: Photograph showing the complete retention of Posterior High strength Glass Ionomer Cement restoration at 3 months interval.

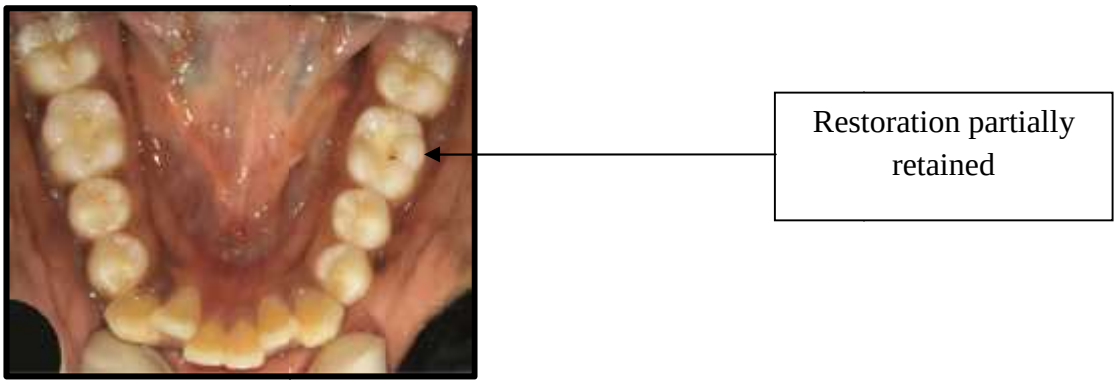


Figure No.22: Photograph showing the partial retention of Posterior High strength Glass Ionomer Cement restoration at 6 months interval.

Clinical evaluation of Glass Hybrid Bulk Fill restoration at 1 month, 3 months and 6 months follow up in Glass Hybrid BulkFill Alkasite Restorationgroup [Group II]

Restoration completely retained

Figure No. 23: Photograph showing the complete retentio

Fill Alkasite restoration at 1 month i

Restoration completely retained

Figure No. 24: Photograph showing the complete retentio

Fill Alkasite restoration at 3 months in

Restoration completely retained

Figure No. 25: Photograph showing the complete retention of Glass Hybrid Bulk Fill Alkasite restoration at 6 months interval.
Microbiological evaluation at 1 month, 3 months and 6 months follow up for Posterior High strength Glass Ionomer Cement restoration Group [Group I].

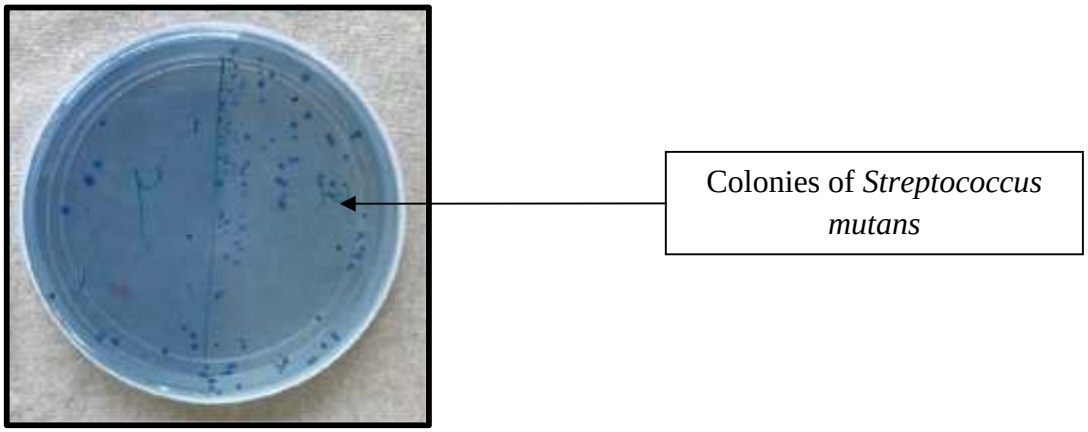


Figure No. 26: Photograph showing the growth and colonization of *Streptococcus mutans* at 1 month afterPosterior High strength Glass Ionomer Cement

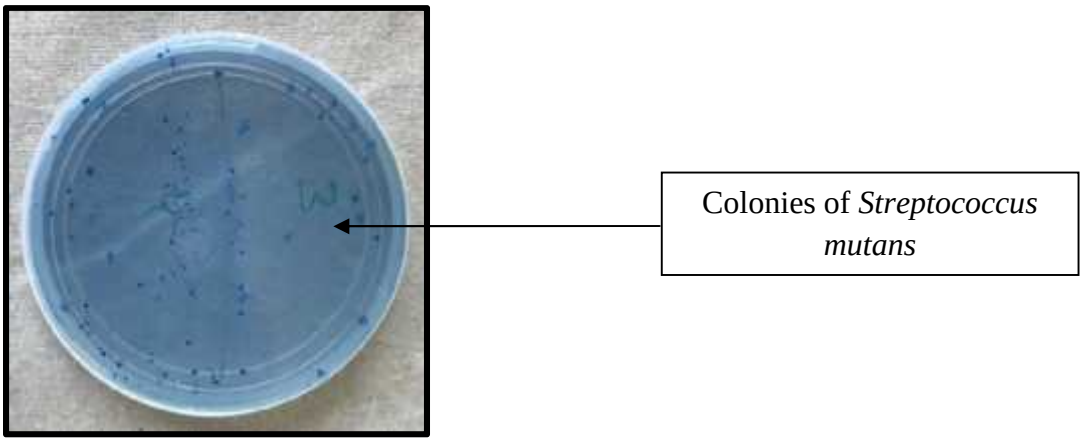


Figure No. 27: Photograph showing the growth and colonization of *Streptococcus mutans* at 3 months afterPosterior High strength Glass Ionomer Cement

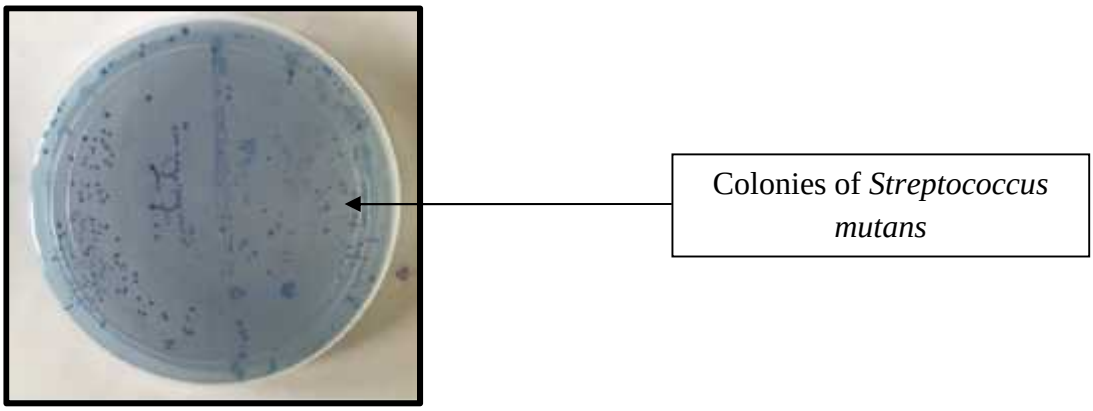


Figure No. 28: Photograph showing the growth and colonization of *Streptococcus mutans* at 6 months afterPosterior High strength Glass Ionomer Cement

Microbiological evaluation at 1 month, 3 monthsand 6 months follow up for Glass Hybrid Bulk Fill Alkasite Restorative material[Group II].

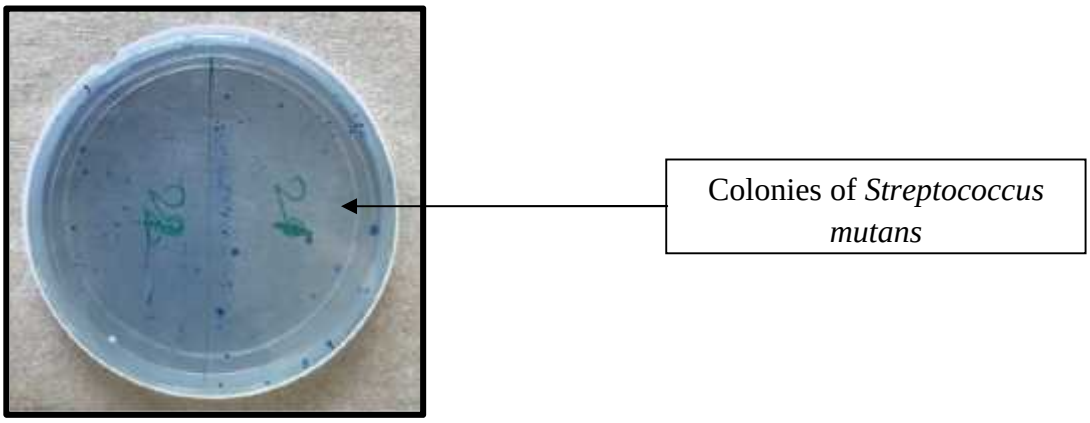


Figure No. 29: Photograph showing the growth and colonization of *Streptococcus mutans* at 1 month afterGlass Hybrid Bulk Fill Alkasite restoration.

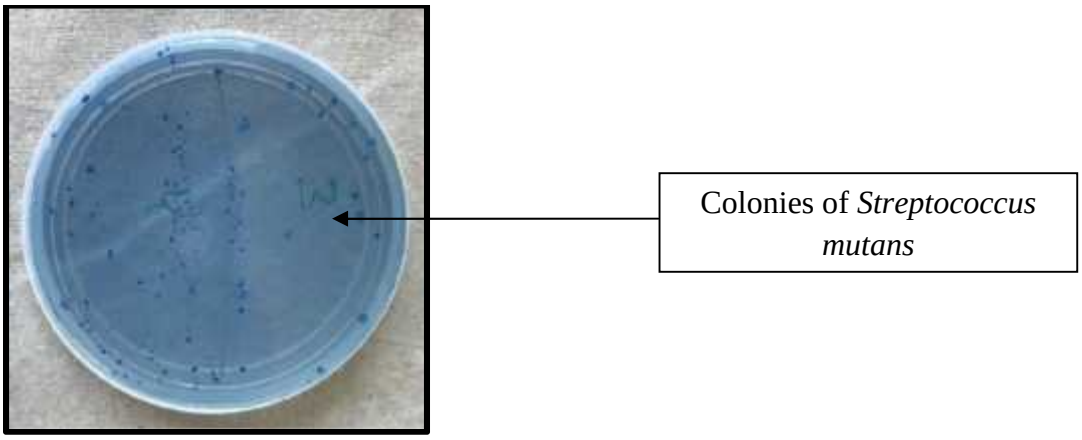


Figure No.30: Photograph showing the growth and colonization ofStreptococcus *mutans* at 3 months afterGlass Hybrid Bulk Fill Alkasite restoration.

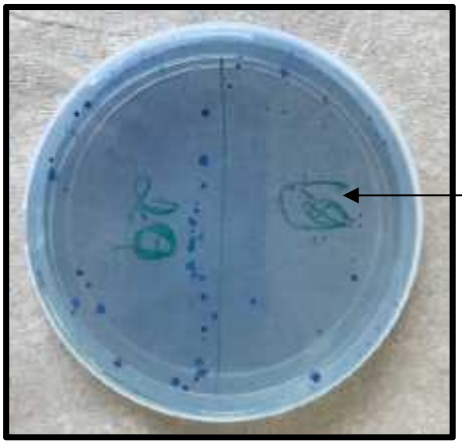


Figure No.31: Photograph showing the growth and colonization of *Streptococcus mutans* at 6 months afterGlass Hybrid Bulk Fill Alkasiterestoration.

Microbiological evaluation at 1 month, 3 months and 6 months follow up for Posterior High strength Glass Ionomer Cement restoration Group [Group I] .

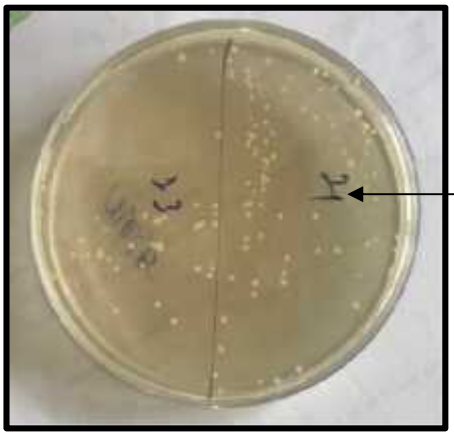


Figure No.32: Photograph showing the growth and colonization of *Lactobacillus species* at 1 month afterPosterior High strength Glass Ionomer Cement restoration.

Figure No.33: Photograph showing the growth and colonizati

at 3 months afterPosterior High strength Glass Ionomer

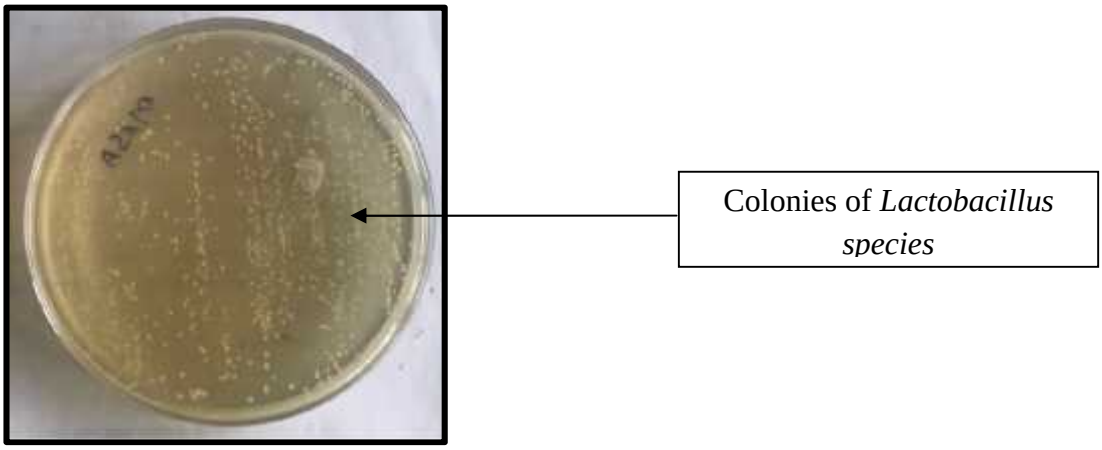


Figure No.34: Photograph showing the growth and colonization of *Lactobacillus species* at 6 months afterPosterior High strength Glass Ionomer Cement restoration.

Microbiological evaluation at 1 month, 3 months and 6 months follow up for Glass Hybrid Bulk Fill Alkasite RestorationGroup [Group II] .

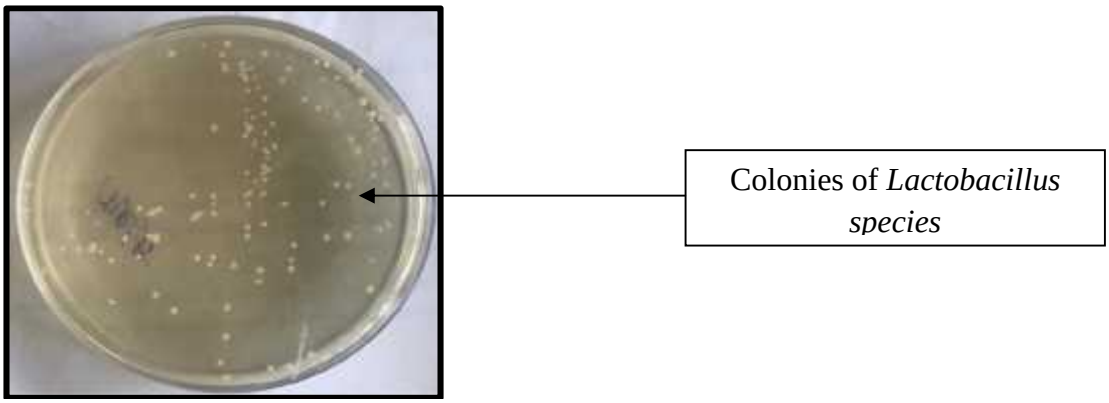


Figure No.35: Photograph showing the growth and colonization of *Lactobacillus species* at 1 month afterGlass Hybrid Bulk Fill Alkasite Restoration.

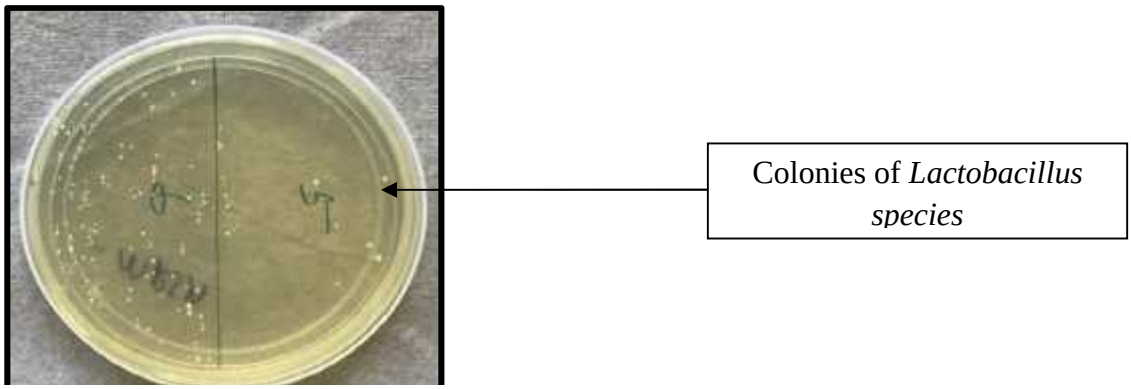


Figure No.36: Photograph showing the growth and colonization of *Lactobacillus species* at 3 months afterGlass Hybrid Bulk Fill Alkasite Restoration.

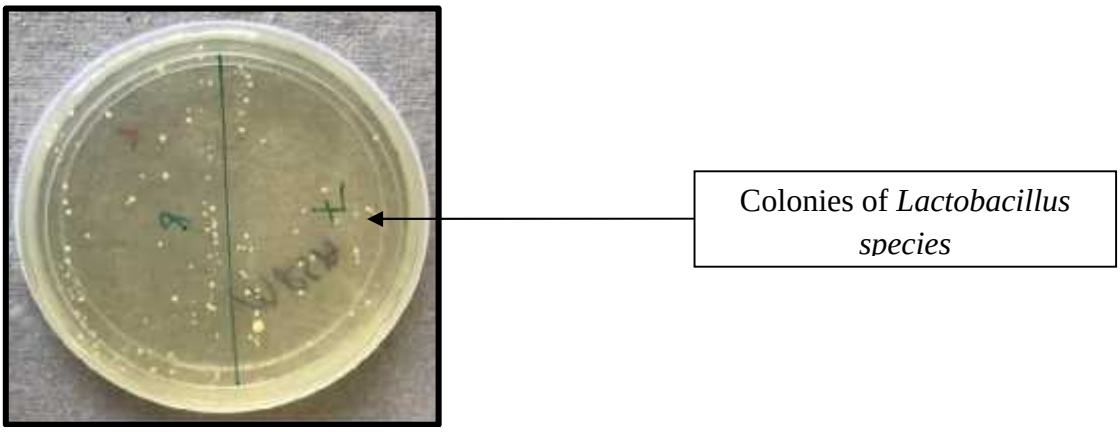


Figure No.37: Photograph showing the growth and colonization of *Lactobacillus species* at 6 months afterGlass Hybrid Bulk Fill Alkasite Restoration.

STATISTICAL ANALYSIS:

The results were tabulated and entered on the excel sheet.Then the results were subjected to the following statistical tests using IBM SPSS software (version 20.0 Chicago IL, USA) by the statistician. **(ANNEXURE VII)**

- Descriptive analysis was carried out to evaluate the retention of restorative material in both the groups at 1 month, 3 months and 6 months intervals respectively.
- Chi square test was used for comparison of qualitative data between two groups.

- Independent 't' test for inter group comparison of *Streptococcus mutans*and *Lactobacillus species*colony count at Baseline, 1 month, 3 months and 6 months.

- Dependent‘t’ test for comparison of time points in two groups with respect to mean *Streptococcus mutans*and *Lactobacillus species* colony count at Baseline, 1 month, 3 months and 6 months.

- Level of significance was set at p=0.05. (p≤ 0.05: Statistically significant, p≤ 0.01: highly significant, p≤ 0.001: very highly significant and p≥ 0.05 not significant).

RESULTS

TABLES, GRAPHS AND OBSERVATIONS

Table No. 1: Table showing master chart of the retention code at 1 month, 3 monthsand 6 months after Conservative Adhesive Restoration of the carious tooth withPosterior High Strength Glass Ionomer Cement[Group I].

Posterior High Strength Glass Ionomer Cement [Group I]				Retention Codes		
Sl. No	**Patients Code**	**DMFT/deft**	**Age**	**1 month**	**3 months**	**6 months**
1	C1	2	11	A	A	A
2	C2	2	11	A	A	A
3	C3	2	10	A	A	A
4	C4	2	11	A	A	A
5	C5	2	11	A	A	A
6	C6	2	11	A	A	B
7	C7	2	10	A	A	A
8	C8	2	10	A	A	A
9	C9	2	11	A	A	A
10	C10	2	11	A	A	A
11	C11	2	11	A	A	A
12	C12	2	11	A	A	B
13	C13	2	11	A	A	A
14	C14	2	12	A	A	A
15	C15	1	12	A	A	A
16	C16	2	11	A	A	A
17	C17	2	11	A	A	A
18	C18	2	12	A	A	B
19	C19	2	9	A	A	A
20	C20	1	9	A	A	A
21	C21	2	9	A	A	A
22	C22	2	12	A	A	A
23	C23	1	12	A	A	A
24	C24	2	12	A	A	A
25	C25	1	11	A	A	A
26	C26	2	11	A	A	A
27	C27	2	8	A	A	A
28	C28	2	9	A	A	B
29	C29	2	12	A	A	A
30	C30	2	8	A	A	A

Table No. 2: Table showing master chart of the retention code at 1 month, 3 monthsand 6 months after Conservative Adhesive Restoration of the carious tooth withGlass Hybrid Bulk FillAlkasite Restorative material[Group II].

Glass Hybrid Bulk Fill Alkasite Restorative material [Group II]				Retention Codes		
Sl. No	Patients Code	DMFT/deft	Age	1 month	3 months	6 months

1	E1	2	11	A	A	A
2	E2	2	11	A	A	A
3	E3	2	10	A	A	A
4	E4	1	11	A	A	A
5	E5	2	11	A	A	A
6	E6	2	11	A	A	A
7	E7	2	10	A	A	A
8	E8	1	10	A	A	A
9	E9	2	11	A	A	A
10	E10	2	11	A	A	A
11	E11	2	11	A	A	A
12	E12	2	11	A	A	A
13	E13	2	11	A	A	A
14	E14	2	12	A	A	A
15	E15	1	12	A	A	A
16	E16	2	11	A	A	A
17	E17	2	11	A	A	A
18	E18	1	12	A	A	A
19	E19	2	9	A	A	A
20	E20	2	9	A	A	A
21	E21	2	9	A	A	A
22	E22	1	12	A	A	A
23	E23	2	12	A	A	A
24	E24	2	12	A	A	A
25	E25	2	11	A	A	A
26	E26	2	11	A	A	A
27	E27	2	8	A	A	A
28	E28	1	9	A	A	A
29	E29	2	12	A	A	A
30	E30	2	8	A	A	A

Table No. 1 and 2: Table showing master chart of retention codes at 1 month, 3 months and 6 months after restoration of the carious tooth in two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] respectively. A total of 60 patients were included in our study. Three children (5%) were 8 years of age, seven children (11.67%) were 9 years of age, nine children (15%) were 10 years of age, twenty four children (40%) were 11 years of age and seventeen children (28.33%) were 12 years of age.

Table No. 3: Table showing master chart of the number of *Streptococcus mutans* Colony forming unit per ml of saliva at Baseline (Before the restoration), 1 month, 3 monthsand 6 months after Conservative Adhesive Restoration of the carious tooth with Posterior High Strength Glass Ionomer Cement [Group I].

Posterior High Strength Glass Ionomer Cement [Group I]				*Streptococcus mutans* count x 10^5 CFU/ml of saliva			
Sl. No	**Patients Code**	**DMFT/deft**	**Age**	**Baseline**	**1month**	**3 months**	**6months**
1	C1	2	11	1850	1500	200	500
2	C2	2	10	2500	1250	340	550
3	C3	2	10	4580	1050	450	400
4	C4	2	10	3800	1650	150	650
5	C5	2	11	3550	1800	200	450
6	C6	2	11	3250	7000	450	00
7	C7	2	11	3300	450	75	1800
8	C8	2	11	2800	800	350	2000
9	C9	2	11	4580	900	100	200
10	C10	2	12	4000	1500	450	450
11	C11	2	12	3500	450	550	300
12	C12	2	12	3000	1500	600	150
13	C13	2	12	2850	850	400	250
14	C14	2	11	4500	1500	350	1150
15	C15	1	12	4800	1500	250	300
16	C16	2	12	1850	1250	200	500
17	C17	2	12	2500	1050	340	550
18	C18	2	12	4580	1650	450	400
19	C19	2	12	3800	1800	150	650
20	C20	1	9	3550	7000	200	450
21	C21	2	9	3250	450	450	00
22	C22	2	10	3300	800	75	1800
23	C23	1	10	2800	900	350	2000
24	C24	2	8	4580	1500	100	200
25	C25	1	11	4000	450	450	450
26	C26	2	9	3500	1500	550	300
27	C27	2	11	3000	850	600	150
28	C28	2	11	2850	1500	400	250
29	C29	2	12	4500	1500	350	1150
30	C30	2	10	4800	1450	250	300

Table No. 4: Table showing master chart of the number of *Streptococcus mutans* Colony forming unit per ml of saliva at Baseline (Before the restoration), 1 month, 3 monthsand 6 monthsafter Conservative Adhesive Restoration of the carious tooth with Glass Hybrid Bulk Fill Alkasite Restorative material [Group II].

Glass Hybrid Bulk Fill [Group II]				***Streptococcus mutans* count x 10^5 CFU/ml of saliva**			
Sl. No	**Patients Code**	**DMFT/deft**	**Age**	**Baseline**	**1month**	**3months**	**6months**
1	E1	2	11	4000	5550	100	400
2	E2	2	11	5500	750	200	550
3	E3	2	10	6500	900	100	250
4	E4	1	11	4580	1000	250	400
5	E5	2	11	4550	120	175	650
6	E6	2	11	3750	1100	150	750
7	E7	2	10	3800	650	200	260
8	E8	1	10	3450	850	00	200
9	E9	2	11	4000	1000	100	1050
10	E10	2	11	5050	2000	200	400
11	E11	2	11	4500	1450	350	200
12	E12	2	11	3800	1400	00	300
13	E13	2	11	3400	1300	100	650
14	E14	2	12	4000	1000	150	850
15	E15	1	12	2850	900	155	800
16	E16	2	11	4000	5550	100	400
17	E17	2	11	5500	750	200	550
18	E18	1	12	6500	900	100	250
19	E19	2	9	4580	1000	250	400
20	E20	2	9	4550	120	175	650
21	E21	2	9	3750	1100	150	750
22	E22	1	12	3800	650	200	260
23	E23	2	12	3450	850	00	200
24	E24	2	12	4000	1000	100	1050
25	E25	2	11	5050	2000	200	400
26	E26	2	11	4500	1450	350	200
27	E27	2	8	3800	1400	00	300
28	E28	1	9	3400	1300	100	650
29	E29	2	12	4000	1000	150	850
30	E30	2	8	2850	900	155	800

Table No. 3 and 4: Table showing master chart of the number of *Streptococcus mutans* Colony Forming Units per mL of saliva at Baseline, 1 month, 3 months and 6 months after restoration of carious tooth in two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] respectively. A total of 60 patients were included in our study. Three children (5%) were 8 years of age, seven children (11.67%) were 9 years of age, nine children (15%) were 10 years of age, twenty four children (40%) were 11 years of age and seventeen children (28.33%) were 12 years of age.

Table No. 5: Table showing master chart of the number of *Lactobacillus species* Colony forming unit per ml of saliva at Baseline (Before the restoration), 1 month, 3 months and 6 months after Conservative Adhesive Restoration of the carious tooth with Posterior High Strength Glass Ionomer Cement [Group I].

Posterior High Strength Glass Ionomer Cement [Group I]				***Streptococcus mutans* count X 10^5 CFU/ml of saliva**			
Sl. No	**Patients Code**	**DMFT/deft**	**Age**	**Baseline**	**1 month**	**3 months**	**6 months**
1	C1	2	11	2000	1200	150	400
2	C2	2	10	1900	800	200	350
3	C3	2	10	2500	650	300	100
4	C4	2	10	3850	700	100	750
5	C5	2	11	4000	950	200	400
6	C6	2	11	4500	1200	250	300
7	C7	2	11	2500	350	150	1200
8	C8	2	11	200	650	300	1500
9	C9	2	11	4500	700	100	800
10	C10	2	12	3700	450	400	300
11	C11	2	12	4050	400	350	250
12	C12	2	12	2800	1200	200	250
13	C13	2	12	2000	700	300	200
14	C14	2	11	3700	1200	400	1000
15	C15	1	12	4200	700	350	450
16	C16	2	12	2000	1200	150	400
17	C17	2	12	1900	800	200	350
18	C18	2	12	2500	650	300	100
19	C19	2	12	3850	700	100	750
20	C20	1	9	4000	950	200	400
21	C21	2	9	4500	1200	250	300
22	C22	2	10	2500	350	150	1200
23	C23	1	10	200	650	300	1500
24	C24	2	8	4500	700	100	800
25	C25	1	11	3700	450	400	300
26	C26	2	9	4050	400	350	250
27	C27	2	11	2800	1200	200	250
28	C28	2	11	2000	700	300	200
29	C29	2	12	3700	1200	400	1000
30	C30	2	10	4200	700	350	450

Table No. 6: Table showing master chart of the number of *Lactobacillus species*Colony forming unit per ml of saliva at Baseline (Before the restoration), 1 month, 3 months and 6 months after Conservative Adhesive Restoration of the carious tooth with Glass Hybrid Bulk Fill Alkasite Restorative material [Group II].

Glass Hybrid Bulk Fill [Group II]				*Streptococcus mutans* count X 10^5 CFU/ml of saliva			
Sl. No	**Patients Code**	**DMFT/deft**	**Age**	**Baseline**	**1month**	**3 months**	**6 months**
1	E1	2	11	4500	400	50	15
2	E2	2	11	4800	600	100	250
3	E3	2	10	5850	800	150	200
4	E4	1	11	3800	1200	200	150
5	E5	2	11	4200	1100	150	400
6	E6	2	11	4100	1200	100	350
7	E7	2	10	3300	640	150	00
8	E8	1	10	3400	450	00	100
9	E9	2	11	3000	500	50	1200
10	E10	2	11	5000	1100	100	350
11	E11	2	11	3400	1200	200	300
12	E12	2	11	3700	750	00	00
13	E13	2	11	3300	950	150	150
14	E14	2	12	3400	550	200	100
15	E15	1	12	3100	400	100	600
16	E16	2	11	4500	400	50	15
17	E17	2	11	4800	600	100	250
18	E18	1	12	5850	800	150	200
19	E19	2	9	3800	1200	200	150
20	E20	2	9	4200	1100	150	400
21	E21	2	9	4100	1200	100	350
22	E22	1	12	3300	640	150	00
23	E23	2	12	3400	450	00	100
24	E24	2	12	3000	500	50	1200
25	E25	2	11	5000	1100	100	350
26	E26	2	11	3400	1200	200	300
27	E27	2	8	3700	750	00	100
28	E28	1	9	3300	950	150	150
29	E29	2	12	3400	550	200	100
30	E30	2	8	3100	400	100	600

Table No. 5 and 6: Table showing master chart of the number of *Lactobacillus species* Colony Forming Units per mL of saliva at Baseline, 1 month, 3 months and 6 months after restoration of carious tooth in two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] respectively. A total of 60 patient were included in our study. Three children (5%) were 8 years of age, seven children (11.67%) were 9 years of age, nine children (15%) were 10 years of age, twenty four children (40%) were 11 years of age and seventeen children (28.33%) were 12 years of age.

Table No.7: Table showing the Mean, Standard Deviation and intergroup comparison of two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] with respect to mean age using Chi square test.

Age	Control Group (Group I)	%	Experimental Group (Group II)	%	Total	%
8 yrs	2	6.67	1	3.33	3	5.00
9 yrs	4	13.33	3	10.00	7	11.67
10 yrs	3	10.00	6	20.00	9	15.00
11 yrs	14	46.67	10	33.33	24	40.00
12 yrs	7	23.33	10	33.33	17	28.33
Total	30	100.00	30	100.00	60	100.00
Mean age	10.67		10.83		10.75	
SD age	1.18		1.12		1.14	
Chi-square=2.6722 p = 0.6140						

Graph No.1: Graphical representation of distribution of subjects according to age in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II]

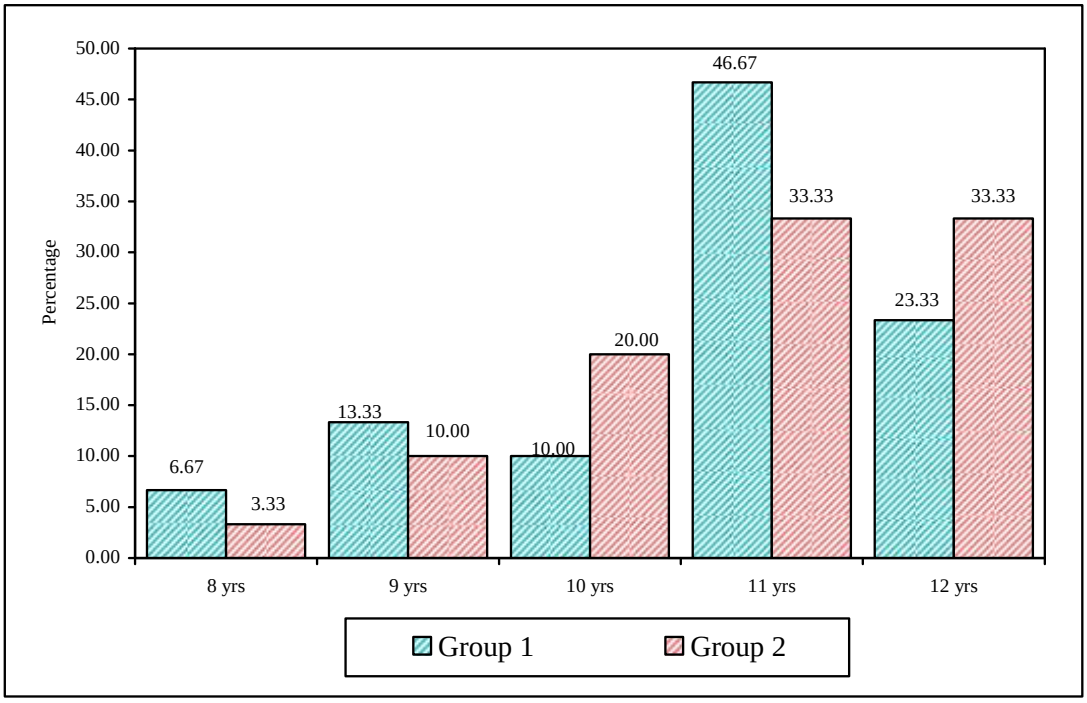


Table No. 7 and Graph No. 1 shows the mean age, standard deviation age of children and intergroup comparison between two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] using Chi square test. The mean age of the participating children of the Posterior High Strength Glass Ionomer Cement [Group I] was found to be 10.67 ($\pm$1.18) while in Glass Hybrid Bulk Fill Alkasite restoration [Group II] was 10.83 ($\pm$1.12) respectively. When intergroup comparison was carried out of mean age for both the groups using Chi square test it was found to be 2.6722 with p value 0.6140 ($p<0.05$) which was found to be statistically not significant. So both the groups have common mean age between 11-12 years which will maintain standardization of selection criteria in our study.

Table No 8: Table showing inter group comparison of gender distribution of subjects in boththegroups namelyPosterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] using Chi square test.

Gender	Control Group (Group I)	%	Experimental Group (Group II)	%	Total	%
Male	11	36.67	18	60.00	29	48.33
Female	19	63.33	12	40.00	31	51.67
Total	30	100.00	30	100.00	60	100.00
Chi-square3.2701 p = 0.0710						

Graph No. 2: Graphical representation of distribution of subjects according to gender in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II].

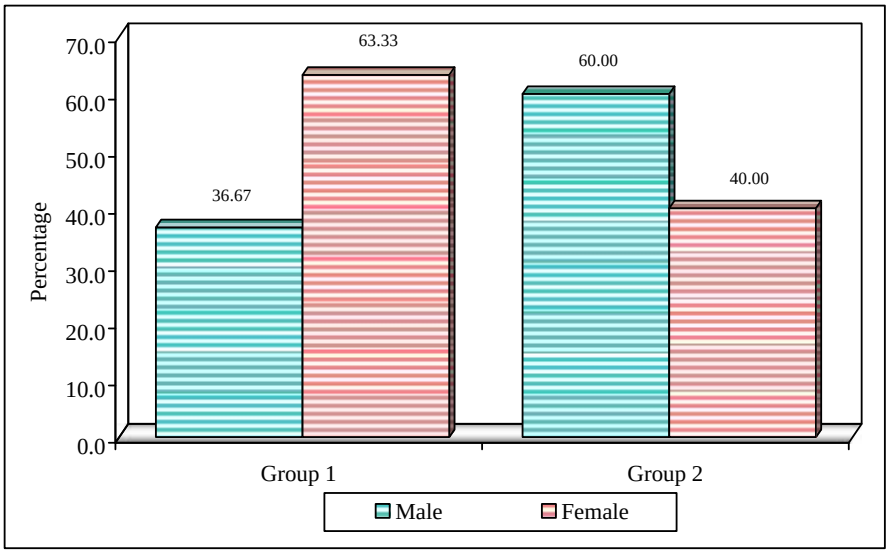


Table No. 8 and Graph No. 2 shows intergroup comparison of gender distribution of participants in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II]. Out of 60 participants included in our study twenty nine were male (48.33%) and thirty one were female (51.67%). In Posterior High Strength Glass Ionomer Cement group [Group I] out of thirty samples eleven were male and nineteen were female whereas in Glass Hybrid Bulk Fill Alkasite restoration [Group II] out of thirty subjects eighteen were male and twelve were female respectively. A intergroup comparison was carried out for gender distribution among the study groups wiz Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] with Chi square value of 3.2701 and p value of 0.0710 ($p<0.05$) was found. It shows that there was no statistically significant difference in between gender in the intergroup comparison. So, participants were equally distributed in both the groups which shows that standardization was followed.

Table No.9: Table showing DMFT /deft in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II].

DMFT/deft	Control Group (Group I)	%	Experimental Group (Group II)	%	Total	%
1	4	13.33	6	20.00	10	16.67
2	26	86.67	24	80.00	50	83.33
Total	30	100.00	30	100.00	60	100.00
Chi-square = 0.4800, p = 0.4880						

Graph No.3: Graphical representation of intergroup comparison between two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II]with respect to mean DMFT /deft scores.

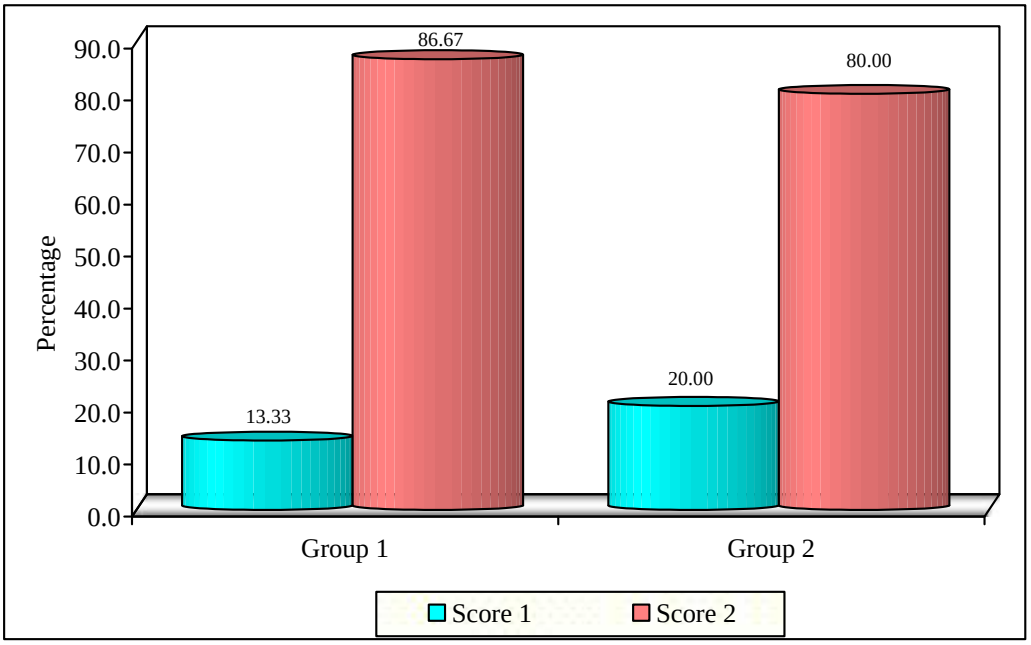


Table No. 9 and Graph No. 3 shows the DMFT/deft for Posterior High Strength Glass Ionomer Cement [Group I] DMFT/deft one was for four tooth

(13.33%) and DMFT/deft two was for twenty six tooth (86.67%) while for Glass Hybrid Bulk Fill Alkasite restoration [Group II] DMFT/deft one was for six tooth (20%) and DMFT/deft two was for twenty four tooth (80%).

Table No.10: Table showing the comparison of retention of the restorative material in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II].

Follow up Visit	Material used	Total	Retention					
			Alpha	(%)	Bravo	(%)	Charlie	(%)
1 month	Posterior High Strength Glass Ionomer Cement [Group I]	30	30	100	-	-	-	-
	Glass Hybrid Bulk Fill Alkasite restoration [Group II].	30	30	100	-	-	-	-
3 months	Posterior High Strength Glass Ionomer Cement [Group I]	30	30	100	-	-	-	-
	Glass Hybrid Bulk Fill Alkasite restoration [Group II].	30	30	100	-	-	-	-
6 months	Posterior High Strength Glass Ionomer Cement [Group I]	30	27	90	3	10	-	-
	Glass Hybrid Bulk Fill Alkasite restoration [Group II].	30	30	100	-	-	-	-

Graph No.4: Graphical representation of intergroup comparison between two groups namely Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II]with respect to retention of the restorative material.

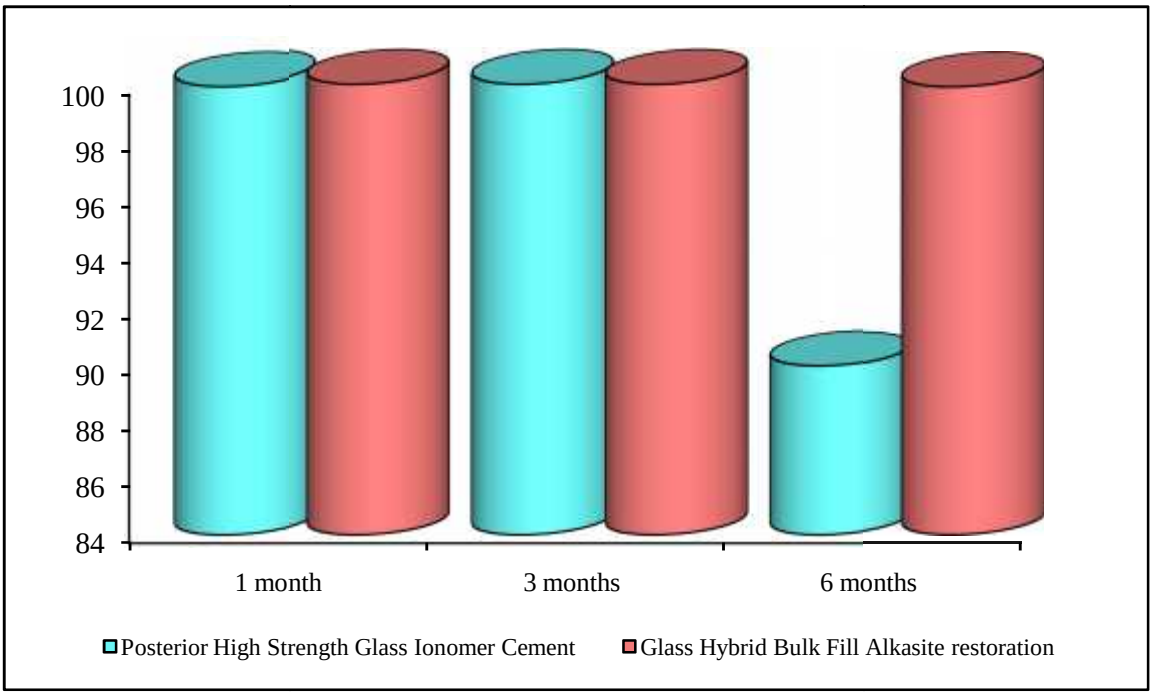


Table No. 10 and Graph No. 4 shows the percentage of retention of restorative material for Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite Restoration Group [Group II]. In Posterior High Strength Glass Ionomer Cement [Group I] 30 participants were included in which 100% retention of restorative material was seen for 1 month and 3 months and was 90% at 6 months interval. In Glass Hybrid Bulk Fill Alkasite Restoration Group [Group II] also 30 participants were included who were restored with Glass Hybrid Bulk Fill material. 100% retention of restorative material was seen at 1 month, 3 months and 6 months interval. The difference between the percentages of retention of restorative material in both the groups were not statistically as only 3 out of 30 patients had

partial loss of restorative material in Posterior High Strength Glass Ionomer Cement [Group I].

Table No.11: Table showing the difference between the mean *Streptococcus mutans* colony forming units/ml of saliva (X10^5 CFU/ml) in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] at baseline, 1 month, 3 monthsand 6 months time points using dependent 't test.

Groups	Time points	Mean	SD	Mean Diff.	SD Diff.	% of change	t-value	p-value
Posterior High Strength Glass Ionomer Cement Group I	Baseline	3.53	0.11					
	1month	3.09	0.28	0.44	0.29	12.46	8.2892	0.0001*
	Baseline	3.53	0.11					
	3 months	2.45	0.27	1.08	0.30	30.67	20.0990	0.0001*
	Baseline	3.53	0.11					
	6months	2.51	0.75	1.03	0.76	29.05	7.3964	0.0001*
	1month	3.09	0.28					
	3 months	2.45	0.27	0.64	0.38	20.80	9.1662	0.0001*
	1month	3.09	0.28					
	6months	2.51	0.75	0.59	0.85	18.95	3.7751	0.0007*
	3 months	2.45	0.27					
	6months	2.51	0.75	-0.06	0.87	-2.33	-0.3582	0.7228
Glass Hybrid Bulk Fill Alkasite restoration Group II	Baseline	3.62	0.09					
	1month	3.01	0.33	0.61	0.35	16.91	9.5080	0.0001*
	Baseline	3.62	0.09					
	3 months	1.91	0.78	1.71	0.76	47.27	12.3993	0.0001*
	Baseline	3.62	0.09					
	6months	2.41	0.85	1.21	0.84	33.39	7.8663	0.0001*
	1month	3.01	0.33					
	3 months	1.91	0.78	1.10	0.87	36.54	6.9306	0.0001*
	1month	3.01	0.33					
	6months	2.41	0.85	0.60	0.94	19.83	3.4651	0.0017*

	3 months	1.91	0.78					
	6months	2.41	0.85	-0.50	0.48	-26.32	-5.7046	0.0001*

* Denotes statistically significant p <0.05

Graph No.5: Graphical representation sh**owing the difference between the mean *Streptococcus mutans* colony forming units/ml of saliva (x10^5 CFU/ml) in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] at baseline, 1 month, 3 monthsand 6 months time points.**

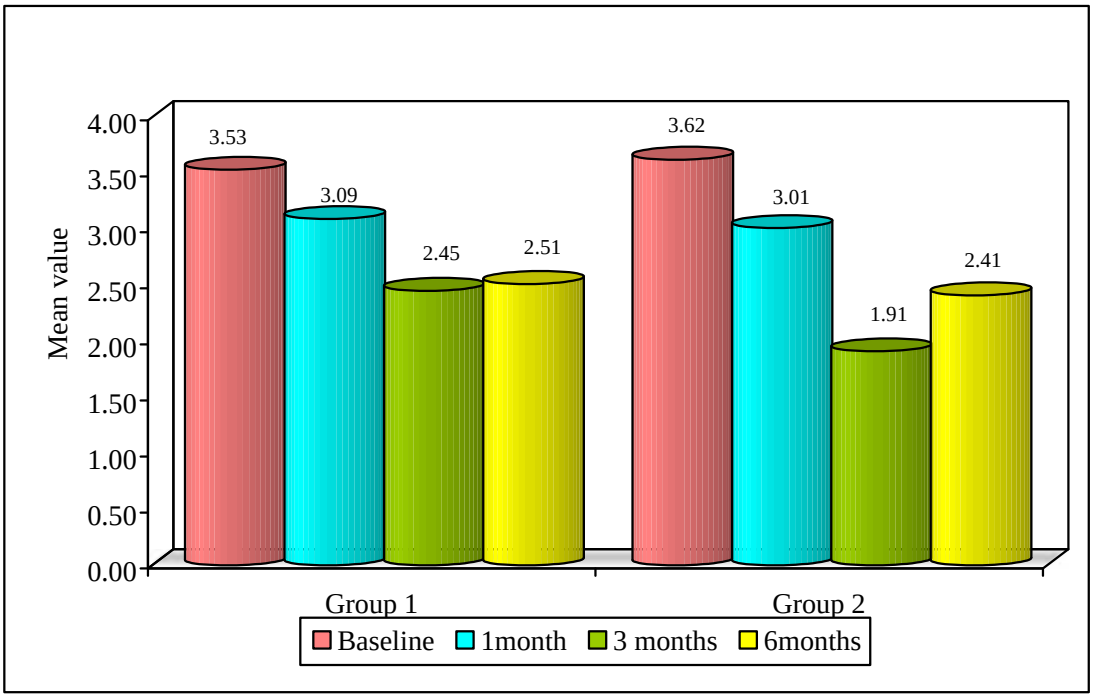


Table No. 11 and Graph No. 5 shows the comparison of Baseline, 1 month, 3 months and 6 months time points in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite Restoration Group [Group II] with respect to *Streptococcus mutans* colony count (x10^5 CFU/mL) of saliva. In Posterior High Strength Glass Ionomer Cement group [Group I] mean value of *Streptococcus*

mutans colony count ($x10^5$ CFU/mL of saliva) at baseline was 3.53 (±0.11) which was reduced to 3.09 (±0.28) with 12.46% reduction in *Streptococcus mutans* with paired 't' value of 8.2892 and p value of 0.0001 ($p<0.05$) indicating drastic reduction in *Streptococcus mutans* level at 1 month. When comparison was made from baseline to 3 months mean *Streptococcus mutans* levels reduced from 3.53 (±0.11) to 2.45 (±0.27) with 30.67% reduction in *Streptococcus mutans* with paired 't' value of 20.0990 and p value of 0.0001 ($p<0.05$) which is also an indication of statistically significant reduction in *Streptococcus mutans* levels. When comparison was made from baseline to 6 months mean *Streptococcus mutans* levels reduced from 3.53 (±0.11) to 2.51 (±0.75) with 29.05% reduction in *Streptococcus mutans* with paired 't' value of 7.3964 and p value of 0.0001 ($p<0.05$) which indicates significant reduction in *Streptococcus mutans* level.

Similarly from 1 month to 3 months interval *Streptococcus mutans* level reduced from 3.09 (±0.28) to 2.45 (±0.27) with 20.80% reduction in *Streptococcus mutans* with paired 't' value of 9.1662 and p value of 0.0001 ($p<0.05$) which showed significant reduction in *Streptococcus mutans* level. Likewise from 1 month to 6 months interval *Streptococcus mutans* level reduced from 3.09 (±0.28) to 2.51 (±0.75) with 18.25% reduction in *Streptococcus mutans* with paired 't' value of 3.7751 and p value of 0.0007 ($p<0.05$) indicative of good antimicrobial property and significant reduction in *Streptococcus mutans* level. When comparison was made between 3 to 6 months it shows that there is increase in *Streptococcus mutans* value from 2.45 (±0.27) to 2.51 (±0.75) with -2.33% increase in *Streptococcus mutans* with paired 't' value of -0.3582 and p value of 0.7228 ($p<0.05$) showing indicates increase in *Streptococcus mutans* level between 3 months to 6 months interval. However, when

compared to baseline *Streptococcus mutans* level was significantly less at 6 months interval.

In Glass Hybrid Bulk Fill Alkasite Restoration Group [Group II] mean value of *Streptococcus mutans* colony count ($x10^5$ CFU/mL of saliva) at baseline was 3.62 (±0.09) which was reduced to 3.01 (±0.33) with 16.91% reduction in *Streptococcus mutans* with paired 't' value of 9.5080 and p value of 0.0001 ($p<0.05$) indicating drastic reduction in *Streptococcus mutans* level at 1 month. When comparison was made from baseline to 3 months mean *Streptococcus mutans* level reduced from 3.62 (±0.09) to 1.91 (±0.78) with 42.2% reduction in *Streptococcus mutans* with paired 't' value of 12.3993 and p value of 0.0001 ($p<0.05$) which is also an indication of statistically significant reduction in *Streptococcus mutans* level. When comparison was made from baseline to 6 months mean *Streptococcus mutans* level reduced from 3.62 (±0.09) to 2.41 (±0.85) with 33.39% reduction in *Streptococcus mutans* with paired 't' value of 7.8663 and p value of 0.0001 ($p<0.05$) which indicates significant reduction in *Streptococcus mutans* level.

Similarly, from 1 month to 3 months interval *Streptococcus mutans* level reduced from 3.01 (±0.33) to 1.91 (±0.78) with 36.54% reduction in *Streptococcus mutans* with paired 't' value of 6.9306 and p value of 0.0001 ($p<0.05$) which showed significant reduction in *Streptococcus mutans* level. Likewise, from 1 month to 6 months interval *Streptococcus mutans* level reduced from 3.01 (+-0.33) to 2.41 (±0.85) with 19.83% reduction in *Streptococcus mutans* with paired 't' value of 3.4651 and p value of 0.0017 ($p<0.05$) indicative of good antimicrobial property and significant reduction in *Streptococcus mutans* level. When comparison was made between 3 to 6 months it *Streptococcus mutans* value increased from 1.91 (±0.78) to

2.41 (±0.85) with -26.32% increase in *Streptococcus mutans* with paired 't' value of -5.7046 and p value of 0.0001 ($p<0.05$) showing indicates significant increase in *Streptococcus mutans* level between 3 months and 6 months interval. However, when compared to baseline *Streptococcus mutans* level was significantly less at 6 months interval.

No.12: Table sh**owing the difference between the mean *Lactobacillus species* colony forming units/ml of saliva (x10^5 CFU/ml) in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II]at baseline, 1 month, 3 monthsand 6 months time points using dependent 't' test.**

Groups	Time points	Mean	SD	Mean Diff.	SD Diff.	% of change	t-value	p-value
Posterior High Strength Glass Ionomer Cement Group I	Baseline	3.42	0.33					
	1month	2.87	0.17	0.55	0.36	16.15	8.3410	0.0001*
	Baseline	3.42	0.33					
	3 months	2.36	0.20	1.06	0.41	31.02	14.3091	0.0001*
	Baseline	3.42	0.33					
	6months	2.63	0.32	0.79	0.53	23.01	8.1670	0.0001*
	1month	2.87	0.17					
	3 months	2.36	0.20	0.51	0.27	17.73	10.2169	0.0001*
	1month	2.87	0.17					
	6months	2.63	0.32	0.23	0.37	8.18	3.4626	0.0017*
	3 months	2.36	0.20					
	6months	2.63	0.32	-0.27	0.42	-11.62	-3.5623	0.0013*
Glass Hybrid Bulk Fill	Baseline	3.59	0.08					
	1month	2.86	0.18	0.72	0.17	20.13	22.7878	0.0001*
	Baseline	3.59	0.08					

Alkasite restoration Group II	3 months	1.80	0.74	1.79	0.73	49.79	13.3258	0.0001*
	Baseline	3.59	0.08					
	6months	1.95	0.98	1.64	0.97	45.61	9.2008	0.0001*
	1month	2.86	0.18					
	3 months	1.80	0.74	1.06	0.70	37.13	8.3269	0.0001*
	1month	2.86	0.18					
	6months	1.95	0.98	0.91	0.95	31.90	5.2525	0.0001*
	3 months	1.80	0.74					
	6months	1.95	0.98	-0.15	0.84	-8.32	-0.9748	0.3317

Graph No. 6: Graphical representation s**howing the difference between the mean *Lactobacillus species*colony forming units/ml of saliva (X10^5 CFU/ml) in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite restoration [Group II] at baseline, 1 month, 3 monthsand 6 months time points.**

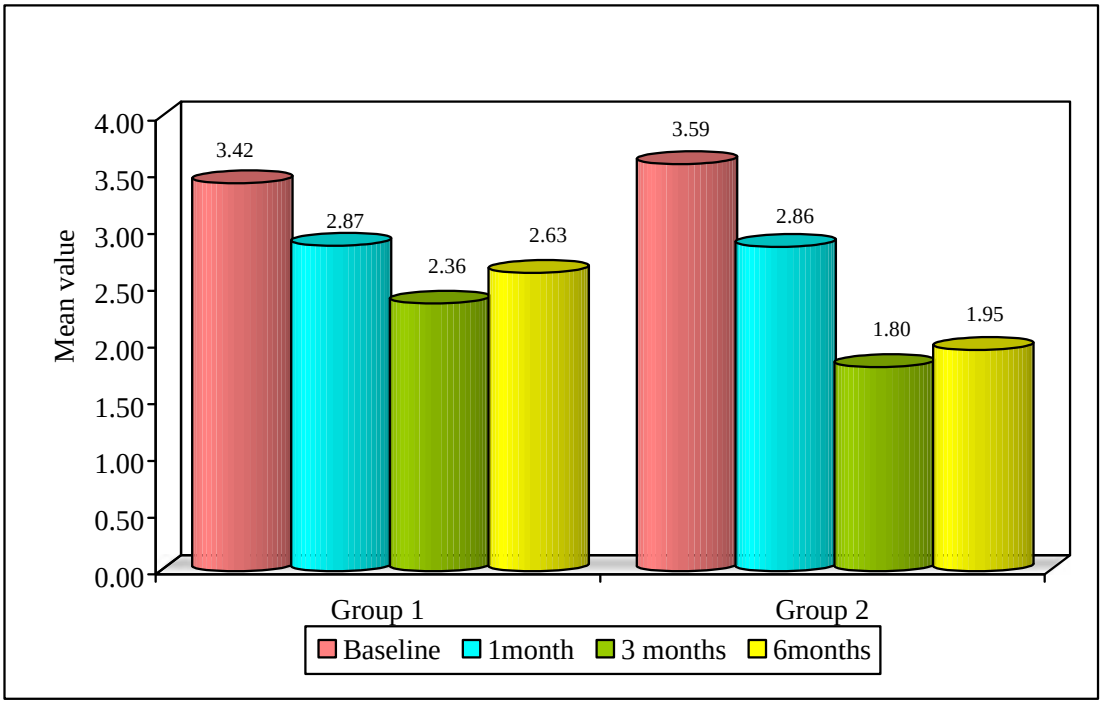


Table No. 12 and Graph No. 6 shows the comparison of Baseline, 1 month, 3 months and 6 months time points in Posterior High Strength Glass Ionomer Cement [Group I] and Glass Hybrid Bulk Fill Alkasite Restoration Group [Group II] with respect to *Lactobacillus species*colony count ($x10^5$ CFU/mL) of saliva. In Posterior High Strength Glass Ionomer Cement group [Group I] mean value of *Lactobacillus species*colony count ($x10^5$ CFU/mL of saliva) at baseline was 3.42 (±0.33) which was reduced to 2.87 (±0.17) with 16.15% reduction in *Lactobacillus species*with paired 't' value of 8.3410 and p value of 0.0001 ($p<0.05$) indicating drastic reduction in *Lactobacillus species*level at 1 month. When comparison was made from baseline to 3 months mean *Lactobacillus species*levels reduced from 3.42 (±0.33) to 2.36 (±0.20) with 31.02% reduction in *Lactobacillus species*with paired 't' value of 14.3091 and p value of 0.0001 ($p<0.05$) which is also an indication of statistically significant reduction in *Lactobacillus species*levels. When comparison was made from baseline to 6 months mean *Lactobacillus species*levels reduced from 3.42 (±0.33) to 2.63 (±0.32) with 23.01% reduction in *Lactobacillus species*with paired 't' value of 8.1670 and p value of 0.0001 ($p<0.05$) which indicates significant reduction in *Lactobacillus species*level.

Similarly from 1 month to 3 months interval *Lactobacillus species*level reduced from 2.87 (±0.17) to 2.36 (±0.20) with 17.73% reduction in *Lactobacillus species*with paired 't' value of 10.2169 and p value of 0.0001 ($p<0.05$) which showed significant reduction in *Lactobacillus species*level. Likewise from 1 month to 6 months interval *Lactobacillus species*level reduced from 2.87 (±0.17) to 2.63 (±0.32) with 8.18% reduction in *Lactobacillus species*with paired 't' value of 3.4636 and p value of 0.0017 ($p<0.05$) indicative of good antimicrobial property and significant reduction in *Lactobacillus species*level. When comparison was made between 3 to 6

months it shows that there is increase in *Lactobacillus species*value from 2.36 (±0.20) to 2.63 (±0.32) with -11.62% increase in *Lactobacillus species*with paired 't' value of -3.5623 and p value of 0.0013 ($p<0.05$) showing indicates increase in *Lactobacillus species*level between 3 months to 6 months interval. However, when compared to baseline *Lactobacillus species* level was significantly less at 6 months interval.

In Glass Hybrid Bulk Fill Alkasite Restoration Group [Group II] mean value of *Lactobacillus species*colony count ($x10^5$ CFU/mL of saliva) at baseline was 3.59 (±0.08) which was reduced to 2.86 (±0.18) with 20.13% reduction in *Lactobacillus species*with paired 't' value of 22.7878 and p value of 0.0001 ($p<0.05$) indicating drastic reduction in *Lactobacillus species*level at 1 month. When comparison was made from baseline to 3 months mean *Lactobacillus species*level reduced from 3.59 (±0.08) to 1.80 (±0.74) with 49.79% reduction in *Lactobacillus species*with paired 't' value of 13.3258 and p value of 0.0001 ($p<0.05$) which is also an indication of statistically significant reduction in *Lactobacillus species*level. When comparison was made from baseline to 6 months mean *Lactobacillus species*level reduced from 3.59 (±0.08) to 1.95 (±0.98) with 45.61% reduction in *Lactobacillus species*with paired 't' value of 9.2008 and p value of 0.0001 ($p<0.05$) which indicates significant reduction in *Lactobacillus species*level.

Similarly, from 1 month to 3 months interval *Lactobacillus species*level reduced from 2.86 (±0.18) to 1.80 (±0.74) with 37.13% reduction in *Lactobacillus species*with paired 't' value of 8.3269 and p value of 0.0001 ($p<0.05$) which showed significant reduction in *Lactobacillus species*level. Likewise, from 1 month to 6 months interval *Lactobacillus species*level reduced from 2.86 (±0.18) to 1.95 (±0.98) with 31.90% reduction in *Lactobacillus species*with paired 't' value of 5.2525 and p value of 0.0001 ($p<0.05$) indicative of good antimicrobial property and significant

reduction in *Lactobacillus species*level. When comparison was made between 3 to 6 months it *Lactobacillus species*value increased from 1.80 (±0.74) to 1.95 (±0.98) with -8.32% increase in *Lactobacillus species*with paired 't' value of -0.9748 and p value of 0.3317 ($p<0.05$) showing indicates significant increase in *Lactobacillus species*level between 3 months and 6 months interval. However, when compared to baseline *Lactobacillus species*level was significantly less at 6 months interval.

CONCLUSION

The advancement in dentistry has replaced GV Blacks principle of***''Extension of Prevention''***to***''Constriction for Conservation''*** or ***''Prevention of Extension''*** whichis a key component of Conservative Adhesive Restoration (CAR). This principle advocates preservation of the tooth structure rather than extensive preparation.

The following conclusions are drawn from the present study:

1. Posterior High Strength Glass Ionomer Cement [Group I] showed 90 % retention of the restorative material and good antibacterial effectiveness against salivary *Streptococcus mutans* at 1 month, 3 month and 6 months interval when used as conservative adhesive restorative material.

2. Glass Hybrid Bulk Fill Alkasite restorative material [Group II] showed 100 % retention of the restorative material and good antibacterial effectiveness against salivary *Streptococcus mutans* at 1 month, 3 month and 6 months interval when used as conservative adhesive restorative material.

3. Among both the materials, Glass Hybrid Bulk Fill Alkasite restorative material showed better retention rate as compared to Posterior High Strength Glass Ionomer Cement but it was not statistically significant. Both the materials have shown good antimicrobial activity after 6 months follow up.

However, we advocate that in futurethe conclusion drawn from the present study need to be carried out with larger sample size covering different geographical

areas and long term follow up needs to done for conservative adhesive restorations in children.

SUMMARY

The present study was conducted on children with mixed dentition with the aim to evaluate and compare the retention and antibacterial effectiveness on salivary *Streptococcus mutans* and *Lactobacillus species* count. Sixty children were selected according to the inclusion criteria. Unstimulated saliva sample was collected at baseline using suction method and microbial assessment of *Streptococcus mutans* and *Lactobacillus species* count was done after which thorough oral prophylaxis was carried out. Children were randomly divided into two groups namely Group I as Posterior High Strength Glass Ionomer Cement and Group II as Glass Hybrid Bulk Fill Alkasite restoration Group.

Following the Minimal Intervention Dentistry Principle Class I cavities were prepared and restoration was done for the children as per their respective groups. After restoration of the cavities salivary sample was again collected at the interval of 1 month, 3 months and 6 months interval. The values for retention of the restoration, *Streptococcus mutans* and *Lactobacillus species* colony forming unit/ ml of saliva was noted and tabulated at every interval of the study. Children were recalled for follow up visits at 1 month, 3 months and 6 months intervals for clinical examination and collection of saliva for microbiological assessment.

Our study showed that both the groups had retention property and inhibitory effect on *Streptococcus mutans* and *Lactobacillus species*. Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restoration Group showed statistically significant and comparable retention property and inhibition of *Streptococcus mutans* and *Lactobacillus species* over a period of 6 months.

Our study aids in rendering empowerment in children by taking care of their oral health which in turn would provide a better nourishment to their body. Since it is rightly said today's nurturing can lay a stronger foundation which in turn would help to strengthen our nation.

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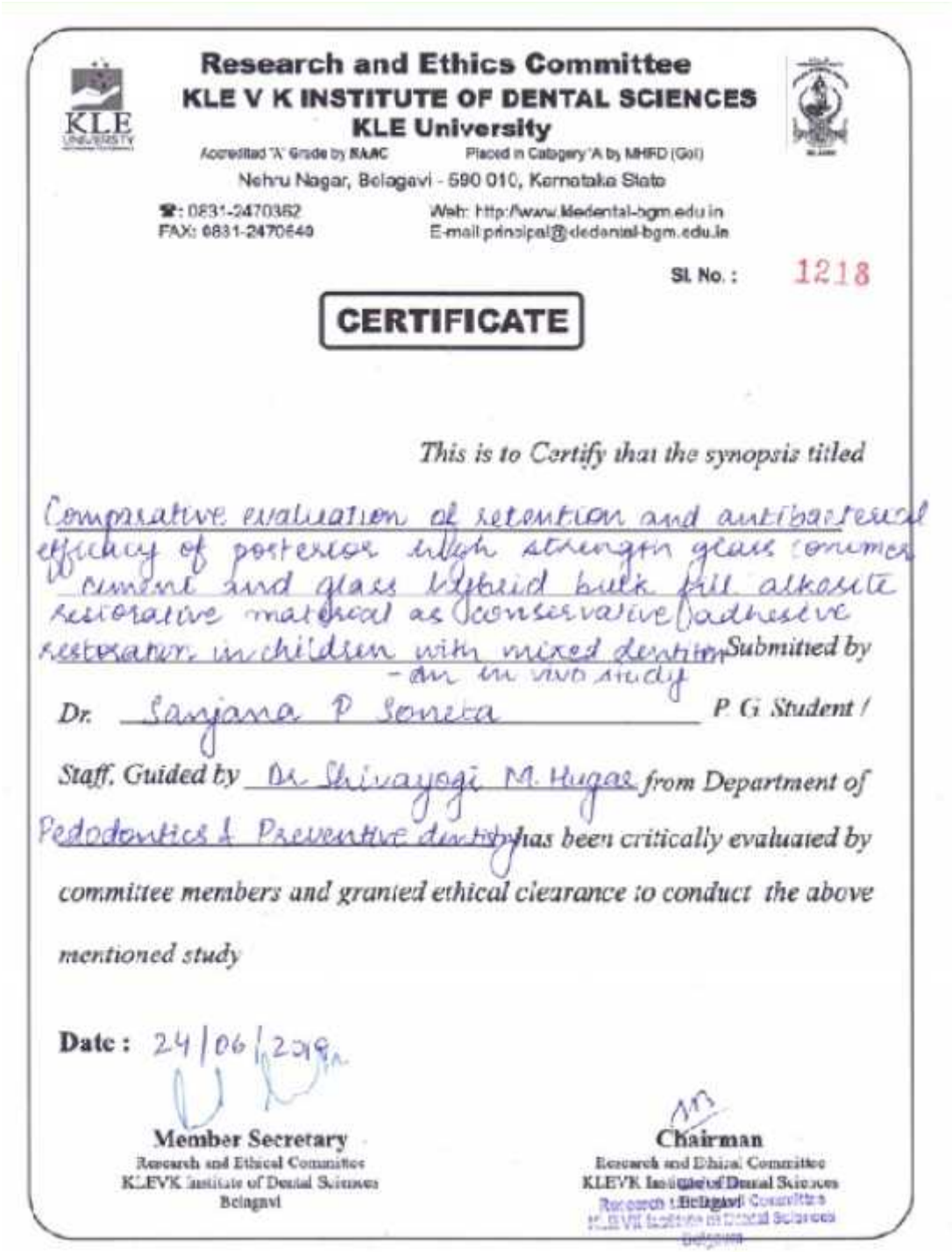
ANNEXURE I

ETHICAL CLEARANCE CERTIFICATE



Research and Ethics Committee
KLE V K INSTITUTE OF DENTAL SCIENCES
KLE University
Accredited 'A' Grade by NAAC Placed in Category 'A' by MHRD (GoI)
Nehru Nagar, Belagavi - 590 010, Karnataka State
☎: 0831-2470362 Web: http://www.kledental-bgm.edu.in
FAX: 0831-2470640 E-mail:principal@kledental-bgm.edu.in

Sl. No.: 1218

CERTIFICATE

This is to Certify that the synopsis titled

Comparative evaluation of retention and antibacterial efficacy of posterior high strength glass ionomer cement and glass hybrid bulk fill alkasite restorative material as conservative adhesive restoration in children with mixed dentition – an in vivo study

Submitted by

Dr. Sanjana P Soneta *P G Student / Staff. Guided by* Dr. Shivayogi M. Hugar *from Department of* Pedodontics & Preventive dentistry *has been critically evaluated by committee members and granted ethical clearance to conduct the above mentioned study*

Date: 24/06/2019

Member Secretary
Research and Ethical Committee
KLEVK Institute of Dental Sciences
Belagavi

Chairman
Research and Ethical Committee
KLEVK Institute of Dental Sciences
Belagavi

ANNEXURE II a

CONSENT FORM (ENGLISH)

KLE Academy of Higher Education and Research. K.L.E. V.K. Institute of Dental Sciences, Belagavi.

Department of Pediatric and Preventive Dentistry

"Comparative Evaluation Of Retention And Antibacterial Efficacy Of Posterior High Strength Glass Ionomer Cement And Glass Hybrid Bulk Fill Alkasite Restorative Material As Conservative Adhesive Restoration In Children With Mixed Dentition – An In Vivo Study.

Date -

I, the undersigned, authorize the performance upon my son/ daughter, Mst. / Miss ……. the advised treatment to be performed under the direction of Dr.Shivayogi M Hugar and by Dr. Sanjana P. Soneta

I consent to the administration of anesthetics as may be considered necessary or advisable by the doctor responsible for this service,

I consent to the photographing or video recording of the operation or procedures to be performed including appropriate portions of my child's body, for medical, scientific or educational purposes provided his/ her identity is not revealed by the pictures or by the descriptive texts accompanying them.

For the purpose of advancing dental education I consent to the admittance of observers to the operating room.

At any time if I don't like I will quit from the study without any guarantee.

I give my consent to publications and presentations of this study.

The nature and purpose of the operation, possible alternative methods of treatment, the risk involved and the possibility of complications have been fully explained to me in my vernacular language. No guarantee or assurance has been given by anyone as to the results that may be obtained.

(Relation to the patient) (Signature)

ANNEXURE II b

CONSENT FORM (KANNADA)

ಸಮ್ಮತಿ ಪತ್ರ

ಪೀಡಿಯಾಟ್ರಿಕ್ ದಂತ ಚಿಕಿತ್ಸಾ ವಿಭಾಗ
ಕೆಎಲ್ಇ ವೀರ ದಂತ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Title: "Comparative evaluation of retention and antibacterial efficacy of Posterior High Strength Glass Ionomer Cement and Glass Hybrid Bulk Fill Alkasite restorative material as Conservative Adhesive Restoration in children with mixed dentition - An in vivo study"

ನಾನು ಶ್ರೀ/ಶ್ರೀಮತಿ_____ಎಲ್ಲ ಮಾಹಿತಿಯನ್ನು ಪಡೆದುಕೊಂಡಿದ್ದೇನೆ ಮತ್ತು ನನ್ನ ಮಗ/ಮಗಳು_____ ವಯಸ್ಸು_____ ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಭಾಗವಹಿಸಲು ಅನುಮತಿಯನ್ನು ನೀಡಿ ಸಹಕರಿಸುತ್ತೇನೆ.

1. ನನ್ನ ಮಗ/ಮಗಳ ಬಗ್ಗೆ ಎಲ್ಲಾ ಮಾಹಿತಿ– ಹೆಸರು, ವಯಸ್ಸು, ಆರೋಗ್ಯದ ಬಗ್ಗೆ ಮಾಹಿತಿ ಕೊಡಲು ಒಪ್ಪುತ್ತೇನೆ.
2. ನನ್ನ ಮಗ/ಮಗಳ ಬಾಯಿಯ ತಪಾಸಣೆ ಹಾಗು ಚಿಕಿತ್ಸೆ ಮಾಡಲು ಸಹಕರಿಸುತ್ತೇನೆ.
3. **ರೋಗಿಯ ಚಿಕಿತ್ಸೆಯ ಬಗ್ಗೆ ತಿಳುವಳಿಕೆ:**
ನನ್ನ ಮಗ/ಮಗಳ ಬಾಯಿಯ ಹುಳುಕು ಹಲ್ಲುಗಳನ್ನು ಸ್ವಚ್ಛಗೊಳಿಸಿ ಹಲ್ಲಿನ ಬಣ್ಣದ ಸಿಮೆಂಟನ್ನು ತುಂಬಲು ಸಮ್ಮತಿಯನ್ನು ನಿಡುತ್ತೇನೆ ಹಾಗು ನಿಯಮಿತವಾಗಿ ತಪಾಸಣೆಗೆ ಬರುತ್ತೇನೆ.
4. ನಾನು ತಪ್ಪದೆ ಕೊಟ್ಟಿರುವ ಸೂಚನೆಗಳನ್ನು ಪಾಲಿಸುತ್ತೇನೆ.
5. ಈ ಸಂಶೋಧನೆಯನ್ನು ಪ್ರಕಟಿಸಲು ಅನುಮತಿಯನ್ನು ಕೊಡುತ್ತೇನೆ.
6. ನನ್ನ ಮಗ/ಮಗಳು ಭಾಗವಹಿಸಿದ್ದಕ್ಕೆ ಪ್ರತಿಯಾಗಿ ಎನೂ ಕೇಳುವುದಿಲ್ಲ.
7. ಏನಾದರು ತೊಂದರೆಯಾದಲ್ಲಿ ತಪ್ಪದೆ ಎಲ್ಲಾ ಜವಾಬ್ದಾರಿಯನ್ನು ತೆಗೆದುಕೊಳ್ಳುತ್ತಾರೆ.
8. ಯಾವುದೇ ಕಾರಣಕ್ಕಾಗಿ ನನ್ನ ಮಗ/ಮಗಳು ಭಾಗವಹಿಸಿದ್ದಕ್ಕೆ ಹಿಂತೆಗೆದುಕೊಳ್ಳಬಹುದು.
9. ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ಗುಪ್ತವಾಗಿಡಲಾಗುವುದು.
10. ಈ ಸಂಶೋಧನೆಯಲ್ಲಿಭಾಗವಹಿಸುವುದರಿಂದ ಯಾವ ಹಾನಿ/ಅಪಾಯ ಇಲ್ಲ.
11. ಬೇರೆ ಚಿಕಿತ್ಸೆ ಬಗ್ಗೆ ಮಾಹಿತಿ ಕೊಡಲಾಗುವುದು.

ನಾನು ಮೇಲೆ ತಿಳಿಸಿದ ಎಲ್ಲಾ ವಿಷಯವನ್ನು ಓದಿದ್ದೇನೆ ಮತ್ತು ಅರ್ಥಮಾಡಿಕೊಂಡು ಸಹಿ ಮಾಡಿದ್ದೇನೆ.

ದಂತ ವೈದ್ಯರ ಹೆಸರು: [redacted]
ವಿಳಾಸ: ಪೀಡಿಯಾಟ್ರಿಕ್ ದಂತ ಚಿಕಿತ್ಸಾ ವಿಭಾಗ
ಕೆಎಲ್ಇ ವೀರ ದಂತ ಮಹಾವಿದ್ಯಾಲಯ
ಬೆಳಗಾವಿ–10

ಮಾರ್ಗದರ್ಶಕರು: ಡಾ: ಶಿವಯೋಗಿ ಮ. ಹೂಗಾರ
ವಿಳಾಸ: ಪೀಡಿಯಾಟ್ರಿಕ್ ದಂತ ಚಿಕಿತ್ಸಾ ವಿಭಾಗ
ಕೆಎಲ್ಇ ವೀರ ದಂತ ಮಹಾವಿದ್ಯಾಲಯ
ಬೆಳಗಾವಿ–10

ಪಾಲಕರ ಹೆಸರು:

ಪಾಲಕರ ಸಹಿ:

ಸಾಕ್ಷಿ ಹೆಸರು:

ಸಾಕ್ಷಿ ಸಹಿ:

ದಿನಾಂಕ:

ಊರು:

ANNEXURE III

ASSENT FORM

KLE Academy of Higher Education and Research. K.L.E. V.K. Institute of Dental Sciences, Belagavi.

Department of Pediatric and Preventive Dentistry

My name is Dr. Sanjana. I am a dentist. I am doing a study to learn about the germs in your teeth and how to destroy them. I will be filling your teeth with a cement and examine for germ levels. The entire procedure is totally painless and will not cause any harm to you.

You can ask questions at any time that you might have about this study. Also, if you decide at any time not to finish, you may stop whenever you want. Signing this paper means that you have read this or had it read to you and that you want to be in the study. If you don't want to be in the study, don't sign the paper. Your parent(s) know that I am asking you to do these things.Remember, being in the study is up to you, and no one will be angry if you don't sign this paper or even if you change your mind later.

Signature of participant _____ Date _____

Signature of investigator _____ Date _____

ANNEXURE IV
CASE-HISTORY FORM

KLE Academy of Higher Education and Research. K.L.E. V.K. Institute of Dental Sciences, Belagavi.

Department of Pediatric and Preventive Dentistry

Name: Sex:

Age: Parent/Guardian:

Address: Contact Number:

HISTORY:

Chief Complaint:

History of Present Illness:

Relevant Medical History:

Previous Dental History:

NATAL HISTORY:

POST NATAL HISTORY:

GENERAL EXAMINATION:

INTRA-ORAL EXAMINATION

Soft Tissue Examination:

Hard Tissue Examination:

No of Teeth:

Decayed Teeth:

Filled Teeth:

Missing Teeth:

Root Stumps:

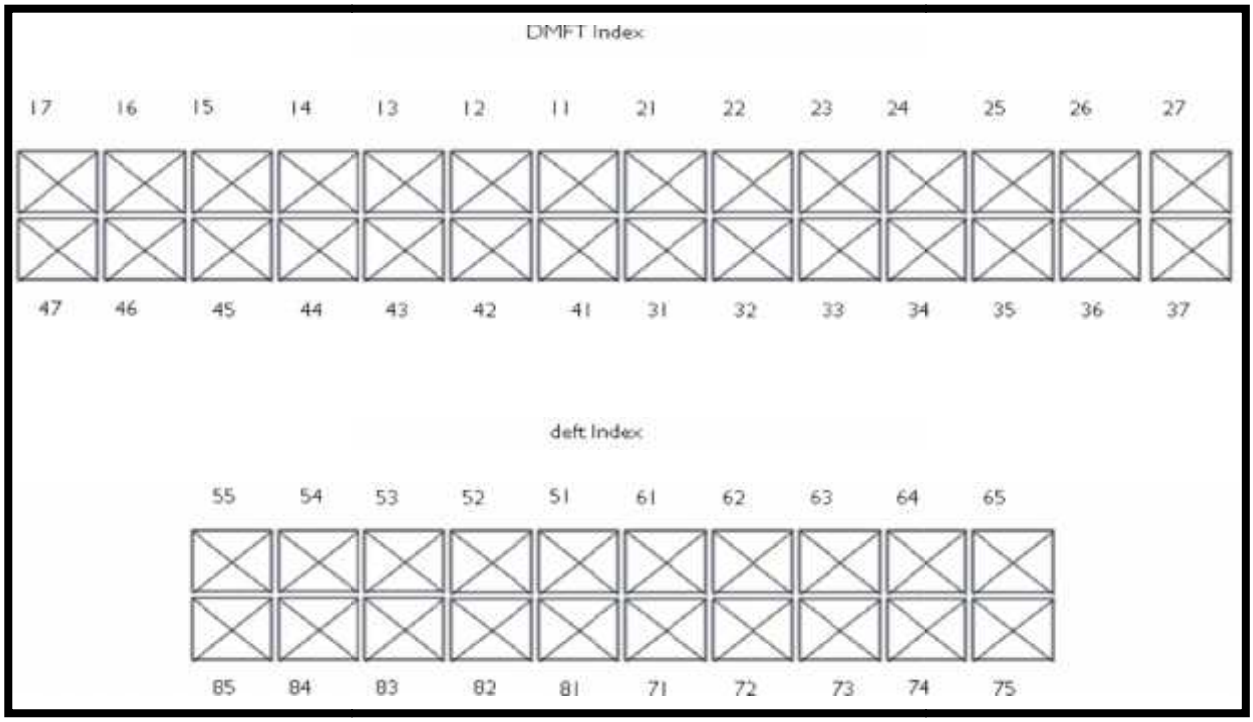
Mobility:

PROVISIONAL DIAGNOSIS:

INVESTIGATION:Inta-oral periapical radiograph

FINAL DIAGNOSIS:

TREATMENT PLANNING: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17 16 15 14 13 12 11 21 22 23 24 25 26 27
47 46 45 44 43 42 41 31 32 33 34 35 36 37
deft Index
55 54 53 52 51 61 62 63 64 65
85 84 83 82 81 71 72 73 74 75

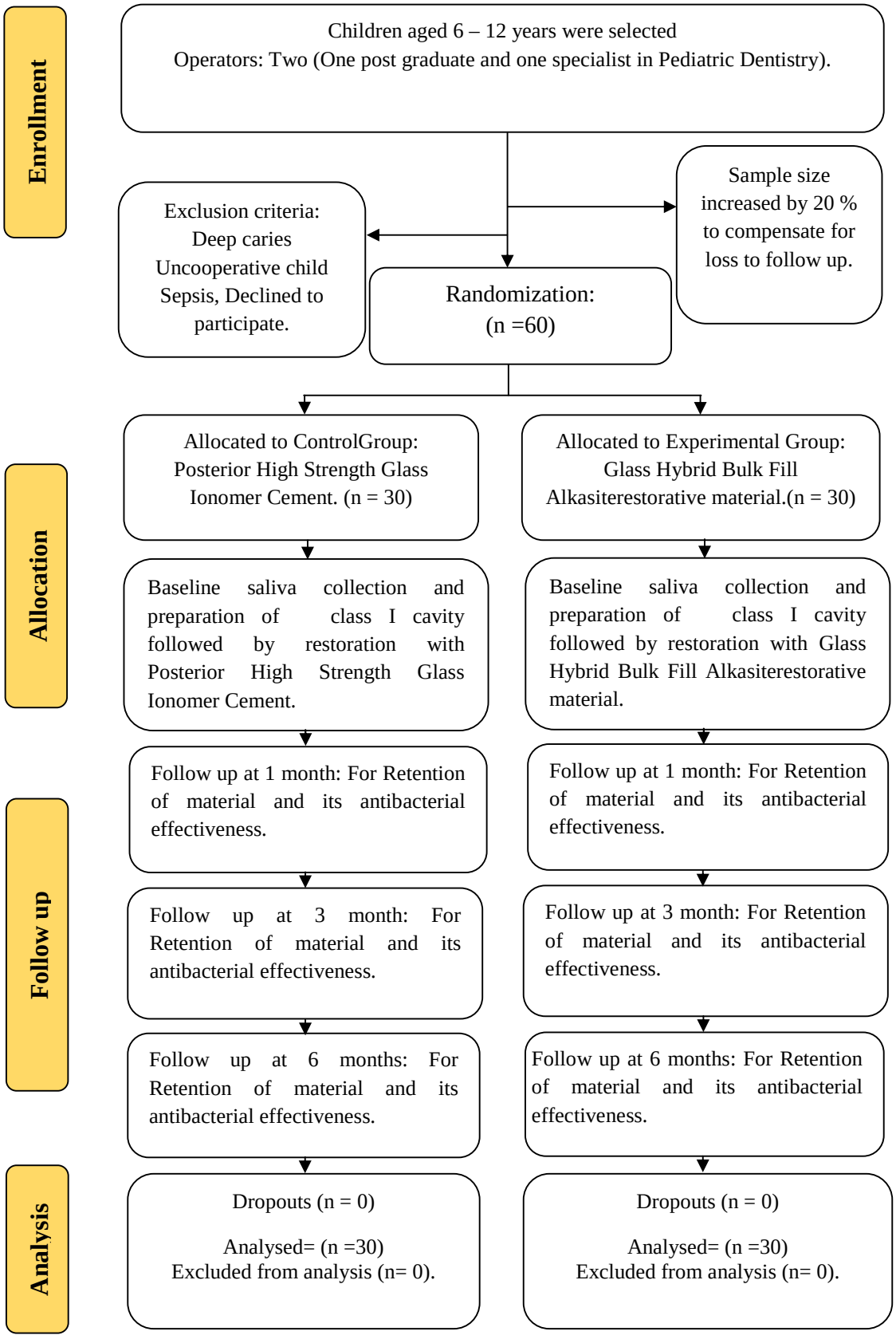
ANNEXURE V:

INITIAL CARIES LESION – WHO IL CODES

RECORDING FOR INITIAL CARIES LESION - WHO-IL CODES [38]		
PRIMARY	**PERMANENT**	**CRITERIA**
A	0	Sound Excluding W (White Spot)
W	WP	W (Active White Spot/ Surface Discontinuity In Enamel Only)
B	1	Decayed Without W(Chronic Lesion)
BW	1W	Decayed With W (Active Lesion)
C	2	Filled With Decay (Chronic Lesion)
CW	2W	Filled With W + Decay (Active Lesion)
D	3	Filled, No Decay
DW	3W	Filled, With W
4	4	Missing, As A Result Of Caries
5	5	Missing, Any Other Reason
F	6	Fissure Sealant
FW	6W	Fissure Sealant With W
7	7	Bridge Abutment, Special Crown Or Veneer / Implant
	8	Unerupted Tooth
T	T	Trauma (Fracture)
	9	Not Recorded

ANNEXURE VI:

FLOW DIAGRAM OF METHODOLOGY FOLLOWED IN THE STUDY



ANNEXURE VII:
BIOSTATISTICS CERTIFICATE

KLE V.K. Institute of Dental Sciences
(A Constituent unit of KLE Academy of Higher Education & Research Deemed-to-be-University u/s 3 of the UGC Act, 1956)
Nehru Nagar, Belagavi-590 010 INDIA
Re-Accredited 'A' grade by NAAC (3rd Cycle) & Placed in Category 'A' by MHRD (GoI)
☎. 0831-2470362
FAX: 0831-2470640
Web: http://www.kledental-bgm.edu.in
E-mail: principal@kledental-bgm.edu.in

BIOSTATISTICS CLEARANCE CERTIFICATE

This is to certify that the Biostatistics aspect of the Dissertation / Research work of **Dr. Sanjana P. Soneta, Postgraduate Student** under the guidance of **Dr. Shivayogi M. Hugar, Professor and Head, Department of Pediatric and Preventive Dentistry** Entitled "***Comparative Evaluation Of Retention And Antibacterial Efficacy Of Posterior High Strength Glass Ionomer Cement And Glass Hybrid Bulk Fill Alkasite Restorative Material As Conservative Adhesive Restoration In Children With Mixed Dentition – An In Vivo Study.***" has been done under my guidance and considered satisfactory.

Place : Belagavi
Date : 26/06/2020

Name & Signature of Biostatistician
(Dr. S. B. Jawali)

ANNEXURE VII:
PLAGARISM CERTIFICATE

Scientific Correspondence and Review Committee

KLE VK Institute of Dental Sciences
A Constituent Unit of KLE Academy of Higher Education and Research
(Deemed-to-be-University u/s 3 of the UGC Act, 1956)
Nehru Nagar, Belagavi - 590 010, Karnataka State
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)
☎: 0831-2470362 Web: http://www.kledental-bgm.edu.in
FAX: 0831-2470640 E-mail:principal@kledental-bgm.edu.in

Date : 28/08/2020 Serial No. : 026

PLAGIARISM CHECK REPORT

Name of the Applicant : Dr. Sangeeta P. Soneta
UG / PG / Ph.D / Staff : Post graduate
Batch & Year : 2018 - 2021
Department : Pedodontics

The soft copy of Research Work / Manuscript by Dr. Sangeeta P. Soneta entitled "Comparative Evaluation of retention & anti-bacterial efficacy of posterior high strength GIC & Glass hybrid bulk fill alkasite restorative material as conservative nonadhesive restorative in children : An invitro study" under the guidance of Dr. Shivayogi. M. Hugar has been submitted for Anti-Plagiarism check to the Scientific Correspondence & Review Committee of KLE VK Institute of Dental Sciences using "Turn-it-in" software.

The scan has been carried out and the scanned output reveals a Similarity Index of 5%, which is within / ~~not within~~ the acceptable limits of 10% as per the UGC guidelines.

Member Secretary
Scientific Correspondence and Review Committee
KLEVK Institute of Dental Sciences
KAHER-Belagavi

Chairman
Scientific Correspondence and Review Committee
KLEVK Institute of Dental Sciences
KAHER - Belagavi