EFFECT OF POTASSIUM IODIDE ON THE TENSILE BOND STRENGTH OF GLASS IONOMER CEMENT AND RESIN MODIFIED GLASS IONOMER CEMENT ON SILVER DIAMINE FLUORIDE TREATED DENTINE: A COMPARATIVE IN VITRO STUDY

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BRANCH VIII

PEDODONTICS AND PREVENTIVE DENTISTRY

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CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"EFFECT OF POTASSIUM IODIDE ON THE TENSILE BOND STRENGTH OF GLASS IONOMER CEMENT AND RESIN MODIFIED GLASS IONOMER CEMENT ON SILVER DIAMINE FLUORIDE TREATED DENTINE : A COMPARATIVE IN VITRO STUDY**" is a bonafide work done by **Dr. ANJUGAM. P** in partial fulfillment of the requirements for the degree of **MASTER OF DENTAL SURGERY** in the speciality of **PEDODONTICS AND PREVENTIVE DENTISTRY**.

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This is to certify that **Dr. ANJUGAM .P ,** post graduate student (2017 – 2020) in the department of Pedodontics and Preventive Dentistry, Vivekanandha Dental College for Women, has done this dissertation titled "**EFFECT OF POTASSIUM IODIDE ON THE TENSILE BOND STRENGTH OF GLASS IONOMER CEMENT AND RESIN MODIFIED GLASS IONOMER CEMENT ON SILVER DIAMINE FLUORIDE TREATED DENTINE : A COMPARATIVE IN VITRO STUDY**" under our guidance and supervision in partial fulfillment of the regulations laid down by **The Tamilnadu Dr.M.G.R Medical University**, Chennai – 600 032 for **Master of Dental Surgery (Branch VIII) PEDODONTICS AND PREVENTIVE DENTISTRY** degree termination.

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DURATION OF COURSE	3 Years
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This is to certify that this dissertation work titled **“EFFECT OF POTASSIUM IODIDE ON THE TENSILE BOND STRENGTH OF GLASS IONOMER CEMENT AND RESIN MODIFIED GLASS IONOMER CEMENT ON SILVER DIAMINE FLUORIDE TREATED DENTINE: A COMPARATIVE IN VITRO STUDY”** of the candidate **Dr. P. ANJUGAM** with Registration Number **241725251** for the award of degree **MASTER OF DENTAL SURGERY** in the branch of **PEDODONTICS AND PREVENTIVE DENTISTRY**. I personally verified the urkund.com website for the purpose of Plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **8%** of plagiarism in the dissertation.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPLANATION
ECC	Early childhood caries
SDF	Silver diamine fluoride
GIC	Glass ionomer cement
RMGIC	Resin modified glass ionomer cement
KI	Potassium iodide
MPa	Mega Pascal
FDA	Food and drug administration
ppm	Parts per million
LC	Light cure
TBS	Tensile bond strength
PVC	Poly Vinyl Chloride
HEMA	Hydroxyethyl methacrylate
Bis-GMA	Bisphenol A-glycidyl methacrylate
P value	Probability value

INTRODUCTION

INTRODUCTION

Dental caries is a multifactorial, complex disease which remains a significant problem in all age groups.[1,57] It is a complex progression involving dietary sugars, bacterial metabolism, demineralization, and organic degradation. The collagenous organic matrix is exposed once a dentin surface is demineralized and destroyed by native and bacterial proteases to enable a lesion to enlarge.[2]

The early stage of microorganism invasion within the cavity process involves Streptococci, Lactobacilli, and Actinomycetes. Streptococci mutans and sobrinus are two of the foremost necessary odontopathogens concerned within the initiation and progression of the cavity. Lactobacilli rhamnosus and acidophilus are both the most ample species usually found in every superficial and deep unhealthy lesions, wherever the hydrogen ion concentration tends to be acidic. Actinomycetes naeslundii has the potential to invade dentinal tubules and is associated with root caries.[3] The cariogenic bacteria of secondary caries are similar to those of primary caries and consist primarily of Streptococci, Actinomyces naeslundii and Lactobacilli.[4]

The treatment of caries in children is virtually non-existent in many low- and middle-income countries. The dramatic decline in caries over the past three decades, seen in many high-income countries, is largely attributed to the widespread use of fluoride toothpaste, in spite of continued consumption of high levels of sugar. Another, potentially more costly and more time-consuming approach, is the provision of sealants.[5]

Early childhood caries (ECC) is highly prevalent, especially in poor and disadvantaged children (Chu et al.1999; Tinanoff and Reisine 2010).Epidemiological studies reported that ECC was mostly left untreated (Chu et al. 2012; Schwendicke et al. 2015). The conventional restorative approach needs subtle dental instrumentation and well-trained health personnel, especially in apprehensive young children (Chu and Lo 2007). Effective and feasible caries treatment protocols are required to address this major dental public health problem.[6,58]

In developed countries, uncooperative children have the options of care delivered with conscious sedation, or in an operating room with general anesthesia. Both increase the risks and cost of treatment and restorative care does not address the underlying bacterial infection. Upon focusing on multiple preventive interventions as alternates to the traditional methods of restorative care, silver diamine fluoride is unique in both killing the bacteria and hardening the teeth, thus both arresting and preventing caries. The U.S. Food and Drug Administration approved the use of SDF in 2014 as a device for the treatment of dentin sensitivity on patients 21 and older. Thus the use of SDF for caries prevention or arrest is off-label, similar to fluoride varnish.

SDF appears to be a useful immediate treatment for children who can't receive traditional restorative treatment for dental decay. It is effective for caries arrest and prevention of new lesions on the teeth where it is applied and is a minimal intervention treatment that is safe and affordable. Given the foregoing, it might be expected that SDF will be widely implemented for caries control to meet the patient's needs, as well as to meet any country’s national goals.[7]

On searching the evidence base for primary and secondary prevention of dental caries through professional and self-care measures the data obtained were as follows.

METHOD	PREVENTED FRACTION
SELF CARE	
1.Xylitol gums	59%
2.Triclosan/copolymer toothpaste	5%
3.Interdental cleaning (brushing and flossing)	24%
PROFESSIONAL CARE	
1.Fissure sealants	84-65%
2.Chlorhexidine varnish	21%
3. Silver diamine fluoride (38%)	70%
4.Ozone	Not determined
5.Oral health counselling, motivational interviews	Not determined
6. Dietary interventions	Not determined
7. Early age preventive dental visits, Recall intervals	Not determined

Table 1. Professional and self-care preventive measures

Fluoride technologies and fissure sealants are used for primary prevention of dental caries in young permanent dentition. For secondary caries prevention, professional and self-care measures are very low.[8]

When silver diamine fluoride was applied to carious lesions, impressive prevention is seen. Fluoride - releasing glass ionomer cement (GIC) will have this effect; but, it is restricted to surfaces adjacent to the treated surface and of a short period. An annual application of SDF prevents many more carious lesions than four times per year fluoride varnish in both children and elders. Conventional treatment of early childhood caries in young children involves many difficulties like behavioural issues and lack of cooperation. Hence, a majority of patients are left untreated, which ultimately results in the loss of teeth. Loss of deciduous teeth mainly upper anterior may cause psychological trauma to the patient or phonation problems. Deciduous teeth are also important for the normal growth of jaw bone and the timely eruption of permanent teeth. From such point of view by the application of silver diamine fluoride, caries can be arrested, and above-described problems can be overcome.[9] Studies have proven that professionally applied 5 % sodium fluoride varnish was found to be effective in remineralizing early enamel caries and 38 % silver diamine fluoride was effective in arresting dentine caries (Chu et al. 2002; Llodra et al. 2005).[6,41,43,45]

However, a significant disadvantage of SDF is the unaesthetic concern of the black staining of teeth caused by silver oxide. It causes permanent dark staining of clinic surfaces and clothes and temporary staining of the skin. If stained it has to be immediately washed with copious water, ethanol or ammonia. The black staining caused by SDF can be overcome by the use of Potassium iodide (KI).[17] However, the influence of potassium iodide on the bond strength of SDF to restorative materials has no enough documentation. Hence this study was designed to estimate the effect of SDF/KI on the restorative materials.

AIM AND OBJECTIVES

AIM AND OBJECTIVES

Aim of the study:

To compare and evaluate the influence of silver diamine fluoride and potassium iodide on the tensile bond strengths of glass ionomer cement and resin-modified glass ionomer cement.

Objectives of the study:

-To evaluate and compare the tensile bond strength of glass ionomer cement (GIC) to dentine surfaces that has been treated with and without silver diamine fluoride (SDF).

- To evaluate and compare the tensile bond strength of resin- modified glass ionomer cement (RMGIC) to dentine surfaces that has been treated with and without SDF.

- To evaluate and compare the tensile bond strength of glass ionomer cement (GIC) to SDF treated dentine surfaces with and without KI.

- To evaluate and compare the tensile bond strength of resin- modified glass ionomer cement (RMGIC) to SDF treated dentine surfaces with and without KI.

-To identify the better choice of material between GIC and RMGIC to be used while using SDF/KI.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Pereira LC et al (2002) evaluated the mechanical properties of glass-ionomer cement (GIC) and resin-modified GIC (RM-GIC) that had been indicated as restorative materials and expressed that among the GICs tested, RM-GIC showed higher values of diametral tensile bond strength and mean tensile bond strength.[23]

Knight GM et al (2005) found out that treatment of demineralized dentine discs with AgF followed by KI allowed the penetration of S. mutans but relatively fewer microorganisms were present subjacent to the discs treated with AgF and KI than the control discs.[19]

Nagaraja Upadhya P et al (2005) in their review have discussed as follows. Despite all improvements, the two problems of conventional glass ionomer cement remained: moisture sensitivity and lack of command cure. To overcome these problems, attempts have been made to combine glass ionomer chemistry with the well-known chemistry of composite resins. In the late Nineteen Eighties and early Nineties, a couple of so called light cured glass ionomers were released on the market. So, resin modification of glass – ionomer cement was designed to produce favourable physical properties just like those of resin composites while maintaining the essential options of the traditional glass ionomer cement. In these newer materials the fundamental acid/ base curing reaction is supplemented by a second curing process, which is initiated by light or chemical.[14]

Choi K et al (2006) concluded from an in vitro study that the microtensile bond strengths of Ketac-Fil Plus Aplicap (conventional GIC) and Photac-Fil Aplicap (RMGIC) to carious dentin were lower than those to sound dentin. RMGIC had high microtensile bond strength to both sound and carious dentin than GIC. The sound dentin had cohesive failure predominant; whereas, mixed failure was predominant in the carious dentin groups.[26]

Knight GM et al (2006) found that the application of AgF and KI onto dentine before the placement of glass ionomer cement did not significantly affect the uptake of strontium into the subjacent demineralized dentine and the fluoride levels in this zone were significantly increased.[21]

Delbem AC et al (2006) concluded that fluoridated varnish was more effective to reduce both the enamel surface demineralization and caries lesion depth than silver diamine fluoride solution.[31]

Knight GM et al (2006) found that the application of AgF/KI to etched dentine samples followed by washing off the precipitate created bond strengths that were not significantly different from conditioned samples. Leaving the AgF/KI precipitate on the dentine surface significantly reduced the bond strength of auto cured glass ionomer cement to dentine. Washing away the reaction products and air drying is recommended as the clinical protocol for using AgF and KI on dentine surfaces prior to application of an auto cure glass ionomer cement.[22]

Knight GM et al (2007) confirmed that a topical treatment with AgF/KI on dentine reduced in vitro caries development and inhibited surface biofilm formation. Reduction of in vitro caries development and viability of S. mutans was more pronounced on the dentine samples that had been demineralized before the application of AgF/KI.[20]

Lim HN et al (2009) suggested that addition of an appropriate amount of HEMA to glass ionomer cement would increase diametral tensile strength as well as bond strength to alloys and teeth. The results also confirmed that the optimal HEMA content ranged from 20 to 40% within the limitations of the experimental condition.[35]

Francisconi LF et al (2009) has reported that the bond failures reported up to now have represented cohesive failure in the cement rather than adhesive failure at the interface with tooth structure.[36]

Chu CH et al (2012) showed that SDF posses an anti-microbial activity against cariogenic biofilm of S. mutans or A. naeslundii formed on dentine surfaces. SDF slowed down demineralization of dentine. This dual activity could be the reason behind clinical success of SDF.[27]

Craig GG et al (2012) has shown that diamine silver fluoride and KI is free of adverse side effects after applications over extended periods when used for treatment on dentinal hypersensitivity.[30]

Monse B et al (2012) has revealed the conclusion that an one - time application of 38% SDF on the occlusal surfaces of permanent first molars of six- to eight-year-old children is not an effective method to prevent dentinal caries lesions. ART sealants significantly reduced the onset of caries over a period of 18 months.[5]

Quock RL et al (2012) found that the effect of SDF on self-etch bonded teeth compared to etch-and-rinse bonded teeth was highly significant, specifically at the 12% concentration. SDF does not adversely affect the bond strength of resin composite to non carious dentin.[34]

Rekha CV et al (2012) had said that compomer has the highest tensile bond strength and then Resin modified GIC with the conventional glass ionomer cement having the least bond strength. And Resin modified GIC has the least microleakage among the three cements primarily due to similarity of coefficient of thermal expansion of teeth and the cement leading to superior adaptation.[24]

Chu CH et al (2013) investigated and proved that 38% SDF inhibits multi-species cariogenic biofilm (Streptococcus mutans, Streptococcus sobrinus, Lactobacillus acidophilus, Lactobacillus rhamnosus and Actinomyces naeslundii) formation on dentin carious lesions and reduces the demineralization process.[27]

Mei ML et al (2013) comprehensively showed that SDF possess an anti-microbial activity against S. mutans and L. acidophilus dual-species cariogenic biofilms formed on dentine surfaces. Also, SDF slowed down demineralization of dentine and protect the collagen from being destroyed. This dual activity could be the reason behind clinical success of SDF.[28]

Gluzman R et al (2013) stated that for primary prevention of root caries the recommended 'best choice' is a 38% Silver Diamine Fluoride solution professionally applied annually, while for the 2° prevention of root caries, the recommended 'best choice' is a 22,500 ppm Sodium Fluoride varnish professionally applied every 3 months.[32]

Imbery TA et al (2013) indicated significant interaction between RMGIs - Fuji II LC, Riva LC, Ketac Nano and conditioning agent - Cavity Conditioner (GC) on evaluating dentin surface treatments for Resin Modified Glass Ionomer Restorative Materials.[11]

Loudon JA et al (2014) concluded the applications of Fuji IXGP include not only restorative but also cementation and core build up scenarios. Fuji IXGP fluoride release, radio-opacity and reasonable aesthetics offer-up advantages in field and Special Needs dentistry as well as in the clinic for caries susceptible individuals.[13]

Savas S et al (2015) stated that SDF has a highly effective antibacterial action against cariogenic Streptococcus mutans biofilm; than the other fluoride agents like acidulated phosphate fluoride, ammonium hexafluorosilicate, ammonium hexafluorosilicate, cetylpyridinium chloride, 0.2% chlorhexidine.[10]

Twetman S et al (2015) reviewed studies on caries, erosion and sensitivity prevention and said that for primary caries prevention, the quality of evidence was high for the use of fluoride dentifrice and moderate for fluoride varnish and fissure sealants. The quality of evidence for fluoride gel, fluoride mouth rinse, xylitol gums and silver diamine fluoride (SDF) was rated as low. For secondary decay hindrance and caries arrest, only fluoride interventions and SDF proved consistent benefits, although the quality of evidence was low. Likewise, the grade score for preventing erosions located in the enamel with fluoride supplements was low. The quality of evidence for various professional and self-care methods to prevent and manage dentine hypersensitivity was very low.[8]

Horst JA et al (2016) has confirmed that in August 2014 the Food and Drug Administration (FDA) of United States of America cleared the first silver diamine fluoride product for market, and as of April 2015 that product is available. Silver diamine fluoride (38% w/v $Ag(NH_3)_2F$) - colorless topical agent comprised of 24.4-

28.8% (w/v) silver and 5.0-5.9% fluoride, at pH 10.4 and marketed as Advantage Arrest™ by Elevate Oral Care, LLC (West Palm Beach, FL).[2]

Crystal YO et al (2016) stated that SDF appears to be a useful immediate treatment for children who can't receive traditional restorative treatment for dental decay. It is effective for caries arrest and prevention of new lesions on the teeth where it is applied, and is a minimal intervention treatment that is safe and affordable.[7]

Alzraikat H et al (2016) evaluated compressive, diametral tensile strength and solubility of a nanofilled GIC, conventional GIC and RMGIC and found that compressive and diametral tensile strength of nanofilled GIC was significantly lower than that of RMGIC. The 24- hour solubility of nano GIC was highest among all.[25]

Fung MH et al (2016) based on his 18-months study results confirmed that SDF is more effective in arresting dentin caries in the primary teeth of preschool children at 38% concentration than 12% concentration and when applied biannually rather than annually.[6]

Selvaraj K et al (2016) stated that pretreatment of dentin with SDF/KI minimized nanoleakage at the resin-dentin interface without adversely affecting the bond strength of resin composite to dentin.[33]

Wang AS et al (2016) declared that the application of SDF on sound or deminearlized dentin prior to GIC application does not influence the mature bond strength at the adhesive interface under the conditions tested.[16]

Koizumi H et al (2016) from their study concluded that if silver diamine fluoride is used as a desensitizing and cavity cleaning agent then tooth surfaces should be lightly roughened.SDF should not be used as a 'whole cavity' 'disinfecting' agent but may be used for spot application where a cavity floor approximates the pulp where caries-affected dentine may still exist, otherwise adhesion may be compromised.[38]

Sidhu SK et al (2016) confirmed that the physical properties of the resin-modified glass-ionomers have been shown to be smart, and comparable with those of conventional glass-ionomers, but biocompatibility is somewhat compromised by the presence of the resin component, 2 hydroxyethyl methacrylate.[15]

Nguyen V et al (2017) confirmed that treatment with SDF followed by KI had little to no darkening, compared to SDF treatment when used with glass ionomer (self - cure), Resin modified GIC, composite or no restorative on carious and sound teeth.[17]

Zhao I et al (2017) investigated the effect of silver diamine fluoride (SDF) and iodide (KI)treatment on secondary caries prevention and tooth discolouration in glass ionomer cement(GIC) restoration and found that SDF + KI treatment reduced secondary caries formation on GIC restoration, but it was not as effective as SDF treatment alone. Moreover, a perceptible staining on the restoration margin was observed, but the intensity of discolouration was less than that with solely SDF treatment.[4]

Sumaya Nouri et al (2018) in their review article has concluded that Glass ionomer is a very versatile material and has boundless potential in pediatric dentistry, it is bioactive because of the ion exchange that occurs after the material sets and allows for adhesion to tooth structure and for fluoride release. Poor mechanical properties were the main weakness of this material, however modifications including resin modified glass ionomers proved to be successful for restoring primary molars.[12]

Galui S et al (2018) in his review has said that 38% silver diamine fluoride is effective in caries prevention. It halts the caries progression. According to different studies, silver diamine fluoride does not produce any pulpal damage. It is simple to use, cost-effective and can be stored in a constant concentration. It is very useful for the management of caries in young children.[9]

Seifo N et al (2019) did the umbrella review that comprehensively appraised the proof for silver diamine fluoride (SDF) to arrest and stop root and coronal caries by summarizing systematic reviews. Adverse events were explored. Systematic reviews constantly supported SDF's effectiveness for preventing coronal tooth decay in the deciduous dentition and controlling and preventing root caries in older adults for all comparators. There is deficient proof to draw conclusions on SDF for hindrance in primary teeth decay and prevention and arrest in permanent teeth in kids. No serious adverse events were reported.[29]

Feiz A et al (2019) found that the micro-tensile bond of the giomer was the strongest, cention N and RMGI were approximately of equal strength, and zirconomer showed the lowest tensile bond strength.[37]

MATERIALS & METHODS

MATERIALS AND METHODS

After getting ethical clearance from the institutional ethics committee of Vivekananda Dental College for Women (No: VDCW/IEC/73/2017), the study was conducted in the Department of Pedodontics and Preventive Dentistry, Vivekananda Dental College for Women, Tiruchengode, in collaboration with the Department of Manufacturing Engineering, Annamalai University, Chidambaram.

ARMAMENTARIUM:

The study done to determine the effect of potassium iodide on the tensile bond strength of glass ionomer cement and resin- modified glass ionomer cement on silver diamine fluoride treated dentin involved the use of following materials. (Fig 1)

1. 120 Extracted premolars
2. Distilled water
3. Acrylic mould
4. Cold cure resin
5. Restorative instruments
6. 10%Polyacrylic acid (GC Dentin conditioner)
7. Glass ionomer cement (GC IX)
8. Resin modified Glass ionomer cement (GC II LC)
9. Mixing pad.
10. Plastic spatula
11. Light curing unit
12. 38% SDF (Fagamin)
13. Potassium iodide

14. Plastic dappen dish
15. Applicator tips
16. Measuring jar
17. Glass stirrer
18. Looped 26 gauge ligature wire
19. KI weighing meter
20. Diamond disc
21. Universal testing machine (INSTRON 3300 100KN)
22. Polyvinyl mould.
23. Bard-Parker blade.

Fig 1. Materials used

1)10%Polyacrylic acid (GC Dentin conditioner, GC Corp, Japan) (Fig 2)

Dentin conditioner – a gentle polyacrylic acid conditioner designed to induce eliminating the dentinal smear layer and to condition dentine and enamel before restoration of glass ionomer restorative material. The recommended application time is 20 seonds.

Advantages:

- Increases the bond between glass ionomer cement and tooth structure for improved longevity.
- Less risk of post operative sensitivity.

Disadvantage:

- Blue tinting.

Fig 2.GC dentin conditioner

2) Glass ionomer cement (GC IX, GC Corp, Tokyo, Japan): (Fig 3)

It is a high strength posterior restorative cement. It is easy to use, handle and place fluoride releasing cement. It cures extremely hard and is very wear resistant. As a true glass ionomer it bonds with chemicals to the tooth structure, encompasses a tooth like coefficient of thermal expansion and releases vital levels of halide. Its best for geriatric and paediatric restorations, non stress bearing areas, intermediate restorative, core material and long run temporary restorations.

Composition:

Powder:

Silica – 29%

Alumina – 16%

Aluminium fluoride – 5%

Calcium fluoride – 34%

Cryolite – 5%

Aluminium phosphate – 9.9%

Lanthanum, strontium, barium (for radio-opacity) – traces

Liquid:

Polyacrylic acid – 35%

Itaconic, maleic acid, tricarballylic acid, tartaric acid – 5 to 15%

Water.

Fig 3. Glass ionomer cement

3) Resin modified Glass ionomer cement (GC II LC, GC Corp, Japan): (Fig 4)

Powder:

Aluminosilicate glass

Pigments

Photo sensitizer

Liquid:

Polyacrylic acid copolymer

Tartaric acid

Dimethacrylate monomer – HEMA (hydroxyl ethyl methacrylate) 17%

Photoinitiator–Camphoroquinone

Resin-modified glass ionomer cements contain the addition of a small number of resin components such as hydroxyethyl methacrylate (HEMA) or Bis-GMA in the liquid of the conventional glass ionomers. Some of the water components of the conventional glass ionomer cement are replaced by a water/HEMA mixture. More advanced materials are developed by modifications of the polyacid with facet chains which will be polymerized by a light-curing mechanism. Up to 18-20 percent of additional resins are added to the liquid and, depending on the powder/water ratio of the mixture, about 4-5 per cent of the final cement mass can be regarded as extra resins. It is then possible to light-cure, resulting in an immediate setting reaction in the resins which will provide an umbrella effect and protect the ongoing acid-base reaction within the cement.

Mechanism of setting:

In the resin-modified glass ionomer cement, the setting reaction is alleged to be a twin mechanism. The usual glass ionomer acid-base reaction begins on initiating the setting, followed by a free radical polymerization reaction which may be generated by either photo-initiator or by chemical initiators or both. If chemical initiators are included, then the polymerization reaction can begin on mixing furthermore. The acid-base reaction in this modified cement system is known to slow down as some of the water has been replaced by HEMA. Finally, two matrices are formed: a metal polyacrylate salt hydrogel and a polymer. The initial set of the resin-modified glass ionomer cement is the result of the formation of polymer matrix and the acid-base reaction serves to harden and strengthen the formed matrix.[51]

Fig 4.Resin modified glass ionomer cement

4) 38% SDF (Fagamin): (Fig 5)

Composition:

24.4-28.8% silver

5-5.9% fluoride

8% ammonia

Silver Diamine Fluoride (SDF) is a colorless topical fluoride with a composition of 24.4-28.8% silver, 5-5.9% fluoride and 8% ammonia as the solvent. Its fluoride concentration is 44,800 parts per million which is near twice the strength of commercially available 5% sodium fluoride varnish used in primary care.SDF is inexpensive, easy to apply and has high efficacy. The professional acceptance of SDF treatment is high[42] and is gradually increasing further.

Mechanism of action of SDF:

Biologically, silver diamine fluoride is a bi-functional agent. Silver and fluoride interact synergistically to form fluorapatite, hardening the teeth preventing further demineralization. Simultaneously the silver precipitates onto the surface of the tissues creating the brown black surface especially in dentin, which together hardens the tissue. The topical application of silver diamine fluoride on the exposed dentinal surface results in the formation of a squamous layer, partially plugging the dentinal tubules. The silver directly kills caries causing bacteria, by interacting with sulfhydryl groups of proteins of deoxyribonucleic acid (DNA), altering hydrogen bonding and inhibiting respiratory processes, DNA unwinding, cell wall synthesis, and cell division. SDF had an inhibitory effect on matrix metalloproteinases (MMPs), which play an important role in the enzymatic degradation of collagen, by inhibiting the proteolytic activities of MMP-2, MMP-8 and MMP-942. The activities of cysteine cathepsins (or cathepsins), which are proteolytic enzymes that contribute to dentine collagen degradation, were also inhibited by SDF.[7,46]SDF thus promoting remineralization, inhibiting demineralization,[9,55] increasing dentin hardness and acting against bacterial cariogenic pathogens outperforms other anti caries medicaments.

Indications:

- Extreme caries risk patients
- Early childhood caries
- Uncooperative child.

Contra indications:

- Allergy to silver
- Ulcerative gingivitis
- Stomatitis.

Fig 5. 38% Silver diamine fluoride

5) Potassium iodide: (Fig 6,7,8,9)

A freshly prepared saturated solution of KI(Fig 9) (1 g 99% KI powder (Fig 6) in 1 ml of distilled water) (Fig 7)[17]prepared using a KI weighing meter(Fig 8).

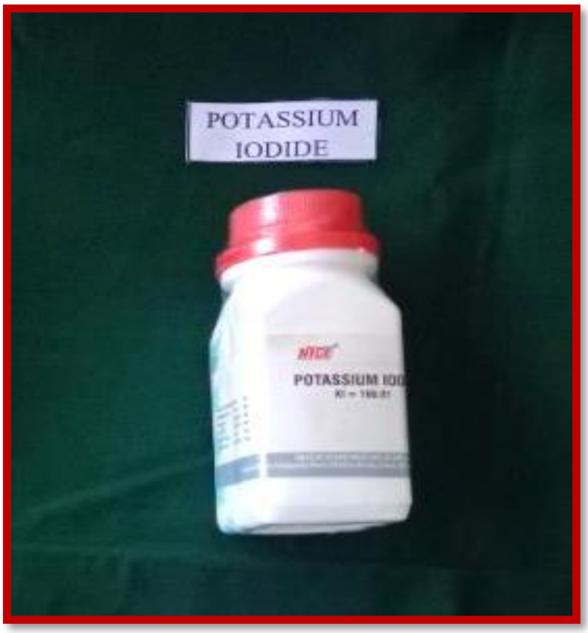

Fig 6.99% KI powder

Fig 7.Distilled water

Fig 8. KI weighing meter

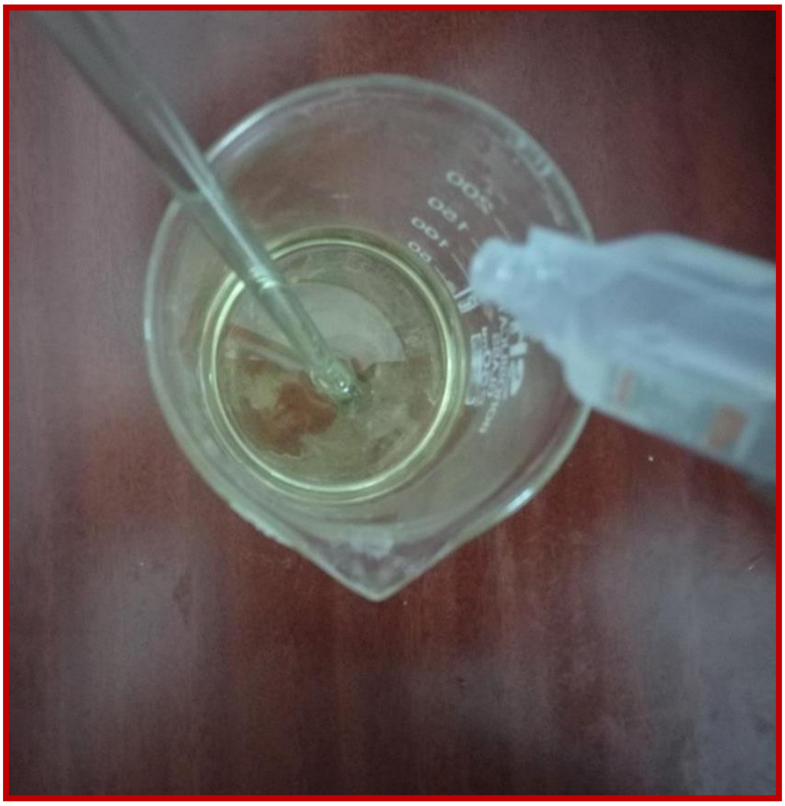

Fig 9. Freshly prepared saturated solution of KI

6) Looped 26 gauge ligature wire: (Fig 10)

Fig 10. Looped 26 gauge ligature wire

7) Polyvinyl mould: (Fig 11)

Polyvinyl mould has an inner diameter of 4mm and a height of 4 mm.

Fig 11. Polyvinyl mould

SAMPLE SELECTION:

The sample consists of 120 extracted human single rooted premolar teeth.

Sample size determination:

With the desired statistical power of 0.99, with effect size of 0.8 which is the expected difference between the means of the target values between the experimental group and the control group divided by the expected SD and with the confidence interval of 95% and significance level of 5% the sample size is calculated as 58 for each group. So the subgroup sample size may be taken as 20 each.

Unpaired t test is suggested for comparison between any two subgroups.

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[4]	Cohen's d		
Power	**0.2**	**0.5**	**0.8**
0.25	84	14	6
0.50	193	32	13
0.60	246	40	16
0.70	310	50	20
0.80	393	64	26
0.90	526	85	34
0.95	651	105	42
0.99	920	148	58

INCLUSION CRITERIA:

Permanent premolars extracted for orthodontic purpose.

Sound tooth structure.

Fully formed root apices.

EXCLUSION CRITERIA:

Teeth with extensive caries

Cracks on the root surface

Decay

Short or thin & multiple rooted teeth

Fluorosis.

METHODOLOGY:

A total of 120 samples are used in the study. (Fig 12)The teeth were stored in aqueous formalin until use.[61] The occlusal surfaces of the teeth were ground to expose dentin (Fig 13).The mid–coronal portion of the occlusal surfaces of dentin was exposed by a flat cut perpendicular to the long axis of the tooth with a fine diamond disc at high speed with copious water spray. The exposed surfaces were polished using 600 grit silicon carbide abrasive paper under running water to obtain a flat dentin surface. Horizontal indentations were placed on the radicular portion of the specimens. The teeth are embedded in self curing acrylic resin (DPI-RR) blocks (Fig 14). A hollow polyvinyl mould with an inner diameter of 4mm and height 4 mm placed on the treated surface. (Fig 15)

Then the specimens are randomly divided into two groups as group A and group B with 60 samples each. This in turn was sub grouped to three subgroups with 20 samples each as A1, A2, A3 and B1, B2, B3. The restorative material for group A samples was glass ionomer cement and the samples in group B were restored with resin-modified glass ionomer cement. Subgroups A3 and B3 were used as control groups. A1 and B1 subgroups were treated with silver diamine fluoride. Subgroups A2 and B2 were treated with silver diamine fluoride followed by the application of potassium iodide. The grouping protocol is given as follows (tables 2,3).

Fig 12. Allocation into groups A and B

GROUP A:

Subgroup	Sample size	Procedure used
Sub Group A1	20	Conditioned, washed, SDF applied, washed, dried, restored with GIC
Sub Group A2	20	Conditioned, washed, SDF/KI applied, washed, dried, restored with GIC
Sub Group A3	20	Conditioned, washed and restored with GIC

Table 2. Group A

GROUP B:

Subgroup	Sample size	Procedure used
Sub Group B1	20	Conditioned, washed, SDF applied, washed, dried, restored with RMGIC
Sub Group B2	20	Conditioned, washed, SDF/KI applied, washed, dried, restored with RMGIC
Sub Group B3	20	Conditioned, washed and restored with RMGIC

Table 3. Group B

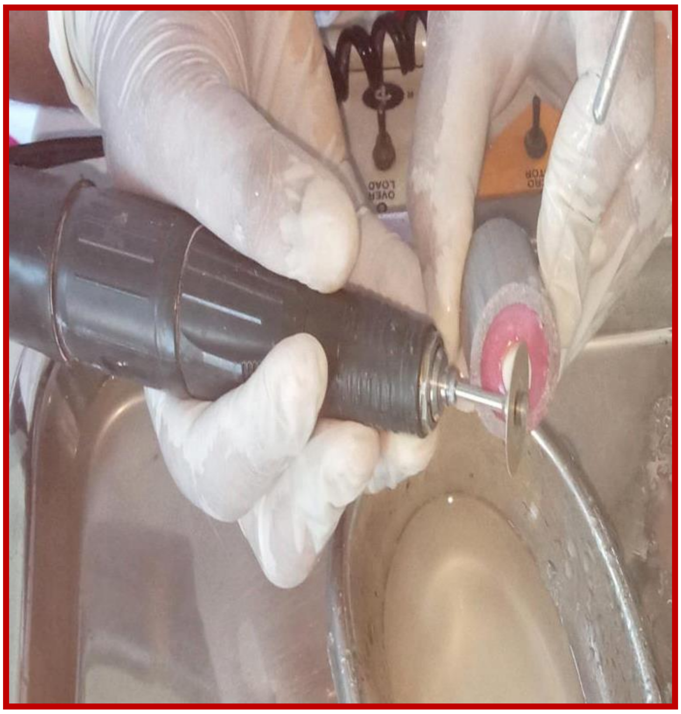


Fig 13. Teeth ground to expose dentin

Fig 14. Teeth embedded in self curing acrylic resin blocks

Fig 15. Polyvinyl mould on treated dentine

PROCEDURE:

The first group is group A with 60 samples.In subgroup A1 (Fig 16) the samples are first conditioned (Fig 17) with 10% Polyacrylic acid (GC dentin conditioner, GC Japan), (Fig 18) rinsed with water (Fig 19) and dried. Care was taken not to desiccate. (Fig 20) Then samples are treated with 38% Silver diamine fluoride (Fagamin) (Fig 21) for ten seconds and then rinsed with water.SDF is taken in a plastic dappen dish and applied with an applicator tip (Fig 22). Dark staining was immediately evident on SDF treated dentine.(Fig 23) The polyvinyl mould is kept over the silver diamine fluoride treated dentine surface.(Fig 24) Then it's filled with GIC(GC 9, GC Japan) (Fig 25,26). A 26 gauge ligature wire was twisted to form a loop at one end and was placed inside the setting cement (Fig 27). After cement is set, polyvinyl mould was removed (Fig 28).

In subgroup A2 (Fig 29) the samples are first conditioned with 10% Polyacrylic acid. It's rinsed off. Then it's treated with 38% Silver diamine fluoride for ten seconds, followed by application of potassium iodide. The silver ions from the SDF solution will react with the iodide ions from the KI solution to form silver iodide which is evident as a creamy white precipitate (Fig 30). On obtaining the precipitate it's rinsed with water. Then it's filled with GIC with the looped 26 gauge ligature wire placed inside the setting cement. In subgroup A3(Fig 31) the samples are conditioned with 10% Polyacrylic acid and restored with GIC restorative glass ionomer cement, with the looped 26 gauge ligature wire placed inside the setting cement.

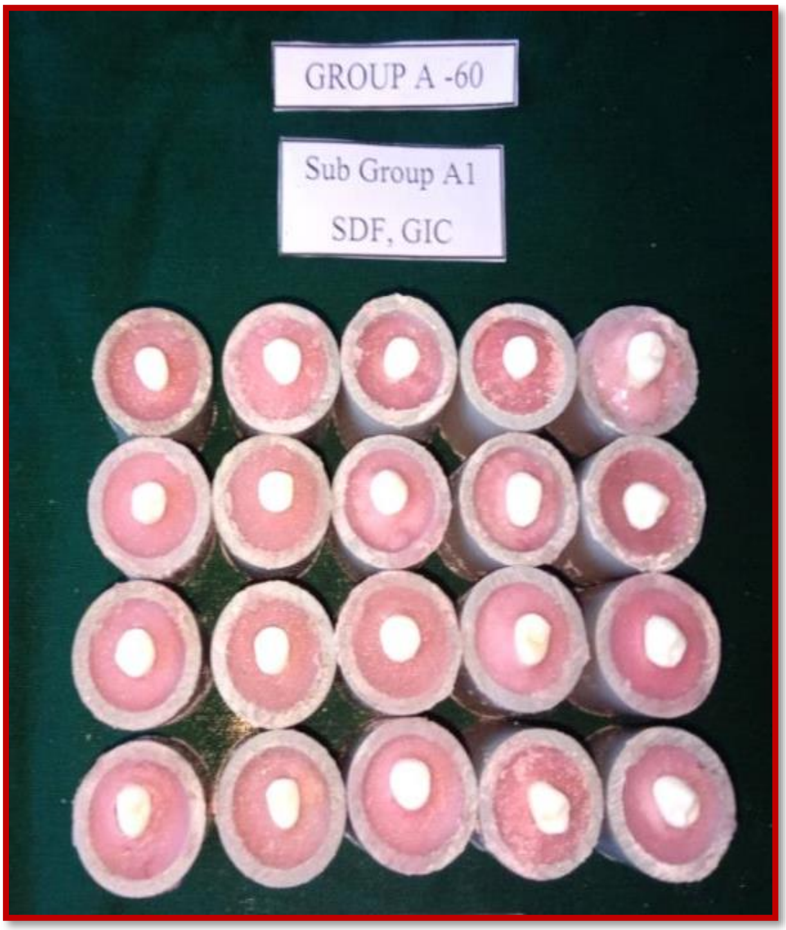


Fig 16. Subgroup A1 - SDF and GIC

Fig 17. 10% Polyacrylic acid

Fig 18.Conditioned with 10% Polyacrylic Acid

Fig 19.Conditioner washed off

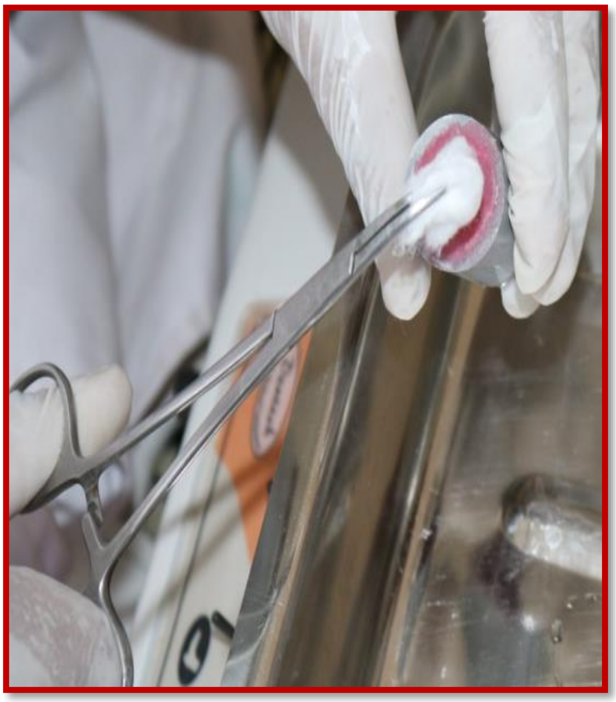


Fig 20. Sample dried after conditioner is washed

Fig. 21. 38% SDF -Fagamin

Fig. 22 SDF drop in plastic dappen dish

Fig 23. Dark staining immediately evident on SDF treated dentine

Fig 24.Polyvinyl mould kept over SDF treated dentine

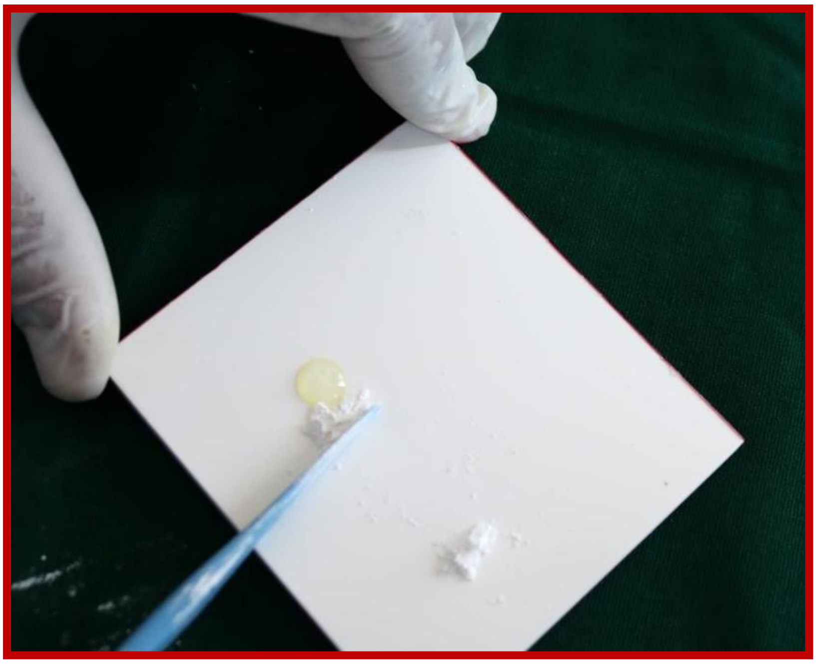


Fig 25. GIC mixed in increments

Fig 26.GIC to be filled in sample

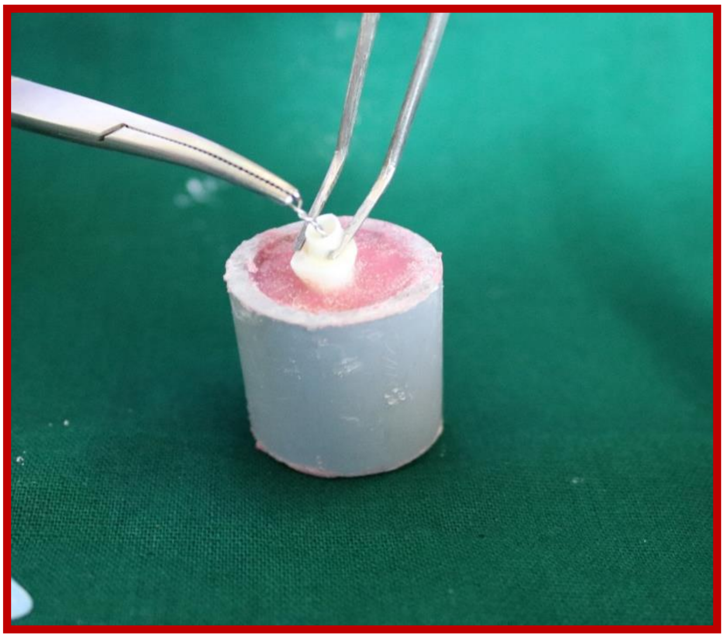


Fig 27.Looped 26 gauge ligature wire placed in set cement

Fig 28. After cement is set, pvc mould removed

Fig 29. Sub group A2

Fig 30. Creamy precipitate with SDF and KI

Fig 31.Sub Group A3

The second group is group B. In subgroup B1 (Fig 32) the samples are first conditioned with 10% Polyacrylic acid (GC dentin conditioner, GC Corp Japan), rinsed with water. Then its treated with 38% Silver diamine fluoride (Fagamin) for ten seconds and then rinsed with water. Then it's filled with RMGIC (GC 2 LC GC Corp Japan). A 26 gauge ligature wire was twisted to form a loop at one end and was placed inside the setting cement and it is light-cured with 400 nm wavelength for 20 seconds (Fig 33).

In subgroup B2 (Fig 34) the samples are first conditioned with 10% Polyacrylic acid. It's rinsed off. Then it's treated with 38% Silver diamine fluoride for ten seconds, followed by the application of potassium iodide. The silver ions from SDF solution will react with the iodide ions from the KI solution to form silver iodide which is evident as a creamy white precipitate. On obtaining the precipitate it's rinsed with water .Then it's filled with RMGIC with the looped 26 gauge ligature wire placed inside the setting cement.

In subgroup B3 (Fig 35) the samples are conditioned with 10% Polyacrylic acid and restored with RMGIC, with the looped 26 gauge ligature wire placed inside the setting cement. After a complete set, the moulds were removed and the looped 26 gauge wire is left in place. The specimens were tested for tensile bond strength (Fig 36) with Universal Testing Machine (INSTRON) running at a crosshead speed of 5mm/minute.(Fig 37) Each sample was mounted in universal testing machine such that the dentin surface was parallel to the trajectory of the machine. A tensile load was applied, using a steel knife edge which engages the hook of the looped 26 gauge ligature wire so that the force of the tensile load was directly applied to the bond interface. The load was applied until restoration failure occurred and values were recorded.

Fig 32. Sub group B1

Fig 33. RMGIC- light cured with 400 nm wavelength for 20seconds

Fig 34.Subgroup B2

Fig 35.Subgroup B3

Fig 36. INSTRON universal testing machine

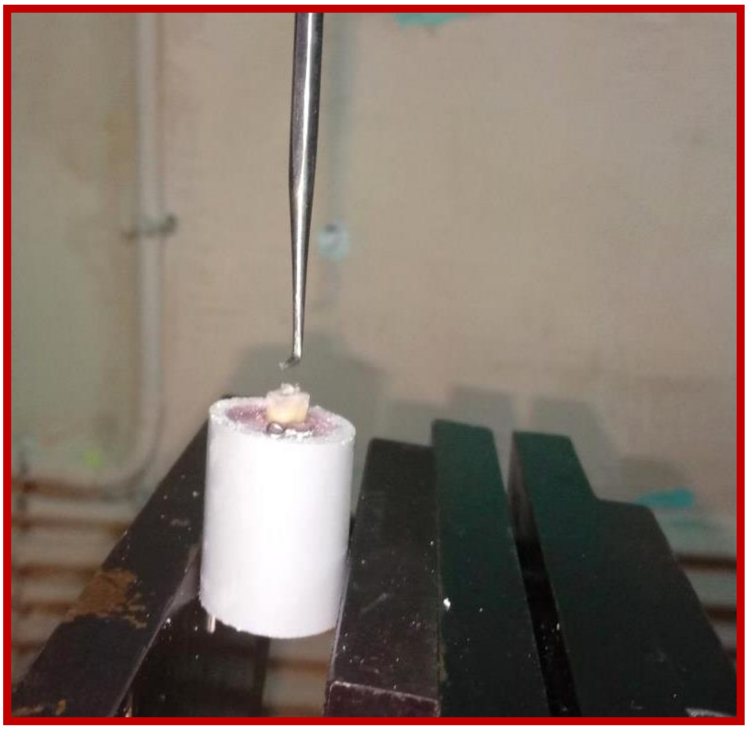


Fig 37. Tensile bond strength

RESULTS

RESULTS

Twenty samples in each subgroup were tested for tensile bond strength and the values obtained were as follows:

Subgroup A1- samples	Tensile bond strength values in MPa
1	1.59
2	1.59
3	1.99
4	2.38
5	1.59
6	2.78
7	1.59
8	2.38
9	1.99
10	2.78
11	1.99
12	2.38
13	2.78
14	1.99
15	1.59
16	1.59
17	1.99
18	2.38
19	2.78
20	1.59

Table 4. Tensile bond strength values in MPa – A1

Subgroup A2- Samples	Tensile Bond Strength Values In MPa
1	2.38
2	1.98
3	2.77
4	2.36
5	1.57
6	2.78
7	1.77
8	2.37
9	2.36
10	2.77
11	1.57
12	2.36
13	2.37
14	2.38
15	2.38
16	2.78
17	2.77
18	1.57
19	1.17
20	2.98

Table 5. Tensile bond strength values in MPa – A2

Subgroup A3-Samples	Tensile Bond Strength Values In MPa
1	1.59
2	2.38
3	1.99
4	2.38
5	1.59
6	1.99
7	2.78
8	1.99
9	1.59
10	1.59
11	2.38
12	1.99
13	2.38
14	1.59
15	2.38
16	1.59
17	1.59
18	1.99
19	2.38
20	2.78

Table 6. Tensile bond strength values in MPa – A3

Subgroup B1- Samples	Tensile Bond Strength Values In MPa
1	5.57
2	6.36
3	6.36
4	6.36
5	4.56
6	3.16
7	4.16
8	3.76
9	4.36
10	5.97
11	5.57
12	5.76
13	6.36
14	4.16
15	4.16
16	4.36
17	3.97
18	5.16
19	6.36
20	6.36

Table 7. Tensile bond strength values in MPa – B1

Subgroup B2- Samples	Tensile Bond Strength Values In MPa
1	4.59
2	5.18
3	4.19
4	6.99
5	5.59
6	5.38
7	4.18
8	4.18
9	4.18
10	4.18
11	5.38
12	7.59
13	6.18
14	3.18
15	3.18
16	5.99
17	3.18
18	3.18
19	5.59
20	5.19

Table 8. Tensile bond strength values in MPa – B2

Subgroup B3- Samples	Tensile Bond Strength Values In MPa
1	4.77
2	5.57
3	3.98
4	3.98
5	3.98
6	5.97
7	4.77
8	5.57
9	5.17
10	4.37
11	5.97
12	4.77
13	5.17
14	3.98
15	4.37
16	3.98
17	5.57
18	5.17
19	5.57
20	4.77

Table 9. Tensile bond strength values in MPa – B3

The mean score values of tensile bond strengths recorded are given for subgroup A1 (Tab 4), subgroup A2 (Tab 5), subgroup A3 (Tab 6), subgroup B1 (Tab 7), subgroup B2 (Tab 8), subgroup B3 (Tab 9).The values were then compared for statistical analysis using unpaired “t” test. The results obtained were as follows:

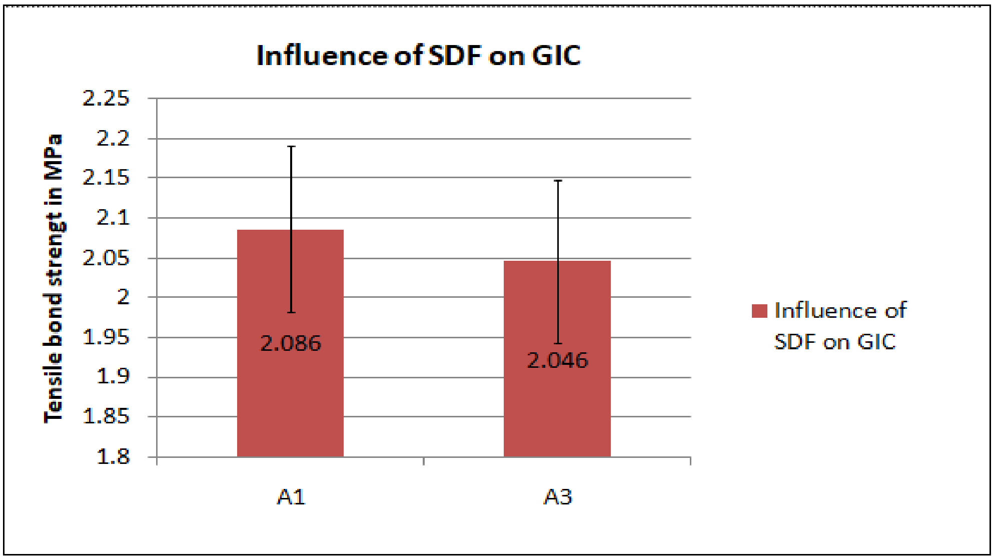
	Mean (with 95% CI)	**P value**
A1	2.086 ± 0.22	0.77
A3	2.046 ± 0.19	

P value – non significant - 0.77

Table 10. Comparison of mean TBS between SDF, GIC group and control group

Table 10 shows the comparison of mean tensile bond strength values of subgroup A1 – silver diamine fluoride teeth restored with glass ionomer cement to subgroup A3 – teeth restored with glass ionomer cement.

The mean score value of subgroup A1 was 2.086 ± 0.22 and the mean score value of subgroup A3 was 2.046 ± 0.19. On comparing the mean values using unpaired “t” test the P value was non significant - 0.77.



Graph 1. Distribution of mean score values comparing subgroups A1 and A3

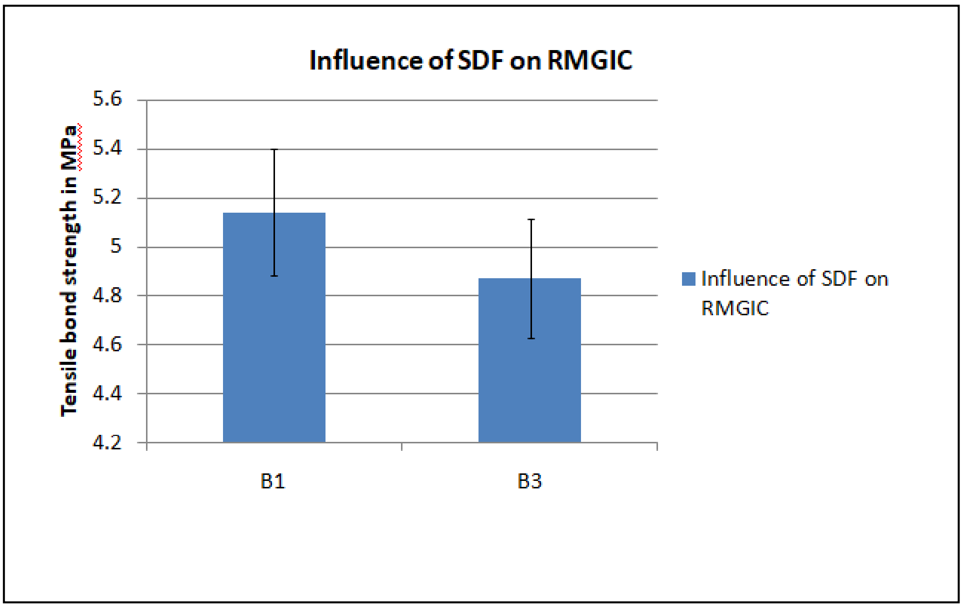
Graph 1 shows the distribution of mean score values comparing subgroups A1- SDF, GIC subgroup and A3 - control group.

	Mean	**P value**
B1	5.142 ± 0.50	0.35
B3	4.872 ± 0.32	

P value - non significant - 0.35.

Table 11. Comparison of mean TBS between SDF, RMGIC group and control group

Table 11 shows the comparison of mean tensile bond strength values of subgroup B1 – silver diamine fluoride teeth restored with resin modified glass ionomer cement to subgroup A3 – teeth restored with resin modified glass ionomer cement. The mean score value of subgroup B1 was 5.142 ± 0.50 and the mean score value of subgroup A3 was 4.872 + 0.32. On comparing the mean values using unpaired "t" test the P value was non significant - 0.35.



Graph 2. Distribution of mean score values comparing subgroups B1 and B3

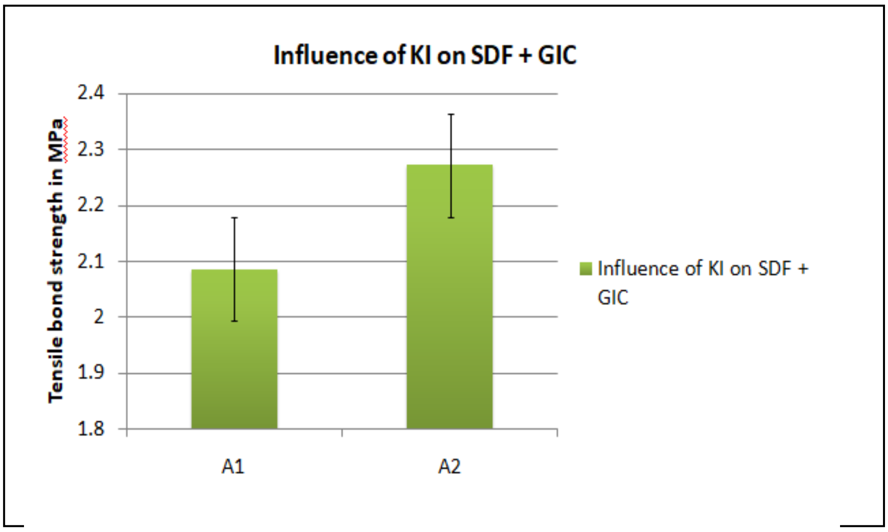
Graph 2 shows the distribution of mean score values comparing subgroups B1 - SDF, RMGIC subgroup and B3 - control subgroup.

	Mean	**P value**
A1	2.086 + 0.22	0.23
A2	2.272 + 0.24	

P value – non significant - 0.23.

Table 12. Comparison of mean TBS between SDF, GIC group and SDF, KI, & GIC group

Table 12 shows the comparison of mean tensile bond strength values of subgroup A1 – silver diamine fluoride teeth restored with glass ionomer cement to subgroup A2 – silver diamine fluoride, potassium iodide and restoration with glass ionomer cement. The mean score value of subgroup A1 was 2.086 ± 0.22 and the mean score value of subgroup A2 was 2.272 ± 0.24. On comparing the mean values using unpaired "t" test the P value was non significant - 0.23.



Graph 3. Distribution of mean score values comparing subgroups A1 and A2

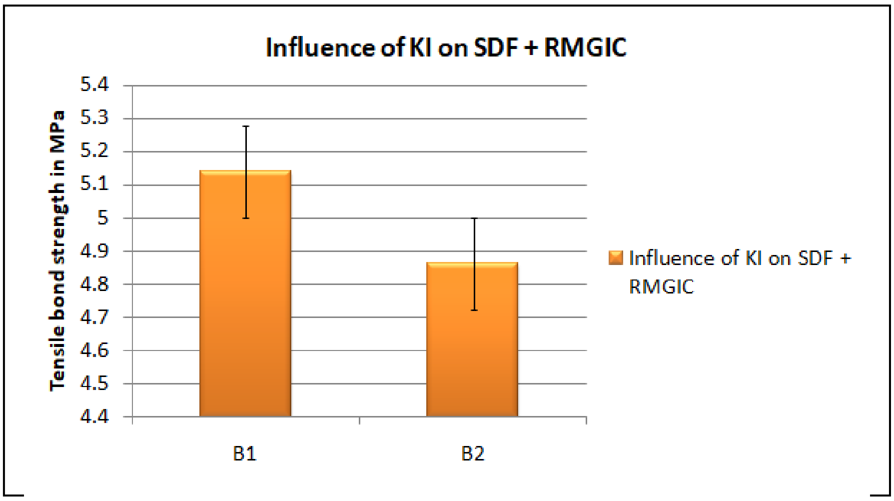
Graph 3 shows the distribution of mean score values comparing subgroups A1- SDF,GIC subgroup and A2 - SDF,KI,GIC subgroup.

	Mean	**P value**
B1	5.142 ± 0.50	0.46
B2	4.864 ± 0.59	

P value - non significant - 0.46.

Table 13. Comparison of mean TBS between SDF, RMGIC group and SDF, KI, & RMGIC group

Table 13 shows the comparison of mean tensile bond strength values of subgroup B1 – silver diamine fluoride teeth restored with resin modified glass ionomer cement to subgroup B2 – silver diamine fluoride, potassium iodide and restoration with resin modified glass ionomer cement. The mean score value of subgroup B1 was 5.142 ± 0.50 and the mean score value of subgroup B2 was 4.864 ± 0.59. On comparing the mean values using unpaired "t" test the P value was non significant - 0.46.



Graph 4. Distribution of mean score values comparing subgroups B1 and B2

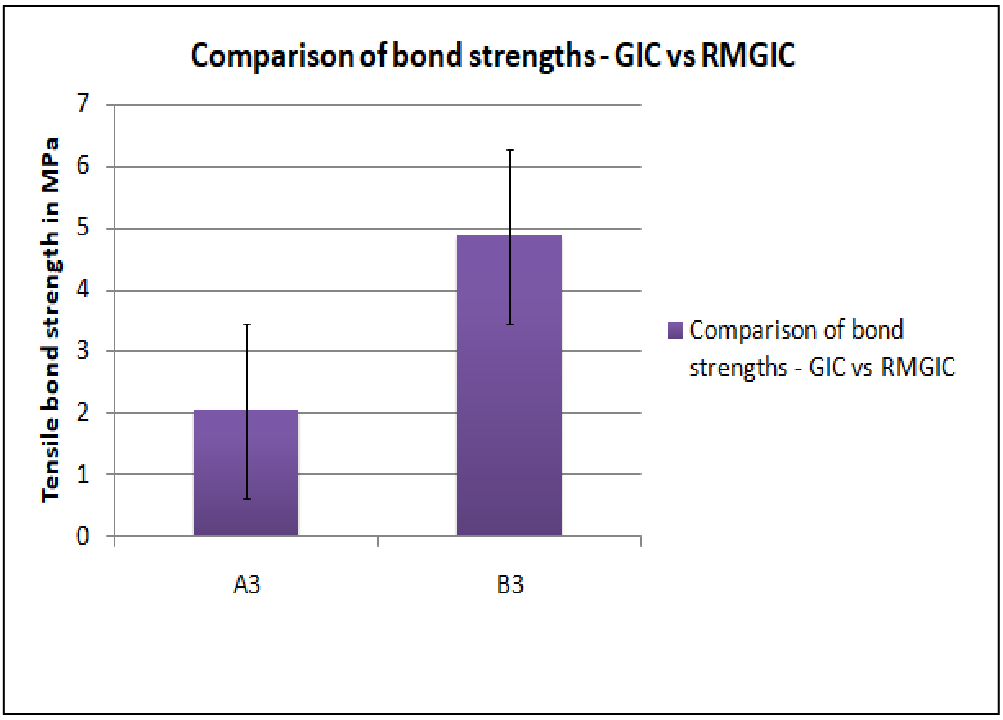
Graph 4 shows the distribution of mean score values comparing subgroups B1 SDF, RMGIC subgroup and B2 - SDF, KI, RMGIC subgroup.

	Mean	**P value**
A3	2.046 ± 0.19	< 0.001
B3	4.872 ± 0.32	

P value -significant - < 0.001

Table 14. Comparison of mean TBS between GIC group and RMGIC group

Table 14 shows the comparison of mean tensile bond strength values of subgroup A3 – glass ionomer cement to subgroup B3 – resin modified glass ionomer cement. The mean score value of subgroup A3 was 2.046 ± 0.19 and the mean score value of subgroup B3 was 4.872 ± 0.32. On comparing the mean values using unpaired "t" test the P value was significant - < 0.001.



Graph 5. Distribution of mean score values comparing subgroups A3 and B3.

Graph 5 shows the distribution of mean score values comparing subgroups A3 - GIC subgroup and B3 – RMGIC subgroup.

STATISTICAL INFERENCE:

On comparing the tensile bond strength of glass ionomer cement to dentin to SDF followed by glass ionomer cement to dentin P value was non significant which implies that the application of SDF onto dentin followed by glass ionomer cement does not influence the mature bond strength of glass ionomer cement to dentine. The comparison of tensile bond strength of resin- modified glass ionomer cement to dentin to SDF followed by resin-modified glass ionomer cement to dentin was not statistically significant. (P-0.35). Hence the application of SDF onto dentin followed by resin-modified glass ionomer cement does not influence the mature bond strength of resin-modified glass ionomer.

The P value for comparison of SDF treated glass ionomer cement was not significant to SDF/KI followed by GIC (P value - 0.23) which denotes that the application of SDF, KI onto dentin followed by glass ionomer cement does not influence the mature bond strength of glass ionomer cement to dentine. Similarly the application of SDF/KI onto dentin does not influence the mature bond strength of resin-modified glass ionomer cement.

On comparing the tensile bond strength of glass ionomer cement to dentin to tensile bond strength of resin-modified glass ionomer cement to dentin the mean difference was statistically significant (P< 0.001) which implies that resin-modified glass ionomer cement has higher tensile bond strength than conventional glass ionomer cement.

DISCUSSION

DISCUSSION

In August 2014 the Food and Drug Administration (FDA) of United States of America cleared the first silver diamine fluoride product for market, and as of April 2015 that product was available.[2] SDF is available in varying concentrations and among that 30% and 38% are found to be more effective than other preventive management strategies for arresting dentinal caries in the primary dentition and permanent first molars. In that 38%, SDF solution contains high concentrations of silver (253870 ppm) and fluoride (44,800 ppm) ions. Both silver and fluoride ions inhibit multi-species cariogenic biofilm[3,49].In an 18-months study, SDF was found to be more effective in arresting dentin caries in the primary teeth of preschool children at 38% concentration than 12% concentration and when applied biannually rather than annually.[6]Silver diamine fluoride was first used in dentistry at a concentration of 38%. A lower concentration of 12% is also available, but it is not as effective as 38% in arresting dental caries in children.[9]and inhibiting specific cariogenic Streptococcus mutans biofilm; than the other fluoride agents like acidulated phosphate fluoride, ammonium hexafluorosilicate, ammonium hexafluorosilicate, cetylpyridinium chloride, 0.2% chlorhexidine etc.[10] So, in this study 38% SDF was used.

RMGICs can bond to the smear layer. RMGIC contain polyacrylic acid (polyalkenoic acid chains), which acts as a mild self-conditioner. The smear layer contains calcium ions that may provide bonding sites for chemical bonding with the polyalkenoic acid chains in the RMGIC. Furthermore, the inherent dentin irregularities produced during specimen preparation provided micromechanical retention. The purpose of cavity conditioner (polyacrylic acid) is to remove the smear layer without completely unplugging the dentin tubules. The exposed metallic element ions inside hydroxyapatite are out there for chemical bonding with the carboxyl groups of the polyalkenoic acid. Any albuminoid that becomes exposed could offer further micromechanical retention. The addition of aluminum chloride in the cavity conditioner stabilizes the collagen matrix during demineralization, allowing better penetration of the RMGIC. Studies have proven that the use of polyacrylic acid cavity conditioner before the application of GIC or RMGIC induced no substantial effect on the bond strength of restorative materials with leaving the smear layer intact.[11,48] So GC cavity conditioners (GC Dentin conditioner, GC CORP, Asia) were used in all groups in this study as a control.

Glass ionomer cement is a highly used potential material in pediatric dentistry. It has wide versatility, it is bioactive because of the ion exchange that occurs after the material sets and allows for adhesion to tooth structure and for fluoride release.[12] Applications include not only restorative but also cementation and core buildup scenarios. Glass ionomer cement fluoride release, radio-opacity and reasonable aesthetics offer-up advantages in caries susceptible individuals.[13] To overcome the minor disadvantages of Glass ionomer cement-like poor mechanical properties, moisture sensitivity and lack of command cure[14] many newer materials are emerging including resin modified glass ionomers which proved to be successful for restoring primary molars.[12] RMGIC has physical properties comparable with those of conventional glass ionomers, but resin components compromise their biocompatibility.[15] In these newer materials the fundamental acid/ base curing reaction is supplemented by a second curing process, which is initiated by light or chemical.[14] To our knowledge studies to compare the effect of silver diamine fluoride on these restorative materials has not been done yet.

On comparing the tensile bond strength of glass ionomer cement on dentin (2.046 ± 0.19) to SDF followed by glass ionomer cement on dentin (2.086 ± 0.22) the mean difference was not statistically significant(P -0.77).So the application of SDF onto dentin followed by glass ionomer cement does not influence the mature bond strength of glass ionomer cement to dentine. This is in accordance with the study done by Angelina Shuhua Wang et al (2016) who found that SDF, when applied before the glass ionomer cement restorations, did not alter the mature bond strength at the adhesive interface.[16]

The comparison of tensile bond strength of resin-modified glass ionomer cement on dentin (4.872 ± 0.32) to SDF followed by resin-modified glass ionomer cement on dentin (5.142 ± 0.50) revealed that the mean difference was not statistically significant. (P - 0.35). So the application of SDF onto dentin followed by resin modified glass ionomer cement does not influence the mature bond strength of resin-modified glass ionomer cement to dentine.

Silver Diamine Fluoride (SDF) promotes remineralization, inhibits demineralization, increases dentin hardness and outperforms in bactericidal effect. A significant disadvantage of SDF is unaesthetic permanent black staining of teeth caused by silver phosphate and silver sulfide precipitates. Studies have proven that the use of saturated solution of Potassium iodide (10% weight % KI) prepared in the dilution of 1 g KI in 1 milliliter of distilled water[4]decreased the intensity of discolouration caused by SDF treatment. Lightening of SDF stains was evident while using KI with glass ionomer (self-cure), Resin modified GIC, composite or no restorative on carious and sound teeth.[17] KI can react with free silver ions to produce silver iodide which is a creamy white reaction product.[18]AgF followed by KI allowed the penetration of S. mutans but still the anti caries activity of silver fluoride was evident.[19] In vitro studies has proved that demineralization of dentin before AgF/KI had more pronounced suppression of in vitro caries development.[20] The ion uptake following SDF was not affected on using KI with glass ionomer cement.[21] Washing away the creamy white reaction products and air drying is recommended as the clinical protocol for using AgF and KI on dentine surfaces before application of an auto cure glass ionomer cement.[22]

Previous studies have been done to establish the influence of potassium iodide on the bond strengths of restorative materials after SDF but no studies were done to compare the influence of potassium iodide on the tensile bond strengths of glass ionomer cement and resin-modified glass ionomer cement on silver diamine fluoride treated dentin. To determine the influence of potassium iodide on the tensile bond strength of silver diamine fluoride treated dentin the comparison of tensile bond strength of silver diamine followed by GIC and RMGIC was done against SDF/KI followed by GIC and RMGIC. The mean obtained for SDF treated glass ionomer cement was (2.086 $\pm$ 0.22) which was not significantly different from the mean obtained for SDF/KI followed by GIC (2.272 $\pm$ 0.24) with the p value of 0.23.So the application of SDF/KI onto dentin followed by glass ionomer cement does not influence the mature bond strength of glass ionomer cement to dentine. Similarly the mean obtained for SDF treated resin modified glass ionomer cement was (5.142 $\pm$ 0.50) which was not significantly different from the mean obtained for SDF/KI followed by resin modified glass ionomer cement (4.864 $\pm$ 0.59) with the p value of 0.46. So the application of KI onto silver diamine fluoride treated dentin followed by resin modified glass ionomer cement does not influence the mature bond strength of resin-modified glass ionomer cement to SDF treated dentin. Thus, SDF effectively prevents dental caries in the entire primary dentition[44,50] and Potassium iodide can be effectively used to overcome the staining which serves to be the reason for majority of parents to reject this type of treatment[47]without altering TBS of restorative material used.

To identify the better choice of material between GIC and RMGIC to be used while using SDF/KI, comparison of tensile bond strengths of glass ionomer cement and resin-modified glass ionomer cement was done. On comparing the tensile bond strength of glass ionomer cement on dentin (2.046 $\pm$ 0.19) to tensile bond strength of Resin modified glass ionomer cement on dentin (4.872 $\pm$ 0.32) the mean difference was statistically significant ($P < 0.001$).Thus resin modified glass ionomer cement had higher tensile bond strength than conventional glass ionomer cement. This was in accordance with the study done by Lucia et al (2002) which revealed that resin-modified glass ionomer cement has higher diametral and tensile bond strengths than glass ionomer cement**.**[23] Similar findings was achieved by Vishnu Rekha et al (2012) that RMGIC has the high tensile bond strength than the conventional glass ionomer cement.[24] Hanan Alzraikat et al (2016) also had achieved similar result that the diametral tensile strength of conventional GIC was lower than that of RMGIC.[25] In the same way K Choi et al (2006) found that RMGIC had high micro-tensile bond strength to both sound and carious dentin than GIC.[26] Since the tensile bond strengths of both glass ionomer cement and resin-modified glass ionomer cement was unchanged with the application of SDF alone or along with KI, the choice of restorative material can be either of the two and cannot be judged based only on the tensile bond strength.

Conventional glass ionomer materials have shown to inhibit secondary caries formation on the tooth surface and along the tooth/restorative interface. However, the conventional glass ionomer cement suffers from certain disadvantages like short working time, long setting time, and susceptibility to early moisture contamination, desiccation after setting and brittleness.[53] To overcome these disadvantages, hybrid glass ionomer materials have been introduced that mix resin composite and glass ionomer cement technologies. These new materials also impart resistance to the development of secondary caries.[54] However, RMGIC also have disadvantages like more difficulty in handling because they require skilful mixing techniques to give the right consistency, and otherwise, the paste is also too sticky throughout placement or hardens too quickly before contouring may be finished. They also exhibit difficulties for intraoral placement of the curing tip to different parts of the mouth, especially in small children. Clinical performance and wear resistance and their life expectancy remains unknown.[51]So the selection of restorative material apart from tensile bond strength is based on the clinician's choice and it is determined by individuality of case treated, treatment needs, age of the patient, salivary components, special children, uncooperative children, etc.

Nevertheless the results of this study confirmed that SDF has the potential to be included in dental armamentarium addressing caries burden in developing countries. Even in developed nations most parents still take their children to the dentist for curative and not for preventive treatment. Orientation to prevention is not considered and preventive dentistry is yet to reach the common population in India.[59] Preventive programs based on the use of fluoride and especially SDF should be expanded to regions/communities at risk, which lack access to those strategies, maximizing cost efficiency.[60] However, further clinical studies should be emphasised on to establish the clinical outcomes of tensile bond strengths of restorative materials while using silver diamine fluoride and potassium iodide.

CONCLUSION

CONCLUSION

From the results obtained from this study, the following conclusions are inferred.

1) Silver diamine fluoride does not affect the tensile bond strength of glass ionomer cement and resin-modified glass ionomer cement to dentin.
2) Potassium iodide does not influence the tensile bond strength of glass ionomer cement and resin-modified glass ionomer cement on silver diamine fluoride treated dentin.
3) Resin modified has higher tensile bond strength than glass ionomer cement and the choice of restorative material relies on the clinician's choice based on individualized patient's treatment needs.

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INSTITUTIONAL ETHICS COMMITTEE
VIVEKANANDHA DENTAL COLLEGE FOR WOMEN

SPONSORED BY : ANGAMMAL EDUCATIONAL TRUST

Ethics Committee Registration No. ECR/784/Inv/TN/2015 Issued under Rule 122 DD of the Drugs & Cometics Rule 1945.

No: VDCW/IEC/73/2017 Date: 30.12.2017

TO WHOMSOEVER IT MAY CONCERN

Principal Investigator: Dr.P.ANJUGAM

Title: EFFECT OF POTASSIUM IODIDE ON THE TENSILE BOND STRENGTH OF GLASS IONOMER CEMENT AND RESIN MODIFIED GLASS IONOMER CEMENT ON SILVER DIAMINE FLUORIDE TREATED DENTINE: A COMPARATIVE IN VITRO STUDY.

Institutional ethics committee thank you for your submission for approval of above proposal. It has been taken for discussion in the meeting held on 22.12.2017. The committee approves the project and it has no objection on the study being carried out in Vivekanandha Dental College for Women.

You are requested to submit the final report on completion of project. Any case of adverse reaction should be informed to the institutional ethics committee and action will be taken thereafter.

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TENSILE BOND STRENGTH VALUES IN MPa IN GROUP A SAMPLES

Subgroup A1- samples	Tensile bond strength values in MPa
1	1.59
2	1.59
3	1.99
4	2.38
5	1.59
6	2.78
7	1.59
8	2.38
9	1.99
10	2.78
11	1.99
12	2.38
13	2.78
14	1.99
15	1.59
16	1.59
17	1.99
18	2.38
19	2.78
20	1.59

Subgroup A2- samples	Tensile bond strength values in MPa
1	2.38
2	1.98
3	2.77
4	2.36
5	1.57
6	2.78
7	1.77
8	2.37
9	2.36
10	2.77
11	1.57
12	2.36
13	2.37
14	2.38
15	2.38
16	2.78
17	2.77
18	1.57
19	1.17
20	2.98

Signature

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TENSILE BOND STRENGTH VALUES IN MPa IN GROUP A SAMPLES

Subgroup A3- samples	Tensile bond strength values in MPa
1	1.59
2	2.38
3	1.99
4	2.38
5	1.59
6	1.99
7	2.78
8	1.99
9	1.59
10	1.59
11	2.38
12	1.99
13	2.38
14	1.59
15	2.38
16	1.59
17	1.59
18	1.99
19	2.38
20	2.78

Signature

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TENSILE BOND STRENGTH VALUES IN MPa IN GROUP B SAMPLES

Subgroup B1- samples	Tensile bond strength values in MPa
1	5.57
2	6.36
3	6.36
4	6.36
5	4.56
6	3.16
7	4.16
8	3.76
9	4.36
10	5.97
11	5.57
12	5.76
13	6.36
14	4.16
15	4.16
16	4.36
17	3.97
18	5.16
19	6.36
20	6.36

Subgroup B2- samples	Tensile bond strength values in MPa
1	4.59
2	5.18
3	4.19
4	6.99
5	5.59
6	5.38
7	4.18
8	4.18
9	4.18
10	4.18
11	5.38
12	7.59
13	6.18
14	3.18
15	3.18
16	5.99
17	3.18
18	3.18
19	5.59
20	5.19

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TENSILE BOND STRENGTH VALUES IN MPa IN GROUP B SAMPLES

Subgroup B3- samples	Tensile bond strength values in MPa
1	4.77
2	5.57
3	3.98
4	3.98
5	3.98
6	5.97
7	4.77
8	5.57
9	5.17
10	4.37
11	5.97
12	4.77
13	5.17
14	3.98
15	4.37
16	3.98
17	5.57
18	5.17
19	5.57
20	4.77

Signature

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