Evaluation Of The Effect Of Three Different Dentinal Desensitizing Agents On Retention Of Full Coverage Restorations Luted Using Resin Modified Glass Ionomer Cement: - An In Vitro Study

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Abstract

Background and objectives-Tooth sensitivity after cementations of crown, is not an uncommon problem and many dentists now use desensitizing agents to prevent its occurrence. The mechanism of action of desensitizing agents is to occlude the dentinal tubules thereby minimizing the tooth sensitivity. So the objective of the study is to find the evaluation of the effect of three different dentinal desensitizing agents on retention of full coverage restorations luted using resin modified glass ionomer cement.

Methods- Fifty one extracted healthy premolar teeth was taken and embedded in metal mold with self-cure acrylic resin. Specimen was prepared for full coverage restorations. Waxing, investing and casting were done. Prior to final cementation, the prepared tooth surface was treated with three commercially available desensitizing agents. All the samples luted with resin modified glass ionomer cement with uniform film thickness. The retention tests of the entire specimen were performed on the Instron universal testing machine.

Results-The results of this experimental study showed that the tensile bond strength was significantly higher in GLUMA desensitizer **(Group A)** followed by Prime desensitizer **(Group C)** and Tooth mousse **(Group B).** But greater numbers of dentinal tubules are occluded with GLUMA desensitizer **(Group A)** followed by Tooth mousse **(Group B)** and Prime desensitizer **(Group C).**

Conclusion-In the present study, the desensitizing agents like GLUMA desensitizer, Tooth Mousse followed by Prime desensitizer can be used during fabrication of simple or complex fixed partial dentures as it will not affect the retentive ability of the resin modified glass ionomer cement. Hence, a judicious use of GLUMA desensitizer, Tooth Mousse and prime desensitizer are advisable in routine clinical practice for prosthodontists and general practitioners for reducing complaint of post-cementation tooth sensitivity.

Keywords— Tooth sensitivity, Desensitizing agents, Glass ionomer luting cement, tensile bond strength, Dentinal tubule occlusion.

INTRODUCTION

A good face signifies a letter of recommendation. From years it has been conceptualized that the first impact a person makes is because of his or her appearance which lasts for long time. The dental appearance is an integral component of facial appeal as well as personality. The judgments, an individual makes concerning the personal characteristics of others, which can be affected by dental appearance. Placement of a good restoration, which improves dental appearance, results in a positive effect on a patient's confidence and quality of life.

As we know, many people are edentulous either partial or complete. There is no age bar for edentulism. So the treatment options for edentulous includes removable or fixed and implant prosthetic restorations. In the case of crown or fixed partial denture restorations, the tooth has to be prepared. So while preparing the tooth for complete crowns, approximately 1.2 to 1.5 mm of tooth structure is removed to ensure appropriate crown contours and adequate occlusal clearance. Due to exposed dentinal tubules or the chemical nature of the luting cements, about 5-24% of crowns and fixed partial dentures may result in pre and postoperative dentinal hypersensitivity. This phenomenon is best explained by Brainstorm's hydrodynamic theory. He speculated that any stimulus to dentin can be transmitted back to nerve receptors. This occurred as a result of fluid movement with stimulation of the odontoblasts which elicited response by nerve fibers and result in pain. The areas of the tubules closer to the pulp chamber are wider and the fluid movement away from the pulp activates the nerves associated with the odontoblasts at the end of the tubule which may result in a pain response. The initial low setting pH of the luting cements is the other possible causes for postoperative hypersensitivity. The acidic nature of the cement widens the dentinal tubules and removes the smear layer. The smear layer is the one which is present after the preparation, covers the dentinal tubules physically and seals them from outside stimuli. The use of desensitizing agents after tooth preparation and before cementation of the crown or fixed partial denture is advocated to reduce the risk of vital teeth sensitivity and to preserve the health of pulpo-dentinal complex. There are many effectively proven commercially available desensitizing agents with seemingly varied chemical forms.

Application of desensitizing agent is gaining popularity, but unfortunately their effect on the retention of the crowns has not been consistent. The surface property of dentin gets altered after the application of the desensitizing agent. Glass ionomer cement (GIC), resin modified GIC (RMGIC), and resin cements are formulated with adhesive properties, which interact interfacially with the tooth structure and the crown substrate to create bonds. Desensitizers may affect the bonding mechanism and interfere with the retention of these cements. In either of these categories of cements, the application of desensitizing agents prior to cementation may have some effect on retention of the crown.

In this context, the present study was conducted to evaluate the effect of three different dentinal desensitizing agents like Gluma desensitizer, Tooth mousse and Prime desensitizer on the retentive ability of resin modified glass Ionomer cement when used as luting agent for full coverage restorations.

MATERIALS AND METHOD

Here two methods used for two assessment.

Procedure A -Assessment of tensile bond strength using Instron universal testing machine

Procedure B -Assessment of dentinal tubule occlusion using scanning electron microscope

Procedure A- Preparation of sample

Fifty one extracted healthy premolar teeth was taken and disinfected with 3% hydrogen peroxide solution to prevent microbial growth (Figure 1). It was then stored in distilled water until used in the experiment. The teeth were caries free and did not contain any restorations for standardization. A metal mold with internal dimensions of 15x15x25mm was used for embedding teeth specimen in self-cure acrylic resin (Figure 2).The roots of the premolars were notched buccolingual with a diamond point for retention .The teeth were mounted vertically in such a way that the cemento enamel junction was 1 mm above the superior surface of the resin block. The samples were fixed vertically in the surveying table and secured with a plaster block. A custom made device was fabricated to attach the handpiece to surveyor. A high speed air-turbine hand piece with water spray was mounted to the movable vertical arm of the surveyor, using a custom made device (Figure 3). Surveyor was used to position the long axis of the clinical crown parallel to that of the mold. Specimen was prepared for full coverage restorations. The occlusal surface was flattened to the depth of central groove and perpendicular to the long axis of the crown. The axial wall of each tooth was prepared to a height of 4mm and a taper of 3 degrees (per wall) using a high speed diamond bur (Figure 4). Approximately 1 to 1.5mm of axial tooth surface was prepared using a round end tapered fissure diamond point (102 Regular grit, Shofu, Japan). The chamfer finish line of about 0.8 mm was kept at the same level all around the tooth, so that 4 mm of axial height from occlusal surface maintained uniformly. The hand piece was rigidly secured with the vertical arm of the surveyor and the preparation was done by moving the cylindrical plastic block attached to the rectangular die stone block in the surveyor base against the diamond point. The 51 prepared samples were categorized into small, medium and large by measuring the buccolingual and mesiodistal width, keeping the constant axial wall height 4mm (Figure 5). Randomized control was performed by selecting samples from each category to get a uniform distribution of samples. For standardization purposes, teeth were prepared by the same operator to prevent the interexaminer differences.

Waxing, investing and casting

Once the teeth were prepared, one coat of the die hardener was applied on the finish line area to prevent abrasion by waxing instruments. During the fabrication of the wax pattern, followed by two coats of die spacer to allow space (25 µ) for the luting cement and to allow better marginal adaptation of the castings. The die spacer was kept 1 mm short of the finish line to allow intimate adaptation of the wax pattern at the margins. A dip in wax method was used to fabricate the wax pattern of 1 mm thickness in typeII casting wax. On the centre of the occlusal surface of the wax pattern, a loop of 10 mm diameter ring of uniform thickness of sprue wax was attached (Figure 6). This loop in the cast metal crown facilitates the engagement of the jig for the retention testing on the universal testing machine. This procedure was followed for all the 51 samples. The wax patterns were assigned numbers corresponding to the prepared teeth in order to orient the individual casting and prevent confusion. Ten wax patterns were attached to one base former taken care that none of them were contacted each other and a debubblizer solution was applied. Then the wax sprues and reservoirs were attached to the wax patterns and invested in high strength phosphate bonded investment. The investment was placed in the burn out furnace (Figure 7). The burn out furnace raised the temperature to 930°C over 2½ hours. Casting was carried out in silver palladium alloy in an induction casting machine following standardized casting procedure (Figure 8). After the casted investments were bench cooled, the castings were retrieved and cleaned using air-abrasion with 50 µ aluminium oxide particles in the sandblaster. The castings were checked for their fit on their respective prepared teeth followed by finishing and polishing. They were evaluated for adequate fit on the teeth (Figure 9). Castings with discrepancies were discarded. The procedure was repeated until all castings fit into the prepared teeth adequately.

Measurement of surface area of prepared teeth samples

Prior to cementation, the axial surface of each prepared tooth was determined. The perimeter of each tooth at occlusal level was marked with the pencil on to a calibrated sheet and calculated. The perimeter of each tooth at the cervical level calculated using dental floss. The surface areas of the axial surface and the occlusal surface were calculated by the following formula;

$$S=1/2bxh$$

Whereas S=total surface area of the tooth

b= total perimeter of cervical area+ perimeter of occlusal area, and h=slant height (4mm)

As the surface area varies in each tooth, so average surface area of the tooth was taken.

Application of dentinal desensitizing agents

Prior to final cementation, the prepared tooth surface was treated with three commercially available desensitizing agents (Figure 10) namely (5% Glutaraldehyde, hydroxyethyl methacrylate (GLUMA DESENSITIZER), Casein Phospho Peptide-Amorphous Calcium Phosphate (TOOTH MOUSSE) and Potassium oxalate (PRIME DESENSITIZER) according to the manufacturer's instructions. **The first group** (GROUP A- GLUMA DESENSITIZER)- the samples were rinsed with water and dried with gentle air spray. One coat of the GLU based primer was applied to the all 17 teeth using an applicator tip and allowed to act for 30 seconds. Then, the dentinal surface was dried with air spray. This procedure was repeated once again and then rinsed with water. **The second group** (GROUP B- TOOTH MOUSSE) was applied evenly over the entire surface of the all 17 teeth with an applicator tip. It was allowed to act for 3 min. **The third group** (GROUP C- PRIME DESENSITIZER) was applied evenly over the entire surface of the all 17 teeth with an applicator tip.

Cementation

To achieve equal cement thickness in all samples, the resin modified glass ionomer cement (Figure 11) was mixed according to the manufacturer's instructions. Each paste was dispensed until a click was heard. The two pastes were mixed for 20 seconds. The crowns were filled with cement and placed on the teeth with finger fissure. The excess cement was removed from the margins with an explorer. After completion of the cementation procedures, all the 51 samples were stored at 37℃ for 24 hours before retention test (Figure 12).

Testing the samples

The retention test of all the samples were performed on the Instron universal testing machine using a custom-made metal jig attached to the upper compartment of the device. The teeth with cemented crowns were placed on the lower compartment, and the upper vertical stylus was lowered until the pin passed through the ring. By doing so, a vertical tensile load was applied to the crown. The load application was continued until the crown was detached from the tooth (Figure 13). Load was applied at a crosshead speed of 5mm/min as recommended by the ADA standards for cement testing. The computer connected to the universal testing machine automatically recorded the loads and stressed induced during testing. The number of the specimens was tabulated and the readings obtained after testing were entered corresponding to the specimen tested.

Procedure B- Sectioning of the sample

Fifty one dentine discs were prepared from extracted healthy premolar teeth by sectioning the crown with a diamond saw (Figure 14) perpendicular to the long axis of the tooth to create a dentine discs with a thickness of 1.0+-0.1mm from the mid coronal dentin. The occlusal enamel was removed from each tooth exposing the middle dentine. The discs surface kept free of enamel and pulp horn. The dentine discs were polished with 600 grit silicon carbide paper to create an even and uniform surface. Once the dentine discs was prepared (Figure 15), the dentinal tubules opened by etching with 37 % phosphoric acid for 30 seconds (Figure 16). After etching, the samples were rinsed with distilled water and placed in a jar of distilled water. Finally it was sonicated once again for five minutes. The etched and sonicated samples were stored in phosphate buffered saline (PBS), pH = 7 for subsequent SEM analysis without coating. The dentine discs were randomly divided into three groups, each containing 17 discs:

Group A – (5% Glutaraldehyde, hydroxyethyl methacrylate (Gluma Desensitizer);

Group B – Casein Phospho Peptide-Amorphous Calcium Phosphate (Tooth Mousse) and

Group C – Potassium oxalate (Prime Desensitizer)

Application of dentinal desensitizing agents

Group A – 5% Glutaraldehyde, hydroxyethyl methacrylate (Gluma Desensitizer); **Group B** – Casein Phospho Peptide-Amorphous Calcium Phosphate (Tooth Mousse) and **Group C** – Potassium oxalate (Prime Desensitizer) was applied into the dentine discs according to manufacturer's instructions (Figure 17). The samples were left undisturbed for five minutes at room temperature. Thereafter, the samples were immersed in a jar of phosphate buffer saline (PBS) for five minutes while stirring. The samples were then gently rinsed with distilled water to ensure removal of any excess product from the surfaces. This treatment was repeated three times. Four specimens were randomly selected from each group to be coated with a layer of gold/palladium using a mini sputter coater for subsequent SEM analysis. The extent of dentinal tubule occlusion was assessed by using SEM (Figure 18). The specimen was examined at an operating voltage of 15 kV in shadow 2 image mode. The micrographs from SEM were obtained at a magnification of 2000X. The images was assessed independently by three well trained blind reviewers to score the level of tubule occlusion (on a categorical scale of 1-5), in accordance with the tubule occlusion classification scoring system. **Categorical scale[40] is as follows:-**

1. Occluded (100% of tubules occluded)
2. Mostly occluded (75% of tubules occluded)
3. Equally occluded/unoccluded (50% of tubules occluded)
4. Mostly unoccluded (25% of tubules occluded)
5. Unoccluded (0% no tubule occlusion)

The mean score of tubule occlusion by the three blind reviewers was taken and used for analysis.

Figure 1 – Extracted healthy premolars

Figure 2 – Specimen embedded in self-cure acrylic resin

Figure 3 – Airotor handpiece attached to the surveyor using custom made device

Figure 4 – Tooth preparation

Figure 5- Prepared samples

Figure 6- Wax pattern of crown with loop

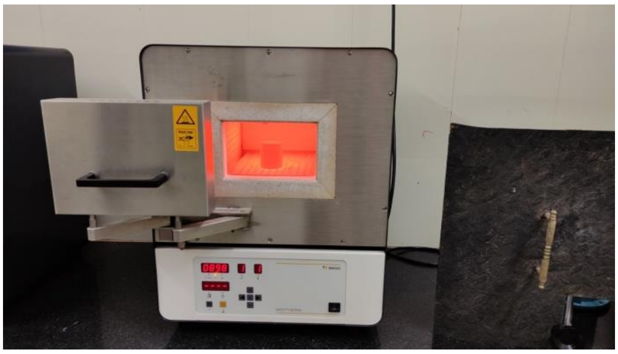


Figure 7- Burn out

Figure 8 –Casting

Figure 9- Completed castings checked for fitting

Figure 10- Desensitizing agents used

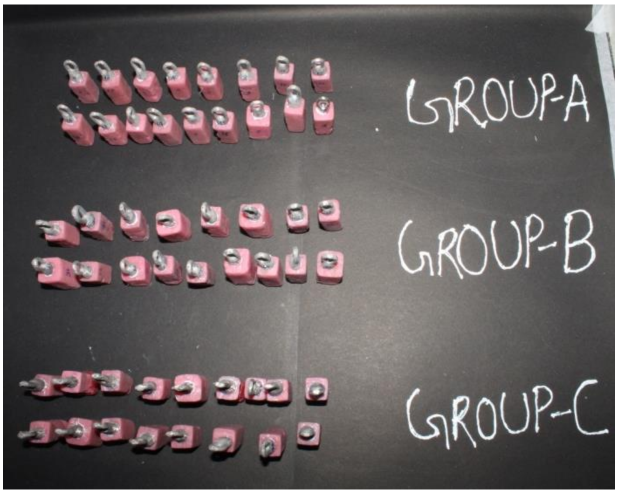


Figure 11- Crown cemented with RMGIC

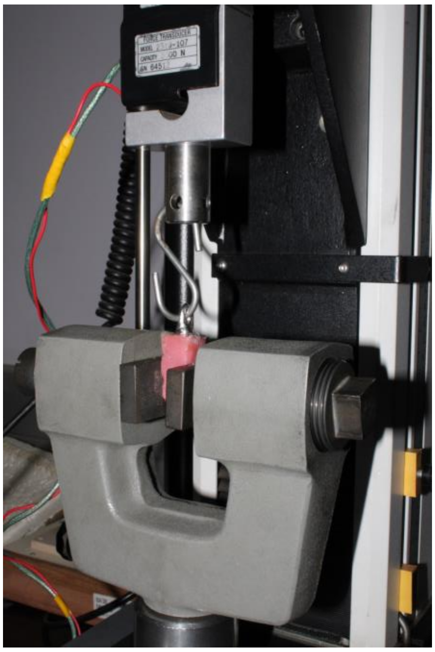


Figure 12- Retention test

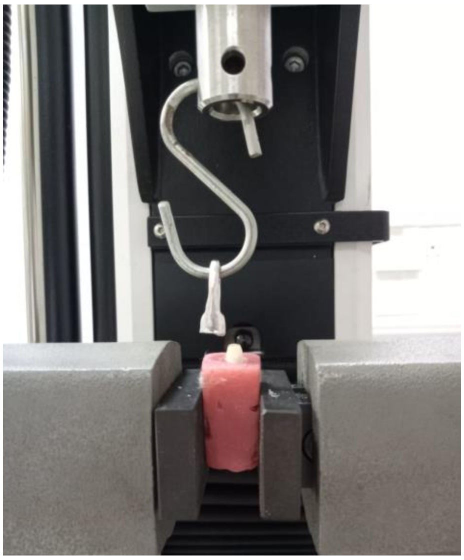


Figure 13- Debonding of the crown

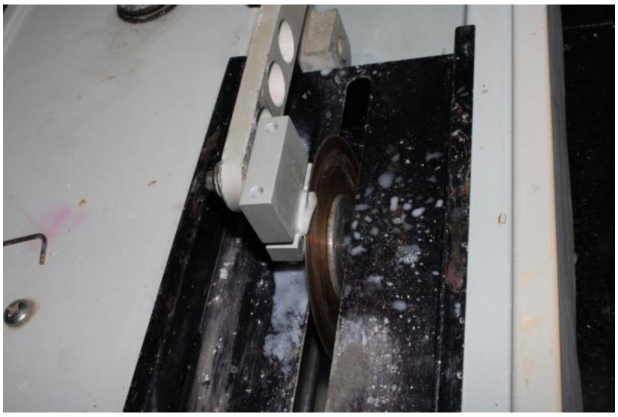


Figure 14- Sectioning the crown with a diamond saw

Figure 15- Prepared dentin discs

Figure 16- Etching with 37% phosphoric acid

Figure 17- Desensitizing agents used

Figure 18- Scanning Electron Microscope (SEM)

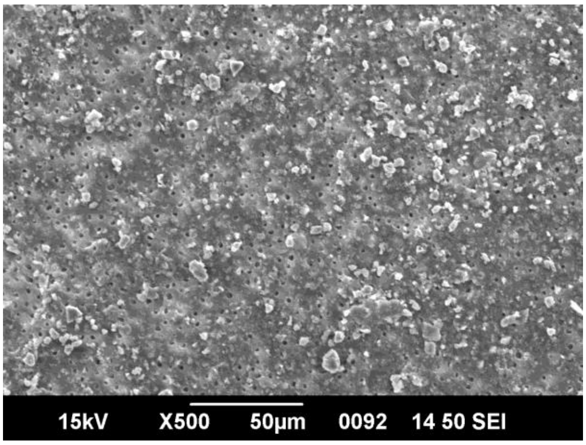


Figure 19- SEM of specimens not treated with the desensitizing agents.

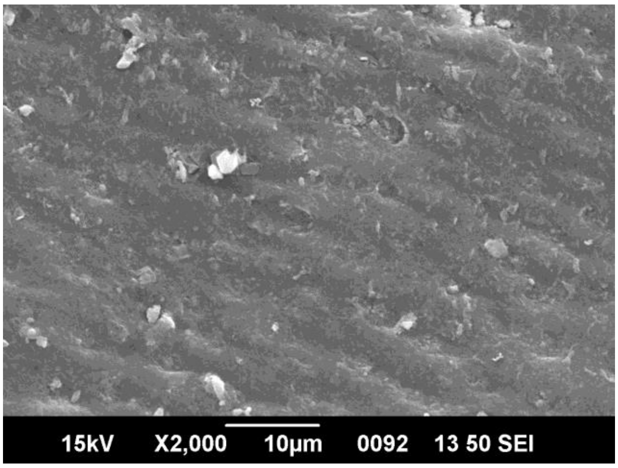


Figure 20- SEM of specimens treated with the GLUMA Desensitizer

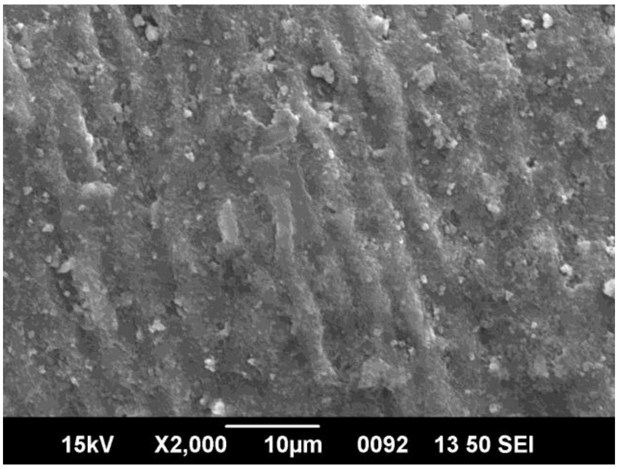


Figure 21- SEM of specimens treated with TOOTH MOUSSE

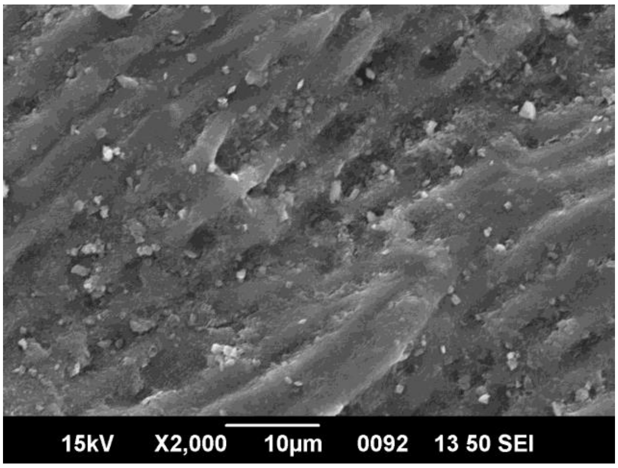


Figure 22- SEM of specimens treated with PRIME Desensitizer

RESULTS

The aim of the present in vitro study was to evaluate the effect of three different dentinal desensitizing agents like Gluma Desensitizer, Tooth Mousse and Prime Desensitizer on the retentive ability of resin modified glass ionomer cement when used as luting agent for full coverage restorations.

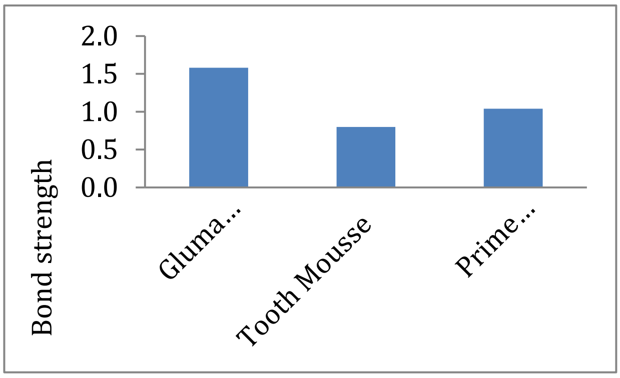
For Gluma desensitizer applied specimen, the mean retentive force required to dislodge crowns cemented with resin modified glass ionomer cement (RMGIC) was (1.58 ± 0.70MPa), which was found to be higher when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) on Tooth mousse applied specimen (0.80 ± 0.55MPa) and prime desensitizer (1.04 ± 0.77MPa). In the assessment of dentinal tubule occlusion, again the mean values of GLUMA desensitizer (4.18) were higher than the Tooth mousse (3.47) and prime desensitizer (2.41).

For Tooth mousse applied specimen, the mean retentive force required to dislodge crowns cemented with resin modified glass ionomer cement (RMGIC) was (0.80 ± 0.55MPa), which was found to be reduced when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) on Prime desensitizer applied specimen (1.04 ± 0.77MPa) and Gluma desensitizer (1.58 ± 0.70MPa). But in the assessment of dentinal tubule occlusion, the numbers of dentinal tubules are more occluded with tooth mousse (3.47) as compared to prime desensitizer (2.41) but less occluded as compared to Gluma desensitizer (4.18). For prime desensitizer applied specimen, the mean retentive force required to dislodge crowns cemented with resin modified glass ionomer cement (RMGIC) was (1.04 ± 0.77MPa), which was found to be reduced when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) on Gluma desensitizer (1.58 ± 0.70MPa) applied specimen but it was found to be higher when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) as compared to tooth mousse (0.80 ± 0.55MPa) applied specimen. But in the assessment of dentinal tubule occlusion, the numbers of dentinal tubules are more occluded with tooth mousse (3.47) as compared to prime desensitizer (2.41) but less number of tubules is occluded as compared to Gluma desensitizer (4.18).

Table1. Comparison of tensile bond strength between three different groups

Group	Mean	± SD	F value
Gluma Desensitizer	1.58^{b}	0.70	
Tooth Mousse	0.80^{a}	0.55	4.896*
Prime Desensitizer	1.04^{ab}	0.77	

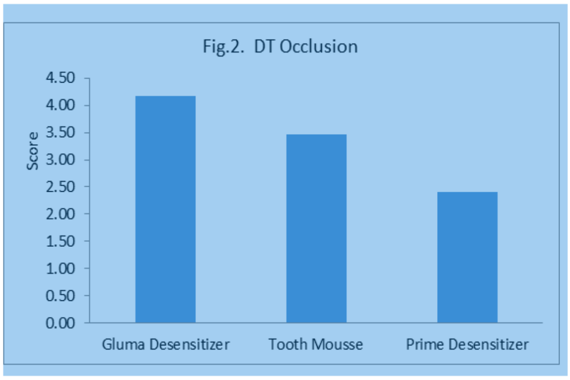
* P < 0.05; a, b – Means with same superscript do not differ each other (Duncan's Multiple Range Test)



Graph 1- Comparison of tensile bond strength between three different groups

Group	Mean	Median	± SD	Kruskal Wallis H
Gluma Desensitizer	4.18[b]	4.00	0.64	
Tooth Mousse	3.47[b]	4.00	0.62	3.564**
Prime Desensitizer	2.41[a]	2.00	0.62	

** P < 0.01; a, b – Means with same superscript do not differ each other (Duncan's Multiple Range Test)



Graph 2- Scoring of dentinal tubule occlusion between three different groups

DISCUSSION

In most of the fixed partial dentures (FPDs) patients, it is seen that they experience pain or discomfort due to prepared teeth. The difficulty faced by the patient during tooth preparation and during cementation of the crown is most often the hypersensitivity. The amount of tooth reduction as well as the area of tooth surface prepared can lead to various degrees of dentin permeability and subsequent pulpal irritation. Prolonged low pH values of various luting cements including glass ionomer cement can also lead to hypersensitivity. Desiccation and frictional heat generated by tooth preparations increases the likelihood of hypersensitivity. To overcome this problem, several desensitizing agents were introduced for sealing dentin before cementation of cast restorations to decrease post cementation sensitivity. The dentinal desensitizing agents prevent the penetration of the dentinal tubules from the bacteria and their products which are the cause of pulpal inflammation seen under crowns. The retentive strength of cemented crowns depends on the physicochemical properties of the luting agent used.

Dentinal hypersensitivity is a very commonly and frequently encountered problem in dental clinics. Tooth sensitivity, or "dentin hypersensitivity," is exactly what it sounds like **pain or discomfort in the teeth as a response to certain stimuli, such as hot or cold, sweets, temperatures,** or even air pressure changes causes' severe discomfort to the patient. It may be temporary or a chronic problem and it can affect one tooth, several teeth, or all the teeth in a single individual. Patients avoid eating from the sensitive side leading to plaque and calculus deposition which further may progress to the development of dental caries and periodontal problems. Thus, it is very essential to manage in house as well as post-operative sensitivity to prevent further oral health problems.

The most accepted theory for dentinal hypersensitivity is the hydrodynamics theory by Brannstrom's[52]. According to this theory, when a stimulus is applied to the dentin, it causes a tubular movement of the fluid within the dentinal tubules. This fluid movement causes a depolarization or deformation of the nerve ending generating a pain stimulus. The dentinal hypersensitivity can be treated by two methods, firstly by occluding the dentinal tubules which is the occlusive mechanism or secondly by reducing the excitability of the nerve which again is a neural mechanism of action.

There are a plethora of dental desensitizing agents available in the market. There are wide ranged products based on sodium fluoride, potassium nitrate, strontium chloride, stannous fluoride, and calcium nitrate which work well as a desensitizing agent. Most of these products have a tubular occlusion mechanism of action.

While choosing a desensitizing agent, it should be non-irritating to the pulp tissue and painless to use. The application has to be easy and non-tedious. The mechanism of action of the desensitizing agents has to be very fast. It should also be bio-compatible. The effect of these agents has to be relatively long term. The most importantly is that it has an anti-staining effect on the teeth.

A study by Johnson GH *et al*[22] compared Glass Ionomer and Zinc Phosphate as cementing medias under full cast crowns, using tests such as cold water test, compressed air test and biting pressure test for postoperative sensitivity. The reason for sensitivity immediately after cementation for all the three groups could be due to the initial acidity of the luting cement, which subsequently leads to the pulpal irritation. Smith et al compared zinc phosphate, Glass Ionomer and Polycarboxylate and found a general rise of pH for all cements during the first 15 minutes. Stanley et al[55] attributed the cause for more sensitivity to low pH and rapid penetration of its low molecular weight phosphoric acid molecule into dentinal tubules. The results of their study were in coordination with survey conducted by Klaussner LH *et al* who concluded that zinc phosphate cement when used as a luting agent may contribute to post-operative sensitivity more often.

The GLUMA desensitizer (glutaraldehyde based desensitizer) was used in this study because studies by Edward J Swift et al[11] and Glen H.Johnson et al[22] showed that GLUMA desensitizer had no effect on crown retention for glass ionomer. The GLUMA desensitizer (5% Glutaraldehyde, 35% hydroxyethyl methacrylate and 60% water) binds chemically to acid polymer of resin modified glass ionomer cement. The resin modified glass ionomer cement contains polyacrylic, itaconic and polymaleic acids along with calcium fluoro alumina silica glass. The GLUMA desensitizer occludes the microscopic tubules that compose dentin as the glutaraldehyde component produces the precipitation of plasma proteins, which reduces dentinal permeability and occludes the peripheral dentinal tubules and this inhibits the flow of fluid through the tubules which is the cause of sensitivity. This desensitizer is the only agent proven to penetrate exposed dentinal tubules upto 200 micrometers. This leads to the formation of multi-layered protein walls which prevent an osmotic fluid exchange with the internal tubules. Here the material forms a hermetic seal that acts as a microbial barrier, inhibiting bacterial growth. It also reorganizes collapsed collagenous fibers and thus improving the bond strength of many adhesives.

Application of Amorphous Calcium Phosphate (ACP) and Casein Phospho Peptide (CPP) in GC tooth mousse on dentine surfaces was able to reduce dentin sensitivity and enhance remineralization of artificial-formed dentine lesions. The mechanism of this action may be the casein phosphopeptide and calcium phosphate components which stabilize calcium phosphate on tooth surface, thus maintaining a high concentration gradient of calcium and phosphate ions, promoting thus remineralization of hard tissues.

The prime dental desensitizer is a potassium oxalate-based agent. The oxalate-based agents precipitate ferric oxalate crystals which occlude the open dentinal tubules and bring about instant sclerosis of tubules. They also react with the calcium ions within the dentin and dentinal fluids to form calcium oxalate crystals. However, these crystals get dissolved in the oral fluids. According to a Brazilian study, the potassium oxalate- based agents reduce the dentin permeability by around 95-98%. It's a 3gm syringe containing transparent gel formulation.

Glass ionomer possesses some molecular adhesive capabilities and molecular adhesion involving physical forces (Bipolar, Van der Walls) and chemical bonds (Ionic, Covalent) between the molecules of two different substances although this is limited by their relatively low cohesive strength[51]. The main reason for using resin modified glass ionomer luting cement because of low microleakage and has antibacterial effect due to slow release of fluoride as reported by Herrera M et al[53]. Adhesive cements have higher technical sensitivity than conventional cements and their clinical success may be compromised by technical errors. Self-adhesive resin cements were introduced to overcome the limitations of adhesive cements. RMGIC (RelyX luting 2) used in our study which is a recently introduced self-adhesive cement with an extra monomer and a new rheology modifier enhanced with filler particles. This new formula has improved mechanical properties of the material. Use of this cement was the strength of our study. By using this cement, complications and possible confounders related to the use of multi-step conventional resin cements (etch, primer, bond) were prevented.

The tensile bond strength was preferred because it is easier to obtain pure tensile strength of luting agents bonded to various materials. It is the most significant property of the luting agent for determining its success. This study was completed within a period of 12 months. The recently extracted teeth was used for assessment of the bond strength for better results, because the teeth which have been extracted and stored for more than 6 months might undergo degenerative changes in the dentinal protein. The methodology used for tooth preparation was by using a handpiece with diamond bur mounted on surveyor for the sake of standardizing the angle of convergence to 3° per wall. Approximately 1 to 1.5mm of axial tooth surface was prepared using a round end tapered fissure diamond point (102 Regular grit, Shofu, Japan). The chamfer finish line of about 0.8 mm was kept at the same level all around the tooth, so that 4 mm of axial height from occlusal surface maintained uniformly. Once the teeth were prepared, waxing, investing and casting done. Prior to final cementation, the prepared tooth surface was treated with three commercially available desensitizing agents namely (5% Glutaraldehyde, hydroxyethyl methacrylate (GLUMA DESENSITIZER), Casein Phospho Peptide-Amorphous Calcium Phosphate (TOOTH MOUSSE) and Potassium oxalate (PRIME DESENSITIZER) according to the manufacturer's instructions.

However, considering the importance of cement-tooth bond strength in success and long-term clinical service of FPDs, the usual challenge is that the application of desensitizing agents, such as GLUMA desensitizer, Tooth mousse and Prime desensitizer affects the retention of full crowns cemented with resin modified glass ionomer cement (RMGIC).

For Gluma desensitizer applied specimen, the mean retentive force required to dislodge crowns cemented with resin modified glass ionomer cement (RMGIC) was (1.58 ± 0.70MPa), which was found to be higher when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) on Tooth mousse applied specimen (0.80 ± 0.55MPa) and prime desensitizer (1.04 ± 0.77MPa). Swift et al(3) who stated that GLUMA desensitizer do not reduce the retention of cast metal crowns luted with a zinc phosphate, conventional glass ionomer or resin modified glass ionomer cement. Johnson et al(1) in their study concluded that GLUMA desensitizer was used in combination with the zinc phosphate, glass ionomer and modified glass ionomer cement without affecting the retentiveness of castings. GLUMA desensitizer, a non-polymerizable resin sealer precipitates within the tubules when applied onto prepared tooth surfaces. Arrais et al(4) in their scanning electron microscope (SEM) analysis stated that tooth surface when treated with GLUMA desensitizer obliterates majority of dentinal tubules and infiltrates into tubules as plugs. Thus, GLUMA desensitizer does not affects the dentin surface irregularities and whereby aiding mechanical or chemical retention for resin modified glass ionomer cement. Hence the casting retention was unaffected when compared with Tooth mousse and Prime desensitizer. The acid polymers of the resin modified glass ionomer cement may have a chemical affinity to the resin sealer, which contains glutaraldehyde and hydroxyethyl methacrylate monomer. In the assessment of dentinal tubule occlusion, again the mean values of GLUMA desensitizer (4.18) were higher than the Tooth mousse (3.47) and prime desensitizer (2.41).

For Tooth mousse applied specimen, the mean retentive force required to dislodge crowns cemented with resin modified glass ionomer cement (RMGIC) was (0.80 ± 0.55MPa), which was found to be reduced when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) on Prime desensitizer applied specimen (1.04 ± 0.77MPa) and Gluma desensitizer (1.58 ± 0.70MPa). But in the assessment of dentinal tubule occlusion, the numbers of dentinal tubules are more occluded with tooth mousse (3.47) as compared to prime desensitizer (2.41) but less occluded as compared to Gluma desensitizer (4.18). The possible explanation of these results could be GC Tooth Mousse, when applied on tooth surfaces, fills and smoothed the surface irregularities. Burwell et al(5) in his scanning electron microscope (SEM) study found that there were more partially occluded tubules visible on the GC Tooth Mousse-treated samples than the control samples.

For prime desensitizer applied specimen, the mean retentive force required to dislodge crowns cemented with resin modified glass ionomer cement (RMGIC) was (1.04 ± 0.77MPa), which was found to be reduced when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) on Gluma desensitizer (1.58 ± 0.70MPa) applied specimen but it was found to be higher when compared with mean retentive force of the crowns cemented with resin modified glass ionomer cement (RMGIC) as compared to tooth mousse (0.80 ± 0.55MPa) applied specimen. But in the assessment of dentinal tubule occlusion, the numbers of dentinal tubules are more occluded with tooth mousse (3.47) as compared to prime desensitizer (2.41) but less number of tubules is occluded as compared to Gluma desensitizer (4.18).

Resin-modified glass ionomer luting cements are a combination of glass ionomer and resin chemistries set by an acid-base reaction between aluminosilicateglass powder and an aqueous solution of polyalkenoicacids modified with methacrylate groups, as well as chemically initiated free-radical polymerization of methacrylate units. RMGIC generally behave in an intermediate manner between composite and glass ionomer cements, so that the values of retentive forces for crowns cemented with RMGIC were significantly higher in comparison to those cemented with a GIC[54].

SEM investigation was selected because it is a non-destructive approach for surface analysis. It also provides high-resolution, three dimensional images and topographical information. SEM has been used in many previous investigations of the effect of desensitizing toothpaste on dentine tubule occlusion.

Most of the clinicians perform crown and bridge restorative procedures on a regular basis. Desensitizing agents should be used routinely based on all abutment tooth which has to be restored with fixed restorations not only to prevent tooth sensitivity but equally important to minimize bacterial contamination to reach the pulp. The desensitizing agents GLUMA desensitizer and Tooth Mousse followed by prime desensitizer can be accepted as treatment protocols in crown and bridge prosthodontics. Hence, a judicious use of GLUMA desensitizer, Tooth Mousse and prime desensitizer are advisable in routine clinical practice for prosthodontists and general practitioners for reducing complaint of post-cementation tooth sensitivity. Application of desensitizing agents can be indicated during fabrication of complex FPDs. In these clinical situations, certain teeth may frequently be hypersensitive, and treatment with an effective desensitizing agent could facilitate management. As stated earlier, approximately 1 to 2 million dentinal tubules are supposed to be exposed during tooth preparation for complete crowns. Sealing of these dentinal tubules may prevent bacterial contamination during provisional treatment and could also control tooth sensitivity after cementation which is often reported with zinc phosphate cement (ZPC), glass ionomer cement (GIC) and polycarboxylate luting cement.

The results of this experimental study showed that the tensile bond strength was significantly higher in GLUMA desensitizer **(Group A)** followed by Prime desensitizer **(Group C)** and Tooth mousse **(Group B).** But greater numbers of dentinal tubules are occluded with GLUMA desensitizer **(Group A)** followed by Tooth mousse **(Group B)** and Prime desensitizer **(Group C).**

CONCLUSION

In the present study, the desensitizing agents like Gluma desensitizer, Tooth Mousse followed by Prime desensitizer can be used during fabrication of simple or complex fixed partial dentures as it will not affect the retentive ability of the resin modified glass ionomer cement.

Hence, a judicious use of GLUMA desensitizer, Tooth mousse and Prime desensitizer are advisable in routine clinical practice for prosthodontists and general practitioners for reducing complaint of post-cementation tooth sensitivity.

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