

Efficacy of Two Commercially Available Desensitizing Agents in Reducing Sensitivity of Teeth Prepared For Fixed Dental Prosthesis

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INTRODUCTION

The ambit of fixed prosthodontic treatment ranges from restoration of a single tooth with cast crown to replacement of one or more missing teeth with fixed dental prosthesis or an implant supported prosthesis[1] Fixed prosthodontic treatment also includes restoration of entire dentition. Fractured vital tooth may require a full coverage crown. Fixed prosthodontic treatment enriches patient comfort and enhances masticatory ability and esthetics. It helps to maintain the health and integrity of dental arches.

Hypersensitivity of a vital tooth after tooth preparation for fixed prosthesis treatment is a frequently encountered problem. Dental hypersensitivity is defined as a short, sharp pain arising from exposed dentin in response to stimuli typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other form of dental defect or

pathology [2]. The most widely accepted theory that explains how pain is transferred from the exposed dentin surface to the pulp is Brännström's hydrodynamic theory. According to this theory, sensitivity of dentin results due to stimulus induced flow of fluid through the dentinal tubules and the concomitant activation of sensory nerves in the pulp.

Luting cements such as Glass ionomer cement, used for final cementation of crown or a fixed prosthesis is known to cause sensitivity of the tooth [3, 4]. Measures to avoid post cementation sensitivity should be conducted early after the completion of tooth preparation. Therefore desensitization of the exposed dentin is essential to prevent or at least reduce the hypersensitivity of vital teeth after provisionalization and also after cementation of the permanent restoration. It is a preventive measure undertaken to avoid pulpal inflammatory lesions from permeation of bacterial substances along the exposed dentinal tubules [5].

There are several methods used to alleviate sensitivity of teeth such as iontophoresis, use of dentin bonding agents, dentin primers and desensitizing toothpastes. Dentin desensitizing agents serve the purpose of decreasing the dentin hypersensitivity by occluding dentinal tubules. Therefore a reasonable therapy of dentin hypersensitivity should hamper the fluid flow through the dentinal tubules. Sealing the dentinal tubules with a desensitizing agent creates a long lasting blockage of dentin hypersensitivity.

The dentin primer Gluma[®] desensitizer (Heraeus Kulzer GmbH, Wehreim, Germany) is reported to be an effective desensitizing agent and commonly used as in office desensitizing agent. It is composed of 5% Glutaraldehyde and 35% Hydroxyethyl methacrylate (HEMA) [6]. Glutaraldehyde acts as a very effective biological fixative and forms a physiological seal by coagulating the plasma proteins in the dentinal tubules. HEMA has the ability to infiltrate the dentinal hard tissues and induce precipitation of serum proteins within tubules thus achieving tubule occlusion and reducing dentin hypersensitivity [7]

The other method to reduce dentin hypersensitivity is the use of desensitizing toothpastes. RA Thermoseal, a desensitizing toothpaste is effective in providing relief from dentin hypersensitivity, which is composed of potassium nitrate 5% w/w in toothpaste/gel base and sodium monofluorophosphate 0.7% w/w (available fluoride content 997 ppm when packed) [8] Potassium nitrate is reported to reduce hypersensitivity in patients with moderate dentine sensitivity and with history of tooth hypersensitivity to hot, cold, hard, sweet or sour food [9]. However, it has never been studied to assess sensitivity of prepared vital tooth.

Although dentin hypersensitivity can be reduced using various methods described above, which amongst dentin primer and desensitizing toothpaste is efficient in reducing sensitivity of prepared vital tooth is unclear. Therefore, the aim of this study is to evaluate and compare the efficacy of dentin primer (Gluma[®] desensitizer Heraeus Kulzer GmbH, Wehreim, Germany) and desensitizing toothpaste (RA Thermoseal) in reducing sensitivity of teeth prepared for fixed dental prosthesis treatment.

MATERIALS AND METHODOLOGY

The observational study was performed in the Department of Prosthodontics Crown & Bridge and Implantology, Rural Dental College & Hospital, Loni. Institutional ethical committee clearance was acquired prior to commencement of this clinical study.

Materials used in this clinical study are as follows (**Fig 1**):-

Diagnostic instruments: Mouth mirror, probe, tweezer, high speed handpiece, Cold cure acrylic resin, VAS (Visual Analogue Scale) sheet, Glass ionomer luting cement for cementation of permanent restoration (GC gold label, Luting and lining cement), Zinc oxide non-eugenol cement (Prime Templute Eugenol free temporary luting cement) for provisionalization, Gluma desensitizer dentin primer (Gluma® desensitizer (Heraeus Kilmer GmbH, Wehreim, Germany)), Rapid Action (RA) Thermo seal desensitizing toothpaste, Applicator tips, Contra-angled hand piece with micromoter, Dental polishing brush, cotton rolls.



Fig 1: Armamentarium.

All patients received detailed information about the study and provided written informed consent. Patients above 18yrs of age and with no history of dentin hypersensitivity were included and those with pulpal pathology such as acute and chronic pulpitis, acute apical periodontitis, internal resorption; carious lesions and with any wasting diseases such as attrition, abrasion, abfraction were excluded from the study.

A total of 80 patients from the OPD advised for fixed dental prosthesis were randomly allotted to group A and group B (40 each) by lottery method. Patients in group A were treated with dentin primer (Gluma® desensitizer Heraeus Kulzer GmbH, Wehreim, Germany) (**Fig 2**) and those in group B were treated with desensitizing toothpaste (RA Thermo seal) (**Fig 3**).

Both the groups were assessed for the following variables:

1. Baseline sensitivity immediately after the vital tooth preparation by air blasting.
2. Sensitivity on application of dentin primer and desensitizing toothpaste immediately after the vital tooth preparation (i.e. before the cementation of provisional restoration).
3. Sensitivity of vital tooth after cementation of permanent restoration.
4. Adverse effect on applying dentin primer and desensitizing toothpaste immediately after vital tooth preparation (MTTES).
5. Adverse effect (delayed reaction) before the second time application of dentin primer and desensitizing toothpaste (MTTES) (i.e. before cementation of permanent restoration).



Fig 2 a): Gluma® desensitizer (Heraeus Kulzer GmbH, Wehreim, Germany).



Fig 2 b): RA Thermosteal Toothpaste.

For Group A- Tooth preparation procedure was performed by high speed handpiece, diamond points and copious water-coolant spray so as to minimize the frictional heat and prevent damage to the pulpal tissue. After the tooth preparation the abutment teeth were isolated with the help of cotton rolls. The baseline sensitivity was checked by applying dry compressed air with a pressure of 20 psi on the prepared abutment tooth surface for 5 seconds[10](Fig 3) using VAS sheet[11]and the score was immediately entered into the master chart. The VAS sheet was combined with underlying pictographs which depicted different facial expression ranging from 0-10 (Fig 4).



Fig 3: Air blasting.

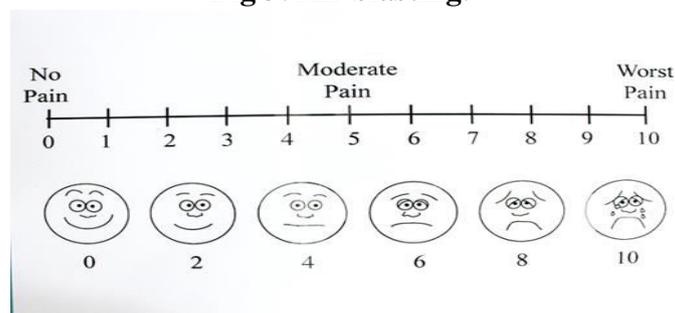


Fig 4: Visual Analogue Scale sheet (VAS).

The isolation of the prepared tooth was maintained and immediately one coat of dentin primer was applied on the prepared tooth surface with the help of an applicator tip and rinsed with a water spray after 30 seconds[10]**Fig 5).**



Fig 5: Application of dentin primer.

The sensitivity was again assessed using VAS and the score was entered in the master chart. Following the application of the dentin primer final impression was made with addition silicone impression material. The teeth were provisionally restored with auto polymerizing acrylic resin with the help of Zinc oxide non-eugenol luting cement (Prime, TempluteEugenol free temporary luting cement). The marginal adaptation of the provisional restoration was checked with an explorer and excess luting cement was removed. After an hour the MTES score was noted in the master chart. No patient showed any evidence of local adverse reaction such as pain, inflammation or swelling around the surface of the tooth applied with the dentin primer.

The patient was recalled for the cementation of permanent restoration. During this visit the provisional restoration was removed and the residual luting cement was removed with a rubber polishing cup. No evident adverse delayed reaction was noted in any patient and the MTES score was recorded again in the master chart. The abutment tooth was isolated with the help of cotton rolls, one coat of the dentin primer was applied over the tooth surface and rinsed with water spray after 30 seconds. The cementation of the permanent restoration was done using Glass ionomer cement. (GC gold label, Luting and lining cement). The sensitivity was checked after 10 min by VAS and the score was noted in the master chart. **For Group B-** Similar procedure was employed for patients in group B except for the application of the desensitizing toothpaste. One coat of Desensitizing toothpaste (RA ThermoSeal) was applied on the surface of the prepared tooth (**Fig 6).**

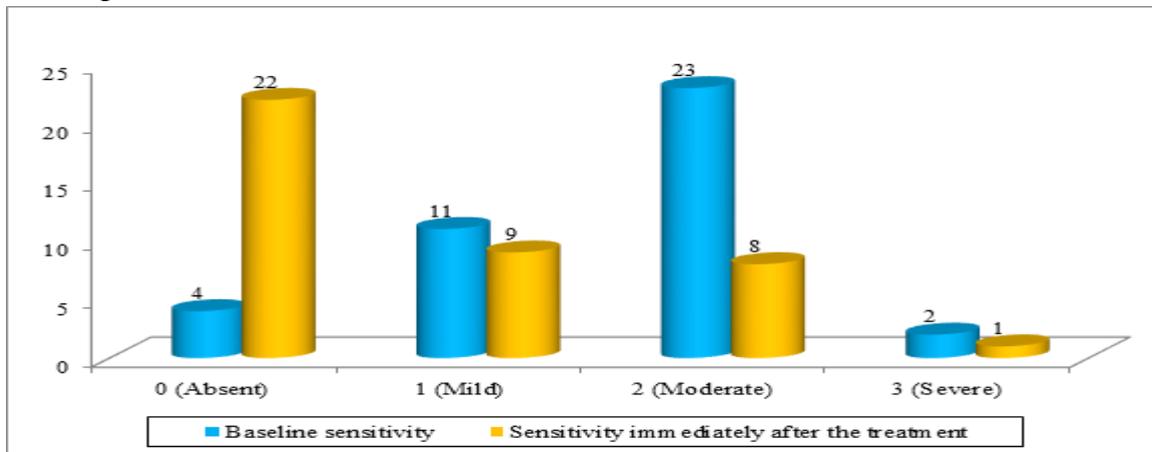


Fig 6: Application of desensitizing toothpaste.

A polishing brush was attached to the contra angled handpiece and the surface of the abutment tooth was covered with the desensitizing toothpaste at low speed by the polishing brush. [12] After 60 seconds the surface of the abutment tooth was rinsed with a water spray

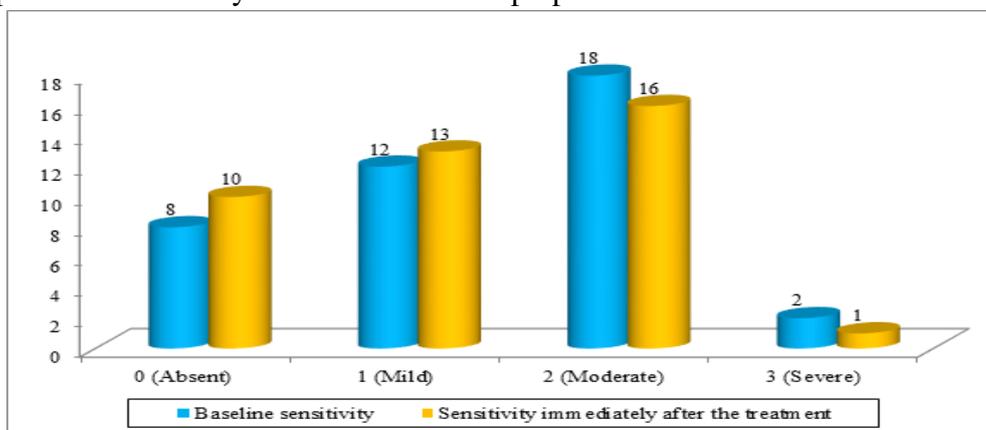
RESULTS

Intragroup comparison of VAS score was done between the baseline sensitivity and sensitivity on application of dentin primer and desensitizing toothpaste for group A and group B respectively, immediately after vital tooth preparation (i.e. before the cementation of temporary restoration). The test applied was Student's paired 't' test at 5% (p, 0.05) and 1% (p, 0.01) level of significance. Intergroup comparison of VAS score between group A and group B was done using Z test of difference between two means at 5% (p, 0.05) and 1% (p, 0.01) significance.



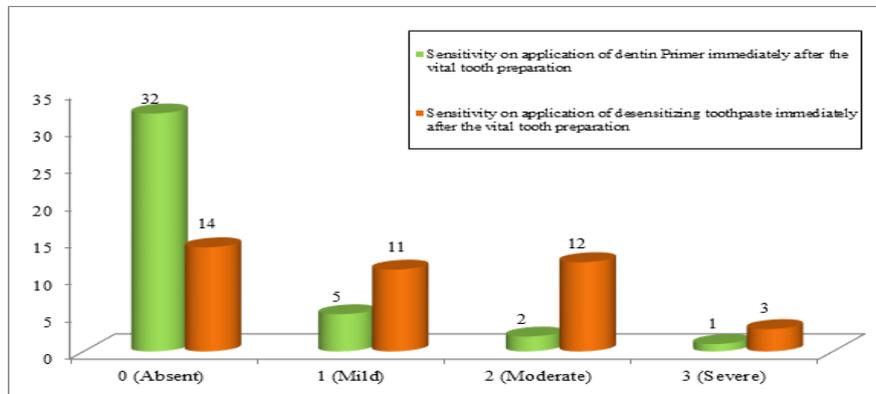
Graph 1: Comparison of baseline sensitivity and sensitivity on application of dentin primer (group A) immediately after vital tooth preparation.

Graph 1 shows the mean value of the sensitivity on application of dentin primer immediately after vital tooth preparation is lower than that of the baseline sensitivity by air blasting. It indicates that there was a significant decrease in sensitivity on application of dentin primer immediately after the vital tooth preparation.



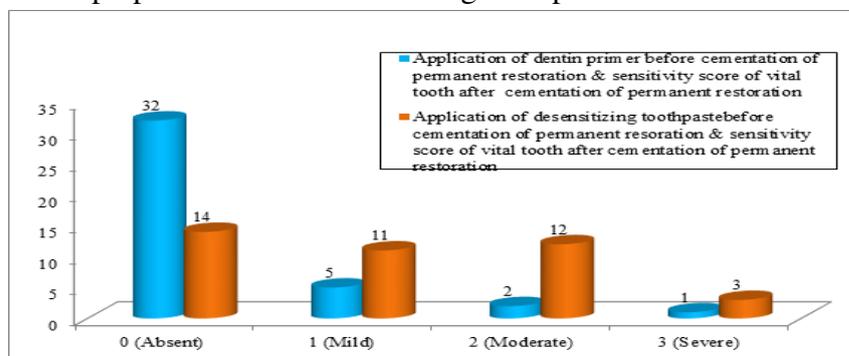
Graph 2: Comparison of baseline sensitivity and sensitivity on application of desensitizing toothpaste (group B) immediately after vital tooth preparation.

Graph 2 shows that the mean value of the sensitivity on application of desensitizing toothpaste immediately after vital tooth preparation is lower than that of the baseline sensitivity by air blasting. It indicates that there was a significant decrease in sensitivity on application of desensitizing toothpaste immediately after the vital tooth preparation.



Graph 3: Comparison of the sensitivity score on application of dentin primer and desensitizing toothpaste immediately after the vital tooth preparation (i.e. before the cementation of temporary restoration).

Graph 3 shows that the mean value of sensitivity on application of dentin primer immediately after the vital tooth preparation is lower than that desensitizing toothpaste. This shows that dentin primer was more effective in reducing the sensitivity of vital tooth immediately after tooth preparation than desensitizing toothpaste.



Graph 4: Comparison sensitivity score of vital tooth between group A and group B after cementation of permanent restoration.

Graph 4 shows that the mean value of sensitivity score after cementation of permanent restoration is lower for group A than group B. Therefore, a significant reduction in sensitivity score was observed on application of dentin primer than desensitizing toothpaste.

DISCUSSION

Tooth preparation for fixed dental prosthesis treatment is a routine dental procedure. Dentin hypersensitivity is commonly encountered after the tooth preparation of vital abutments and also after the cementation of the fixed dental prosthesis. In view of this clinical scenario an attempt was made to check the efficacy of the two commercially available desensitizing agents in reducing sensitivity of the prepared vital abutment teeth.

There are several methods that can be employed to treat dentin hypersensitivity such as instructions for proper brushing, dietary advice, occlusal adjustment, the use of adhesive systems and adhesive restorations, desensitizing products and irradiation with low-power or high-power lasers, yet dentinal hypersensitivity remains the most common problem encountered in clinics after vital tooth preparation and post cementation of final restoration.[5,13] There are several possible factors such as the preparation procedures, as well as the potential effect of the luting agent on the neurovasculature, leakage of bacteria and bacterial products from the oral environment along the margins of the cast restoration that may contribute to hypersensitivity after tooth preparation. Few studies reported that the glass ionomer cement generated inflammatory changes in the pulp in the first 48 hours after placement of the material on the dentine.[4,16] Tooth hypersensitivity can be alleviated by two approaches: either sealing the dentinal tubules or by preventing nerve depolarization. Since sensory transduction to the pulp is mediated through sudden and rapid movement of fluids in the dentinal tubules according to the hydrodynamic theory of dentinal pain, it is logical to treat this condition by an agent that can obliterate the peripheral ends of the exposed dentinal tubules. Brannstrom M and Lam CW et al [15] through their studies demonstrated that dentin permeability increased as dentin is prepared closer to pulp. They emphasized the need to use materials that are biologically compatible with the pulp and that seal the dentin well. In another study, Richardson D et al suggested sealing of dentin with bonding agent or desensitizing agent after tooth preparation and before impression making. [17] The application of desensitizing agents to the exposed dentinal tubules constitutes the basis of traditional dentin hypersensitivity treatment.

In this clinical study a dentin primer and a desensitizing toothpaste were compared to check their efficacy in reducing sensitivity of prepared vital abutment teeth. The sensitivity was subjectively judged by the patient. VAS was used in the study for assessment of sensitivity level as it offers the advantage of being a continuous scale [20] and it provides quantitative measurements that are readily averaged and tested with parametric statistics. In many clinical studies VAS was used extensively which supports the fact that it is a sensitive tool for the measurement of dentin sensitivity and the reliability was found to be high when repeatedly used with the same individual.

Modified Treatment Tolerability Evaluation Score (MTTES) was incorporated in the study for the assessment of any immediate and delayed adverse effects on application of dentin primer and desensitizing toothpaste after their application on the prepared vital abutment tooth [19]. No adverse effects were observed in any of the patients enrolled in the study.

Since the dentin primer, Gluma[®] desensitizer (HeraeusKulzer GmbH, Wehreim, Germany) is proven to have strong desensitizing effect, [6] it was included in this study. Gluma[®] desensitizer (HeraeusKulzer GmbH, Wehreim, Germany) is composed of 5% Gluteraldehyde and 35% Hydroxyethyl methacrylate (HEMA). Schupbach P et al in his study concluded that glutaraldehydecan intrinsically block dentinal tubules and the septa in the tubules counteract the hydrodynamic mechanism for dentinal sensitivity [7] Glutaraldehyde reacts with serum albumin in the dentin fluid by coagulation, thus counteracting the hydrodynamic mechanism of dentin hypersensitivity. Qin C et al in a spectroscopic investigation inferred that the reaction mechanism between glutaraldehyde and 2-

hydroxethylmethacrylate (HEMA) occurred as a two-step reaction [20]. First glutaraldehyde reacted with serum albumin inducing precipitation that mediates in a second step polymerization of HEMA.

The desensitizing toothpaste RA Thermosteal is a multi-ingredient toothpaste which is composed of potassium nitrate 5% w/w in toothpaste/gel base and sodium monofluorophosphate 0.7% w/w (available fluoride content 997 ppm when packed). Potassium nitrate is a substance that increases the nerve depolarization threshold preventing the nerve from becoming depolarized and the entrance of sodium ions into the nerve. Though 5% potassium nitrate is found to reduce sensitivity against both thermal and mechanical stimuli,

[21] Desensitizing tooth paste was never studied earlier for its efficacy to reduce sensitivity of prepared vital tooth.

According to the results of this study, both dentin primer and desensitizing toothpaste were effective in reducing sensitivity when compared individually. However, desensitizing toothpaste was not as effective as dentin primer, this could possibly be due to faster blockage of dentinal tubules by glutaraldehyde and HEMA containing dentin primer. The time for which desensitizing toothpaste was applied i.e. 60 seconds, might not be sufficient for it to block the dentinal tubules as effectively as dentin primer.

In this in-vivo study it was encouraging to note that there was significant reduction in dentin hypersensitivity on application of the dentin primer on the prepared vital teeth. The multi-ingredient desensitizing toothpaste used in this study was not as effective in reducing dentin hypersensitivity as dentin primer after its application on the prepared vital abutment. Immediate reduction in postoperative sensitivity relatively in a short time period may be beneficial in terms of patient's comfort. Nonetheless, long-term clinical trials should be conducted to test the efficacy of desensitizing toothpaste to reduce sensitivity of vital teeth prepared for fixed dental prosthesis.

CONCLUSION

Within limitations of the study, following conclusions were derived from the present study:-

1. The dentin primer was more effective in reducing the sensitivity of vital tooth immediately after tooth preparation than desensitizing toothpaste.
2. When dentin primer and desensitizing toothpaste were applied before the cementation of permanent prosthesis, dentin primer was found to be more effective in reducing sensitivity score after cementation of permanent prosthesis.
3. No local immediate and delayed adverse effects were noticed with the use of dentin primer and desensitizing toothpaste.

SUMMARY

Desensitizing agents act by either sealing the dentinal tubules or by preventing nerve depolarization level thus decreasing the pain sensation by counteracting the hydrodynamic mechanism of dentin hypersensitivity. The effectiveness of various desensitizing agents to block the dentinal tubules and to reduce dentin permeability when applied on vital abutment teeth prepared to receive fixed dental prosthesis has been reported in many in-vivo and in-vitro studies.

Dentin primer and desensitizing toothpaste were used in this study to assess the sensitivity of vital prepared tooth. Statistical significant difference was observed between the two agents used. Dentin primer showed better results than desensitizing toothpaste.

There is a scope to conduct more clinical trials to check efficacy of the desensitizing toothpaste on the vital teeth prepared for fixed dental prosthesis.

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