Influence of desensitizing agents in management of noncarious cervical lesion and bonded restorations: A preliminary 12-week report

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Abstract

Objectives: The primary objective of this study was to investigate the effectiveness in reducing dentin hypersensitivity in noncarious cervical lesions (NCCLs) by home-based desensitizing toothpaste (TP), in-office Gluma desensitizer application, and resin-modified glass-ionomer cement (RMGIC) restoration. The secondary objective was to evaluate the long-term outcome of the glass-ionomer cement restoration following the application of bioactive glass-containing desensitizer TP.

Materials and Methods: A total of 73 patients or 151 teeth were included in the study and randomly allotted to one of the four different treatment groups. Pre- and postoperative symptom and air-blast/tactile sensitivity scores were recorded for statistical analysis. Postoperative sensitivity was analyzed at 1, 4, and 12 weeks after treatment. Nonparametric statistical tests were employed.

Results: Kruskal-Wallis test noted a significant reduction in postoperative sensitivity at all time periods with the RMGIC group compared to other treatment options. Significantly higher patient dropout was observed in desensitizing TP regimen.

Conclusions: This interim 12-week report on dentin hypersensitivity management of NCCLs concludes that resin-modified glass-ionomer restoration was able to achieve a significant instant reduction in sensitivity and patient satisfaction compared to other noninvasive at-home and in-office procedures.

Clinical relevance: This interim 12-week report on dentin hypersensitivity management of noncarious cervical lesions concludes that resin-modified glass-ionomer restoration was able to achieve a significant reduction in sensitivity, and patient satisfaction was higher compared to other noninvasive at-home and in-office procedures.

Keywords: Bioactive glass-containing desensitizing toothpaste; dentin hypersensitivity; Gluma desensitizer; noncarious cervical lesions; resin-modified glass-ionomer cement

INTRODUCTION

Noncarious cervical lesion (NCCL) has often been associated with dilemma whether to intervene with restoration or manage noninvasively with desensitizing agent.[1] When restorative option is chosen, the variables to be considered are the size of the lesion, degree of dentin sclerosis or hypermineralization, bonding capability of total-etch or self-etch systems, choice of restorative material such as resin-modified glass ionomers, bulk-fill composites, or flowable composites.[2]

If the option of desensitizing agent application supersedes the restorative intervention, the issue arises of the options of home-based desensitizing toothpaste (TP) or professionally
applied (in-office) agents. Popular commercially available desensitizing TP contains a varying number of active ingredients to select from such as potassium nitrate, sodium fluoride, strontium-based, bioactive glass, or calcium sodium phosphosilicate (Novamin™). If in-office desensitizing agent is preferred, the preferred choice and most commonly used by the practitioners is glutaraldehyde/hydroxyethyl methacrylate (Gluma™) desensitizer. If, at a later stage, a bonded restoration is required for the teeth subjected to desensitizing agent, the efficacy of bonding may be questionable.\(^{3-6}\) In vitro studies have reported both improved and decreased bond strength after a tooth has been subjected to desensitizing treatment.\(^{5,6}\)

Also considered in the management of NCCL is the treatment options that provide the fastest relief of patient’s symptoms. Direct comparison of the relief of patient’s symptoms by these treatment options is lacking in the literature. Furthermore, there is a lack of clinical studies on the performance of bonded restorations placed on teeth that have undergone desensitizing agents compared to teeth which have not undergone desensitizing treatment.

Therefore, the primary aim of this study was to compare the effectiveness in relieving patient’s sensitivity in NCCLs by either home-use desensitizer TP containing bioactive glass, Gluma desensitizer (GD) application, or resin-modified glass-ionomer cement (RMGIC) restoration. The secondary objective is to evaluate the long-term outcome of the glass-ionomer restoration following the application of home-use desensitizer TP containing bioactive glass.

**MATERIALS AND METHODS**

**Subject recruitment**

After obtaining institutional ethical committee approval, the study was registered with Clinical Trials Registry of India (CTRI/2019/09/021231). A sample of 240 patients were recruited for the study based on sample size calculation using G*Power software (Universität Kiel, Germany) with effect size ($\beta$) of 0.2, $\alpha$ error 0.05, and power 0.95. The effect size of 0.2 was determined from previous clinical studies on efficacy of desensitizing TP and restoration of NCCL using RMGIC.\(^{7-9}\) The study was a plan to last from December 2018 to December 2020, so this is an interim 12-week posttreatment sensitivity assessment report of 73 patients or 151 teeth with complaints of cervical dentin sensitivity in the trial so far. Long-term restorative evaluation is to be compiled after the completion of the trial period. Table 1 shows the inclusion and exclusion criteria for the patient selection.

Patients’ preoperative sensitivity was assessed using a 10-point Visual Analog Scale (VAS) with the following categorization: mild (1–3), moderate (4–7), and severe (8–10). Both anterior and posterior teeth were included in the investigation. This assessment was performed at each visit before sensitivity was elicited by air-blast and tactile stimuli, as described below. In patients with multiple hypersensitive teeth, the VAS score for each individual was calculated by averaging the values obtained from the designated study teeth.

**Baseline sensitivity measurement**

**Air-blast sensitivity**

Sensitivity was elicited from each tooth in which patients have got the most compliant by air blast. Teeth were evaluated for air-blast hypersensitivity in the following manner. Each hypersensitive tooth was isolated from the adjacent teeth (mesial and distal) by the placement of the examiner’s fingers over the adjacent teeth. Air was delivered from a standard dental unit air syringe at 60 psi (±5 psi) and 70°F (±3°F) (21°C). The air was directed at the exposed buccal surface of the hypersensitive tooth for approximately 1 s from a distance of approximately 1 cm. The Schiff Cold Air Sensitivity Scale (SCASS)\(^{71}\) was used to assess individual response to this stimulus. This scale is scored as follows: 0 = Individual does not respond to air stimulus. 1 = Individual responds to air stimulus but does not request discontinuation of stimulus. 2 = Individual responds to air stimulus and requests discontinuation or moves from stimulus. 3 = Individual responds to air stimulus, considers stimulus to be painful, and requests discontinuation of the stimulus.

**Tactile sensitivity**

After 2 min of air-blast assessment, sensitivity was assessed by tactile stimulus. Tactile sensitivity measurement was performed using blunt-ended probe with gentle force stroked perpendicular across the NCCL to elicit sensitivity response. SCASS was also used for tactile sensitivity evaluation. In a patient with multiple hypersensitive teeth, the highest SCASS score obtained from one of the study teeth was assigned for the patient; this would enable better assessment of the treatment options in relieving the sensitivity for the individual patient. SCASS assessment was immediately followed by VAS assessment for air-blast and tactile sensitivity.

The number of teeth with NCCL managed in each patient was recorded. The degree of dentin sclerosis was assessed using the Sclerosis Scale\(^{68}\) and recorded. Dentin sclerosis was calculated by averaging the values obtained from the multiple study teeth for each patient.

**Randomization**

Randomization is done by taking up a concealed envelope containing the treatment options when the patient reports for treatment by an independent restorative dentist. Patients are randomly allocated to the following 4 treatment groups. The flowchart of the experimental procedure is depicted in Figure 1.

- Group 1 (17 patients) – Home-use desensitizing TP containing bioactive glass (Novamin™) (Sensodyne
Repair and Protect™, GlaxoSmithKline, Mumbai, India

- Group II (18 patients) – Gluma™ (Kulzer GmbH, Hanau, Germany) desensitizer application
- Group III (21 patients) – Resin-modified glass-ionomer restoration (GC Fuji II LC, GC Corp., Tokyo, Japan)
- Group IV (17 patients) – Home-use desensitizing TP (Sensodyne Repair and Protect™, GlaxoSmithKline, Mumbai, India) for 1 month followed by RMGIC restoration.

**Use of desensitizing toothpaste**

Patients used the bioglass-containing TP with a super-soft toothbrush twice daily, morning, and last thing before bed. Given brushing instructions include avoiding excessive force and horizontal brushing strokes. The duration of brushing was not more than 60 s. All the patients in this study were given dietary advice to avoid acidic beverages and drastic temperature variations in drinks.

**Gluma desensitizer application**

Gluma desensitizer (GD) application was done according to manufacturer’s instructions. GD agent was applied in two coats after cleaning of the NCCLs with pumice under water coolant aided with slow speed handpiece and rubber polishing cup. Lesion was rinsed with water after cleaning. The desensitizer agent was applied with the smallest amount possible required to cover the NCCL using micro-applicator tips and leaving it for 60 s. Then, the surface was dried with gentle stream of air with three-way syringe until the fluid film has disappeared and surface was no longer shiny. This was followed by thorough rinsing with water. Air-blast and tactile sensitivity scores were recorded immediately after placing the desensitizer (T1 Gluma). Both the air-blast and tactile sensitivity scores were assessed using SCASS and VAS [Figure 2].

**Resin-modified glass-ionomer cement restoration**

Tooth preparation for RMGIC did not involve placement of retention grooves or bevels but was limited to roughening the involved surfaces with a coarse rotary diamond abrasive and producing a definite finish line, where indicated.

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**Table 1: Inclusion and exclusion criteria for the study**

| Inclusion criteria                                                                 | Exclusion criteria                                                                 |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Age group between 20 and 70 years with teeth responding immediately and positively to cold stimulus (Endo Frost, Coltene-Whaledent, Switzerland) | Tooth with signs or symptoms of irreversible pulpitis or necrotic pulp.          |
| Patients with at least one tooth having NCCL with complaints of sensitivity to cold and/or air blast to level of 1 in SCASS[10] | Cervical lesions with pulp exposure evident                                       |
| Periapical radiographs revealing no evidence of periapical changes                  | Patients not able to localize the cervical dentin hypersensitivity to any particular tooth |
| Lesion depth has to be a minimum of 1 mm with exposed dentin                         | Lesions extending subgingivally and requiring gingival tissue removal             |
| Patients with good oral hygiene and no periodontal disease                          | Patients who had previous restorations of the concerned teeth or using desensitizing TP or had treatment for cervical dentin hypersensitivity |
| All types of NCCLs are to be included.                                               | Teeth periodontally compromised                                                   |
|                                                                                     | Patients with any uncontrolled medical conditions                                 |

SCASS: Schiff Cold Air Sensitivity Scale, NCCL: Noncarious cervical lesion, TP: Toothpaste

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**Figure 1:** Flowchart of the experimental procedure
The mean age of the patients was 49.22 ± 12.75 years (52 males and 21 females). Each patient had a mean of 2.06 ± 1.12 teeth managed. The preoperative sensitivity scores for the four treatment groups were not significantly different (Kruskal–Wallis test) [Table 2]. There was a significant difference (Wilcoxon signed-rank test \( p = 0.00 \)) in VAS and SCASS scores at baseline and immediately after the application of GD [Figure 2 and Table 3].

A total of 47 (64.38\%) patients were evaluated for 12-week posttreatment sensitivity scores. Dropout for posttreatment evaluation was 14 (19.2\%), 23 (31.5\%), and 26 (35.6\%) patients for 1, 4, and 12 weeks respectively. Patient dropout from each treatment group was 6 (35.3\%), 4 (22.2\%), 4 (19\%), and 12 (70.6\%) for TP, GD, RMGIC, and TP RMGIC, respectively at 12 weeks. Kruskal–Wallis test showed a significant \( p < 0.05 \) difference in posttreatment air-blast and tactile sensitivity scores between the four treatments at each assessment time point except for 12th-week tactile sensitivity scores [Table 4]. The RMGIC group had significantly least air-blast and tactile posttreatment sensitivity scores. Within each treatment group, Friedman test demonstrated a significant \( p = 0.00 \) reduction in the posttreatment air-blast and tactile sensitivity scores from the baseline scores. Figure 3 depicts the significant (Kruskal–Wallis test \( p < 0.05 \)) reduction at all time periods of posttreatment sensitivity score evaluation in RMGIC treatment compared to other treatment options. Figure 4a shows that all patients (100\%) treated with RMGIC restoration who returned for 12-week treatment evaluation \( n = 17 \) accepted the treatment as successful. This number was statistically significantly greater (Kruskal–Wallis test \( p = 0.031 \)) when compared with the TP-only and Gluma groups. 63.6\% and 71.4\% of the patients in the TP-only and Gluma groups, respectively, accepted the treatment as successful. The causes of failure for the TP-only and Gluma...
The aim of this study was to investigate the reduction in sensitivity following either home-use desensitizing bioactive glass-containing TP, in-office treatment with GD, or restoration with RMGIC. Considering that the employment of either home-use TP or in-office Gluma to relieve sensitivity is usually followed by restoration, the long-term effect on the success of subsequent restorative treatment of the application of these desensitizing agents before restoration was evaluated as the secondary objective of this study. However, the outcome of this secondary objective will be presented at the completion of the study. Patients were randomly allocated to one of the four different treatment groups; however, the mean preoperative sensitivity VAS and the mean air-blast/tactile sensitivity scores were not significantly different across the four treatment groups. Sclerosis data will be correlated to long-term retention of RMGIC and will be discussed in the next paper at the completion of the trial period. In the present study, it was observed that the application of GD resulted in a significant immediate reduction in the air-blast and tactile sensitivity scores when compared to the preoperative scores. This observation is in agreement with earlier investigations.[12,13] Furthermore, in agreement with the findings of the present study is a previous investigation in the management of cervical dentin hypersensitivity, which reported that both bioglass TP and Gluma yielded similar posttreatment VAS and SCASS scores.[14] It was not surprising that in the present study, all four desensitizing treatment options demonstrated a significant reduction in sensitivity scores at all time periods, considering that previous studies in cervical dentin hypersensitivity management reported a similar outcome.[7,10,12-14] The significant reduction in sensitivity scores by RMGIC in the present study, which was close to zero immediately following restoration and at all recall visits, was in

| Table 2: Mean preoperative and baseline sensitivity scores |
|----------------------------------------------------------|
| Preoperative sensitivity score (VAS) for all patients (n=73) | 5.75±1.60 |
| Desensitizing TP preoperative sensitivity score (TP) (VAS) | 6.11±1.83 |
| GD preoperative sensitivity score (GD) (VAS) | 5.63±1.60 |
| RMGIC preoperative sensitivity score (RMGIC) (VAS) | 6.02±1.62 |
| Desensitizing TP followed by RMGIC preoperative sensitivity score (TP RMGIC) (VAS) | 5.17±1.28 |
| Baseline SCASS for cold air blast (n=73) | 1.38±0.51 |
| Baseline VAS for cold air blast (n=73) | 6.68±1.61 |
| Baseline SCASS for tactile probing (n=73) | 0.79±0.57 |
| Baseline VAS for tactile probing (n=73) | 2.60±2.27 |

Total number of patients: 73

Patients’ sensitivity levels were scored by VAS and recorded (preoperative sensitivity) before sensitivity was elicited by air and cold stimuli and measured by SCASS and VAS and recorded as baseline values. n: Number of patients, SCASS: Schiff Cold Air Sensitivity Scale, VAS: Visual Analog Scale, RMGIC: Resin-modified glass-ionomer cement, TP: Toothpaste, GD: Gluma desensitizer

| Table 3: Mean±standard deviation baseline air-blast and tactile Schiff Cold Air Sensitivity Scale and Visual Analog Scale sensitivity scores for the four treatment groups |
|----------------------------------------------------------|
| Treatment groups | SCASS air blast | VAS air blast | SCASS tactile | VAS tactile |
| Desensitizing TP | 1.53±0.62 | 7.12±1.58 | 0.59±0.80 | 1.71±2.64 |
| GD | 1.33±0.49 | 6.75±1.61 | 0.89±0.58 | 3.06±2.39 |
| RMGIC | 1.38±0.50 | 6.36±1.70 | 0.86±0.48 | 2.81±1.97 |
| Desensitizing toothpaste followed by RMGIC (TP RMGIC) | 1.29±0.47 | 6.55±1.55 | 0.82±0.39 | 2.80±2.00 |

SCASS: Schiff Cold Air Sensitivity Scale, VAS: Visual Analog Scale, RMGIC: Resin-modified glass-ionomer cement, TP: Toothpaste, GD: Gluma desensitizer

Figure 3: Pre- and postoperative patient sensitivity Visual Analog Scale scores at 4- and 12-week period for the four treatment groups. These are Visual Analog Scale scores taken at each visit before eliciting sensitivity by air and tactile stimuli treatment groups are outlined in Figure 4b. The mean period of failure of 8 patients (4 – TP and 4 – GD groups) was 7.25 and 6.50 weeks for the TP and GD groups, respectively, with no significant difference (Mann–Whitney test).

Of the total of 17 patients in the group treated with desensitizing TP followed by RMGIC, only 5 (29.41%) patients returned for restoration after 1 month. Of these five patients, only four patients completed the 12-week posttreatment sensitivity evaluation and all four patients accepted the treatment as successful.

DISCUSSION

The aim of this study was to investigate the reduction in sensitivity management in noncarious cervical lesion.
Table 4: Mean posttreatment air-blast and tactile sensitivity scores at 1, 4, and 12 weeks and number of patients that reported for posttreatment evaluation in each of the four groups

| Treatment group | One-week SCASS air-blast ±SD | One-week VAS air-blast ±SD | One-week SCASS tactile score ±SD | Four-week SCASS air-blast ±SD | Four-week VAS air-blast ±SD | Four-week SCASS tactile score ±SD | Four-week VAS air-blast ±SD | Twelve-week SCASS air-blast ±SD | Twelve-week VAS air-blast ±SD | Twelve-week SCASS tactile score ±SD | Twelve-week VAS air-blast ±SD |
|-----------------|-------------------------------|-----------------------------|---------------------------------|-------------------------------|-----------------------------|---------------------------------|-----------------------------|-------------------------------|-------------------------------|---------------------------------|-------------------------------|
| Desensitizing TP | 0.76±0.59                    | 2.69±2.17                   | 0.23±0.59                       | 0.61±1.93                     | 1.00±0.81                   | 2.20±1.54                       | 0.00                         | 0.00                          | 0.33±0.50                     | 0.55±0.88                       | 0.00                          |
| GD              | 0.42±0.51                     | 1.00±1.30                   | 0.14±0.36                       | 0.21±0.57                     | 0.25±0.45                   | 0.50±1.16                       | 0.00                         | 0.00                          | 0.09±0.30                     | 0.45±1.50                       | 0.00                          |
| RMGIC           | 0.10±0.45                     | 0.10±0.45                   | 0.00                            | 0.05±0.22                     | 0.00                        | 0.00                            | 0.00                         | 0.00                          | 0.00                          | 0.00                            | 0.00                          |
| Desensitizing TP followed by RMGIC | 0.84±0.37                   | 2.92±2.01                   | 0.38±0.50                       | 0.76±1.09                     | 0.62±0.51                   | 1.66±2.71                       | 0.25±0.46                   | 0.50±0.92                     | 0.00                          | 0.00                            | 0.00                          |

SD: Standard deviation, n: Number of patients reported for posttreatment evaluation, SCASS: Schiff Cold Air Sensitivity Scale, VAS: Visual Analog Scale, RMGIC: Resin-modified glass-ionomer cement, TP: Toothpaste, GD: Gluma desensitizer.
CONCLUSIONS

This interim 12-week report on dentin hypersensitivity management of NCCLs confirmed the observations of previous studies that RMGIC restoration achieved a significant reduction in sensitivity, and patient satisfaction was higher compared to other noninvasive at-home and in-office procedures. Long-term follow-up of the patients recruited in the study is underway for restorative treatment evaluation.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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