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A COMPARATIVE ANALYSIS OF CHITOSAN BASED DESENSITIZING AGENT WITH GLUMA, IN REDUCING DENTINE HYPERSENSITIVITY - A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Introduction: Dentinal hypersensitivity (DH) is a common clinical condition usually associated with exposed dentinal surfaces, which often resolves with the natural sclerotic obturation of dentinal tubules. Chitosan, a natural biopolymer which has excellent properties like biocompatibility, anti inflammatory, bio-adhesive which makes it suitable for treating dentine hypersensitivity, though commonly used desensitizers like gluma have many advantages, exhibit certain adverse effects like acute toxicity, skin corrosions, respiratory sensitizations. **Objective:** To compare the effectiveness of chitosan hydrogel and GLUMA (glutaraldehyde containing desensitizer) in reducing dentin hypersensitivity. **Methodology:** A randomized, single-blind, split mouth clinical trial was conducted on 30 patients aged 18–60 years who were suffering from dentinal hypersensitivity in relation to canine, premolar and molars with erosion, abrasion, and gingival recession were randomly enrolled. Response to tactile stimuli were measured using visual analogue scale initially on baseline, after intervention and final assessment was done on the 15th day. Desensitizing agents used were GLUMA desensitizer and chitosan

hydrogel. Baseline sensitivity scores after tactile stimuli were recorded following which desensitizing agents were applied sensitivity scores were recorded. The data was analyzed using paired t-test, repeated measure ANOVA was used for multiple comparisons at different time interval. ($P < 0.05$ was considered statistically significant). **Result:** There was significant reduction in VAS score from baseline to 15th day in both the groups. Chitosan hydrogel showed significant reduction in hypersensitivity scores at different time interval ($P < 0.001$). **Conclusion:** Gluma and Chitosan Hydrogel both are potential desensitizer.

KEYWORDS: Dentine hypersensitivity, chitosan hydrogel, VAS scale.

INTRODUCTION

Dentin hypersensitivity (DH) is an exaggerated response to the stimulation of vital dentin exposed to the oral environment, which causes extreme discomfort to the patient, characterized by short-term, acute pain of variable intensity, occurs in response to thermal, volatile, tactile, osmotic or chemical stimuli that cannot be attributed to any other type of defect or dental pathology according to Grossman L et al (1935).[1] Condition generally involves the facial surfaces of teeth near the cervical border, and is very common in canine, premolars, and molars.[2] These stimuli are produced by the ingestion of hot or cold beverages, by contact with acidic foods, or by tooth brushing.[3]

The reported prevalence of DH ranges from 3 to 57%, and it is estimated to affect 15% of the adult population, according to Reas et al (2003) and Irwin et al (2014). Although its occurrence increases with age, the majority of afflicted individuals are between 20 and 50 years of age, with a peak between 30 and 40 years of age.[4] Nield-Gehrig et al 2005 stated that Women are affected more than men. Patients who exhibit periodontal diseases tend to be afflicted more often, with a prevalence that varies between 72 and 98%.[5]

Kapferer I et al (2013) suggested that the most active treatment options of dentine hypersensitivity are physical or chemical occlusion of patent tubules, i.e the use of tubule-occluding agents that physically block exposed dentinal tubules.[6] There is a vast array of treatment available for desensitization including solutions, gels, and pastes that contain fluorides in varying compounds and percentages, calcium hydroxide, strontium chloride, potassium nitrate, sodium citrate, glutaraldehyde and hydroxyethyl methacrylate, potassium, or ferric oxalate.[7]

A combination product consisting of an aqueous solution of 2% glutaraldehyde and 35% hydroxyethyl methacrylate (Gluma desensitizer, Heraeus Kulzer GmbH, Wehreim, Germany) has been reported to be an effective desensitizing agent. The glutaraldehyde intrinsically blocks dentinal tubules, counteracting the hydrodynamic mechanism that leads to dentin hypersensitivity, where as Glutaraldehyde is know to cause acute toxicity in oral cavity and on Inhalation, Skin corrosion, Serious eye damage.[8] Chitosan a known versatile natural biomaterial that has been explored for a range of bio-dental applications. CHS has numerous favorable properties such as biocompatibility, bio-adhesive in nature, hydrophilicity, biodegradability, and a broad antibacterial spectrum none of the studies have evaluated the efficiency of desensitizing agents *in vivo with chitosan.*[9] present study is conducted to evaluate the effectiveness of chitosan hydrogel in reducing pain perception due to dentine hypersensitivity, compared to gluma.

AIM OF THE STUDY

To assess the effectiveness of two desensitizing agents in reducing dentin hypersensitivity.

MATERIALS AND METHODS

A Randomized controlled split mouth trail trail was conducted over a period of 6 months from May to October 2018, among adolescents working in the Asian Aluminium metal factory, Bangalore.

1. Prior to the initiation of the study ethical committee clearance and informed consent was obtained from K.L.E Society's institute of Dental sciences. Bangalore and the study participants respectively.
2. Individuals aged between 18-60 years complaining of hypersensitivity to taticle stimulus, exhibiting pain scores of two or more on the visual analogue scale (VAS), with gingival recession and/or non-carious cervical lesions and were included.
3. Individuals with dental caries, restorations, and ongoing orthodontic or periodontal treatment presenting systemic diseases, recurrent hypersensitivity in the last 30 days, pregnant or breastfeeding are excluded from the study.

A Convenience sampling technique was applied and 30 individuals were enrolled in the study, Type III examination was performed using mouth mirror and CPI probe, under natural lighting condition to record baseline data for the presence of bilateral dentine hypersensitivity in permanent first mandibular molars, Sensitivity was assessed by means of tactile stimuli.

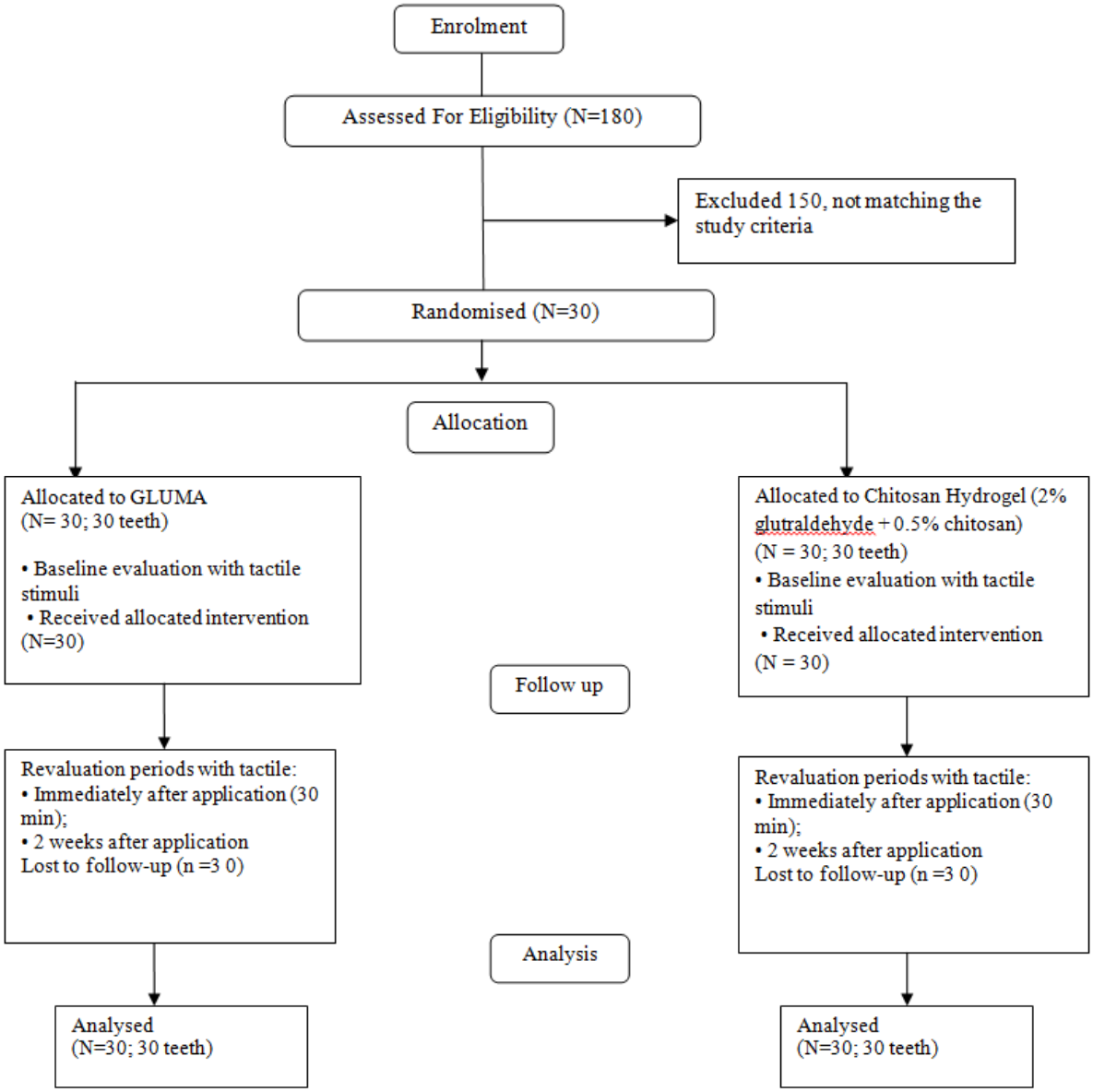

Fig. 1: Flowchart of the study design.

Intervention

Subject were blinded to treatment conditions and received verbal and written information that no other oral hygiene product with a desensitizing effect should be used. In addition, they received professional instructions on adequate oral hygiene. a paired (split-mouth) study design was performed with sagittal midline as reference. Mandibular first molar from each side of the mouth (left or right) were randomly allocated (by chance, in a sealed envelope). Each material was applied on the affected teeth from the same side of the mouth, employing isolation with cotton rolls.

The sensitive tooth surface was cleaned and rinsed with water for the application of GLUMA desensitizer. Pooled water was removed and the tooth was left slightly moist. A thin layer (0.5 mm or less) was applied to the sensitive tooth surface. Further, the process was repeated for the application of chitosan hydrogel.

Measurement Protocol

The pain response was assessed using the numerical Visual Analogue Scale (VAS, range 0–10), with 0 indicating 'no pain' and 10 indicating 'intolerably severe pain'. Pre-treatment sensitivity (baseline) was evaluated by the researcher, with the following test stimuli:

a. Tactile test (mechanical method): A sharp dental explorer (17/23) was passed lightly across the affected area, perpendicular to the long axis of the tooth. The test was repeated two times and the score was recorded.

Further evaluation was done post treatment, VAS response was recorded by applying test stimuli immediately after treatment (approximately 30 minutes) and at 15 days. Neighbouring teeth were isolated with cotton rolls and suction devices to prevent false responses.

Statistical Analysis

Paired t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale before and after in a group (Intra group analysis) on metric parameters.

The data was entered in excel sheet and analysed using SPSS statistical software package version 20.0. Descriptive statistics were computed first to summarize characteristics of the study population. Paired t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale before and after in a group (Intra group analysis) on metric parameters. Results on the continuous measurements are presented on Mean ± SD (Min-Max). Significance is assessed at 5% level of significance.

RESULTS

All 30 subjects featuring 60 teeth with dentin hypersensitivity at the buccal surfaces completed the 6-month study period. In this split-mouth study design, The range of teeth evaluated by subject was of 2 to 10. No complications, such as adverse pulp effects, were observed throughout the study. Subjects´ response to stimuli throughout the study is shown in Table.1.

A statistically significant difference was detected by repeated measure ANOVA ($p < 0.001$) after 15 days for tactile and air blast tests (VAS scores). When compared to baseline, all evaluation times under analysis provided significantly lower means and indicated a reduction of pain sensitivity scores ($p < 0.05$). No significant differences in the reduction of painful symptoms were detected when treatments with Gluma and Chitosan Hydrogel were compared at same evaluation time on the response to tactile stimuli.

Table 1: VAS means scores.

Mean (standard deviation) of baseline, immediate, 15 day of visual analog scale scores recorded after topical application				
Evaluations	**Test Groups**	**N**	**Tactile stimuli, mean (SD)**	***P* < 0.001**
Baseline	Gluma Chitosan Hydrogel	30 30	6.53 (1.13) 6.53(1.13)	1.000
Immediately	Gluma Chitosan Hydrogel	30 30	3.80(0.997) 4.33(1.12)	.634
After 15 days	Gluma Chitosan Hydrogel	30 30	3.60(0.770) 5.67 (1.37)	.001

DISCUSSION

Dentine hypersensitivity is characterized by sharp pain of short duration due to thermal or evaporative stimuli on exposed dentinal surfaces. Treatment options available for managing DH, and the rapid reduction of DH and long-term duration of these desensitizing effects are critical. According to the Hydrodynamic theory by Brannstrom,[10] stimulation of dentin results in a flow movement in the tubules, toward or away from the pulp which can cause deformation of nerve endings in dentin or at the dentin/pulp interphase resulting in pain transmission. Treatment for DH is mainly focused on the occlusion of dentinal tubules.

Different mechanisms have been proposed for occlusion of dentinal tubules, Occlusion can be done by the precipitation of proteins or by the formation of a superficial pellicle The neural blocking method is done by the direct diffusion of potassium ions through dentin increasing its concentration in the pulp tissue which can block nerve impulse conduction by alteration of action potentials.[10-13]

It may be difficult to accurately quantify DH as it is a subjective condition previously reported methods to provoke and quantify pain of DH are the evaporative method and the tactile method Pain due to DH using tactile and evaporative stimuli was determined by VAS.

VAS has been reported to be the most appropriate method to diagnose pain levels as it allows for the translation of subjective feedback into objective data.[14]

In this study, patients with DH in lower quadrants were selected. Gluma™, also a non-fluoride product, is one of the systems marketed solely for treatment of dentin hypersensitivity. It is a dentin bonding system containing gluteraldehyde (GA), a biological fixative. Gluma™ acts as a desensitizer through the reaction of GA with part of the serum albumin in dentinal fluid which induces a precipitation of serum albumin, Kakaboura et al.[15] found Gluma™ reduced hypersensitivity in dentin for up to nine months, Cochran et al found Gluma™ performed better than oxalate systems in terms of longevity of their effectiveness, but has some side effects also like acute toxicity in oral cavity and on Inhalation, Skin corrosion, Serious eye damage.[8]

Chitosan being natural biopolymer that is derived from chitin known for its nontoxic, biocompatible, biodegradable properties, well known for their hemostatic[16], fungistatic[16,17], antibacterial, antitumor, anticholesteremic and immunoadjuvant[18] characteristics. Chitosan is also a prudent bioadhesive, being used as self etched primers, can also be used to seal the dentinal tubules, occluding them hence prevent dentine sensitivity.

Both the desensitizing agents showed significant ($P < 0.001$) reduction in DH immediately after application, at 15 days, and compared to baseline mean VAS scores for both tactile and evaporative stimuli. In addition, immediately after application, there was no significant difference between both the groups. Similarly, Torres *et al*. reported a significant reduction immediately after the application of Admira Protect, Bifluorid 12, and Colgate Pro Relief.[19] Yu *et al*. Have also reported that one bottle self etching adhesives, Gluma desensitizer, and Bifluorid 12 can cause an immediate reduction in DH.[20] Samuel *et al*. have also have compared three agents and have reported a significant immediate reduction in DH in their study. Therefore, it can be interpreted that most desensitizing agents will cause an immediate and significant reduction in DH.

At 2 week both the desensitizing agents showed significant ($P < 0.001$) reduction in DH compared to baseline mean VAS scores for both tactile and evaporative stimuli. However, gluma desensitizer has showed significantly effective in reducing DH compared to chitosan hydrogel at 2 week.

Similarly, Torres *et al*. reported a significant reduction in DH at 1 week using Admira Protect, Bifluorid 12, or Colgate Pro Relief.[19] Another study reported the use of calcium, sodium phosphosilicate desensitizer resulted in significant hypersensitivity reduction after 1 week and 4 weeks compared to baseline values.[21] Erdemir *et al*. reported that the three desensitizing agents (Pain Free, Bis Block, and Seal and Protect) used in their study provided effective desensitization for 4 weeks.[22]

In the present study, gluma showed better reduction in pain of Dentin Hypersensitivity compared to other chitosan hydrogel evaluated in this study Further studies using chitosan hydrogel in different concentration for a longer period of time will have to be done to evaluate long term performance in the treatment of DH.

CONCLUSION

Within the conditions of this clinical study, it can be concluded that Gluma desensitizer and chitosan hydrogel Coat can reduce DH immediately after application, at 2 week, compared to baseline mean VAS scores for both tactile stimuli. Gluma desnsitizer Coat was significantly more effective in reducing DH compared to chitosan hydrogel at 2 week follow-up.

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