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ORIGINAL RESEARCH

Effect of the Clinical Application of the GLUMA Desensitizer *vs* Gallium Aluminum Arsenide Diode Laser in the Treatment of Dentin Hypersensitivity: A Scanning Electron Microscopy Study

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ABSTRACT

Aim: To compare the effect of GLUMA desensitizing agent with gallium aluminum arsenide (GaAlAs) diode laser on dentinal tubule occlusion, analyzed under scanning electron microscope (SEM).

Materials and methods: The study was conducted on 20 upper first permanent molars with dentinal hypersensitivity (DH), recession, and grade III mobility with poor prognosis and indicated for extraction. Three roots of each molar were randomly assigned by toss of a coin method into one of the following groups: Group I: Control group with no treatment, group II: Treated with GLUMA desensitizing agent, group III: Lased by GaAlAs diode laser.

Dentin hypersensitivity was graded clinically based on pain numeric rating scale (PNRS) and was measured at pretreatment session and a 15-minute posttreatment session.

Then the tooth was extracted and the roots were sectioned and analyzed for dentinal tubule occlusion under SEM.

Results: On intracomparison, both test groups II and III showed statistically significant reduction in the dentinal tubule occlusion as compared with group I.

Conclusion: According to the present study, the GaAlAs laser and GLUMA both have proved to cause occlusion of dentinal tubules; however, light amplification by stimulated emission of radiation (LASER) is seen to be more effective due to more visible number of completely occluded tubules.

Clinical significance: Dentin hypersensitivity is one of the major complaints of patients across the globe. The treatment modalities also vary dentist to dentist and there is no fixed protocol for its treatment. The LASER is a newer treatment modality, which is being implemented for dentin hypersensitivity treatment. Thus we compared LASER with one of the conventional product GLUMA to check the efficacy and see if LASER is equally potent/superior in occluding the dentinal tubules.

Keywords: Dentin hypersensitivity, Gallium aluminum arsenide diode laser, GLUMA, Scanning electron microscopy study.

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INTRODUCTION

- Periodontal disease is multifactorial in nature and is characterized by soft and hard tissue destruction.
- According to American academy of periodontology (2001), DH is defined as the short, exaggerated, painful response elicited when exposed dentin is subjected to certain thermal, mechanical, or chemical stimuli.
- According to Landry and Voyer,[1] agents to treat DH must comply with the following characteristics:
  - Not irritate the pulp
  - Easy application
  - Effective on a permanent basis
  - Not discolor the teeth
  - Not irritate the soft tissues or the Periodontal ligament
  - Have low cost
- Conventional therapies for the treatment of DH comprehend the topical use of desensitizing agents, either professionally or at home, such as protein precipitants, tubule-occluding agents, tubule sealants,[2] and recently lasers.
- Toothpastes containing potassium salts, fluoride composites, resins, laser, bioglass.
- GLUMA desensitizer solution containing 5% glutaraldehyde and 35% hydroxyethyl methacrylate has been reported to be an effective desensitizing agent.[3]
- According to various studies, Matsumoto et al,[4] Yamaguchi et al,[5] Kumazaki et al,[6] it has been seen that lasers can be used effectively in the management of DH.

AIM

- To compare the effect of GLUMA desensitizing agent with GaAlAs diode laser on dentinal tubule occlusion, analyzed under SEM.

Fig. 1: Thermal test

Fig. 2 GLUMA application

MATERIALS AND METHODS

Inclusion Criteria

- DH>6 on PNRS
- Upper first molar
- Grade IV recession (Millers)
- Grade III mobility with poor periodontal prognosis and indicated for extraction (Millers)

Exclusion Criteria

- Those undergone treatment for hypersensitivity in past 6 months
- Carious tooth
- Known allergy to hydroxyethyl-methacrylate
- Patients receiving periodontal therapy or had received nonsurgical periodontal treatment within the previous 3 months
- Taking any kind of medication
- Pregnant or lactating patients.

Twenty permanent upper first molars in patients meeting the inclusion and exclusion criteria were selected for the study.

Scaling and root planing was done for each selected tooth.

The thermal test with cold stimulus was done using cold air blast and cold water, hence the PNRS value was recorded for each tooth.

Dentinal hypersensitivity evaluated for pain response to both air and cold water stimuli that were registered by PNRS (from 0 to 10, where 0 meant the absence of pain and 10 represented an unbearable pain and discomfort felt by the patients).

Thermal Test

- Three roots of each molar were randomly assigned by toss of a coin method into one of the following groups (Fig. 1).

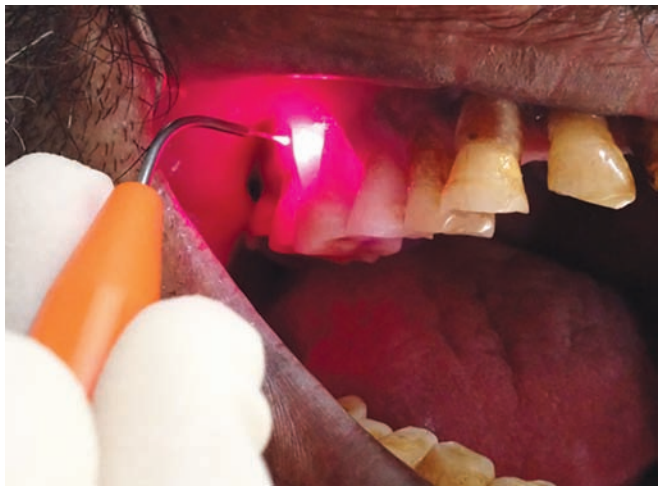


Fig. 3: LASER application

- *Group I*: Control group with no treatment
- *Group II*: Treated with GLUMA desensitizing agent (Fig. 2)
- *Group III*: LASED by GaAlAs diode laser (Fig. 3)
- GLUMA desensitizer applied on the selected root with a disposable applicator tip
- LASED by 810 nm GaAlAs diode laser in noncontact mode, for 60 seconds at 0.5 W

Sample Preparation

- Fifteen minutes posttreatment the PNRS values were recorded and the teeth were extracted.
- The crown was separated using straight fissure bur and the roots sectioned using Carborundum disk for 2 to 3 mm thick dentin sections and transported in saline medium for SEM analysis (Fig. 4).
- The samples were mounted on the small stub with the help of silver paste.
- The specimens were sputter coated with a thin layer of gold in a vacuum using a fine coat ion sputter (Quorum, Q150 RS) (Fig. 5).

Fig. 4: Crown separation

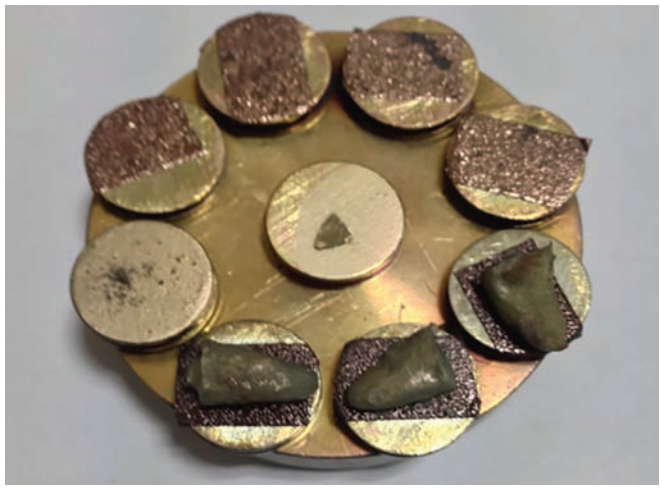


Fig. 5: Sputter-coated roots on stub

Fig. 6: SEM by Carl Zeiss, EVO-18

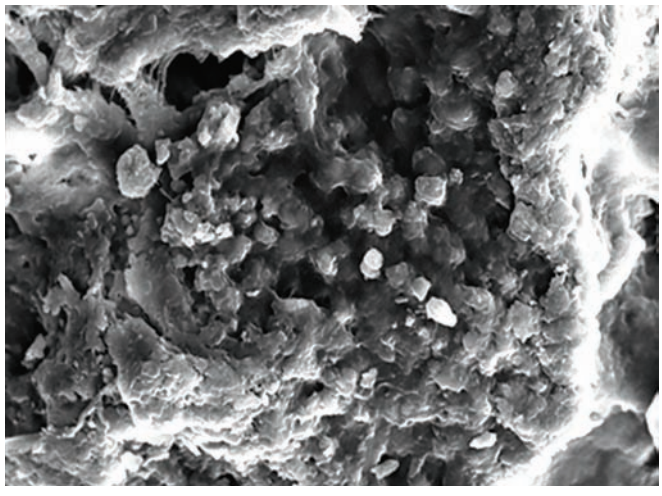


Fig. 7: Magnification of ×10,000

- This ensured a proper conduction surface to the nonconducting specimens. Ions were sputtered on the samples for 5 minutes and thus the samples were ready for the SEM.
- The specimens were then examined by one SEM (Carl Zeiss, EVO-18) at University Science Instrumentation center Department of Rajasthan University (Fig. 6).
- The surface of all the specimens was scanned and observed at a magnification of ×10,000 and the photographs of the representative areas were obtained (Figs 7 and 8).

Scanning Electron Microscopy Analysis

The following criteria were used for determining the type of occlusion when counting the tubules:

- The tubules that showed complete penetration of the crystal or complete obliteration of the canals with the reaction products were considered completely occluded.
- Those that showed reduction of the diameter of the tubule by more than 50% or circumferential closure of the tubule with the presence of a central opening in the canal were considered partially occluded.

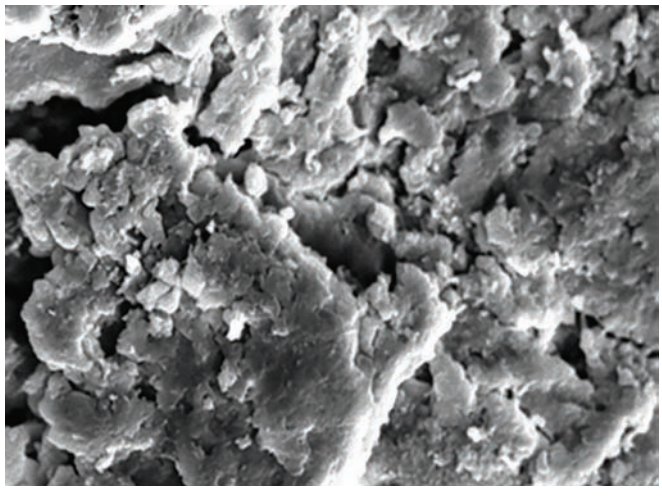


Fig. 8: Magnification of ×10,000

RESULTS

Inter- and multiple group comparison as well as mean and standard deviation (SD) calculation of Control, GLUMA, and laser.

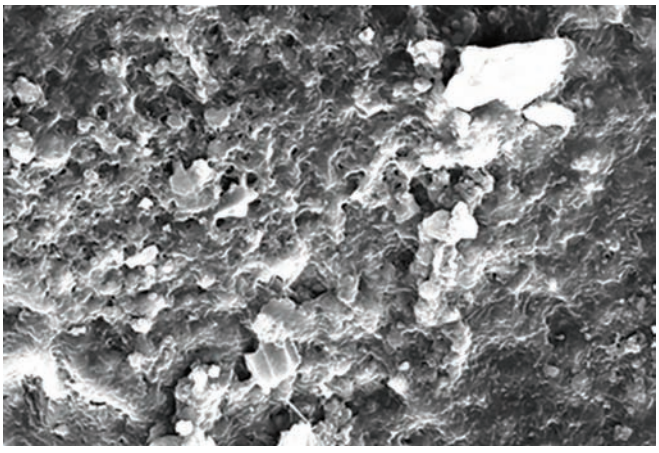


Fig. 9: Magnification of ×10,000

Kruskal–Wallis test and Wilcoxon rank sum test

The bar graph (Graph 1) depicts the mean ratio of the number of completely occluded tubules to the total number of tubules. The mean value is highest for the GaAlAs laser, which indicates more completely occluded tubules than the other groups.

The bar graph (Graph 2) depicts the mean ratio of the number of partially occluded tubules to the total number of tubules. The mean value is highest for the GLUMA desensitizer group, which indicates more partially occluded tubules than the other groups.

DISCUSSION

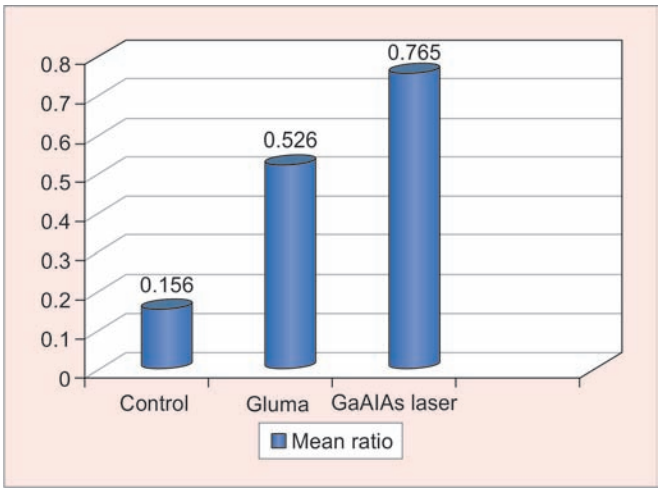
- Dentin hypersensitivity as a chronic disease is increasingly prevalent among adults and research has been done on determining its etiological factors, diagnosis, and treatment.
- The intensity and degree of sensitivity depend on different factors and are different in different people.

Table 1: Inter- and multiple group comparison as well as mean and standard deviation calculation of control, Gluma and Laser

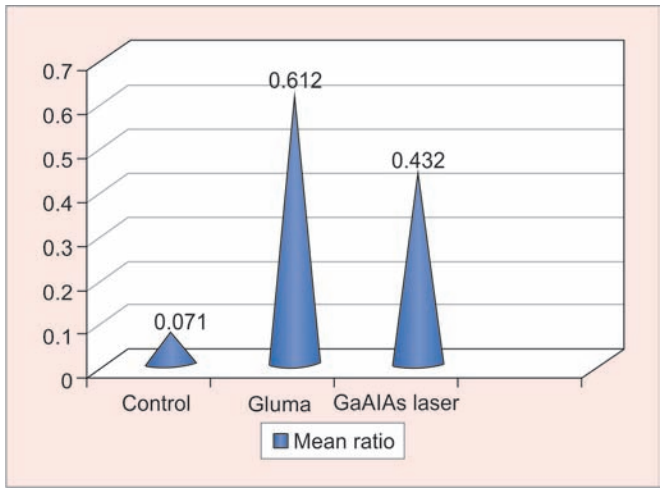
Group	*No. of specimen*	*Mean ± SD Ratio of completely occluded tubules and total tubules*	*Mean ± SD Ratio of partially occluded tubules and total tubules*
CONTROL	20	0.156 ± 0.071	0.071 ± 0.026
GLUMA desensitizer	20	0.526 ± 0.067	0.612 ± 0.069*
GaAlAs laser	20	0.765 ± 0.049*	0.432 ±0.049

SD: Standard deviation; *Statistically significant

- Many effective materials and methods have been proposed in order to reduce or remove sensitivity.
- GLUMA and GaAlAs laser are two of the methods proposed to be effective in hypersensitivity, thus in this study, both test groups and their results have been evaluated.
- On intracomparison, both test groups II and III showed statistically significant reduction in the dentinal tubule occlusion as compared with group I.
- These results are in accordance with the studies done by Felton, Tenorio, Matsumoto et al.[4]
- In group II, higher number of partially occluded tubules and fewer completely occluded tubules were seen.
- This may be attributed to the property of GLUMA containing glutaraldehyde being a biological fixative, and has been suggested that the dentinal tubules are occluded as an effect of reaction with plasma proteins from dentinal fluid.[7]
- In addition, hydroxyethyl methacrylate is a hydrophilic monomer compound of dentin bonding agents with the ability to infiltrate into acid-etched and moist dental hard tissue.



Graph 1 Bar graph depicts the mean ratio of the number of completely occluded tubules to the total number of tubules. The mean value is highest for the GaAlAs LASER , which indicates more completely occluded tubules than the other groups



Graph 2 Bar graph depicts the mean ratio of the number of partially occluded tubules to the total number of tubules. The mean value is highest for the Gluma desensitizer group, which indicates more partially occluded tubules than the other groups

- It is in accordance with the results of Schüpbach et al[8] and Kolker et al,[9] which showed partially occluded dentinal tubules.
- In group III, the highest number of completely occluded tubules and fewer partially occluded tubules were seen.
- The results are in agreement with studies by MaCarthy et al,[10] Schwarz et al,[11] Corono, which showed completely occluded dentinal tubules.
- On intergroup comparison between the two test groups, group III displayed the highest number of completely occluded tubules with fewer partially occluded tubules, whereas group II showed higher number of partially occluded tubules and fewer completely occluded tubules.
- This may be attributed to the property of diode laser that leads to increase in mitochondrial ATP through biostimulation.[12]
- Coagulate the proteins provoking melting of the dentin tissue causing thermochemical ablation blocking the movement of fluid.[10]
- Could stimulate fibroblast proliferation.
- Conversion of arachidonic acid into prostaglandin.
- Increases pain threshold of free nerve ending by depolarization of C-fiber afferents.[13]
- Provide analgesic effect because of increase in beta-endorphin.[14]

CONCLUSION

- According to the present study, the GaAlAs laser and GLUMA both have proved to cause occlusion of dentinal tubules; however, LASER is seen to be more effective due to more visible number of completely occluded tubules.
- Further, long-term studies with varying laser wavelengths, multiple application of laser or GLUMA, as well as use of various high and low-level laser systems can be researched.

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