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Original Research Article

# Evaluation of the efficacy of sodium fluoride varnish, dentine bonding agent and diode laser in the treatment of dentine hypersensitivity: A clinical and scanning electron microscopic study

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ABSTRACT

**Context:** One of the most commonly faced clinical problems is dentinal hypersensitivity (DH). It's a "enigma" that's "often met yet seldom comprehended." It is defined as a sensation of discomfort caused by exposed dentine in response to heat, chemical, tactile, or osmotic stimulation. It appears to be a common ailment, with estimates ranging from 4% to 74 percent of the population.

**Aim:** The study aimed in evaluating the efficacy of sodium fluoride varnish, dentine bonding agent and diode laser in treating dentine hypersensitivity in vitro and in vivo.

**Materials and Methods:** The research was split into two parts: in vitro and in vivo. In the in vitro study, 40 anterior teeth were extracted and separated into four groups: control, group A (fluoride varnish), group B (dentine bonding agent), and group C (laser), all of which were studied under a scanning electron microscope. For the in vivo part 30 patients aged 20-50 years with the chief complaint of sensitivity to hot and cold were selected from the outpatient department (OPD) of Seema Dental college and Hospital. The patients were divided into 3 groups, group A(fluoride varnish), group B (dentine bonding agent) group C (laser).

**Results:** At the end of 3 months, there was a statistically significant difference seen in mean VAS and VRS scores between Group A, Group B, and Group C; additionally, the mean of dentinal tubules in the SEM study (In vitro) was seen to be significantly higher in the Control group compared to Group A and Group B, and significantly higher than Group C.

**Conclusion:** According to the findings of this study, all three treatment methods, sodium fluoride varnish, dentine bonding agent and laser are efficient in reducing dentine hypersensitivity in both in vivo and vitro studies, with laser showing better outcomes.



## 1. Introduction

DH can affect anyone at any age, but it is more common in people in their third and fourth decades. Dentinal hypersensitivity can affect any tooth surface, however it is most common in canines and premolars' buccal cervical region.[1] Periodontal pathogenesis, trauma, teeth whitening, professional oral hygiene, acidic foods and beverages, poor oral hygiene practises or incorrect brushing techniques with subsequent gingival recessions, and other variables may all contribute to dentinal hypersensitivity. Even the removal of orthodontic fixed appliances can result in tooth hypersensitivity. DH is rarely caused by only one of the variables listed above, but rather by a mixture of several.[2]

Dentinal hypersensitivity is caused by three primary mechanisms: direct innervation, Odontoblast receptor, and

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by the fluid movement/hydrodynamic theory. In direct innervation theory, nerve endings enter dentine and extend to the dentino-enamel junction. According to the odontoblast receptor theory, odontoblasts act as receptors and send impulses to nerve terminals. Dentinal pain is caused by a hydrodynamic mechanism, or fluid force. The presence and flow of the fluid within the dentinal tubules is the basis for this theory. Nerve endings at the end of dentinal tubules or at the pulp–dentine complex are activated by this centrifugal fluid movement.[3] Traditional DH treatments involve the application of a desensitising agent either professionally or at home. Protein precipitants, tubule occluding agents, and tubule sealants are the commonly used agents. Other treatments include iontophoresis and the application of steroid suspension to the root surface to reduce dentin hypersensitivity.[4]

Hence, this study aimed to evaluate the efficacy of laser and desensitizing agent in the treating dentine hypersensitivity and also to compare the efficacy of laser and desensitizing agent on dentin tubule occlusion by scanning electron microscopy.

## 2. Materials and Methods

The research was split into two parts: in vitro and in vivo. For the in vitro phase, 40 extracted anterior teeth were used. The outpatient department (OPD) of Seema Dental College and Hospital was used to recruit 30 individuals aged 20 to 50 years who had a primary complaint of sensitivity to hot and cold for the in vivo study.

### *2.1. Subject selection*

The patient selection was based on the following criteria.

### *2.2. Inclusion criteria*

The study included:

1. Teeth with attrition
2. Erosion
3. Recession
4. Cervical abrasion

### *2.3. Exclusion criteria*

1. Patients having allergic reaction or hypersensitivity to any product used in the study.
2. Patients on long term systemic therapy (antibiotics, anti-inflammatory and any other.
3. Teeth with restoration and carious lesion.

### *2.4. Sample size*

1. For in vitro study 40 extracted teeth.
2. For in vivo study 30 patients.

### *2.5. Pre-operative protocol*

1. Detailed medical history.
2. Clinical photographs.

### *2.6. Clinical parameters assessed*

The following clinical parameters were assessed:

1. Visual analogue scale (VAS) and verbal rating scale (VRS) for in vivo study at baseline,1 month and 3 months.
2. Scanned electron microscopy for in vitro study. The specimens were visualized under SEM for magnification.

## 3. Results

The demographic details of participants enrolled for the study are summarized in Table 1.

**Table 1:** Gender wise distribution of subjects

| Gender | No. of Cases | Percentage |
|---|---|---|
| Male | 14 | 47% |
| Female | 16 | 53% |
| Total | 30 | 100% |

Distribution of mean visual analogue score of group A, B and C at Baseline, 1 Month and 3 Months. (Table 2)

The mean VAS score was recorded at Baseline, 1 month and 3 months was compared between Group A, Group B and Group C using the one-way ANOVA test. The mean VAS score at baseline was 7.30±2.40, 5.90±1.72 and 6.80±2.34 in group A, B and C respectively. The mean VAS score at 1 month was 4.10±2.64, 4.00±1.73 and 1.70±2.21 in group A, B and C respectively. The mean VAS score at 3 months was 3.11 ±2.14, 3.11±1.83 and 0.70±1.33 in group A, B and C respectively. There was a statistically significant difference in mean VAS score at 3 months between Group A, Group B and Group C.

Comparision of Mean visual analogue score of group a, b and c at baseline, 1 month and 3 months. (Table 3) The inter-group comparison of mean VAS score at Baseline, 1 month and 3 months was done using the Post-hoc Dunnett T3 test. The mean VAS score at 3 months was satistically significant among Group A and Group B compared to Group C. ($p<0.05$)

Distribution of mean verbal rating scale score of group a, b and c at baseline, 1 month and 3 months. (Table 4)

The mean VRS score was recorded at Baseline, 1 month and 3 months was compared between Group A (Fluoride Varnish), Group B (Dentin Bonding Agent) and Group C (Laser) using the one-way ANOVA test. The mean VRS score at baseline was 3.70±1.25, 3.30±0.80 and 3.60±1.07 in group A, B and C respectively. The mean VRS score at 1 month was 2.10±1.37, 2.33±1.15 and 1.10±1.19 in group A,

**Table 2:** Distribution of mean visual analogue score of group a, b and c at baseline, 1 month and 3 months

| VAS score | | Mean | Std. Deviation | F-value | p-value |
|---|---|---|---|---|---|
| Baseline | Group A (Fluoride Varnish) | 7.30 | 2.40 | 1.057 | 0.362 |
| | Group B (Dentin Bonding Agent) | 5.90 | 1.72 | | |
| | Group C (Laser) | 6.80 | 2.34 | | |
| 1 month | Group A (Fluoride Varnish) | 4.10 | 2.64 | 2.828 | 0.083 |
| | Group B (Dentin Bonding Agent) | 4.00 | 1.73 | | |
| | Group C (Laser) | 1.70 | 2.21 | | |
| 3 months | Group A (Fluoride Varnish) | 3.11 | 2.14 | 5.848 | 0.008* |
| | Group B (Dentin Bonding Agent) | 3.11 | 1.83 | | |
| | Group C (Laser) | 0.70 | 1.33 | | |

**Table 3:** Intergroup comparision of mean visual analogue score of group A, B and C at baseline, 1 month and 3 months

| | | | Mean difference | p-value |
|---|---|---|---|---|
| Baseline | Group A (Fluoride Varnish) | Group B (Dentin Bonding Agent) | 1.40 | 0.382 |
| | Group A (Fluoride Varnish) | Group C (Laser) | 0.50 | 0.951 |
| | Group B (Dentin Bonding Agent) | Group C (Laser) | -0.90 | 0.703 |
| 1 month | Group A (Fluoride Varnish) | Group B (Dentin Bonding Agent) | 0.10 | 1.000 |
| | Group A (Fluoride Varnish) | Group C (Laser) | 2.40 | 0.116 |
| | Group B (Dentin Bonding Agent) | Group C (Laser) | 2.30 | 0.296 |
| 3 months | Group A (Fluoride Varnish) | Group B (Dentin Bonding Agent) | 0.00 | 1.000 |
| | Group A (Fluoride Varnish) | Group C (Laser) | 2.41 | 0.035* |
| | Group B (Dentin Bonding Agent) | Group C (Laser) | 2.41 | 0.016* |

B and C respectively. The mean VRS score at 3 months was 1.77 ±1.09, 1.66±1.00 and 0.40±0.69 in group A, B and C respectively. There was a statistically significant difference in mean VRS score at 3 months between Group A, Group B and Group C.

Mean diameter of dentinal tubules under sem of control group, fluoride, dentin bonding agent and laser (Tables 5 and 6)

The mean diameter of dentinal tubues was seen under SEM (In vitro) was compared between Control group (Figure 1), Group A (Figure 2), Group B (Figure 3) and Group C (Figure 4) using the one-way ANOVA test. The mean diameter was 5.43±2.30, 2.03±0.62, 1.62±0.37 and 0.68±0.29 for control, group A, group B, group C respectively. There was a satistically significant difference in mean SEM study (In vitro) between Control group, Group A, Group B and Group C. The inter-group comparison of SEM study (In vitro) was done using the Post-hoc bonferroni test. The mean of dentinal tubules in SEM study (In vitro) was significantly more among Control group compared to Group A and Group B which was significantly more than Group C.

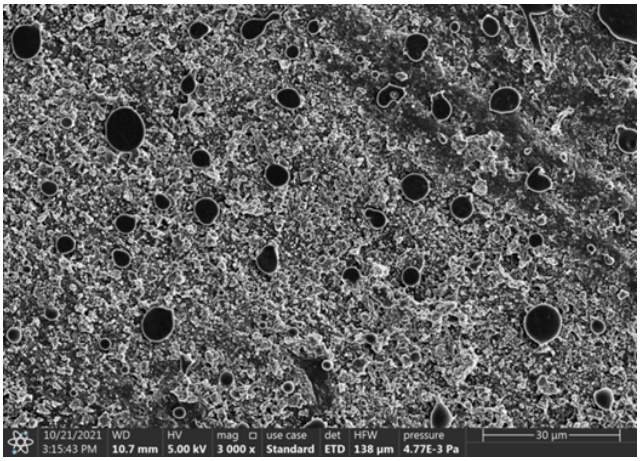


**Fig. 1:** Control group

**Table 4:** Distribution of mean verbal rating scale score of group A, B and C at baseline, 1 month and 3 months

| VRS score | | Mean | Std. Deviation | F-value | p-value |
|---|---|---|---|---|---|
| Baseline | Group A (Fluoride Varnish) | 3.70 | 1.25 | 0.382 | 0.686 |
| | Group B (Dentin Bonding Agent) | 3.30 | 0.82 | | |
| | Group C (Laser) | 3.60 | 1.07 | | |
| 1 month | Group A (Fluoride Varnish) | 2.10 | 1.37 | 1.972 | 0.165 |
| | Group B (Dentin Bonding Agent) | 2.33 | 1.15 | | |
| | Group C (Laser) | 1.10 | 1.19 | | |
| 3 months | Group A (Fluoride Varnish) | 1.77 | 1.09 | 6.43 | 0.006* |
| | Group B (Dentin Bonding Agent) | 1.66 | 1.00 | | |
| | Group C (Laser) | 0.40 | 0.69 | | |

**Table 5:** Mean diameter of dentinal tubules under sem of control group, A, B and C

| | Mean | Std. Deviation | F-value | p-value |
|---|---|---|---|---|
| Control group | 5.43 | 2.30 | 29.129 | 0.001** |
| Group A (Fluoride Varnish) | 2.03 | 0.62 | | |
| Group B (Dentin Bonding Agent) | 1.62 | 0.37 | | |
| Group C (Laser) | 0.68 | 0.29 | | |

**Table 6:** Inter-group comparision of mean diameter of dentinal tubules among control, A, B and C

| | | Mean Difference | p-value |
|---|---|---|---|
| Control group | Group A (Fluoride Varnish) | 3.40 | 0.001** |
| Control group | Group B (Dentin Bonding Agent) | 3.81 | 0.001** |
| Control group | Group C (Laser) | 4.75 | 0.001** |
| Group A (Fluoride Varnish) | Group B (Dentin Bonding Agent) | 0.41 | 1.000 |
| Group A (Fluoride Varnish) | Group C (Laser) | 1.35 | 0.046* |
| Group B (Dentin Bonding Agent) | Group C (Laser) | 0.94 | 0.048* |

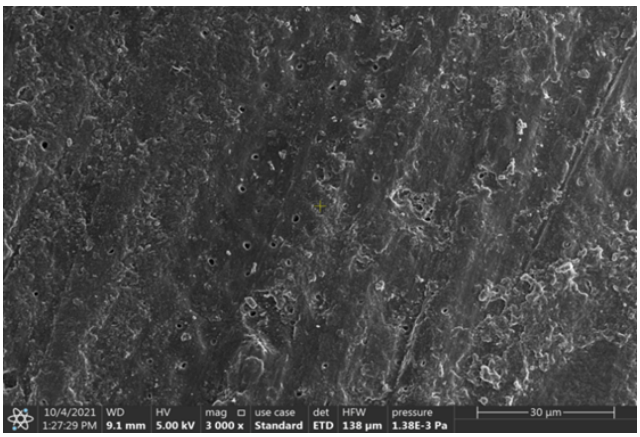


**Fig. 2:** Fluoride group

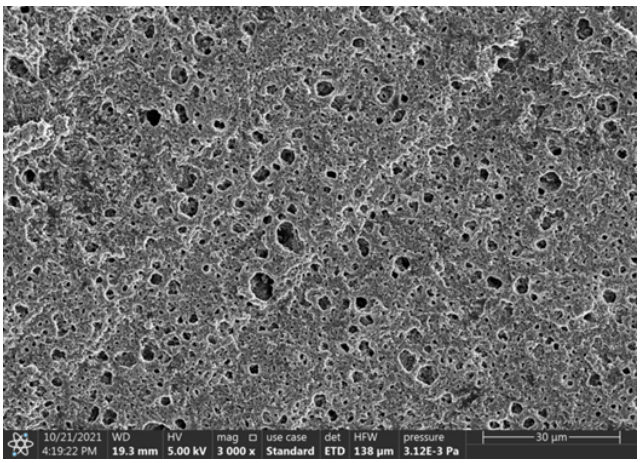


**Fig. 3:** Dentin bonding group

## 4. Discussion

Dentinal hypersensitivity is a common clinical condition caused by exposure to dentin.

In reaction to certain stimuli, exposed dentinal tubules emit short, acute pain. Females are thought to have a higher rate of dentine hypersensitivity than males.

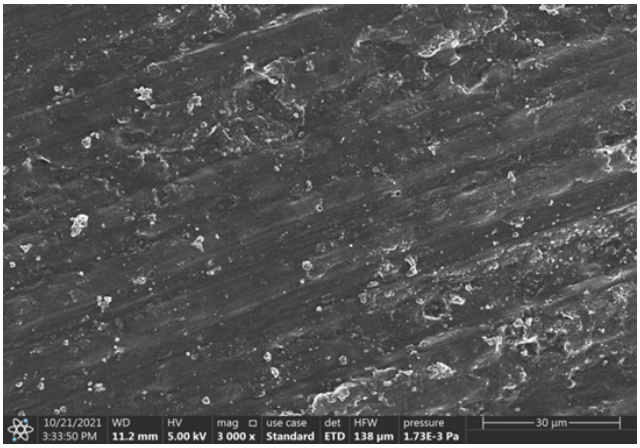


**Fig. 4:** Laser group

Dentinal hypersensitivity is typically treated with physical or chemical therapy. The agents work by occluding the tubule, which restricts fluid passage, or by altering the neurological response to pain stimuli.[5]

Fluoride varnish seem to work by decreasing dentinal permeability by formation of calcium fluoride crystals inside the tubules of the dentinal tubules. Saliva dissolves these crystals to some extent.[6] Dentin bonding agents reduce dentinal hypersensitivity by occluding the tubules in the dentin.[7] The laser affects the dentinal tubules, which alters neural transmission. Lasers may also coagulate proteins inside dentinal tubules, limiting fluid passage, according to certain theories.[8]

In the present study on intergroup comparsion, the mean VAS score at 3 months was satistically significant among Group A (Fluoride Varnish) and Group B (Dentin Bonding Agent) compared to Group C (Laser). A study conducted by Gupta J et al[9] to compare the effectiveness of diode laser and fluoride varnish. The diode laser and fluoride varnish resulted in reduction in VAS score. After 15 days both the treatment.

modalities were effective and the effectiveness was maintained all through 60 days. However, at the end of the 60th day, the efficacy of fluoride varnish had started to decrease, but diode laser continued to show significant efficacy in lowering DH. A similar result was reported in a study conducted by Jain PR et al[10] on the comparison of fluoride varnish and laser, as well as in a clinical trial conducted by Aghanashini S et al,[11] which indicated a drop in VAS score when compared to fluoride and laser. Low-power laser therapy for DH is an effective treatment option for promoting biomodulatory effects, reducing pain, and decreasing inflammatory processes. Agarwal PK et al[12] found statistically significant reduction in dentine hypersensitivity when laser and dentine bonding agent were used. Laser showed greater clinical efficacy over dentin bonding agent. This significant decrease in dentin hypersensitivity score after laser therapy might be due to biostimulation and interference with neural transmission in the dental pulp. Similarly the significant decrease in dentin hypersensitivity score after dentin bonding agent thereby might be due to occlusion of dentinal tubules due to formation of resin tags. Same results were found in a study conducted by Praveen R et al.[13] Ahmed J et al[14] conducted a study to compare dentin bonding agent and fluoride varnish in which dentin bonding agent showed significant reduction in VAS score. Mazur M et al[15] did a study toevaluate the clinical effifficacy of a in-office application of a fluoride varnish and a bonding resin. Both treatment reduced pain intensity. Fluoride varnish showed better results in reducing dentine hypersensitivity.The mean VRS score at 3 months was statistically significant among Group A (Fluoride Varnish) and Group B (Dentin Bonding Agent) compared to Group C (Laser). Pantuzzo ES et al[16] observed that using a laser and fluoride varnish reduced dentine hypersensitivity on the VRS score by a statistically significant amount. Diode laser therapy was found to be more effective than fluoride therapy in lowering DH. Similar results were demonstrated by Pesevska et al[17] who observed the reduction of DH in 86.6% of the individuals treated with diode laser and 26.6% of individuals treated with fluoride.

In vitro study the mean SEM was significant among Control group compared to Group A (Fluoride Varnish) and Group B (Dentin Bonding Agent) which was significant than Group C (Laser). A study conducted by Corneli R et al[18] showed similar result as in this study in which laser showed 100% occluded tubules followed by fluoride varnish while the control group showed completely open tubules. In a study comparing laser and fluoride, Tosun S et al[19] found that laser application improved tubular occlusion capacity. After using a diode laser, Umana M et al[20] obtained a similar result. DH is an oral condition that has a severe influence on people's quality of life.

## 5. Conclusion

According to the findings of this study, sodium fluoride varnish, dentine bonding agent, and laser are all effective in reducing dentine hypersensitivity in vivo, with laser having the best effects. In an in vitro study, the laser group showed a greater reduction in mean diameter of dentinal tubules when compared to sodium fluoride varnish, dentine bonding agent, and the control group.

## 6. Source of Funding

None.

## 7. Conflict of Interest

The authors declare no conflict of interest.

## References


1. Kumari M, Naik SB, Rao NS, Martande SS, Pradeep AR. Clinical efficacy of a herbal dentifrice on dentinal hypersensitivity: A randomized controlled clinical trial. *Aust Dent J*. 2013;58(4):483–90.
2. Miglani S, Aggarwal V, Ahuja B. Dentin hypersensitivity: Recent trends in management. *J Conserv Dent*. 2010;13(4):218–24.
3. Pashley DH. Dynamics of the pulpo-dentinal complex. *Crit Rev Oral Biol Med*. 1996;7(2):104–33.
4. Davari AR, Ataei E, Assarzadeh H. Dentin Hypersensitivity: Etiology, Diagnosis and Treatment; A Literature Review. *J Dent (Shiraz)*. 2013;14(3):136–45.
5. Mrinalini, Sodvadiya UB, Hegde MN. An update on dentinahypersensitivity - aetiology to management - A review. *J Evolution Med Dent Sci*. 2021;10(37):3289–93.
6. Bamise CT, Esan TA. Mechanisms and treatment approaches of dentine hypersensitivity: a literature review. *Oral Health Prev Dent*. 2011;9(4):353–67.
7. Yadav BK, Jain A, Rai A, Jain M. Dentine hypersensitivity: A review of its management strategies. *J Int Oral Health*. 2015;7(10):137–43.
8. Schwarz F, Arweiler N, Georg T, Reich E. Desensitizing effects of an Er: YAG laser on hypersensitive dentine. *J Clin Periodontol*. 2002;29(3):211–5.
9. Gupta J, Kumar K, Ismail PMS, Kumar S, Hegde SS, Jagadeesh KN. A comparative study of diode laser and fluoride varnish in dentin hypersensitivity cases- A clinical study. *J Adv Med Dent Scie Res*. 2020;8(2):176–9.
10. Jain PR, Naik GD, Uppor SA, Kamath DG. Diode laser and fluoride varnish in the management of dentin hypersensitivity. *J Interdiscip Dent*. 2015;5:71–4.
11. Aghanashini S, Puvvalla B, Nadiger S, Mundinamanae DB, Bhat D, Andavarapu S. Comparative evaluation of diode laser and fluoride varnish for treatment of dentin hypersensitivity: A clinical study. *J Interdiscip Dent*. 2018;8:110–7.
12. Agrawal PK, Jibhkate N, Warhadpande MM. Comparative evaluation of diode laser and dentin bonding agent in the treatment of dentin hypersensitivity - An in vivo study. *IP Indian J Conserv Endod*. 2017;2(2):50–4.
13. Praveen R, Thakur S, Kirthiga M, Narmatha M. Comparative evaluation of a low-level laser and topical desensitizing agent for treating dentinal hypersensitivity: A randomized controlled trial. *J Conserv Dent*. 2018;21(5):495–9.
14. Ahmed J, Ali SA, Jouhar R, Shah H. Clnical assessment of dentin bonding agent v/s fluoride varnish in dentinal hypersensitivity. *J Bahria Uni Med Dent Coll*. 2019;9(1):53–6.
15. Mazur M, Jedlinski M, Ndokaj A, Ardan R, Janiszewska-Olszowska J, Nardi GM, et al. Long-Term Effectiveness of Treating Dentin Hypersensitivity with Bifluorid 10 and Futurabond U: A Split-Mouth Randomized Double-Blind Clinical Trial. *J Clin Med*. 2021;10(10):2085.
16. Pantuzzo ES, Cunha FA, Abreu LG, Esteves RP. Effectiveness of diode laser and fluoride on dentin hypersensitivity treatment: A randomized single-blinded clinical trial. *J Indian Soc Periodontol*. 2020;24(3):259–63.
17. Pesevska S, Nakova M, Ivanovski K, Angelov N, Kesic L, Obradovic R. Dentinal hypersensitivity following scaling and root planing: comparison of low-level laser and topical fluoride treatment. *Lasers Med Sci*. 2010;25(5):647–50.
18. Corneli R, Kolakemar A, Damda A, Naik R. An in vitro evaluation of dentinal tubule occlusion using three desensitizing methods: A scanning electron microscopic study. *J Conserv Dent*. 2020;23(1):86–90.
19. Tosun S, Culha E, Aydin U, Ozsevik AS. The combined occluding effect of sodium fluoride varnish and Nd:YAG laser irradiation on dentinal tubules-A CLSM and SEM study. *Scanning*. 2016;38(6):619–24.
20. Umana M, Heysselaer D, Tielemans M, Compere P, Zeinoun T, Nammour S. Dentinal tubules sealing by means of diode lasers (810 and 980 nm): a preliminary in vitro study. *Photomed Laser Surg*. 2013;31(7):307–14.


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