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Original Research Article

Comparative evaluation of efficacy of diode laser and bifluorid 10 on dentinal tubule occlusion- A scanning electron microscope (SEM) study

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ABSTRACT

Background: The present study aimed to evaluate the use of Bifluorid 10 and 810-nm diode laser alone on the exposed dentinal tubules by occluding the tubules, which is one of the treatment measures including gels, adhesives, toothpastes and mouthwashes used to treat dentinal hypersensitivity.
Materials and Methods: The study involved 20 periodontally compromised extracted teeth which were sectioned, and dentin samples were prepared. The samples were divided into two groups by using simple randomization technique by tossing a coin; Group A: was treated with Bifluorid 10 alone and Group B: was treated with Laser alone. The treated dentin samples were gold sputtered and were then examined under Scanning electron microscope at a fixed magnification of X5000 and the photomicrographs of the area were obtained.
Results: It was seen that the specimens in Group A showed better dentinal tubule occlusion as compared to Group B. Lesser tubule occlusion was seen in Group B.
Conclusion: After the evaluation of samples treated with Bifluorid 10 and Laser, it was concluded that Bifluorid 10 had shown better tubule occlusion than Laser.

1. Introduction

Dentin Hypersensitivity can be defined as short, sharp pain which arises from the exposed dentin in response to a stimuli usually thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other dental pathology or defect.[1] Dentine sensitivity or dentinal hypersensitivity is one of the most commonly encountered clinical problem with an incidence ranging from 4 to 74%.[2] It can affect the patient of any age, most commonly affecting 20–50 years of age, with a peak between 30 and 40 years of age and its occurrence increases with age.[3]

Numerous theories have been proposed to explain the mechanism of dentinal hypersensitivity. Currently, the most accepted theory is the hydrodynamic theory which formulates that external stimuli cause movement of fluid inside the dentinal tubules inwardly or outwardly, leading to mechanical deformation of the nerve endings at the pulp/ dentin interface, which is transmitted as a painful sensation.[4]

Various therapies have been introduced which includes home and office applied agents, with varying degrees of success. In home-desensitizing treatment includes toothpastes, mouthwashes, and chewing gum. In office-desensitizing treatment comprises of gels, solutions, fluoride varnishes, resin sealers, dentin adhesives, dental lasers and tubule occluding agents.[5]

Bifluorid 10 is a liquid, colophony-free fluoride varnish that contains 5% sodium fluoride (22,600ppm fluoride) and 5% calcium fluoride.[5] It is indicated for the prevention of hypersensitivity, including sensitivity caused by cervical areas and crown margins, after enamel injury. Over the past

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decade, the use of lasers in dentistry has become common place. Low power lasers such as gallium/aluminum/arsenide (GaAlAs) diode laser and medium power lasers, including CO_2, Nd: YAG, and Er: YAG lasers cause desensitization as they have the ability to melt the peritubular dentin, leading to total or partial occlusion of dentinal tubules thereby, reducing the sensitivity.

The present study aimed to evaluate the effect of Bifluorid 10 and Laser when used alone on exposed dentinal tubules.

2. Materials and Methods

2.1. Study design and setting

The present study was performed in the Department of Periodontology, Himachal Institute of Dental Sciences, Paonta Sahib (H.P.). The teeth selected for the study were obtained from the patients who reported to the outpatient Department of Oral and Maxillofacial Surgery of Himachal Institute of Dental Sciences, Paonta Sahib (H.P.) for extraction of periodontally compromised maxillary and mandibular anterior teeth.

2.2. Inclusion criteria

The inclusion criteria were Maxillary and Mandibular anterior teeth which were vital teeth at the time of extraction, teeth without any prior restoration.

2.3. Exclusion criteria

Teeth with caries, fractured tooth, hypoplastic teeth, or tooth exhibiting fluorosis and tooth with developmental anomaly were not included in the study. Teeth with wasting diseases as attrition, erosion and abrasion were also excluded from the study as they might produce secondary changes such as alteration in mineral composition.

2.4. Procedure

The teeth were sectioned transversely with diamond disc to create dentin specimens. The sectioned tooth sample were then polished with sandpaper. The sections were etched with 37% Ortho phosphoric acid solution and were stored in phosphate buffered solution.

The specimens were divided into 2 groups by using simple randomization technique by tossing a coin. GROUP A: Dentin specimen was immersed in artificial saliva and treated with Bifluorid 10. GROUP B**:** Dentin specimen was immersed in artificial saliva and treated with 810 nm diode laser. The samples were then thoroughly washed in distilled water and were dried.

2.5. Description of the desensitizing agents

2.5.1. Bifluorid 10

The material used in this study was Bifluorid 10 (VOCO GmbH Anton-Flettner-str. 1-3 27472 Cuxhaven Germany). It contains 5% Sodium fluoride, 5% Calcium fluoride, Ethyl acetate, Cellulose ester and Eugenol. It was uniformly applied for a period of 60 seconds and the samples were allowed to air dry.

2.5.2. Diode laser

The equipment used in this study was a Gallium-Arsenide (Ga-As) semi-conductor diode laser (PICASSO DENTAL LASER), emitting infra-red radiation at 810 nm. All irradiations were done by the same operator with an output power of 2.5W, dose of 4.2 J/cm2 and exposure time of 60 seconds. The tip was held perpendicular and in non-contact mode.

In Group A, multiple application of Bifluorid 10 was uniformly applied for a period of 60 seconds and the samples were allowed to air dry. In Group B after adjusting the laser radiation parameters on laser source, laser irradiation was applied for 60 seconds at each site in a continuous non-contact mode. The specimens were stored in artificial saliva and were allowed to air dry and were gold sputtered.

The gold sputtered specimens was then transferred to SEM machine and the area of interest was examined at fixed magnification of X5000 and the photomicrographs of the area were obtained. The SEM images were assessed independently by two trained blinded reviewers to score the level of dentinal tubule occlusion (on the categorical scale of 1-5). Tubule occlusion scoring index given by West et al.[6]

Table 1:

Scores	Description
1	Completely occluded tubules (100%)
2	Mostly occluded (50-<100% of tubules occluded)
3	Partially occluded (25-50% of tubules occluded)
4	Mostly unoccluded (<25% of tubules occluded)
5	Unoccluded (0%, no tubule occlusion)

3. Observations and Result

3.1. Statistical analysis

SPSS (Statistical Package for Social Sciences, SPSS Inc. Version 16, USA) was used to do the statistical analysis. The mean and standard deviations were computed for descriptive statistics. Prior to analysis, normality testing of the data was carried out using Shapiro-Wilk test which showed that the data deviated from normal distribution ($P<0.05$). Thereafter, comparison of tubule occlusion scores between the two groups was done using Mann Whitney U test. The level of

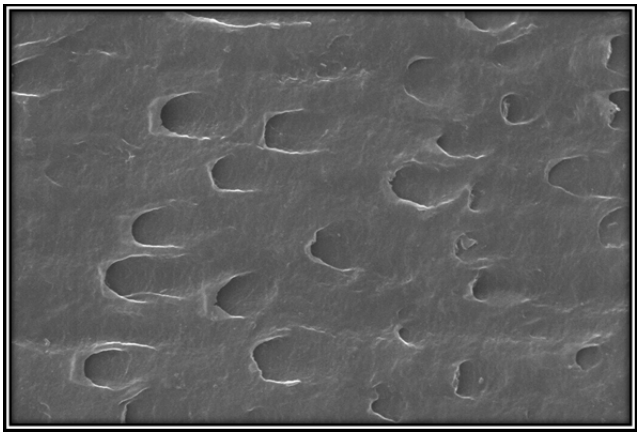


Figure 1: (Group A) photo micrographs of root dentin samples in X5000 Magnification.

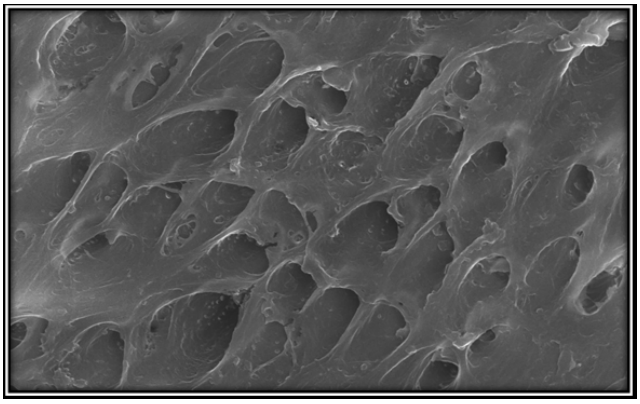


Figure 2: (Group B) photo micrographs of root dentin samples in X5000 Magnification.

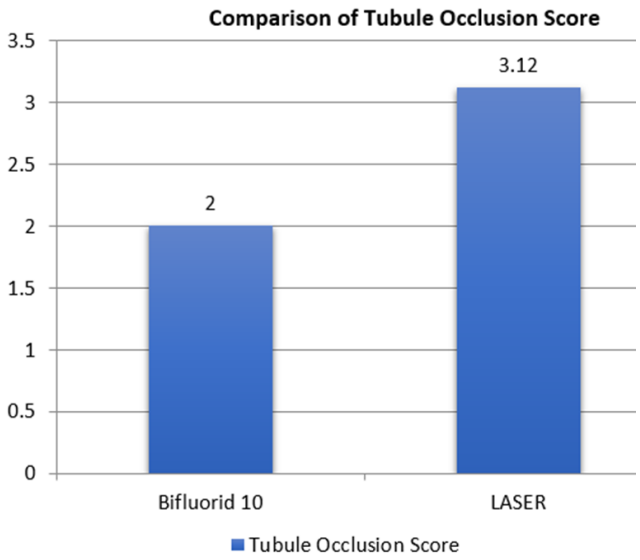
significance for the present study was set at P value of less than 0.05.

3.2. Tubule occlusion

Table 2 shows the comparison of tubule occlusion scores between the two groups. Statistical analysis using Mann-Whitney U test showed that there was a statistically significant difference in tubule occlusion scores between the two groups (P=0.001). The tubule occlusion score was significantly higher in LASER group as compared to Bifluorid 10 group. This shows that Bifluorid 10 was able to achieve more tubule occlusion as compared to LASER.

4. Discussion

Dentin is mineralised hard tissue forming the main bulk of tooth. It consists of dentinal tubules and is sensitive because of the extensions of odontoblasts and formation of dentin-pulp complex. Dentine hypersensitivity is still



Graph 1: Shows the comparison of tubule occlusion scores among group A and group B.

a global concern for adult oral health. A significant percentage of exposed cervical dentine, ranging from 3 to 57%, is its defining feature.[7] The hydrodynamic theory, which is the most widely accepted explanation, postulates that a stimulus applied to the dentin surface results in the movement of tubular fluid within the dentinal tubules.[8]Gingival recessions due to abrasion, dehiscence and fenestrations, frenum pulls and orthodontic movement, post-dental bleaching, and exposure of dentinal tubules following the removal of supra and/or sub gingival calculi could predispose teeth to hypersensitivity. [9] Various therapies have been introduced which includes in-home and in-office applied agents, with varying degrees of success.

The evaluation of SEM images was done by two blinded examiners in accordance with tubules occlusion classification given by West et al.[9] The samples which presented total occlusion of tubules were given score 1, the samples with most of the occluded tubule were given score 2, samples which showed partially tubule occlusion were given score 3, samples with the tubules mostly unoccluded were given score 4, samples which showed total tubules unoccluded were given score 5. The mean score of the tubule occlusion by the blinded reviewers was taken and used for statistical analysis. The result obtained were statistically analysed using the Mann-Whitney U test.

Table I shows the Comparison of tubule occlusion scores between Bifluorid 10 and Laser. Score 1 i.e. 100% tubule occlusion was not achieved by any group. Group A had the most frequent score 2 i.e. most tubules were occluded. For score 3 i.e. partially occluded tubules were seen in Group B. For score 4 i.e. mostly unoccluded tubules were also seen in

Table 2: Comparison of tubule occlusion scores between bifluorid 10 and laser.

Tubule Occlusion Score	Group	N	Mean	Std. Deviation	Mean Rank	P value
	Bifluorid 10	10	2.0000	0.00000	5.00	0.001*
	Laser	10	3.1250	0.64087	12.00	

Table 3: Tubule occlusion score for Group A

		Frequency	Percentage
Dentinal tubule occlusion score	Score 1	0	0%
	Score 2	8	80%
	Score 3	2	20%
	Score 4	0	0%
	Score 5	0	0%
	Total	10	100%

Table 4: Tubule occlusion score for Group B

		Frequency	Percentage
Dentinal tubule occlusion score	Score 1	0	0%
	Score 2	2	20%
	Score 3	5	50%
	Score 4	3	30%
	Score 5	0	0%
	Total	10	100%

Group B.

It is evident from the above description of the table, that significant number of tubules got occluded after being treated with Bifluorid 10. The probable reasons that the results of specimens treated with Bifluorid 10 surpassed the results of that with laser, could be because fluoride agents are thought to interfere with the hydrodynamic mechanisms, as they act on exposed tubules thus reducing the number and diameter of the tubules ultimately minimising the movement of dentinal fluid and reducing the DH.

Group A had 10 samples but no sample showed 100% tubule occlusion. Score 2 was shown by 8 samples (80%), Score 3 was shown by 2 samples (20%). Group B had 10 samples but no sample showed 100% tubule occlusion. Score 2 was shown by 2 samples (20%), Score 3 was shown by 5 samples (50%), Score 4 was shown by 3 samples (30%). None of the samples from both the groups got score 5.

Earlier study done by Mahsa et al.[10] compared the effect of sodium fluoride varnish, Gluma and Er, Cr: YSGG laser. In contrary to our study, their results showed that Er, Cr: YSGG laser alone or in combination with Gluma was more effective than sodium fluoride varnish. When dentine hypersensitivity treatment was followed up for six months, Gluma's impact was noticeably greater than that of sodium fluoride. When dentine hypersensitivity treatment was followed up for six months, Gluma's impact was noticeably greater than that of sodium fluoride.

In another study done by Isha Suri et al.[11] revealed that best results were shown when sodium fluoride varnish was used with laser. In a similar study (Mohammad Asna Ashari et al.[12] GLUMA bonding and the 660 nm diode laser were combined together and found to be effective in reducing DH.

Ankur Tailor, Nina Shenoy and Biju Thomas[13] also compared the combined effect of 810nm diode laser and Bifluorid 12 and got the significant results. But in contrary to all of these studies we have used Bifluorid 10 and laser alone in separate groups and out of which Bifluorid 10 group showed better results. The superior results in Group A of the present study can be credited to the one of the properties of fluoride agents that precipitates calcium fluoride crystals inside the dentinal tubules minimizing the dentinal permeability.

Corona et al.[14] conducted a study to compare the effects of low level laser therapy and fluoride varnish for treatment of cervical hypersensitivity. The results showed that there was no significant difference for fluoride varnish and laser. In a similar study (Yilmaz et al.)[15] compared the effects of (GaAlAs) laser and fluoride varnish on dentin hypersensitivity which was checked by Visual Analog Scale (VAS). The results showed that both laser and Fluoride resulted in reduction in VAS scores.

In another study, Praveen et al.[16] compared the effects of 1.23% APF and 810nm laser alone and APF combined with 810 diode laser. Their results also were in contradiction to our study, where Bifluorid 10 showed better results. This difference in results can be attributed to the use of different fluoride agent (Bifluorid 10) in the present study.

Within the limitations of this study it was concluded that Group A (Bifluorid 10) shows better occlusion of dentinal tubules as compared to Group B (Laser).

5. Limitations and Futuristic Approach

Present study was performed on extracted teeth which do not imitate the actual biological environment. So, further clinical trials should be carried out to prove the potency of the Bifluorid 10 and Laser in actual clinical settings. Another limitation of current study was the limited sample size, so the results have to be confirmed by larger sample size.

6. Conclusion

In the present study, 20 single rooted teeth were taken and were randomly divided into two groups where Group A was treated with Bifluorid 10 and Group B was treated with diode laser. The samples were then dehydrated with alcohol and were gold sputtered, after which they were visualized under SEM at a magnification of X5000.

The photomicrographs thus obtained were evaluated by two blind scorers, which revealed that Bifluorid 10 led to significant dentinal tubule occlusion. The use of Bifluorid showed maximum samples having mostly occluded tubules although Laser showed partially occluded tubules and mostly unoccluded tubules. From the study, after the evaluation of samples treated with Bifluorid10 and Laser, it was concluded that Bifluorid 10 had shown better tubule occlusion than Laser.

7. List of Abbreviations

Scanning Electron Microscope (SEM), Gallium Aluminum Arsenide (GaAlAs), Gallium-Arsenide (Ga-As), Statistical Package for Social Sciences (SPSS), Dentinal Hypersensitivity (DH), Erbium chromium: Yttrium Scandium Gallium Garnet (Er, Cr: YSGG), Acidulated Phosphate Fluoride (APF)

8. Conflict of Interest

There are no conflict of interest.

9. Source of Funding

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References

1. Jain A, Rao J, Pal N, Singh A. Effectiveness of fluoride varnish, diode laser, and their combination in treatment of dentin hypersensitivity: A randomized split-mouth clinical trial. *J Indian Soc Periodontol*. 2020;24(4):369–74.
2. Rees JS, Jin LJ, Lam S, Kudanowska I, Vowles R. The prevalence of dentine hypersensitivity in a hospital clinic population in Hong Kong. *J Dent*. 2003;31(7):453–61.
3. Miglani S, Aggarwal V, Ahuja B. Dentin hypersensitivity: Recent trends in management. *J Conserv Dent*. 2010;13(4):218–24.
4. Liu Y, Gao J, Gao Y, XU S, Zhan X, Wu B, et al. In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser. *J Lasers Med Sci*. 2013;4(3):111–9.
5. Mazur M, Jedliński 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):1–10.
6. West NX, Macdonald EL, Jones SB, Claydon NC, Hughes N, Jeffery P, et al. Randomized in situ clinical study comparing the ability of two new desensitizing toothpaste technologies to occlude patent dentin tubules. *J Clin Dent*. 2011;22(3):82–9.
7. Gojkov-Vukelic M, Hadzic S, Zukanovic A, Pasic E, Pavlic V. Application of Diode Laser in the Treatment of Dentine Hypersensitivity. *Med Arch*. 2016;70(6):466–9.
8. Reshma SA, Masthan KMK, Babu N, Anitha N. Dentinal Hypersensitivity. *Eur J Mol Clin Med*. 2020;7(3):1752–60.
9. Rezazadeh F, Dehghanian P, Jafarpour D. Laser Effects on the Prevention and Treatment of Dentinal Hypersensitivity: A Systematic Review. 2019;10(1):1–11.
10. Forouzande M, Rezaei-Soufi L, Yarmohammadi E, Ganje-Khosravi M, Fekrazad R, Farhadian M, et al. Effect of sodium fluoride varnish, Gluma, and Er,Cr:YSGG laser in dentin hypersensitivity treatment: a 6-month clinical trial. *Lasers Med Sci*. 2022;37(7):2989–97.
11. Suri I, Singh P, Shakir QJ, Shetty A, Bapat R, Thakur R, et al. A comparative evaluation to assess the efficacy of 5% sodium fluoride varnish and diode laser and their combined application in the treatment of dentin hypersensitivity. *J Indian Soc Periodontol*. 2016;20(3):307–14.
12. Ashari MA, Berijani A, Anbari F, Yazdani Z, Zandian A. Comparison of the Effectiveness of Combined Diode Laser and GLUMA Bonding Therapy With Combined Diode Laser and 5% Sodium Fluoride Varnish in Patients With Dentin Hypersensitivity. *J Lasers Med Sci*. 2021;12:e62. doi:10.34172/jlms.2021.62.
13. Tailor A, Shenoy N, Thomas B, Student PG. To compare and evaluate the efficacy of bifluorid 12, diode laser and their combined effect in treatment of dentinal hypersensitivity-a clinical study. *J Health Allied Sci NU*. 2014;4(2). doi:10.1055/s-0040-1703764.
14. Corona SAM, do Nascimento T, Catirse ABE, Lizarelli RFZ, Dinelli W, Palma-Dibb RG, et al. Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity. *J Oral Rehabil*. 2003;30(12):1183–9.
15. Yilmaz H, Kurtulmus-Yilmaz S, Cengiz E. Long-term effect of diode laser irradiation compared to sodium fluoride varnish in the treatment of dentine hypersensitivity in periodontal maintenance patients: a randomized controlled clinical study. *Photomed Laser Surg*. 2011;29(11):721–5.
16. Jayaram P, Coutinho AO, Bhadranna A, Chatterjee A, Raghunathan V, Imran F, et al. Evaluation of diode laser along with 1.23% acidulated phosphate fluoride gel on dentinal tubule occlusion: An in vitro study. *J Indian Soc Periodontol*. 2020;24(3):253–8.

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