JFCR
Journal of Fundamental and Clinical Research
https://jfcr.journals.ekb.eg/
ISSN 2735-023X
Vol. 1, No. 2, 106-120, December 2021

The Effect of Dentin Surface Treatment with Diode Laser versus Desensitizing Agents on Shear Bond Strength

Ahmed Shalaby[1], Tarek Salah[2], Tamer Hamza[3]

ABSTRACT

Background: Measuring and comparing shear bond strength after cementation by resin cement when using desensitizing agents versus diode laser in dentin desensitization. ***Objectives:*** To evaluate the difference between desensitizing agents and diode laser on shear bond strength between dentin and resin cement. ***Materials and methods:*** 2 mm standardized dentin samples were obtained from thirty molars to form sixty samples that were divided randomly into five groups (n=12). Group C (no surface treatment), Group GL (Gluma desensitizing agent was applied on dentin, Group BF (Bifluoride desensitizing agent was applied on dentin), Group DL2 (Diode laser 2W was irradiated on dentin) and Group DL3 (Diode laser 3W was irradiated on dentin). All samples were cemented by resin cement then tested for shear bond strength using a universal testing machine. Data obtained was analyzed using one-way (ANOVA) ($P \leq 0.05$) then Tukey post-hoc test. Representative samples from each group were analyzed using SEM. ***Results:*** There was significant difference between all groups but there was no significant difference between group (C, GL, DL2 and DL3) (10.87 MPa, 12.88 MPa, 9.81 MPa and 10.64 MPa) respectively. Significant difference was found between group (GL and BF) (12.88 MPa and 7.33 MPa) respectively. Lowest resin cement infiltration was observed under SEM in group (BF) having lowest shear bond strength. ***Conclusion:*** Bifluoride treatment had least shear bond strength and least resin cement infiltration, better not to be used in dentin desensitization before cementation.

Keywords: Gluma, Bifluoride, Diode laser, shear bond strength.

INTRODUCTION

A significant problem that affects 13 to 74 percent of the population is Hypersensitivity, this is a huge percentage of patients when getting their teeth prepared, what is worse is that desensitizing dentin could affect the bond strength negatively afterwards.[1-3]

Fortunately, there were many methods of desensitizing dentin which made a positive effect on hypersensitivity. Starting by the old

1. Post graduate student, Department of Fixed Prosthodontics, Faculty of Oral and Dental Medicine, Misr International University, Cairo, Egypt.
2. Professor of Fixed Prosthodontics, Faculty of Dentistry, Ain-Shams University, Cairo, Egypt.
3. Professor of Fixed Prosthodontics, Faculty of Dental Medicine, Al-Azhar University. Cairo, Egypt.

methods like anti-inflammatory drugs as corticosteroids and going through blocking the nerve activity by using potassium nitrate. New effective methods acting on blocking the dentinal tubules as calcium hydroxide, fluoride and oxalates, then the adhesives showed more positive effect as Gluma, ending by Diode Lasers that led to a noticeable decrease in the hypersensitivity.[4]

To achieve the ideal effect of dentin desensitization, the pulp must not be irritated, relatively painless when applied, easy application, rapid action, permanently effective and do not discolor the teeth.[5]

Desensitizing agents are the most frequently used treatment for dentin hypersensitivity which are applied on the exposed dentin after preparation, as it decreases the pain by occluding the tubules and also by altering the pulpal sensation nerve activity.[6,7]

So, after analyzing many in-vitro studies, it was stated that Gluma had highest positive effect on decreasing hypersensitivity when compared by other desensitizing agents because of its components Hema that blocks dentinal tubules and Glutraldahyde that leads to coagulation and precipitation of protein plasma in dentinal tubules.[8-10] while some other authors discussed that Gluma had almost no positive effect on hypersensitivity.[11-13]

As well as, bifluoride that had positive effect on dentin desensitization in some studies.[14] On the other hand the majority stated that the bifluoride had a negative effect on dentin desensitization.[15]

Application of desensitizing agents affect the bond strength of resin to dentin, when the procedure of desensitization is done in office it is preferred to do adhesive restorations after two weeks, as the desensitizing agents remain in dentinal tubules preventing the cement to penetrate in the dentinal tubules.[16]

Previous studies of scanning electron microscope (SEM) for the resin infiltration after treatment with Gluma showed the high infiltration of resin cement in the dentinal tubules leading to partial or complete blockage which was the reason for its positive effect on shear bond strength or at least no negative effect.[17-21] On the contrary other authors claimed that Gluma showed significantly lower shear bond strength.[22, 23]

While the Bifluoride SEM results of many studies showed the opposite of Gluma as it did not allow the resin cement to infiltrate to the dentinal tubules affecting shear bond strength negatively.[24] But some claimed that bifluoride application to the demineralized dentin might increase resin-dentin bond strength by improving the mechanical properties of the dentin that led to high shear bond strength.[25]

Lasers (Light Amplification by Stimulated Emission of Radiation) existed in research from two decades ago in dentistry and their rising popularity among both dentists and patients is fast, it is indicated for a wide variety of dental procedures and it is available in two categories (Hard and Soft) tissue application.[26]

Diode laser is a type of lasers that mainly works on soft tissue, its wavelength 980 nm and it is absorbed in pigmented tissue which are melanin and hemoglobin, its indication is in esthetic procedure as gingival depigmentation, gingival recontouring or gingivectomy, soft tissue crown lengthening, also could be used in exposure of soft tissue over partially erupted teeth, removal of hypertrophic tissue, frenectomy and photo-stimulation of the aphthous and herpetic ulcers or lesions. They are less absorbed in the hydroxyapatite and enamel (hard tissues).[26, 27]

Various ways of Diode laser mechanisms that led to nerve fiber alteration such as coagulation of plasma and protein precipitation in the dentinal tubules, its low intensity that interferes with potassium ions, interaction with pulp causing Photobiomoudulating effect and finally the laser energy interference with the sodium pump mechanism that changed the membrane permeability, all led to an increase in dentinal tubules occlusion decreasing the dentin hypersensitivity.[28-31]

The shear bond strength was affected positively when dentin was subjected to Diode laser irradiation as discussed by many authors as they concluded that the dentin surface treated with diode laser 980 nm showed the highest shear bond strength mean value compared to other types of laser and also the SEM showed irregular dentin surface without carbonization but with melted and sealed dentinal tubules apparently.[32] Oppositely some authors concluded that diode laser showed no positive effect on the shear bond strength resulted from complete coverage and sealed dentinal tubules that minimize the resin cement infiltration leading to low shear bond strength.[33]

The null hypothesis that there is no difference between the effect of the Desensitizing Agent and Diode Laser on the shear bond strength. The objectives are to evaluate the difference between desensitizing agents and diode laser on shear bond strength between dentin and resin cement.

MATERIAL AND METHODS

Sample size calculation:

Since no published data could be found for estimation of sample size, we assume to design a two-way fixed effect study to detect large effect size (0.4). Using alpha (α) level of (5%) and Beta (β) level of (20%) i.e., power = 80%; the minimum estimated sample size was 12 specimens per group giving a total of 60 specimens. IBM® SPSS® Sample Power® Release 3.0. was executed for the sample size calculation.[19, 34]

Sample Selection and Preparation

Thirty human molars extracted from diabetic patients who suffered from bone loss that led to teeth mobility, that were obtained from the outpatient clinic at Misr International University after approval of the local research ethics committee **(MIU-IRB-1718-061)**. Two Standardized 2 mm dentin sections were obtained from each molar of average dimensions 9-10 width and 20-21 height to form 60 samples using a microtome sectioning device (IsoMet precision cutting micro saw, Buehler, USA), the occlusal of the crown of the teeth were sectioned into two parts to expose the dentin and then roots were sectioned off at the level of the cemento-enamel junction. Each dentin section measured approximately 7-8 mm in width and 6-7 mm in height, each dentin section was then imbedded in self-curing acrylic resin using a custom-made 1.5 × 1.5 cm with the dentin surface exposed at the surface that was then grinded using a yellow fine-grit diamond stone to simulate clinical smear-layer formation.

Sample procedure:

The samples were numbered from 1-60 using Microsoft Excel's [i] random sampling tool then the 60 prepared samples were randomized and categorized into 5 groups (n=12). The procedure of applying surface treatments and cementation is shown in **figure 1.**

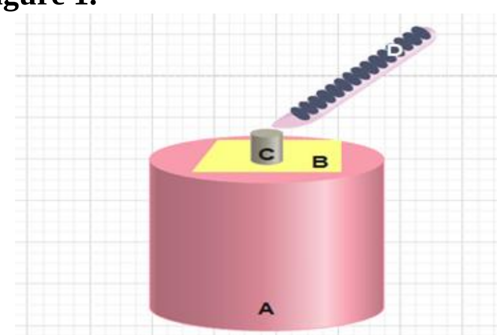

Figure (1): Model of the sample. **A.** Acrylic resin block, **B.** Dentin sample, **C.** Catheter tube holding the resin cement and **D.** Mixing tube of the resin cement.

In order to prevent the resin cement from spreading out, a standardized Catheter Tube 2 mm in diameter was used, then sectioned into 60 equal parts 2 mm in height using a sharp lancet. This was designed to illustrate the final cementation of the sample (**Figure 2).**

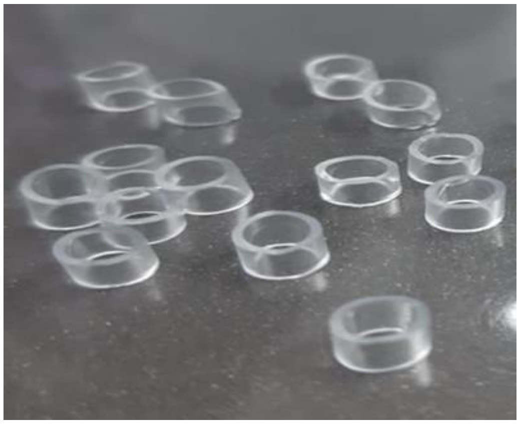

Figure (2): Sectioned Catheter Tube into 2 mm height by sharp lancet.

To prevent laser irradiation from scattering two Acrylic Resin Templates were designed and milled by standardized measurements in laboratory, which was 6 mm inner diameter resembling the inner diameter of the laser handpiece and 8 mm outer diameter. One of them was 1 mm in height for the Diode Laser 2 W group and the other was 2 mm in height for Diode Laser 3 W group (**Figure 3**). **Figure 4** was designed to illustrate the two acrylic resin templates measurements.

Group (C) - the dentin surface received (Resin Cement) (C-Ram Itena) through the Catheter Tube and a 650 mW/cm2 LED light cure device (i LED-D, Woodpecker, Guilin, China) away 2 mm in distance for 20 seconds to be polymerized.

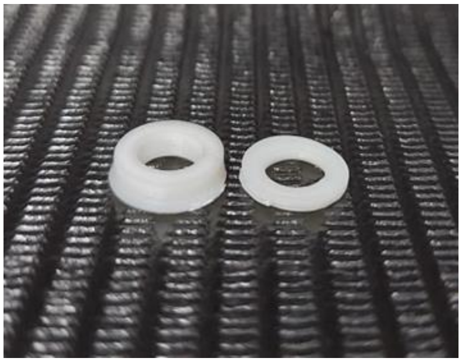

Figure (3): The two Acrylic Resin Templates for Diode Laser groups.

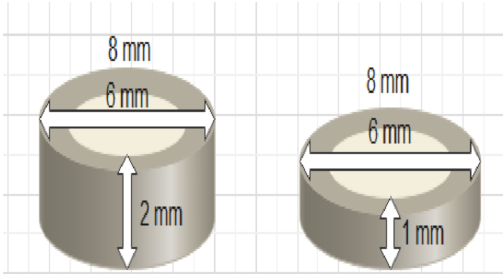

Figure (4): A designed diagram of the two Acrylic Resin Templates with 8 mm outer diameter and 6 mm inner diameter and 1 mm height for group DL2 and 2 mm height for group DL3.

Group (BF) - the dentin surface received (Bifluoride Desensitizer) by a micro brush in a very thin coat and it was allowed to be absorbed for 10-20 seconds and dried with air ship syringe upon manufacturer instructions. Then (Resin Cement) was applied and light cured following the same protocol as used with group (C).

Group (GL) - the dentin surface received (Gluma Desensitizer) by a micro brush, left for 30 seconds and then water and air were applied using ship syringe upon manufacturer instructions. Then (Resin

Cement) was applied and light cured following the same protocol as used with group (C).

Group (DL2) - the dentine surface received irradiation from (Diode Laser) with parameters 2W, continuous wavelength, for 10 seconds, non- contact. The Diode Laser irradiation tip was placed away from the sample by 1 mm directed vertically with 90 degrees through the 6 mm diameter hole of the 1 mm height customized acrylic resin template. Then (Resin Cement) was applied and light cured following the same protocol as used with group (C).

Group (DL3) – the dentine surface received irradiation from (Diode Laser) with parameters 3W, continuous wavelength, for 10 seconds, non- contact. The Diode Laser irradiation tip was placed away from the sample by 2 mm vertically with 90 degrees which was pointed through the 6 mm diameter hole of the 2 mm height customized acrylic resin template. Then (Resin Cement) was applied and light cured following the same protocol as used with group (C).

Shear bond strength:

To test the shear bond strength of the formed adhesive bond, a computerized universal testing machine (Instron, England) with a load cell of 500N was used, the shear force rod was set to travel at a crosshead speed of 0.5 mm/min. The bond strength was measured from the peak point on the stress-strain curve (maximum stress) determined by the load cell of the testing machine. Results obtained were expressed in Megapascals (MPa).

Scanning Electron Microscope (SEM) preparation and analysis:

One additional sample was made in each group for analysis of resin cement infiltration in dentinal tubules using Scanning Electron Microscopy (SEM) (Quanta FEG 250, FEI Co., Netherlands) with an accelerating voltage of 30 K.V. and a magnification from 2000 to 2500 X, the SEM images were analyzed using the software image ImageJ (ImageJ 1.52k, Wayne Rasband, NIH, USA).

1. Sectioned Vertically: using the sectioning machine (IsoMet precision cutting micro saw, Buehler, USA), each sample was split into two equal sections to expose the adhesive layer.

2. Decalcified: using 32% phosphoric acid for 30 seconds to remove all inorganic material within the hybrid layer that was not supported by resin.

3. Deproteinized: using 2% sodium hypochlorite for 2 minutes to remove any demineralized dentin matrix or organic

material around the resin tags. This ensures full exposure of the resin tag length.

4. Rinsed and Dehydrated: the samples are rinsed with water, air-dried, and submitted to 70%, 80%, 90%, and 99% alcohol concentrations for total elimination of the water content.

Statistical analysis:

The calculations for the mean and standard deviation values were done for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests and showed parametric (normal) distribution. One-way ANOVA followed by Tukey post hoc test was used to compare between more than two groups in non-related samples. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

RESULTS

There was a statistically significant difference between (Group C), (Group BF), (Group GL), (Group DL2) and (Group DL3) where (p=0.017).

No statistically significant difference was found between (Group C) and each of (Group BF), (Group GL), (Group DL2) and (Group DL3) where (p=0.175), (p=0.700), (p=0.961) and (p=0.998) respectively.

Also, no statistically significant difference was found between (Group GL) and each of (Group DL2) and (Group DL3) where (p=0.516) and (p=0.229) respectively.

While a statistically significant difference was found between (Group BF) and (Group GL) where (p=0.007).

No statistically significant difference was found between (Group GL) and each of (Group DL2) and (Group DL3) where (p=0.298) and (p=0.611) respectively. Also, no significant difference was found between (Group DL2) and (Group DL3) where (p=0.984).

The highest mean value was found in (Group GL) followed by (Group C), (Group DL3) and (Group DL2), while the least mean value was found in (Group BF) **Table 1, Figure 5**.

Table (1): Means with different l letters in the same column indicate statistically significance difference.

Shear bond strength Shear stress at Maximum Compressive load		
Variables	**Mean**	**SD**
Group1	10.87 ^{ab}	0.51
Group2	7.33 ^{b}	0.94
Group3	12.88 ^{a}	1.34
Group4	9.81 ^{ab}	0.94
Group5	10.64 ^{ab}	0.98
p-value	**0.017***	

*; significant (p<0.05) ns; non-significant (p>0.05)

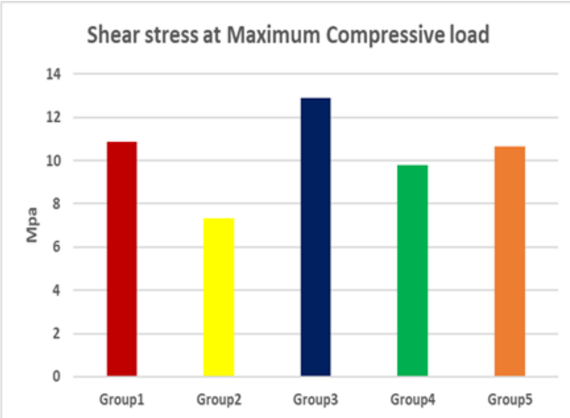

Figure (5): Bar chart representing shear stress for different groups.

Scanning Electron Microscope Analysis of the Dentinal Tubules:

1.a. Group (C); Normal dentin with neither surface treatment nor resin cement applied: SEM examination showed normal dentinal tubules with no resin cement infiltration (**Figure 6).**

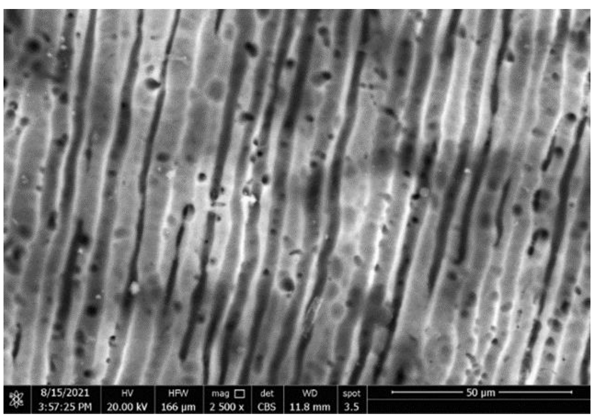

Figure (6): Normal dentinal tubules with no resin cement infiltration.

1.b. Group (C); Dentin with no surface treatment applied but with resin cement only: SEM examination showed high resin cement infiltration in dentinal tubules (**Figure 7).**

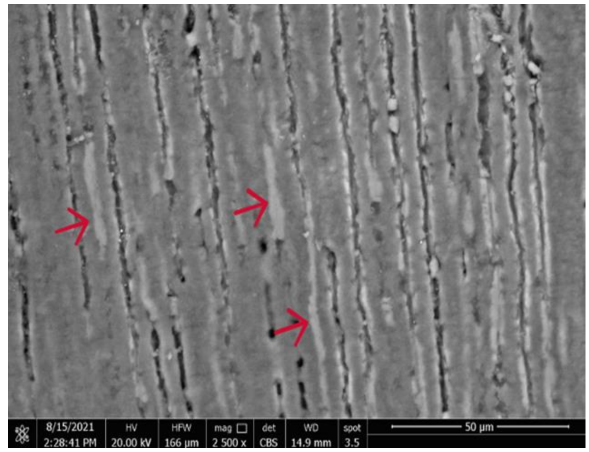

Figure (7): Dentinal tubules after resin cement application with no surface treatment.

2. Group (BF); Dentin after the application of Bifluorid Desensitizer surface treatment followed by resin cement: SEM examination showed no resin cement infiltration in the dentinal tubules due to the effect of Bifluorid Desensitizer which altered the resin cement infiltration (**Figure 8).**

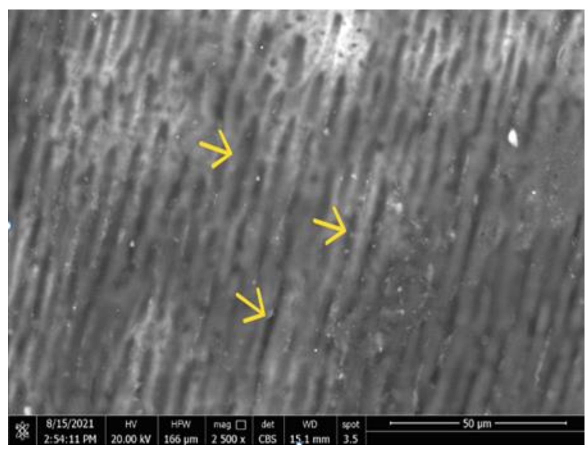

Figure (8): Empty dentinal tubules after Bifluoride desensitizer application followed by resin cement.

3. Group (GL); Dentin after the application of the Gluma Desensitizer surface treatment followed by resin cement: SEM

examination showed the best infiltration of the resin cement in the dentinal tubules due to the effect of Gluma Desensitizer which did not alter the resin cement infiltration (**Figure 9).**

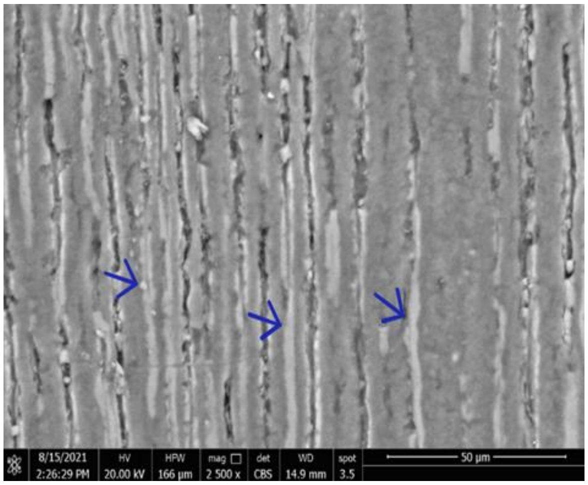

Figure (9): Dentinal tubules filled with resin cement after Gluma desensitizer application followed by resin cement.

4. Group (DL2); Dentin after the application of Diode Laser with wattage 2W surface treatment followed by resin cement: SEM examination showed the least resin cement infiltration in the dentinal tubules due to the effect of Diode Laser with wattage 2W which altered the resin cement infiltration (**Figure 10).**

5. Group (DL3); Dentin after the application of Diode Laser with wattage 3W surface treatment followed by resin cement: SEM examination showed few number of dentinal tubules filled with resin cement due to the effect of Diode Laser with wattage 3W which altered the resin cement infiltration (**Figure 11).**

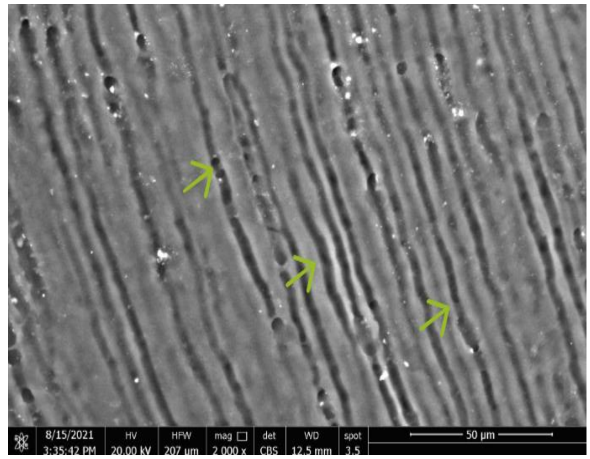

Figure (10): Empty dentinal tubules after application of Diode Laser with 2W surface treatment followed by resin cement.

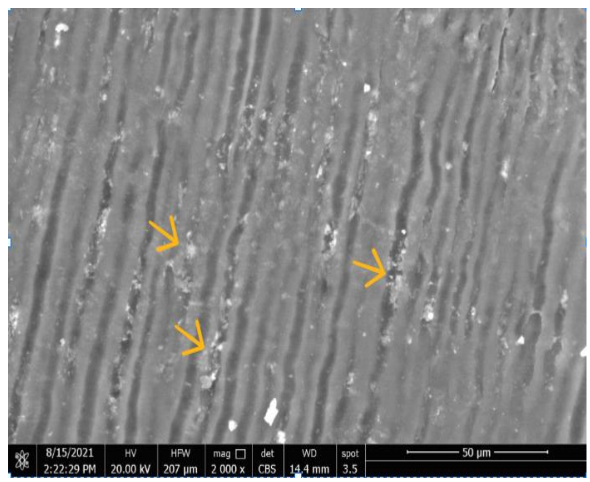

Figure (11): scattered resin cement in dentinal tubules after application of Diode Laser 3W surface treatment followed by resin cement.

DISCUSSION

Based on the findings of this study, the null hypothesis that there is no difference between the effect of the Desensitizing Agent and Diode Laser on the shear bond strength was partially accepted. There was statistically significant difference found between the control, desensitizing agents and the diode laser when tested to shear bond strength on the dentin samples.

The outcome results of this study showed that (Group GL) Gluma desensitizing agent had the highest shear bond strength, and statistically there was difference from (Group BF). This was confirmed under SEM done in this study, as it showed that the resin cement had the most infiltration through the dentinal tubules that led to the highest shear bond strength. These results agreed upon the conclusion of Soeno K[23] who conducted that Gluma had the highest shear bond strength when compared to other desensitizers due to its composition which consist of Glutraldahyde and Hema that bind with protein within the dentinal tubules that led to dentinal tubules partial occlusion that led to an increase in the shear bond strength. And also, Dundar et al[25] conducted that the use of Hema-induced rehydration mechanism allowing time for the penetration of the primer into dentin as it contained hydrophilic monomers that helped in rehydrating the collapsed dentinal tubules caused by air-drying, as this facilitated the resin infiltration into the dentinal tubules. SEM images also supported these high shear bond strength values because the dentinal tubules were adequately sealed with the resin.[35, 36] While Wang X[10] disagreed as he stated in his study that the Gluma showed low shear bond strength as Gluma had complete dentinal tubules occlusion.

The least shear bond strength shown in the (Group BF) Bifluoride desensitizing agent that had statistically difference than the (Group GL). This was confirmed under SEM done in this study, as it showed the least infiltration of resin cement in dentinal tubules that led to the least shear bond strength among the groups. These results agreed upon the conclusion of Sarac D[24] who conducted that the Bifluoride have shown that fluoride-containing agents demonstrated lower shear bond strength values as it produced a thick layer that led to total and complete blockage of the dentinal tubules that led to huge decrease in the shear bond strength.[23] While Dundar et al[25] disagreed as he reported that bifluoride application to the demineralized dentin might increase resin-dentin bond strength by improving the mechanical properties of the dentin that led to high shear bond strength.

The laser groups (Group DL2, DL3) showed no statistically significant difference from the (Group GL) and (Group C) in shear bond strength and there was no statistically significant difference in shear bond strength between (Group DL3) and (Group DL2) with the difference in wattage (DL3 = 3 W, DL2 = 2 W) and distance between the laser tip and the sample (DL3 = 2 mm, DL2 = 1 mm) respectively, and 10 seconds exposure time for both Groups. These results were shown in the SEM by increase of infiltration of the resin cement in dentinal tubules in (Group DL3) more than (Group DL2). These results came in agreement with the results of other study done by Marto CM[29] who mentioned in his study that the diode laser had better effect on shear bond strength was considered a low intensity laser which led to partial occlusion to dentinal tubules upon irradiation on dentin, which then showed that resin cement could infiltrate in dentinal tubules under SEM, and used non-contact mode and 10 seconds like the present study. Also Fawaz Y[37] and Gupta T[34] approved that the diode laser with wattage 2 and 3 showed best results in shear bond strength with using non-contact mode and time of exposure 10 seconds like the present study.

While Gabriel A[33] disagreed with the present study as he concluded that the Diode Laser showed a negative effect on shear bond strength explaining that the samples treated with 980-nm Diode Laser had the lowest shear bond strength that derived from the fact that Diode Laser was not able to remove the smear layer from dentinal tubules which directly affect the shear bond strength negatively, he also used in his study a contact mode and 400-micron tip in contrast to the present study that used non-contact mode and the intra-oral tip.[38]

CONCLUSION

Based on the findings of this study, the following conclusions could be drawn:

1- The untreated dentin, Gluma and Diode Laser surface treatments are comparable in shear bond strength between resin cement and dentin.

2- The Bifluoride treatment had the least shear bond strength and least resin cement infiltration, better not to be used in dentin desensitization before cementation.

FUNDING INFORMATION

No funding was received for this article.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Biagi R, Cossellu G, Sarcina M, Pizzamiglio IT, Farronato G. Laser-assisted treatment of dentinal

hypersensitivity: a literature review. Annali di stomatologia. 2015;6(3-4):75.
2. Dowell P, Addy M. Dentine hypersensitivity-A review: Aetiology, symptoms and theories of pain production. Journal of clinical periodontology. 1983;10(4):341-50.
3. 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. Journal of Interdisciplinary Dentistry. 2018;8(3):110.
4. Porto IC, Andrade AK, Montes MA. Diagnosis and treatment of dentinal hypersensitivity. Journal of oral science. 2009;51(3):323-32.
5. Addy M, West NX. The role of toothpaste in the aetiology and treatment of dentine hypersensitivity. Toothpastes. 2013;23:75-87.
6. Kerns DG, Scheidt MJ, Pashley DH, Horner JA, Strong SL, Van Dyke TE. Dentinal tubule occlusion and root hypersensitivity. Journal of periodontology. 1991;62(7):421-8.
7. Olley R, Parkinson CR, Wilson R, Moazzez R, Bartlett D. A novel method to quantify dentine tubule occlusion applied to in situ model samples. Caries research. 2014;48(1):69-72.
8. Olusile AO, Bamise CT, Oginni AO, Dosumu OO. Short-term clinical evaluation of four desensitizing agents. J Contemp Dent Pract. 2008;9(1):22-9.
9. Abuzinadah SH, Alhaddad AJ. A randomized clinical trial of dentin hypersensitivity reduction over one month after a single topical application of comparable materials. Scientific Reports. 2021;11(1):1-9.
10. Wang X, Li J-H, Mu J-G, Liu H. The microscopic characteristic of the dentinal tubule obstructed by desensitizer and the effect of desensitizer on the shear strength of resin cements. Hua xi kou qiang yi xue za zhi= Huaxi kouqiang yixue zazhi= West China journal of stomatology. 2008;26(3):233-6.
11. Joshi S, Gowda AS, Joshi C. Comparative evaluation of NovaMin desensitizer and Gluma desensitizer on dentinal tubule occlusion: a scanning electron microscopic study. Journal of periodontal & implant science. 2013;43(6):269-75.
12. Jalalian E, Meraji N, Mirzaei M. A comparison of the efficacy of potassium nitrate and gluma desensitizer in the reduction of hypersensitivity in teeth with

full-crown preparations. J Contemp Dent Pract. 2009;10(1):66-73.

13. Samuel S-R, Khatri SG, Acharya S. Clinical Evaluation of self and professionally applied desensitizing agents in relieving dentin hypersensitivity after a single topical application: A Randomized Controlled Trial. Journal of clinical and experimental dentistry. 2014;6(4):e339.
14. Mohamed AF. Clinical evaluation of different types of topical desensitizing and dentinal sealing system on reducing dentinal hypersensitivity. 2004.
15. Kim S-Y, Kim E-J, Lee I-B. Real-time measurement of dentinal fluid flow during desensitizing agent application. Journal of Korean Academy of Conservative Dentistry. 2010;35(5):313-20.
16. Khoroushi M, Ghazalgoo A. Effect of desensitizer application on shear bond strength of composite resin to bleached enamel. Indian Journal of Dental Research. 2013;24(1):87.
17. Ravikumar N, Shankar P, Indira R. Shear bond strengths of two dentin bonding agents with two desensitizers: An in vitro study. Journal of conservative dentistry: JCD. 2011;14(3):247.
18. Davalloo R, Darabi F. In Vitro Comparative Evaluation of Newly Produced Desensitizer, Chlorhexidine and Gluma on Bond Strength and Bond Longevity of Composite to Dentin. Journal of Dentistry. 2020;21(2):111.
19. Sabatini C, Wu Z. Effect of desensitizing agents on the bond strength of mild and strong self-etching adhesives. Operative dentistry. 2015;40(5):548-57.
20. Li W-y, Zhang L, Zhang H, Li A-l, Guo L. Influence of Gluma desensitizing agents on dentin bond strength: a Meta-analysis. Chinese Journal of Tissue Engineering Research. 2016;20(47):7119.
21. Schweppe J, Hoffmann M, Kastrati A, Utterodt A, Riedel N, Schaub M. Effect of Gluma Desensitizer on bond strength of etch & rinse adhesives. J Dent Res. 2011;90(Spec Issue A):3172.
22. KÜLÜNK Ş, Sarac D, Külünk T, KARAKAŞ Ö. The effects of different desensitizing agents on the shear bond strength of adhesive resin cement to dentin. Journal of Esthetic and Restorative Dentistry. 2011;23(6):380-7.
23. Soeno K, Taira Y, Matsumura H, Atsuta M. Effect of desensitizers on bond strength of adhesive luting agents to dentin. Journal

of Oral Rehabilitation. 2001;28(12):1122-8.

24. Saraç D, Külünk S, Saraç YS, Karakas Ö. Effect of fluoride-containing desensitizing agents on the bond strength of resin-based cements to dentin. Journal of Applied Oral Science. 2009;17:495-500.
25. Dündar M, Çal E, Gökçe B, Türkün M, Özcan M. Influence of fluoride-or triclosan-based desensitizing agents on adhesion of resin cements to dentin. Clinical oral investigations. 2010;14(5):579-86.
26. Verma SK, Maheshwari S, Singh RK, Chaudhari PK. Laser in dentistry: An innovative tool in modern dental practice. National journal of maxillofacial surgery. 2012;3(2):124.
27. Hilgers JJ, Tracey SG. Clinical uses of diode lasers in orthodontics. Journal of clinical orthodontics: JCO. 2004;38(5):266-73.
28. Orchardson R, Gangarosa Sr L, Holland G, Pashley DH, Trowbridge H, Ashley F, et al. Dentine hypersensitivity—into the 21st century. Archives of oral biology. 1994;39:S113-S9.
29. Marto CM, Baptista Paula A, Nunes T, Pimenta M, Abrantes AM, Pires AS, et al. Evaluation of the efficacy of dentin hypersensitivity treatments—A systematic review and follow‐up analysis. Journal of oral rehabilitation. 2019;46(10):952-90.
30. Asnaashari M, Moeini M. Effectiveness of lasers in the treatment of dentin hypersensitivity. Journal of lasers in medical sciences. 2013;4(1):1.
31. Kimura Y, Wilder‐Smith P, Yonaga K, Matsumoto K. Treatment of dentine hypersensitivity by lasers: a review. Journal of Clinical Periodontology: Review article. 2000;27(10):715-21.
32. Ibrahim T, Gheith M, editors. Evaluation Of The Shear Bond Strength Between Dentin And Dental Luting Cement Following Dentin Surface Treatment By 980 Nm Diode Laser And Desensitizing Agent. AIP Conference Proceedings; 2011: American Institute of Physics.
33. Souza-Gabriel AE, Curylofo-Zotti FA, Scatolin RS, Corona SAM. Post-treatment with high-power lasers to improve bond strength of adhesive systems to bleached dentin. Journal of adhesion science and Technology. 2017;31(17):1888-99.
34. Gupta T, Nagaraja S, Mathew S, Narayana IH, Madhu K, Dinesh K. Effect of desensitization using bioactive glass, hydroxyapatite, and diode laser on the shear bond strength of resin composites

measured at different time intervals: An In vitro Study. Contemporary clinical dentistry. 2017;8(2):244.

35. Ritter AV, Heymann HO, Swift Jr EJ, Perdigao J, Rosa BT. Effects of different re-wetting techniques on dentin shear bond strengths. Journal of Esthetic and Restorative Dentistry. 2000;12(2):85-96.
36. Saygili G, Şahmali S. Effect of ceramic surface treatment on the shear bond strengths of two resin luting agents to all-ceramic materials. Journal of oral rehabilitation. 2003;30(7):758-64.
37. AlFawaz YF, Alonaizan FA. Efficacy of phototherapy in the adhesive bonding of different dental posts to root dentin: A systematic review. Photodiagnosis and photodynamic therapy. 2019;27:111-6.
38. 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. Photomedicine and Laser Surgery. 2013;31(7):307-14.