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Research Article

In Vitro Evaluation of the Affects of Diode Lasers on Resin Modified Glass Ionomer Cement's Shear Bond Strength in Noncarious Cervical Lesion Restorations

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Abstract

Noncarious cervical lesions (NCCLs) and cervical dentin hypersensitivity (CDH) are two common conditions. The failure ratio of noncarious cervical lesions are lower than other restorations. There is no exact consensus on the restoration of NCCLs among dentists. Resin-modified glass ionomer cement (RMGIC) is one of the most preferred materials in the cervical region. The aim of this study is to evaluate *in vitro* the shear bond strength of RMGIC in the restoration of NCCLs by diode lasers used in CDH. All groups using the diode laser found that the shear bond strengths increased according to the control group, but no significant difference was seen ($p > 0.05$). The combined use of RMGIC and diode lasers during NCCL restorations may increase the restorations' longevity.

Keywords: Diode Laser; Dentin Hypersensitivity; Shear Bond Strength

Abbreviations

NCCL: Noncarious Cervical Lesion; CDH: Cervical Dentin Hypersensitivity; RMGIC: Resin-Modified Glass İonomer Cement; MPa: Megapascal

Introduction

Due to preventive dentistry and modifications in the human diet, noncarious cervical lessions (NCCLs) are predominantly seen in developed countries [1-3]. They are hard dental tissue defects that consist of two different types; wedge-shaped and saucer-shaped [4] and described as hard tissue loss at the enamel-cement junction in the coronal part of the tooth [5]. NCCLs and cervical dentin hypersensitivity (CDH) are observed together in modern clinical applications [6].

CDH can occur as a result of abrasion, abfraction, and erosion, causing loss of dental tissue and exposure of dentin tubules [7]. There are a number of hypotheses to determine mechanisms of dentin hypersensitivity. One of them is Bronstrom's hydrodynamic theory, which is widely accepted at this point. According to this theory, dentinal and pulpal nerve endings are stimulated from the rapid movement of the liquid inside the dentinal tubules through tactile and thermal stimulants [8].

After identifying the etiologic factors that lead to the formation of NCCLs, it is necessary to focus on the elimination of CDH, the major complaint of patients with cervical lesions [9].

There are many treatments to contain CDH, such as desensitizing agents, lasers, restorative materials, root canal treatments, and mucogingival surgery. The diode laser is also commonly used to treat dentin hypersensitivity [10-18].

The preferred material for the restoration of NCCLs is glass ionomer cement (GIC), resin-modified glass ionomer cement (RMGIC, PhotacTM Fil Quick, Los Angeles, CA, USA), and compomer and composite resins [19,20].

Restoration of NCCLs is done to prevent tooth loss, reduce hypersensitivity, and provide enhanced aesthetics. However, it has been determined that restorations made in the cervical region have a higher percentage of failure compared to occlusal and anterior restorations; in this way, the longevity of cervical restorations is still not satisfactory [21-24]. There is a need for additional adhesive techniques for restorative material to prolong clinical longevity of NCCLs [25,26].

Aim of the Study

The aim of this study is to investigate the in vitro effect of four different diode lasers that reduce CDH; this relies on the shear bond strength of RMGIC for the restoration of NCCLs.

Materials and Methods

Furthermore, 100 extracted human premolar teeth with periodontal and orthodontical issues were included this study, although none contained areas with caries, or were hypomineralized with developmental anomalies. The debris was removed, and teeth were cleaned using ultrasonic scalers.

Teeth were embedded in 3 cm diameter circular teflon molds, using self-curing acrylic resin, with the crowns exposed in the occlusal-cervical direction. The buccal surfaces of teeth were flattened with diamond burs until the yellow dentin was eliminated. The surface of the dentin was smoothed with a 400-level silicon carbide abrasive.

The samples were divided into 5 groups of 20 teeth per group:

- **Group 1 (1-20):** No specimens were irritated with diode lasers. RMGIC was added onto 1/3 of the cervical dentin of each specimen by packing the material into a cylindrically-shaped plastic apparatus with an internal diameter of 2 mm and a height of 2 mm. Finally, RMGIC was polymerized by a light source (Elipar™ S10 3M ESPE, Ann Arbor, MI, USA) for 20 sec.
- **Group 2 (21-40):** Specimens were irritated with a diode laser (AMD Doctorsmile, Vicenza, Italy; 0.2W, 20s; 0.5W, 20s; 1W, 20s). RMGIC was added onto 1/3 of the cervical dentin of each specimen by packing the material into a cylindrically-shaped plastic apparatus with an internal diameter of 2 mm and a height of 2 mm. Finally, RMGIC was polymerized by a light source (Elipar™ S10 3M ESPE, Ann Arbor, MI, USA) for 20 sec.
- **Group 3 (41-60):** Specimens were irritated with diode lasers (Picasso Lite, Indiannoplis, IN, USA; 0,5 W, 60s). RMGIC was added onto 1/3 of the cervical dentin of each specimen by packing the material into a cylindrically-shaped plastic apparatus with an internal diameter of 2 mm and a height of 2 mm. Finally, RMGIC was polymerized by a light source (Elipar™ S10 3M ESPE, Ann Arbor, MI, USA) for 20 sec.
- **Group 4 (61-80):** Specimens were irritated with a diode laser (Ezlase, BİOLASE, Irvine, CA, USA; 1 W, 15 s). RMGIC was added onto 1/3 of the cervical dentin of each specimen by packing the material into a cylindrically-shaped plastic apparatus with an internal diameter of 2 mm and a height of 2 mm. Finally, RMGIC was polymerized by a light source (Elipar™ S10 3M ESPE, Ann Arbor, MI, USA) for 20 seconds.
- **Group 5 (81-100):** Specimens were irritated with diode lasers (Gıgaalase CHEESE, Huangpu, China; 1,5 W, 15 seconds). RMGIC was added onto 1/3 of the cervical dentin of each specimen by packing the material into a cylindrically-shaped plastic apparatus with an internal diameter of 2 mm and a height of 2 mm. Finally, RMGIC was polymerized by a light source (Elipar™ S10 3M ESPE, Ann Arbor, MI, USA) for 20 seconds.

Shear bond strength was assessed with a universal testing machine (AGS -1OK NG Shimadzu, Japan) with a notched blade attached to a compression load, traveling at a crosshead speed of 1 mm/min. Maximum loads of bond failure were recorded in megapascals (MPa).

Results

The recorded values subjected to statistical analysis were done with SPSS verison 20 (IBM Corporation, Armonk, NY, USA). One-way ANOVA and the Tukey test were performed to analyze the intergroup comparisions. A value of $p < 0.05$ was considered statistically significant. It was observed that the use of diode lasers increased shear bond strength in all groups (as seen in table 1).

Groups	Min.	Max.	Mean	Standard deviation
Group 1 (Control)	8.41	13.98	11.32	1.82
Group 2 (Doctor-smile)	8.05	14.94	12.01	2.12
Group 3 (Picasso lite)	8.82	15.49	11.88	1.91
Group 4 (Eslase 940)	9.01	15.94	11.56	1.89
Group 5 (Gıgaalaser Chesee)	9.20	16.83	12.33	2.15
No statistically significant differences were observed ($p > 0.05$)				

Table 1: Shear bond strength means (in MPa) and standard deviations, according to the diode lasers.

Study results revealed that when the shear bond strength of RMGIC and dentin were compared to pretreatment with different diode lasers, no statistically significant difference was observed.

Discussion

Several treatment strategies have been proposed to treat NCCLs associated with cervical dentin sensitivity. Dentists have different treatment options, given a lack of sufficient clinical evidence to manage these lesions [27-29]. Composite resins, RMGIC and conventional glass ionomer cements can be used to restore NCCLs. However, studies have shown that the ratio of restorations in the cervical region was lower than that of other restorations [21-24].

However, the use of RMGIC in cervical restorations has advantages [30-31]. RMGICs can release fluoride. They can be bonded to dentin chemically and micromechanically; chemical interaction between hydroxyapatite and carboxy groups is considered to be an important factor for the performance of RMGIC in the treatment of NCCLs [32,33]. Depending on the laser application, it can result in a breakdown of organic and inorganic content and affects the presence of ions in dental structures; chemical and mechanical adhesion of RMGIC is affected as well [34-36].

The retention of restorations is a function of bond strength [37], as we evaluated shear bond strength in this study, which is important for clinical success of the restorative material; however, it is also important to evaluate tensile and compressive bond strengths as well.

In studies where the shear bond strengths of RMGICs were evaluated, the composite resins were found to be stronger; dentin shear bond strengths were 9.71 MPa, as discussed in Suryakimaru., *et al.* 9.81 MPa in Somani., *et al.* and 11.37 MPa in Wakel., *et al.* [38-40]. In our study, there were similar results, as the shear bond strength in Group 1 was 11.036 MPa.

Some investigators reported that RMGIC should be treated with dentin agents to remove or modify the smear layer in order to increase adhesion [41-44]. This procedure aims to increase resin monomer penetration into dentin tubules [45-48]. However, in the case of NCCL used with CDH, direct application of RMGIC, as suggested by the manufacturer, is more accurate when the pain is thought to be a function of exposed dentin tubules, according to hydrodynamic theory.

Zorba., *et al.* reported that different desensitization agents reduced the shear bond strength of dentin, although there were no statistically significant differences [49]. In some studies, treatment of dentin hypersensitivity with lasers was found to reduce the shear bond strength of resin composites [50-52]. In our study, shear bond strength increased in all groups after being irritated with diode lasers. Differences in shear bond strength in these studies may either occur due to variations in desensitization or the selected restorative material and adhesive system. The role of lasers in the treatment of dentin hypersensitivity has not been clearly explained to date. It is thought to reduce sensitivity by sealing the dentin tubulies or depolarizing the C fibers.

In our study, we used 4 different diode lasers for dentin desensitization. The shear bond strengths were found to be 11.32 MPa in the control group; 11.56 MPa in Group 2; 11.88 MPa in Group 3; 12 MPa in Group 4; and 12.33 MPa in Group 5. It was observed that shear bond strength values of all groups treated with diode lasers increased, compared to the control group. However, there was no statistically significant difference between groups.

Output power of lasers is a critical factor in micromechanical retention [53]. In this study, diode lasers were used at a 810 - 940 nm wavelength. The highest shear bond strength was found in Group 5, while in the other 3 groups, the diode laser output power was between 0.2W and 1W, while it was found to be 1.5W in Group 5.

Conclusion

Although laboratory tests to estimate clinical performance of dental materials do not precisely reflect the clinical performance of the material, the combined use of diode lasers and RMGIC in the treatment of noncarious cervical lesions (associated with clinical cervical dentin sensitivity) may increase the success rate of restorations; however, more clinical evaluations are necessary.

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The authors deny any conflicts of interest.

Bibliography

1. Bartlett D., *et al*. "A difference in perspective - the North American and European interpretations of tooth wear". *International Journal of Prosthodontics* 12.5 (1999): 401-408.
2. Oginni and Olusil AO. "The prevalence, aetiology and clinical appearance of tooth wear: the Nigerian experience". *International Dental Journal* 52.4 (2002): 268-272.
3. Borcic J., *et al*. "The prevalence of non-carious cervical lesions in permanent dentition". *Journal of Oral Rehabilitation* 31.2 (2004): 117-123.
4. C Walter., *et al*. "The anatomy of non-carious cervical lesions". *Clinical Oral Investigations* 18.1 (2014): 139-146.
5. Ceruti P., *et al*. "Non carious cervical lesions. A review". *Minerva Stomatologica* 55.1-2 (2006): 43-57.
6. Vittorio Moraschini., *et al*. "Effectiveness for dentin hypersensitivity treatment of non-carious cervical lesions: a meta-analysis". *Clinical Oral Investigations* 22 (2018): 617-631.
7. Orchardson R., *et al*. "Dentine hypersensitivity-into the 21st century". *Archives of Oral Biology* 39 (1994): 113-119.
8. Brännström M and Aström A. "The hydrodynamics of the dentine its possible relationship to dentinal pain". *International Dental Journal* 22.2 (1972): 219-227.
9. Francisconi LF., *et al*. "Glass ionomer cements and their role in the restoration of non-carious cervical lesions". *Journal of Applied Oral Science* 17.5 (2009): 364-369.
10. Jain PR., *et al*. "Diode laser and fluoride varnish in the management of dentin hypersensitivity". *Journal of Interdisciplinary Dentistry* 5.2 (2015): 71-74.
11. Nada Tawfig Hashim., *et al*. "Effect of the clinical application of the diode laser (810nm) in the treatment of dentine hypersensitivity". *BMC Research Notes* 7 (2014): 31.
12. Mirjana GV., *et al*. "Application of diode laser in the treatment of dentine hypersensitivity". *Medical Archives* 70.6 (2016): 466-469.
13. Chuan-hang Y and Yu CC. "Clinical efficacy of the er: yag laser treatment on hypersensitive dentin". *Journal of the Formosan Medical Association* 113.6 (2014): 388-391.
14. Yilmaz HG., *et al*. "Clinical evaluation of Er,Cr: YSGG and GaAlAs laser therapy for treating dentine hypersensitivity: A randomized controlled clinical trial". *Journal of Dentistry* 39.3 (2011): 249-254.
15. Mohammed Abdelfattah Ahmed Samy M.A. "Role of 810 nm and 980 nm diode laser in treatment of dentinal hypersensitivity: A literature review". *Journal of Medicine and Medical Sciences* 8.5 (2017): 69-76.
16. Mohammad A and Masoumeh M. "Effectiveness of Lasers in the Treatment of Dentin Hypersensitivity". *Journal of Lasers in Medical Sciences* 4.1 (2013): 1-7.

17. Jaber Y., *et al*. "Evaluation of the Effect of Low Level Laser Therapy Toothbrush in Treatment of Dentin Hypersensitivity". *Journal of Lasers in Medical Sciences* 6.2 (2015): 85-91.

18. Amaury N., *et al*. "Treatment of Dentinal Hypersensitivity by means of Nd: YAP Laser: A Preliminary In Vitro Study". *Scientific World Journal* (2014): 323604.

19. Lyttle HA., *et al*. "A study of the classification and treatment of noncarious cervical lesions by general practitioners". *Journal of Prosthetic Dentistry* 79.3 (1998): 342-346.

20. Onal B and Pamir T. "The two-year clinical performance of esthetic restorative materials in noncarious cervical lesions". *Journal of the American Dental Association*. 136.11 (2005): 1547-1555.

21. Brackett MG., *et al*. "One-year clinical performance of a resin-modified glass ionomer and a resin composite restorative material in unprepared Class V restorations". *Operative Dentistry* 27.2 (2002): 112-116.

22. Matis BA. "A three-year clinical evaluation of two dentin bonding agents". *The Journal of the American Dental Association* 135.4 (2004): 451-457.

23. Folwaczny M., *et al*. "Clinical performance of a resin-modified glass-ionomer and a compomer in restoring non-carious cervical lesions. 5-year results". *American Journal of Dentistry* 14.3 (2001): 153-156.

24. Smales RJ and Gerke DC. "Clinical evaluation of light-cured anterior resin composites over periods of up to 4 years". *American Journal of Dentistry* 5.4 (1992): 208-212.

25. Li Q., *et al*. "Flowable materials as an intermediate layer could improve the marginal and internal adaptation of composite restorations in Class-V-cavities". *Dental Materials* 22.3 (2006): 250-257.

26. van Dijken JW. "Clinical evaluation of three adhesive systems in class V non-carious lesions". *Dental Materials* 16.4 (2000): 285-291.

27. Brackett WW., *et al*. "Two year clinical performance of Class V resin-modified glass-lonomer and resin composite restorations". *Operative Dentistry* 28.5 (2003): 477-481.

28. Wood I., *et al*. "Non-carious cervical tooth surface loss: a literature review". *Journal of Dentistry* 36.10 (2008): 759-766.

29. Duke ES and Lindemuth J. "Polymeric adhesion to dentin: contrasting substrates". *American Journal of Dentistry* 3.6 (1990): 264-270.

30. Franco EB., *et al*. "5-year clinical performance of resin composite versus resin modified glass ionomer restorative system in non-carious cervical lesions". *Operative Dentistry* 31.4 (2006): 403-408.

31. Gladys S., *et al*. "Evaluation of esthetic parameters of resin-modified glass-ionomer materials and a polyacid-modified resin composite in Class V cervical lesions". *Quintessence International* 30.9 (1999): 607-614.

32. Carvalho RM., *et al*. "Durability of bonds and clinical success of adhesive restorations". *Dental Materials* 28.1 (2012): 72-86.

33. Sidhu SK. "Glass-ionomer cement restorative materials: a sticky subject?". *Australian Dental Journal* 56.1 (2011): 23-30.

34. Chinelatti MA., *et al*. "Influence of the use of Er: YAG laser for cavity preparation and surface treatment in microleakage of resin-modified glass ionomer restorations". *Operative Dentistry* 29.4 (2004): 430-436.

35. Corona SA., *et al*. "Assessing microleakage of different Class V restorations after Er: YAG laser and bur preparation". *Journal of Oral Rehabilitation* 30.10 (2003): 1008-1014.

36. Liberman R., *et al*. "Glass ionomer cement restorations: The effects of lasing the cavity walls on marginal microleakage". *Clinical Preventive Dentistry* 12.1 (1990): 5-8.

37. Tyas MJ and Burrow MF. "Adhesive restorative materials: a review". *Australian Dental Journal* 49.3 (2004): 112-121.

38. Suryakumari Nujella BP., *et al*. "Comparison of shear bond strength of aesthetic restorative materials". *Contemporary Clinical Dentistry* 3.1 (2012): 22-26.

39. Aliaa Mohamed EW., *et al*. "Bonding of contemporary glass ionomer cements to different tooth substrates microshear bond strength and scanning electron microscope study". *European Journal of Dentistry* 9.2 (2015): 176-182.

40. Rani S., *et al*. "Comparative Evaluation of Shear Bond Strength of Various Glass Ionomer Cements to Dentin of Primary Teeth: An in vitro Study". *International Journal of Clinical Pediatric Dentistry* 9.3 (2016): 192-196.

41. Lin A., *et al*. "Studies on the adhesion of glass- ionomer cements to dentin". *Journal of Dental Research* 71.11 (1992): 1836-1841.

42. Mauro SJ., *et al*. "Influence of polyacracrilic acid in bond strength of glass ionomer cement to dentin". *Revista De Odontologia Da Universidade De Sao Paulo* 7 (1993): 27-33.

43. Tanumiharja M., *et al*. "Microtensile bond strengths of glass-ionomer (polyalkenoate) cements to dentine using four conditioners". *Journal of Dentistry* 28.5 (2000): 361-366.

44. Abdalla AI. "Morphological interface between hybrid ionomers and dentin with and without smear-layer removal". *Journal of Oral Rehabilitation* 27.9 (2000): 808-814.

45. Maruo IT., *et al*. "Effect of etching and light-curing time on the shear bond strength of a resin-modified glass ionomer cement". *Brazilian Dental Journal* 21.6 (2010): 533-537.

46. Di Nicolo R., *et al*. "Bond strength of resin modified glass ionomer cement to primary dentin after cutting with different bur types and dentin conditioning". *Journal of Applied Oral Science* 15.5 (2007): 459-464.

47. Wang L., *et al*. "Effect of adhesive systems associated with resin-modified glass ionomer cements". *Journal of Oral Rehabilitation* 33.2 (2006): 110-116.

48. Almuammar MF., *et al*. "Shear bond strength of six restorative materials". *Journal of Clinical Pediatric Dentistry* 25.3 (2001): 221-225.

49. Zorba Y., *et al*. "The effects of three different desensitizing agents on the shear bond strength of composite resin bonding agents". *Journal of the Mechanical Behavior of Biomedical Materials* 3.5 (2010): 399-404.

50. Can-Karabulut DC. "Influence of a dentin desensitizer and a red-wavelength diode laser application on bond strength of composite to dentin in vitro". *Photomedicine and Laser Surgery* 28.2 (2010): 19-24.

51. Malekipour M., *et al*. "The effect of 808 nm diode laser irradiation on shear bond strength of composite bonded to dentin before and after bonding". *Journal of Dental Lasers* 9.2 (2015): 69-74.

52. AE Souza-Gabriel., *et al*. "Shear Bond Strength of Resin-modified Glass Ionomer Cements to Er: YAG Laser-treated Tooth Structure". *Operative Dentistry* 31.2 (2006): 212-218.

53. Ural C., *et al*. "The effect of different power outputs of carbon dioxide laser on bonding between zirconia ceramic surface and resin cement". *Acta Odontologica Scandinavica* 70.6 (2012): 541-546.

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