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# EFFECTS OF ETIOLOGICAL FACTORS ON DIFFERENT TREATMENT METHODS IN DENTIN HYPERSENSITIVITY

Fatma Sağ Güngör[1],Said Karabekiroğlu[2], Nimet Ünlü[3]
1.Department of Restorative Dentistry, Faculty of Dentistry, Necmettin Erbakan University, Konya, Turkey
2.Department of Restorative Dentistry, Faculty of Dentistry, Necmettin Erbakan University, Konya, Turkey
3.Department of Restorative Dentistry, Faculty of Dentistry, Selcuk University, Konya, Turkey

## ABSTRACT:

**Objectives:** Elimination of etiological factors is great importance in the treatment of dentin hypersensitivity (DH). The aim of this study is to compare the effect of DH etiology and risk factors on different treatment methods [5% sodium fluoride (Duraphat fluoride varnish), 5% glutaraldehyde-35% hydroxyethyl methacrylate (Gluma desensitizer), 8% arginine and calcium carbonate-containing desensitizing paste (Pro-Argin) and erbium-doped yttrium aluminum garnet (Er:YAG) laser].

**Methods:** 40 patients (16 male and 24 females) with 200 teeth affected by DH and bruxism were included in this study. The patients were divided into two main groups. In the first group, there were patients who could not regularly use the night guard for bruxism due to individual reasons, and who could not complied advices on nutrition and oral hygiene habits (Group-A). The second group consisted of patients who could regularly use the night guard and could complied advices (Group-B). Then, both groups were divided into five subgroups: Group 1: Duraphat fluoride varnish, Group 2: Gluma desensitizer, Group 3: Pro-Argin, Group 4: Er:YAG laser Group 5: Control. DH was assessed with a visual analog scale (VAS); before the treatment, immediately, 1, 4, and 12 weeks after the treatment. The obtained data were evaluated statistically.

**Results:** In both groups, it was seen that the most effective treatment methods were the Er:YAG laser and Pro-Argin. Gluma desensitizer and Duraphat fluoride varnish were also found to be effective in DH compared with control group, but they were not found to be as successful as the Er:YAG laser and Pro-Argin in the long term. It was found that all treatment methods, including the control group, applied to Group-B significantly increased their activities compared to Group-A in the 4 and 12 weeks ($p$<0.05).

**Conclusions:** It has been found that the success rates of all treatment methods are increased when the etiological factor can be eliminated. It was also observed that Er:YAG laser and Pro-Argin demonstrated statistically similar success rates in both groups. It was seen that Er:YAG laser and Pro-Argin could have hope for long-term DH treatment.

**Key Words:** Dentin hypersensitivity, bruxism, etiology, Pro-Argin, Er:YAG laser

## INTRODUCTION:

Dentin hypersensitivity (DH) is defined as a acute, sudden, sharp and brief pain of exposed dentin in response to thermal, chemical, mechanical and osmotic stimulus that cannot be referred to any other dental defect or pathology.[1,2,3,4]

DH is a common dental problem that affects the patient's life quality. However, available treatment options are not entirely sufficient and successful. Because DH has a multifactorial etiology and treatment methods can be determined according to subjective reactions of the patient.[5,6] Moreover,

*Corresponding Author Address: Dr. Fatma Sag Gungor. E-mail: dtfatmasag@gmail.com

the symptoms of DH are similar to other dental defects and pathologies which makes clinical diagnosis difficult.

Dentin tubules exposed to the oral environment as a result of erosion, loss of cement, or gingival recession and DH occurs.[7] Non-carious cervical lesions such as abrasion, erosion, attrition, and abfraction cause loss of enamel. Endogenous acid exposure caused by gastroesophageal reflux disease, as well as acids from food, and parafunctional habits such as bruxism also play role in formation of these lesions.[8]

Gingival recession can occur as a result of traumatic or improper tooth brushing, periodontal diseases, high frenum attachment, occlusion disorders, bad habits, incompatible restorations and clasps, and aging. The root surface thus becomes exposed, facilitating erosion of the cement tissue, which results in exposure of dentin tubules.

Several theories have been proposed for the mechanism of DH. The most widely accepted is hydrodynamic theory. This theory, suggested by Brannström, is based on the activation of mechanoreceptors located at the demarcation between pulp and dentin as a result of movement of the fluid inside tubules following a stimulus.[9]

Determine the treatment method of DH is difficult. Because pain threshold varies among the patients, and assessment of the degree of pain relies on subjective methods. For this reason, a detailed anamnesis should be obtained from the patient, and a clinical examination should be performed.[2,3,4] Also, early diagnosis of etiology, and changing or giving up the risk factors are very important for eliminating DH and obtaining good results at the long term.[10]

Treatment methods mainly purpose changing of fluid flow in the tubules, and modification or blockage of the neural response of the pulp.

Treatments in the clinic include the use of anti-inflammatory agents (corticosteroids), blockage of neural stimulation (potassium nitrate), and various physical and chemical materials that cover (adhesives and resins) or obstruct (ions and salts such as fluoride and oxalate, and protein aggregates such as glutaraldehyde and pro-arginine) dentinal tubules.[11] Also lasers are one of the effective and current treatment methods.

Several desensitizing agents have been tested for DH. The results can change due to different methods, subjective responses and the placebo effect. Furthermore, effective treatment planning is often impossible. Because DH has a multi-factorial etiology.

The main purpose of this study is a comparative evaluation of the long-term clinical efficacies of desensitizing paste containing 8% arginine and calcium carbonate (Pro-Argin), Duraphat fluoride varnish, Gluma desensitizer, and Er: YAG laser, when etiological factors are eliminated and not.

## MATERIALS AND METHODS:

The study included 40 patients with 200 hypersensitive teeth, over 18 years old, who had complaints of both bruxism and DH. Patients were informed about all the procedures, and all patients provided verbal and written consent, signing 'Voluntary Consent Form'.

### 1.1. Patient Selection

Inclusion Criteria:

- Good systemic health condition
- Complaining of both DH and bruxism.

Exclusion Criteria:

- Having professional DH and periodontal treatment within the last 3 months
- Presence of dental pathologies such as pulpitis, caries, or fracture
- Presence of crown, restoration, crack, or congenital enamel or dentin defect at the hypersensitive or adjacent teeth
- Hypersensitive teeth is devital
- Bleaching within the last 6 months
- Ongoing orthodontic treatment
- Pregnancy
- Long-term using analgesic or anti-inflammatory drug.

### 1.2. Assessment of DH

After a detailed anamnesis and clinical examination, each patient was advised about general health problems, oral hygiene habits, and diet consumption indices. A night guard was prepared to treat bruxism, and patients were informed about how to use it. All patients were advised not to use any oral care products such as toothpaste containing desensitizing agents, or fluoride tablets during the treatment.

Supragingival plaque was removed from all the teeth, and cold air was applied to the buccal cervical areas from a distance of 0.5-1 cm until getting a reaction, for a maximum of 3 seconds (55-60 psi pressure, 19-20°C temperature). Adjacent teeth were isolated with cotton rolls and fingers. Patients were asked to record their overall sensitivity by marking a point on a 10 cm visual analog scale (VAS), anchored at each end by the phrases ''no pain'' and ''unbearable pain''.

### 1.3. Study Design

After two weeks evaluation period, patients were divided into two groups:

- Group-A: Patients who could not regularly use the night guard and could not complied advices
- Group-B: Patients who could regularly use the night guard and could complied advices

Both groups were divided into five subgroups according to the treatment methods (Figure 1-2):

1. Duraphat fluoride varnish
2. Gluma desensitizer
3. Pro-Argin
4. Er:YAG Laser
5. Distilled Water

Application procedures of all desensitizing agents and Er:YAG laser have been showed in Table1.

VAS scores were assessed in each patient before treatment, immediately after treatment, and after 1, 4 and 12 weeks.

For both groups, analyses were made to compare the VAS scores recorded at five different follow-up periods in five different treatment subgroups.

## RESULTS:

### 1.1. Comparison between the treatment subgroups in Group-A

VAS scores recorded before, immediately, 4 and 12 weeks after treatment showed statistically significant difference across the treatment subgroups. Additionally, comparison of different follow-up periods showed that VAS scores changed significantly over time in each subgroup (Table 2).

In all treatment subgroups, the percentage changes in VAS scores from baseline were statistically significant for every follow-up period (Table 3). The greatest reduction in VAS scores recorded immediately after was observed in the Er:YAG laser group (71.43%). This was followed by Pro-Argin (55.23%), Duraphat fluoride varnish (49.68%), Gluma desensitizer (43.68%) and control (32.50%) subgroups, respectively. The percentage of reduction in VAS scores after 12 weeks according to the treatment subgroups was showed a similar order to the 'immediately' period. The control group showed an 11.90% increase in the VAS score after 12 weeks compared to baseline, and the placebo effect was found to disappear at the end of 12 weeks period (Table 3).

There were statistically significant differences in VAS scores between the control and the other treatment subgroups at all follow-up periods. The percentage reductions in VAS scores in Er:YAG laser immediately after, after 4 and 12 weeks were significantly higher than the other treatment subgroups except Pro-Argin. Er:YAG laser showed greater percentage reduction in VAS scores than Pro-Argin, although the difference was not statistically significant (Table 4).

After 12 weeks, Pro-Argin showed a significantly greater reduction in VAS scores compared to Gluma desensitizer. Also, the percentage reduction in VAS scores in Pro-Argin at the 12th week was greater than Duraphat fluoride varnish, although the difference was not statistically significant. The percentage reduction in Duraphat fluoride varnish was greater than Gluma desensitizer, although the difference was not statistically significant (Table 4).

VAS scores in the control subgroup assessed immediately after, after 1 and 4 weeks were significantly lower than the baseline scores. However, after 12 weeks, VAS scores in the control group were higher than the baseline scores, although the difference was not

statistically significant. Unlike the control group, all treatment groups showed a significant reduction in VAS scores during the 12 weeks long period compared to baseline (Table 5).

It was observed that the VAS scores in control, Fluoride and Gluma desensitizer subgroups, showed a significant increase over time when compared to VAS scores assessed 'immediately after'. Despite the progressive decrease in efficacy, the scores did not reach baseline throughout the 12 weeks period in any of these subgroups (Table 5).

In Pro-Argin and Er:YAG laser, VAS scores assessed after 1, 4, and 12 weeks were higher than 'immediately after' scores and the differences were not statistically significant. Their effectiveness observed immediately after the treatment were preserved during the 12-weeks period (Table 5).

### 1.2. Comparison between the treatment subgroups in Group-B

VAS scores recorded before, immediately, 1, 4 and 12 weeks after treatment showed significant difference across the treatment subgroups. Additionally, comparison of different follow-up periods showed that VAS scores changed significantly over time in each subgroup (Table 6).

In all treatment subgroups, the percentage changes in VAS scores from baseline were statistically significant for every follow-up period (Table 7). The percentage reduction in VAS scores observed immediately after was greatest in Er:YAG laser, similar to the Group-A. Unlike the Group-A, the percentage reduction in VAS scores at the 12th week was greatest in Pro-Argin. Pro-Argin was followed by Er:YAG laser (67.80%), Gluma desensitizer (60.68%), Duraphat fluoride varnish (37.93%) and control (12.60%) subgroups, respectively (Table 7).

There were statistically significant differences between the control subgroup and the other treatment subgroups at all the follow-up periods except for 'immediately after'. Only the percentage reduction in the Er:YAG laser was significantly greater than the control subgroup immediately after the treatment. This showed that using of the night guard was effective even in the control subgroup. The percentage reduction at the 'immediately after' period was greatest in Er:YAG laser compared the other treatment subgroups (Table8).

At the 4th week, unlike the Group-A, the percentage reduction in the VAS scores was significantly greater in Pro-Argin compared to Er:YAG laser and Duraphat fluoride varnish. At the 12th week, percentage reduction in the VAS scores was significantly greater in Pro-Argin and Gluma desensitizer in comparison to Duraphat fluoride varnish, and in Er:YAG laser in comparison to Duraphat fluoride varnish. Percentage reduction was greater in Er:YAG laser compared to Gluma desensitizer, and in Pro-Argin compared to Gluma desensitizer and

Er:YAG laser, although these differences were not statistically significant (Table 8).

Unlike the Group-A, the control subgroup showed significantly lower VAS scores at the 12th week compared to baseline scores. This showed that using the night guard and compliance with the physician's advices were effective even in the control subgroup. Although VAS scores at the 12th week showed a significant increase compared to the 'immediately after' scores, they did not return to the baseline scores, indicating preserved effectiveness (Table 9).

In all other treatment groups, VAS scores assessed at all follow-up periods were significantly lower compared to the baseline scores. In Duraphat fluoride varnish subgroup, VAS scores at 4th and 12th weeks showed a significant increase compared to 'immediately after' scores; however, they did not return to a baseline scores, indicating preservation of efficacy in the long-term (Table 9).

VAS scores in Pro-Argin at the 1st week showed an increase compared to 'immediately after' scores, although this increase was not statistically significant. VAS scores at the 4th and 12th weeks in Pro-Argin showed statistically significant reduction compared to 'immediately after' scores. This result showed that Pro-Argin was an effective treatment method in the 12 weeks-long periods. In Er:YAG laser, although there was a statistically significant increase in the VAS scores at 1st week compared to 'immediately after' scores, the rising of increase at the 4th and 12th weeks was not statistically significant (Table 9).

In the Group-A, there was no statistically significant difference between efficacies of Pro-Argin and Er:YAG laser in the long term; however, since the percentage reduction in VAS scores was greater in the Pro-Argin group, Pro-Argin was determined to be the most effective treatment method. Pro-Argin was followed by Er:YAG laser, Gluma desensitizer, Duraphat fluoride varnish and control subgroups, in decreasing order of effectiveness (Table 9).

### 1.3. Comparison between the treatment subgroups in the Group-A and Group-B

The percentage changes from baseline did not show a significant difference immediately after and 1 week after in all treatment subgroups in Group-A and Group-B. The percentage reduction in VAS scores of all treatment subgroups in Group-B was significantly higher than the percentage reduction in VAS scores of all treatment subgroups in Group-A at 4 and 12 weeks long term. Elimination of etiological factors has been shown to increase the effectiveness of all treatment subgroups, including the control subgroup (Table 10).

## DISCUSSION:

Many invasive treatment methods have been applied with the purpose of obstructing or covering the dentinal tubules or blocking neural stimulation.[12]

Studies have shown contradicting results in terms of success rates of the desensitizing agents, and none of them demonstrate all the features that Grossman has defined as an ideal desensitizing agent.[13-21] However, it was observed that the reason for lack of high success with various treatment methods was not only related to the properties of the desensitizing agents or the method of application by the physician. Failure in the long-term appears to be related to the trial of invasive treatment methods without elimination of etiological factors causing DH. Previous studies have used various materials, but very few of them have assessed etiological factors by standardizing the subjective symptom of pain between individuals. Thus, DH is a very common condition in clinics, still waiting to be analyzed.

On the basis of these problems, in the present study, we compared efficacies of different clinical treatment methods including various agents and Er:YAG laser, considering the etiological factor elimination.

Precipitation at the tooth surface with sodium fluoride can be removed from the tooth either with the effect of saliva or acidic foods or mechanically.[23] In a clinical study which compared Gluma Desensitizer (Heraeus Kulzer), UltraEZ (Ultradent Products, Inc) containing 3% potassium nitrate and fluoride, and Duraphat varnish containing 5% NaF with each other, VAS scores were assessed before, 24 hours and 7 days after treatment. All of the agents were found effective for DH, and no agent was found to be superior to any other.[24] In the present study, although Duraphat fluoride varnish caused decrease in DH in both groups, in the long-term it was not as successful as Pro-Argin and Er:YAG laser.

A study in 2014 compared toothpaste containing 8% arginine and Gluma desensitizer. At the end of 1-month follow-up, a remarkable decrease was seen in DH in both groups ($p<0.05$). However, at all follow-up periods, 8% arginine resulted in greater decrease compared to the group treated with Gluma desensitizer ($p<0.05$).[25] In the present study, Gluma desensitizer showed lower efficacy in the long term compared to Er:YAG laser and Pro-Argin. It showed statistically similar effects in comparison to Duraphat fluoride varnish.

Desensitizing paste containing 8% arginine and calcium carbonate has an advantage over other agents, because arginine and calcium are naturally occurring in the saliva, and this paste occludes dentinal tubules with a mineral similar to dentin, containing calcium and phosphate. A limited number of studies conducted so far have provided clinical evidence that Pro-Argin technology which is based on arginine and carbonate is effective in rapidly and permanently treating DH.[26-31]

Er:YAG laser provides the evaporation of the dentin fluid in the dentinal tubules and the deposition of organic elements and insoluble salts of the dentin into the

dentinal tubules. Aoki et al. reported that Er:YAG laser application caused minimal thermal damage to the sound dentin.[32] Er:YAG laser has been shown to be clinically successful in the treatment of DH.[33,34]

A clinical study in 2013 found significantly reduced VAS scores 4 weeks after desensitizing treatment using Er:YAG laser (energy level: 60 mJ/pulse, frequency: 2 Hz) ($p<0.05$).[35] Another randomized, controlled, double-blinded clinical study conducted in 2012 showed that Er:YAG (2 Hz/32.4 mJ/5.9 J/cm2) laser and Er,Cr:YSGG (0.25 W/4.4 J/cm2) laser were appropriate for use in the treatment of DH, with Er:YAG laser yielding the greatest reduction in DH scores.[36]

In conclusion, our results indicate that Er:YAG laser and Pro-Argin are the most effective treatment methods, even in the presence of etiological factors. Additionally, minimization or completely elimination of these factors resulted in increased success rates of all treatment methods, even reducing DH scores in the control group.

## CONCLUSION:

In light of all these studies, and based on the results of the present study, in which the effects of etiological factors on treatment success was evaluated for the first time in the literature, it is concluded that in order to achieve the highest success possible with such treatment methods, elimination of factors that cause the DH in the first place is essential. Among the treatment methods, Er:YAG laser and Pro-Argin (desensitizing paste containing 8% arginine and calcium carbonate) are thought to be promising in the treatment of DH.

## REFERENCES:


1. Addy M. Dentin hypersensitivity: Definition, prevalence, distribution aetiology. In: Addy M, Embery G, Edgar WM, Orchardson R, eds. Tooth wear and Sensitivity Clinical Advances in Restorative Dentistry Martin Dunitz, London 2000:239-48.
2. Canadian Advisory Board on Dentin Hypersensitivity: Consensus-based recommendations for the diagnosis and management of dentin hypersensitivity. J Can Dent Assoc 2003;69:221-226.
3. Bartold P. Dentinal hypersensitivity: A review. Austral Dent J 2006;51(3):212-8.
4. Apama S, Setty S, Thakur S. Comparative efficacy of two treatment modalities for dentinal hypersensitivity: a clinical trial. Indian J Dent Res 2010;21(4):544-8.
5. Aranha AC, Pimenta LA, Marchi GM. Clinical evaluation of desensitizing treatments for cervical dentin hypersensitivity. Braz Oral Res 2009;23:333-9.

6. Chu CH, Lo ECM. Dentin hypersensitivity: a review. Hong Kong Dent J 2010;7:15-22.
7. Parolia A, Kundabala M, Mohan M. Management of dentinal hypersensitivity: a review. J Calif Dent Assoc 2011;39(3):167-79.
8. Smıth A, Sloan A, Matthews J, Murray P, ve Lumley, P. Reparative processes in dentine and pulp. Tooth Wear and Sensitivity: Clinical Advances in Restorative Dentistry: 2000;53.
9. Närhi MV, Hirvonen T. The response of dog in tradental nerves to hypertonic solutions of $CaCl_2$ and NaCl, and other stimuli, applied to exposed dentine. Arch Oral Biol 1987;32(11):781-6.
10. Dababneh RH, Khouri AT, Addy M. Dentine hypersensitivity-an enigma? A review of terminology, mechanisms, aetiology and management. Br Dent J 1999;187:606-61.
11. Dondi dall'Orologio G, Lone A, Finger WJ. Clinical evaluation of the role of glutardialdehyde in a one-bottle adhesive. Am. J. Dent. 2002;15:330-4.
12. Pashley DH. Dentin permeability, dentin sensitivity, and treatment through tubule occlusion. J Endod, 1986;12(10):465-74.
13. Grossman L. A systematic method for the treatment of hypersensitive dentine. J Am Dent Assoc, 1935;22:592-598.
14. Trowbridge H, Edwall L, Panopoulos P. Effect of zinc oxide-eugenol and calcium hydroxide on intradental nerve activity. J Endod, 1982;8(9):403-406.
15. Kimura, Y., Wilder-Smith, P., Yonaga, K. ve Matsumoto, K. Treatment of dentine hypersensitivity by lasers: a review. Journal of Clinical Periodontology, 2000;27(10),715-21.
16. Panduric V, Knezevic A, Tarle Z, Sutalo J. The efficiency of dentine adhesives in treating non-caries cervical lesions. J Oral Rehabil, 2001;28(12):1168-74.
17. Duran I, Sengun A. The long-term effectiveness of five current desensitizing products on cervical dentine sensitivity. J Oral Rehabil, 2004;31(4):351-6.
18. Poulsen S, Errboe M, Lescay Mevil Y, Glenny AM. Potassium containing toothpastes for dentine hypersensitivity. Cochrane Database Syst Rev,2006;(3):CD001476.
19. Demi M, Delme K.I.M, De Moor, R.J.G. Hypersensitive teeth: conventional versus laser treatment. Part I: conventional treatment of dentin hypersensitivity. Journal of Oral Laser Applications 2009;9(1):7-20.
20. Ipci SD, Cakar G, Kuru B, Yilmaz S. Clinical evaluation of lasers and sodium fluoride gel in the treatment of dentine hypersensitivity. Photomed Laser Surg, 2009;27(1):85-91.
21. Cunha-Cruz J1, Wataha JC, Heaton LJ, Rothen M, Sobieraj M, Scott J, Berg J; Northwest Practice-Based

Research Collaborative İn Evidence-Based Dentistry. The prevalence of dentin hypersensitivity in general dental practices in the northwest United States. J Am Dent Assoc. 2013 Mar;144(3):288-96.

22. He S, Wang Y, Li X, Hu D. (2011). Effectiveness of laser therapy and topical desensitising agents in treating dentine hypersensitivity: a systematic review. J Oral Rehabil, 38(5):348-58.
23. Miglani S, Aggarwal V, Ahuja B. Dentin hypersensitivity: Recent trends in management. J Conserv Dent 2010;13:218-24.
24. Ozen T., Orhan K., Avsever H., Tunca YM., Ulker AE., Akyol M. Dentin hypersensitivity: a randomized clinical comparison of three different agents in a short-term treatment period. Oper. Dent. 2009;34:392-8.
25. Samuel SR1, Khatri SG1, Acharya S2 Clinical Evaluation of self and profes sionally applied desensitizing agents in relieving dentin hypersensitivity after a single topical application: A Randomized Controlled Trial. J Clin Exp Dent. 2014;6(4):339-43.
26. Hamlin D., Williams KP., Delgado E., Zhang YP., DeVizio W., Mateo LR. Clinical evaluation of the efficacy of a desensitizing paste containing 8% arginine and calcium carbonate for the in-office relief of dentin hypersensitivity associated with dental prophylaxis. Am. J. Dent. 2009;22:16A-20A.
27. Panagakos F, Schiff T, Guignon A. Dentin hypersensitivity: effective treatment with an in-office desensitizing paste containing 8% arginine and calcium carbonate. Am J Dent, 2009;22:(Spec No A):3A-7A.
28. Petrou I, Heu R, Stranick M, Lavender S, Zaidel L, Cummins D, Sullivan RJ, Hsueh C, Gimzewski JK. A breakthrough therapy for dentin hypersensitivity: how dental products containing 8% arginine and calcium carbonate work to deliver effective relief of sensitive teeth. J Clin Dent 2009;20:23-31.
29. Schiff T, Delgado E, Zhang YP, Cummins D, DeVizio W, Mateo LR. Clinical evaluation of the efficacy of an in-office desensitizing paste containing 8% arginine and calcium carbonate in providing instant and lasting relief of dentin hypersensitiv-ity. Am. J. Dent. 2009;22:8A-15A.
30. Tunar OL, Gürsoy H, Çakar G, Kuru B, Ipci SD, Yılmaz S. Evaluation of the effects of Er:YAG laser and desensitizing paste containing 8% arginine and calcium carbonate, and their combinations on human dentine tubules: a scanning electron microscopic analysis. Photomed Laser Surg. 2014;32(10):540-5.
31. Kleinberg I. SensiStat. A new saliva-based composition for simple and effective treatment of dentinal sensitivity pain. Dent Today 2002;21:42-7.
32. Aoki A, Ishikawa I, Yamadal T, Otsukil M, Watanabe H, Tagamil J, Ando Y, Yamamoto H. Comparison

between Er:YAG laser and conventional technique for root caries treatment in vitro. J Dent Res, 1998;77:1404-14.
33. Schwarz F, Arweiler N, Georg T, Reich E. Desensitizing effects of an Er:YAG laser on hypersensitive dentine. A controlled, prospective clinical study. J Clin Periodontol 2002;29:211–5.
34. Birang R, Poursamimi J, Gutknecht N, Lampert F, Mir M. Comparative evaluation of the effects of Nd:YAG and Er:YAG laser in dentin hypersensitivity treatment. Lasers Med Sci, 2007;22(1):21-24.
35. Yu CH, Chang YC2. Clinical efficacy of the Er:YAG laser treatment on hypersensitive dentin. J Formos Med Assoc. 2014;113(6):388-91.
36. Aranha AC1, Eduardo Cde P. Effects of Er:YAG and Er,Cr:YSGG lasers on d entine hypersensitivity. Short-term clinical evaluation. Lasers Med Sci. 2012;27(4):813-8.

## FIGURE:

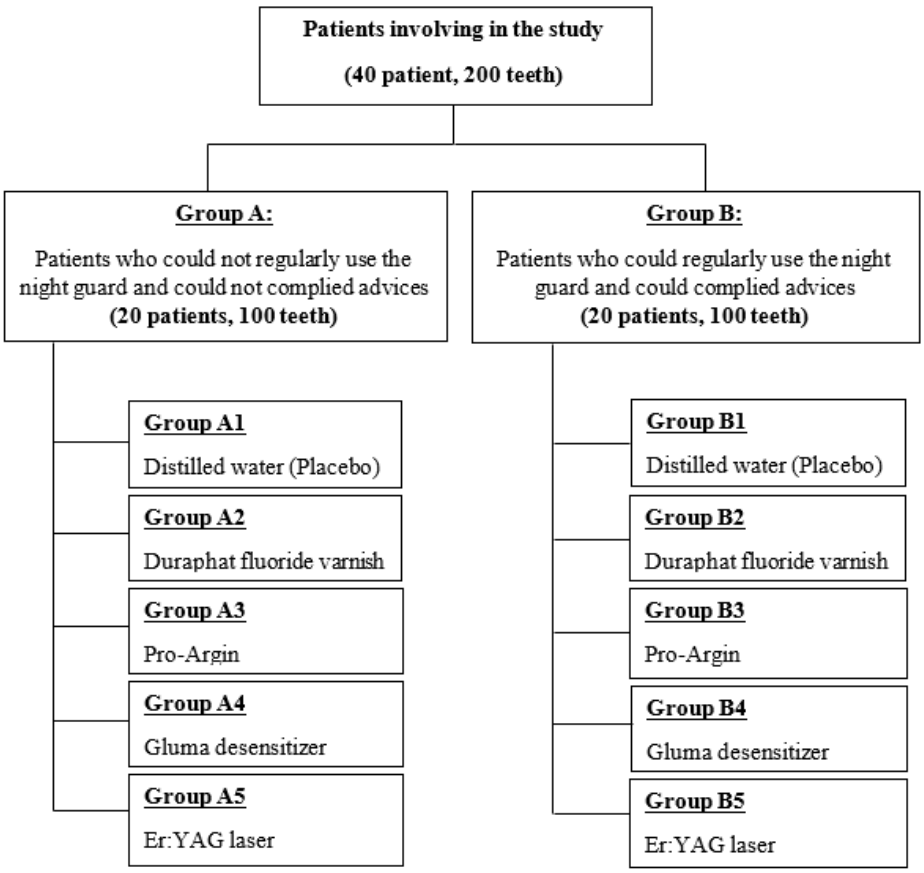


**Figure 1.** Grouping of patients included in the study

## TABLES:

**Table 1:** Compositions and procedures of application for all agents and the Er:YAG laser

| | Manufacturer | Composition | Procedures of Application |
|---|---|---|---|
| **Duraphat fluoride varnish** | Colgate-Palmolive Company, ABD | 5% Sodium fluoride | Applied with a microbrush in a thin layer, then removed with a cotton pellet |
| **Gluma desensitizer** | Heraeus Kulzer, Hanau, Germany | 5% gluteraldehyde, 35% HEMA (2-hydroxyethyl methacrylate), water | Applied with a microbrush and left for 60 s, dried, then rinsed with water |
| **Pro-Argin desensitizing paste** | Colgate Sensitive Pro-relief Colgate-Palmolive Company, ABD | 8% arginine and calcium carbonate | Applied with a polishing tire for 3 seconds, rinsed with water, then dried |
| **Er/YAG laser** | Fotona Light Walker DT, US | Non-contact, SP mode, 80-90 mJ/pulse, 2 Hz | Applied 6 cm distance from left to right, repeated 3 times, then soaked with saliva |

**Table 2.** Comparison of VAS scores according to the treatment subgroups and follow-up periods in Group-A.

| | Control | Duraphat | Pro-Argin | Gluma | Er:YAG Laser | P* |
|---|---|---|---|---|---|---|
| | Mean±SD | Mean±SD | Mean±SD | Mean±SD | Mean±SD | |
| Baseline | 4,28±2,98 | 5,00±0,91 | 5,00±1,59 | 5,00±1,68 | 4,98±1,47 | **0,014** |
| Immediate | 1,28±2,52 | 1,38±0,87 | 1,88±1,83 | 1,73±1,63 | 1,73±1,86 | **0,005** |
| 1 week after | 1,83±2,86 | 2,15±1,26 | 2,33±1,89 | 1,93±1,53 | 2,35±2,82 | 0,129 |
| 4 weeks after | 3,28±2,68 | 2,80±0,98 | 2,45±1,34 | 3,00±1,63 | 2,70±1,05 | **0,000** |
| 12 weeks after | 4,35±3,08 | 3,68±1,18 | 3,35±1,63 | 3,35±1,31 | 3,25±1,73 | **0,002** |
| **Pc** | **0,000** | **0,000** | **0,000** | **0,000** | **0,000** | |

***** *Kruskal Wallis Test ɕ Friedman Test, p <0,05* *SD: Standard Deviation*

**Table 3.** Multiple comparison of percentage changes of baseline VAS scores between treatment subgroups according to follow-up periods in Group-A.

| | Control | Duraphat | Pro-Argin | Gluma | Er:YAG Laser | P* |
|---|---|---|---|---|---|---|
| Baseline-Immediate | -35,50 | -49,68 | -55,23 | -43,68 | -71,43 | **0,000** |
| Baseline-1 week | -30,33 | -56,73 | -52,25 | -47,33 | -65,88 | **0,002** |
| Baseline-4 weeks | -12,43 | -59,78 | -62,73 | -39,38 | -78,20 | **0,000** |
| Baseline-12 weeks | +11,90 | -53,88 | -64,18 | -48,65 | -73,90 | **0,000** |

***** *Kruskal Wallis Test, p <0,05* *(-) = Reduction, (+) = Increase*

**Table** Error! No text of specified style in document.**.** Binary comparison of percentage changes of VAS scores according to the baseline in the all follow-up periods in Group-A.

| | Baseline-Immediate | Baseline-1 week | Baseline-4 weeks | Baseline-12 weeks |
|---|---|---|---|---|
| Control/Duraphat | **0,017 (D)** | **0,001 (D)** | **0,000 (D)** | **0,000 (D)** |
| Control/Pro-Argin | **0,020 (P)** | **0,018 (P)** | **0,000 (P)** | **0,000 (P)** |
| Control/Gluma | **0,043 (G)** | **0,017 (G)** | **0,000 (G)** | **0,000 (G)** |
| Control/Er:YAG Laser | **0,000 (E)** | **0,003 (E)** | **0,000 (E)** | **0,000 (E)** |
| Duraphat/Pro-Argin | 0,462 | 0,713 | 0,723 | 0,119 |
| Duraphat/Gluma | 0,341 | 0,163 | **0,001 (D)** | 0,471 |
| Duraphat/Er:YAG Laser | **0,002 (E)** | 0,091 | **0,002 (E)** | **0,014 (E)** |
| Pro-Argin/Gluma | 0,196 | 0,567 | **0,002 (P)** | **0,028 (P)** |
| Pro-Argin/Er:YAG Laser | 0,065 | 0,102 | **0,041 (E)** | 0,091 |
| Gluma/Er:YAG Laser | **0,002 (E)** | **0,031 (E)** | **0,000 (E)** | **0,001 (E)** |

*Mann Whitney U Test, p <0,05*

*(D=Duraphat, P=Pro-Argin, G=Gluma, E=Er:YAG Laser): The difference indicates that there is a further reduction in the observed treatment groups.*

**Table 5.** Binary comparison of VAS scores in Group-A according to follow-up periods.

| | Control | Duraphat | Pro-Argin | Gluma | Er:YAG Laser |
|---|---|---|---|---|---|
| Baseline-Immediate | **0,000** | **0,000** | **0,001** | **0,000** | **0,011** |
| Baseline-1 week | **0,000** | **0,000** | **0,000** | **0,000** | **0,005** |
| Baseline-4 weeks | **0,001** | **0,000** | **0,000** | **0,000** | **0,000** |
| Baseline-12 weeks | 0,244 | **0,000** | **0,000** | **0,000** | **0,000** |
| Immediate-1 week | **0,012** | **0,002** | 0,321 | 0,203 | 0,066 |
| Immediate-4 weeks | **0,000** | **0,001** | 0,218 | **0,003** | 0,603 |
| Immediate-12 weeks | **0,000** | **0,000** | 0,052 | **0,002** | 0,163 |

*Wilcoxon Sign Test, p<0,05*

**Table 6.** Comparison of VAS scores according to the treatment subgroups and follow-up periods in Group-B.

| | Control | Duraphat | Pro-Argin | Gluma | Er:YAG | P* |
|---|---|---|---|---|---|---|
| | Mean±SD | Mean±SD | Mean±SD | Mean±SD | Mean±SD | |
| Baseline | 4,83±1,19 | 5,00±2,15 | 5,00±1,59 | 4,95±1,44 | 5,00±1,88 | **0,033** |
| Immediate | 1,03±1,67 | 1,70±1,14 | 3,28±2,17 | 2,55±1,86 | 1,63±1,32 | 0,063 |
| 1 week after | 2,60±1,53 | 1,95±1,42 | 2,53±2,54 | 2,68±2,30 | 3,88±0,94 | **0,000** |
| 4 weeks after | 3,03±1,49 | 2,73±1,46 | 2,35±1,50 | 2,40±1,84 | 2,68±0,94 | **0,000** |
| 12 weeks after | 3,53±1,72 | 3,63±1,84 | 1,85±0,85 | 2,43±1,63 | 1,83±1,03 | **0,000** |
| **Pc** | **0,000** | **0,000** | **0,000** | **0,000** | **0,000** | |

***** *Kruskal Wallis Test* **c** *Friedman Test, p <0,05 SD: Standard Deviation*

**Table 7.** Multiple comparison of percentage changes of baseline VAS scores between treatment subgroups according to follow-up periods in Group-B.

| | Control | Duraphat | Pro-Argin | Gluma | Er:YAG Laser | P* |
|---|---|---|---|---|---|---|
| Baseline-Immediate | -38,83 | -53,60 | -43,55 | -47,00 | -69,53 | **0,000** |
| Baseline-1 week | -22,25 | -64,33 | -64,18 | -55,83 | -45,93 | **0,000** |
| Baseline-4 weeks | -12,68 | -44,40 | -71,78 | -63,03 | -60,63 | **0,000** |
| Baseline-12 weeks | -12,60 | -37,93 | -73,50 | -60,68 | -67,80 | **0,000** |

***** *Kruskal Wallis Test, p <0,05* *(-) = Reduction, (+) = Increase*

**Table 8.** Binary comparison of percentage changes of VAS scores according to the baseline in the all follow-up periods in Group-B.

| | Baseline-Immediate | Baseline-1 weeks | Baseline-4 weeks | Baseline-12 weeks |
|---|---|---|---|---|
| Control/Duraphat | 0,054 | **0,000 (D)** | **0,000 (D)** | **0,000 (D)** |
| Control/Pro-Argin | 0,532 | **0,000 (P)** | **0,000 (P)** | **0,000 (P)** |
| Control/Gluma | 0,462 | **0,024 (G)** | **0,000 (G)** | **0,000 (G)** |
| Control/Er:YAG Laser | **0,002 (E)** | **0,000 (E)** | **0,000 (E)** | **0,000 (E)** |
| Duraphat/Pro-Argin | 0,211 | 0,252 | **0,000 (P)** | **0,000 (P)** |
| Duraphat/Gluma | 0,471 | 0,934 | 0,083 | **0,005 (G)** |
| Duraphat/Er:YAG Laser | **0,024 (E)** | 0,001 | **0,002 (E)** | **0,000 (E)** |
| Pro-Argin/Gluma | 0,754 | 0,790 | 0,630 | 0,117 |
| Pro-Argin/Er:YAG Laser | **0,004 (E)** | **0,023 (P)** | **0,035 (P)** | 0,284 |
| Gluma/Er:YAG Laser | **0,023 (E)** | 0,414 | 0,327 | 0,510 |

*Mann Whitney U Test, p <0,05*

*(D=Duraphat, P=Pro-Argin, G=Gluma, E=Er:YAG Laser): The difference indicates that there is a further reduction in the observed treatment groups.*

**Table 9.** Binary comparison of VAS scores in Group-B according to follow-up periods.

| | Control | Duraphat | Pro-Argin | Gluma | Er:YAG Laser |
|---|---|---|---|---|---|
| Baseline-Immediate | **0,000** | **0,000** | **0,000** | **0,000** | **0,000** |
| Baseline-1 week | **0,000** | **0,000** | **0,000** | **0,000** | **0,000** |
| Baseline-4 weeks | **0,000** | **0,000** | **0,000** | **0,000** | **0,000** |
| Baseline-12 weeks | **0,000** | **0,000** | **0,000** | **0,000** | **0,000** |
| Immediate-1 week | **0,012** | 0,153 | 0,794 | **0,019** | **0,004** |
| Immediate-4 weeks | **0,000** | **0,010** | **0,013** | 0,861 | 0,180 |
| Immediate-12 weeks | **0,000** | **0,000** | **0,002** | 0,471 | 0,317 |

*Wilcoxon Sign Test, p<0,05*

**Table 10.** Binary comparison of percentage changes of baseline VAS scores of all follow-up periods of the same treatment groups in Group-A and Group-B

| | **Baseline-Immediate** | **Baseline-1 week** | **Baseline-4 weeks** | **Baseline-12 weeks** |
|---|---|---|---|---|
| Control (-)/Control (+) | 0,231 | 0,231 | **0,001 (K(+))** | **0,000 (K(+))** |
| Duraphat (-)/Duraphat (+) | 0,340 | 0,016 | **0,021 (D(+))** | **0,018 (D(+))** |
| Pro-Argin (-)/Pro-Argin (+) | 0,319 | 0,130 | **0,000 (P(+))** | **0,000 (P(+))** |
| Gluma (-)/Gluma (+) | 0,644 | 0,538 | **0,000 (G(+))** | **0,003 (G(+))** |
| Er:YAG Laser(-)/Er:YAGLaser(+) | 0,678 | 0,065 | **0,018 (E(+))** | **0,000 (E(+))** |

*Mann Whitney U Test, p<0,05*

*(+) = patients who could use the night guard, (-) = patients who could not use the night guard*

*(D=Duraphat, P=Pro-Argin, G=Gluma, E=Er:YAG Laser): The difference indicates that there is a further reduction in the observed treatment groups.*