Original Article

Evaluation of the Effect of Low Level Laser Therapy Toothbrush in Treatment of Dentin Hypersensitivity

Jaber Yaghini[1], Ahmad Mogharehabed[2]*, Nassimeh Safavi[3], Mehrnush Mohamadi[4], Fahime Ashtiju[4]

[1]Dental Materials Research Center, Department of Periodontics, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
[2]Dental Implannts Research Center, Department of Periodontics, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
[3]Laser Application in Medical Sciences Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[4]School of Dentistry, Esfahan University of Medical Sciences, Esfahan, Iran

Abstract:

Introduction: Dentin hypersensitivity is one of the most common complications that affect patients after periodontal therapy. Recently low level laser therapy has been introduced as a new treatment modality and has produced beneficial results. The purpose of this study is to evaluate the effect of low level laser therapy toothbrushes in reduction of dentin hypersensitivity.
Methods: In this pilot interventional controlled clinical trial, 40 patients suffering from dentin hypersensitivity were selected using simple randomization. Half of the patients were given laser toothbrushes and the other half was given non-laser sensodyne toothbrushes. Primary dentin hypersensitivity was recorded by visual analogue scale (VAS) score and ice spray. Then dentin hypersensitivity was measured right after the treatment as well az in the intervals of 1 month and 2 months after initiation of the study. Data were compared using Statistical Package for the Social Sciences (SPSS) software and Analysis of variance (ANOVA) paired T test.
Results: The results of this study showed that there was a significant difference in each of the two kinds of tooth brushes separately for all time intervals ($P < 0.001$). Also the effect of the type of toothbrush was investigated using before treatment VAS with covariance analyses. P values for immediately, 1 month and 2 months after treatment were calculated to be 0.078, 0.02, 0.01 respectfully. Also the effect of the toothbrush type was significant in the manner that laser toothbrushes reduce dentin hypersensitivity more than ordinary toothbrushes ($P< 0.05$).
Conclusion: Both sensodyne and laser tooth brushes improve dentin hypersensitivity, although the laser toothbrush led to better results in short.
Keywords: diode laser; hypersensitivity, dentin; laser therapy, low level

Please cite this article as follows:
Yaghini J, Mogharehabed A, Safavi N, Mohamadi M, Ashtiju F. Evaluation of the Effect of Low Level Laser Therapy Toothbrush in Treatment of Dentin Hypersensitivity. J Lasers Med Sci 2015;6(2):85-91

***Corresponding Author:** Ahmad Mogharehabed, MD; Dental Implannts Research Center, Department of Periodontics, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran. Tel: +98-31 37922864; Fax: +98-3136687080; E-mail: mogharehabed@dnt.mui.ac.ir.

Introduction

Dentin hypersensitivity usually happens in patients after receiving periodontal therapies [1,2]. Hypersensitivity is a common complication which presents as sharp acute pains following nude dentin excitation by thermal, tactile, osmotic or chemical stimulus. And it cannot be related to any dental defect or pathologic injury [3,4]. Cold is the main pain trigger in patients suffering from dentin hypersensitivity. But mechanical agents such as brushing or flossing the sensible area of teeth as well as chemical

agents such as acid foods, acid fruits particularly, high glycemic index aliments and salted one may also be pain triggers [5,6]. Several therapeutic methods have been introduced to reduce dentin hypersensitivity, but none showed predictable long-term results [7,8].

In some cases, it has been suggested to cover the denuded root surface by different methods, such as gingival grafting, composite or glass-ionomer filling or even crowning the sensitive tooth; and in extreme cases of acute dentin hypersensitivity where the other therapies have failed, root canal therapy has been suggested as a final solution [9]. Recently, laser therapy has also been presented as a treatment method to reduce dentin hypersensitivity [10,11]. Plaque accumulation causes root surface demineralization, plaque control is also effective in the long term in the treatment of dentin hypersensitivity, which has been proved in multiple researches [12-15].

To treat dentin hypersensitivity, different types of lasers have been used, including (Neodymium-doped Yttrium Aluminum Garnet) Nd:YAG, Carbon Dioxide Laser (CO2), etc…. Recently, low level laser has been presented as a new method to treat dentin hypersensitivity [16]. Low level Diode Laser is one of them. Diode Lasers are semi-conductive and considered to be the newest generation of Laser [17]. This Laser creates lots of wavelengths in visible and infrared regions, and emits continuously or by pulse [18]. In dentistry, 655-810-980 nm are the wavelengths which are widely used. This Laser is used for cutting soft tissues and reducing the amount of bacteria present in periodontal pockets. One of application of low level Diode Laser is in treatment of dentin hypersensitivity. Applying this Laser on sensitive collar of teeth, may be an adequate treatment to eliminate sensibility [18]. According to multiple studies, in comparison with other methods, Diode Laser acts more efficiently in dentin hypersensitivity treatment [19-24].

Of course dentin hypersensitivity reduction with any Laser or therapeutic protocol depends on amount of radiation and time elapsed after treatment [16]. Kimura and Aranha [16,25] believe that although the use of Diode Laser is efficient in dentin sensibility reduction, more research need to be carried to understand the mechanism by which Diode Laser acts and reduces dentin hypersensitivity.

Umana, 2013, believed that Diode Laser application induces dentin sensitivity reduction, by blocking or narrowing dentinal tubulins, but some researchers don't believe in this mechanism [26].The fact is that placebo effect in dentin hypersensitivity reduction cannot be underestimated [27,28].

Jokstad, 2012, evaluated Laser effect on dentin hypersensitivity, and reached the conclusion that Laser therapy induces dentin hypersensitivity reduction, but evidences for this fact are very poor and placebo effect should also be taken in consideration[28].

In this study, the effect of toothbrush with low level Laser emission in treatment of dentin hypersensitivity has been evaluated. One advantage of using Laser in toothbrush is that the patient can use it at home, which is cost benefit, less time-consuming and easily used by patients.

Methods

In this pretest-posttest type of interventional clinical trial with control group, 40 patients referring to the periodontal department of Esfahan Dental Faculty, suffering from dentin hypersensitivity on at least one tooth, having good cooperation and consciousness, and whose dentin hypersensitivity was caused by dentin denudation, have been enroled. Patients presenting dentin hypersensitivity caused by pregnancy, decay and fissure were rule out of the study. Half of the patients were given Laser containing toothbrushes Dr.m (m&h co, Korea) characterized by 650 nm wavelength and 5mW power (Figure 1) and the necessary instructions about how to use toothbrushes at home. The other half in control group was given non-laser sensodyne toothbrushes (Glaxo Smith Kline co, Germany) with normal Pooneh (Oregano) toothpaste. Ice spray (a+d co, Germany) was used to evaluate pain intensity. Patients were asked to score the intensity of pain on a scale of one to ten, recorded by visual analogue scale (VAS) score. Then dentin hypersensitivity was measured just before and right after the treatment and in the intervals of 1 month, 2 month after beginning of the study.

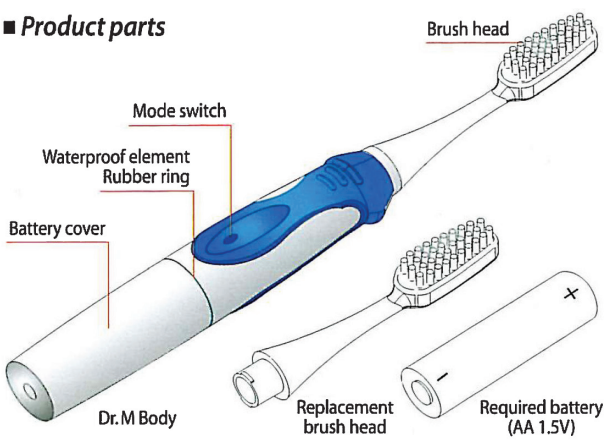

Figure 1. Schematic of laser toothbrush

To use Laser toothbrush, first of all the bottom switch mode should be pushed for the tooth brush starts working. Once started, the toothbrush works for 55 seconds on the area receiving the treatment. During this time, Laser is applied directly on the treated field, on which toothpaste shouldn't be used. After 55 seconds, for 5 seconds, Laser blinks every 0.5 second interval indicating that the treatment is completed. Then Pooneh toothpaste is put on toothbrush and patients brush their teeth for 2 minutes. At the end of the 2 minutes, once again Laser starts blinking (3 times every 0.5 seconds). Then the toothbrush's head and patients' mouth are rinsed, and during one minute and 57 seconds, Laser is again directly applied on the treated area, to have complete treatment. Overall, the toothbrush works for 5 minutes, after what all it automatically completely stops and turns to safe mode. Any time it is needed to stop the toothbrush, the bottom switch mode has to be pushed and it automatically goes to safe mode.

Patients were told that after usage, they should place the toothbrush head up in an open recipient, and during usage, to avoid Laser contact with eyes.

Data were collected by dental examination using ice spray [29] and questioning patients about the pain degree, according to VAS. In different reliable researches VAS is considered as a method to evaluate pain degree of dentin hypersensitivity, and its use is recommended [30,31]. Variance Analysis and also co-variance analysis were used for repeated data concerning the main variables,.

First, Variance Analysis was done for repeated bilateral data. Considering the significant vice-versa effect between the time and the toothbrush type in this analysis, with P <0.001(decreasing variance analysis credit for repeated bilateral data), variance analysis was calculated separately for each toothbrush for repeated data in order to compare VAS for different periods.

Results

After primary examination, 40 patients, who each had dentin hypersensibility on at least one tooth, were chosen, and the study was carried on 40 hypersensitive teeth. After intervention, dentin hypersensitivity was measured immediately, one month later and two months after. Table 1 and Figure 2 show mean patients' VAS at different times, for the two kinds of toothbrushes.

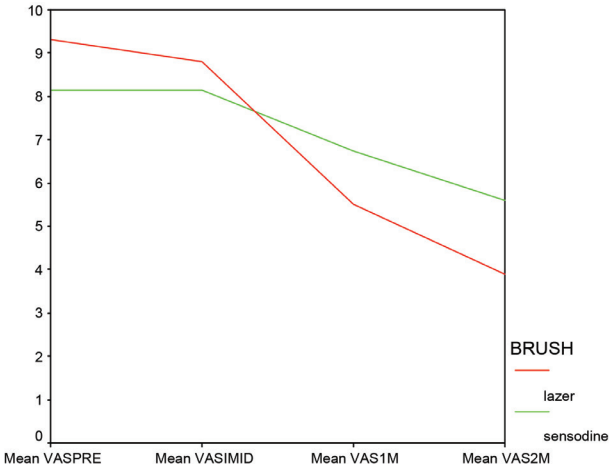

Figure 2. Mean VAS index for two toothbrushes at different times

To evaluate the timing effect on toothbrush type, unilateral repeated measure Analysis of variance (ANOVA) test showed that except for immediately after treatment, there is a significant difference between different times in the sensodyne toothbrush group (P <0.001). The results also showed that in the Laser toothbrush group there was a significant difference between the four steps (P <0.001). Paired t-test was performed to compare VAS at the different times mentioned above, and the result is shown in Tables 2 and 3.

The complementary paired t-test showed that in sensodyne toothbrush, except just after treatment, there is a significant difference for all the other intervals of treatment (Table 2). In Laser toothbrush, there was a significant difference between all 4 intervals (Table 3).

Considering VAS difference before treatment, determined by t-test (P =0.024), dentin hypersensitivity's intensity just after treatment, one and two months later were measured separately, using bilateral variance analysis, with control group, the effect of different VAS obtained before treatment was determined and it showed that although VAS before treatment had significant effect (P<0.001), immediately after brushing the type of toothbrush hadn't significant effect (P=0.078).

One month after treatment, although VAS effect was

Table 1. Mean VAS index for the two types of toothbrushes at different times

Type of toothbrush	Time			
	Before Treatment	Immediately	1 month after	2 months after
Sensodyne	8.15±1.75	8.15±1.75	6.75±2.35	5.60±2.98
Laser	9.30±1.30	8.80±1.47	5.50±2.81	3.90±2.65
Pvalue	0.024	0.078	0.02	0.027

Table 2. Comparison of VAS index at different times for sensodyne toothbrush

Time	2 months after	1 month after	Immediately	Before Treatment
Before Treatment	<0.001	0.006	0.99	-
Immediately	<0.001	0.006	-	-
1 month after	<0.001	-	-	-
2 months after	-	-	-	-

Table 3. Comparison of VAS index at different times for laser toothbrush

Time	2 months after	1 month after	Immediately	Before Treatment
Before Treatment	<0.001	0.001	0.038	-
Immediately	<0.001	0.001	-	-
1 month after	<0.001	-	-	-
2 months after	-	-	-	-

significant before treatment (P =0.016), the type of toothbrush had also significant effect (P =0.02).

Two months after treatment, although VAS was significant before treatment (P=0.027), the type of toothbrush had significant effect (P=0.01).

Discussion

Dentin hypersensitivity is a common painful complain which bothers patients and lessens their cooperation, especially after periodontal surgeries, which leads to a less successful outcome of treatment [32]. In this condition, different stimulus applied on dentinal surface displaces dentinal intra-tubular liquid and excite neural dendrites of the whole complex tooth-dentin and creates painful pulses [33]. Two main methods are used to treat dentin hypersensitivity:

1- Change by blocking pulp's neural response

2- Change in dentinal liquid flow [34]

The aim of this study was to compare clinical changes in two therapeutic methods using Laser toothbrushes and anti- sensitivity ones (sensodyne). Patients' dentin hypersensitivity was measured at 4 different times via VAS test: Before treatment, just after treatment, one month and two months after treatment.

The comparison of obtained VAS at different follow up periods with just before treatment revealed, in sensodyne toothbrush group, that there was a significant difference all periods except for just after treatment. Table 2 shows that this difference had a decreasing tendency.

These results show that plaque control is efficient during dentin hypersensitivity treatment. This probably happens due to secondary dentin precipitation and pulp protection against future excitations [35].

Appropriate methods of teeth brushing with dentin preservation reduce dentin hypersensitivity [36]. In a study carried out by Bartold, a decrease in dentin hypersensitivity has been reported for patients having plaque control [37].

Schiff and Sgan-cohen evaluated the role of anti-sensibility toothbrushes on plaque control and concluded that brushing sensitive teeth with these kinds of toothbrushes cause teeth hypersensitivity reduction [38,39].

Plaque accumulation causes root surface demineralization and micro-organism penetration through dentinal tubules entrance [12]. Some researchers believe that the exact mechanism of plaque control in dentin hypersensitivity reduction is unknown, but we could presume that bacteria's toxin dilution or move away while improving gingival health helps reduce dentin hypersensitivity [13].

It is obvious that plaque control effect on dentin hypersensitivity reduction cannot occur immediately after teeth brushing and it isn't related to the type of toothbrush. What is interesting is that sensodyne toothbrush doesn't have immediate dentin hypersensitivity reduction effect just after usage.

In the Laser toothbrush group, the comparison of VAS determinant showed a significant difference for any period, which means that using Laser toothbrush helps to reduce dentin hypersensitivity. What is interesting is that Laser toothbrush has immediate dentin hypersensitivity reduction effect just after usage.

Richur et al. mentioned in their study, that in comparison with stannous fluoride and potassium nitrate, Diode Laser's immediate effect in dentin hypersensitivity reduction is more important [23]. These results are in concordance with the present study results and counts as positive point in favor of using Laser toothbrush instead of normal toothbrushes. Several studies concluded that low level Lasers are efficient in dentin hypersensitivity reduction. Of course there are also researches which

consider that low level Laser have the same efficiency than other anti-sensitivity agents, in dentin hypersensitivity reduction [19-24].

Yilmaz and Corona compared the effect of low level Laser and fluoride varnish for treating dentin hypersensitivity. They concluded that low level Laser showed better results on treating hypersensitive teeth [19,40]

It seems that Diode Laser uses one of the three following mechanisms which could lead to dentin hypersensitivity reduction:

1- Blocking dentinal tubules: Both, red and infra-red wave Diode Lasers are efficient for treating dentin hypersensitivity, and act by blocking dentinal tubules. Laser induces hyper activation of cellular metabolism in odontoblasts, which blocks dentinal tubules by producing third type dentine [26].
2- Neural analgesia: In neural analgesia, Diode Laser acts by depolarizing C afferent fibers. C fibers are non-myelin pain afferent receptors with 0.5-1 mm diameter. They transmit chronic and secondary pain with a speed of 0.5-1meter per second. This polarity change is done by reduction of cellular membrane Potential of Action, and that is how pain transmission is blocked. Seal and neural analgesia are considered long lasting effects, although it is not the same for Placebo effect [22].
3- Placebo effect: Joksad and Lier mentioned that Placebo effect of Laser cannot be underestimated in dentin hypersensitivity reduction [27,28]. Kienle [41] cited some fields in which Placebo effect interferes and should be taken in consideration:
    1- A permanent change is clearly made in pain degree of patients suffering from dentin hypersensitivity, in which the difference of environmental position could have a role.
    2- In clinical studies, the fact of being polite could make the patient express less pain.

It seems that evaluating Diode Laser mechanism in dentin hypersensitivity reduction needs more studies. The results of this study show that both Laser toothbrush and anti-sensitivity sensodyne toothbrush are effective in dentin hypersensitivity reduction, but Laser is more efficient than anti-sensitivity toothbrush.

In this study, Laser toothbrush effect on dentin hypersensitivity reduction is the result of combination of Laser effect and plaque control effect, because while using Laser toothbrush, patients also benefits from routine plaque control with toothbrush and toothpaste. Based on obtained results, it has been revealed that even the use of anti-sensitivity toothbrushes combined with plaque control induces dentin hypersensitivity reduction.

Finally, in order to evaluate the results, we should take in consideration the fact that evaluating dentin hypersensitivity treatment is a complicated process, and is influenced by different factors including Placebo effect, physiological desensitization effect, subjective patients' response, etc…[42]. Nevertheless, the results show that Laser toothbrushes, besides their mechanism, act sooner and more efficiently on dentin hypersensitivity treatment, in comparison with normal toothbrushes. Although some of previous researches have already put the accent on the positive effect of low level Laser on dentin hypersensitivity reduction, but the use of this kind of Laser in toothbrush allows the patient to take care of this problem without being present at dental office or in Laser clinics with minimum expense.

One restriction of this study was the absence of VAS homogeneity before treatment in all patients; that is the reason why some results were not significant.

Conclusion

The results show that both sensodyne toothbrush and Laser toothbrush are efficient in dentin hypersensitivity reduction, but Laser toothbrush is more efficient than sensodyne toothbrush.

References

1. Rees JS, Addy M. A cross-sectional study of dentine hypersensitivity. J Clin Periodontol. 2002;29(11):997-1003.
2. Von Troil B, Needleman I, Sanz M. A systematic review of the prevalence of root sensitivity following periodontal therapy. J Clin Periodontol. 2002;29:173-7.
3. Dowell P, Addy M. Dentine hypersensitivity--a review. Aetiology, symptoms and theories of pain production. J Clin Perinodontol. 1983;10(4):341-50.
4. Brännström M, Åström A. A study on the mechanism of pain elicited from the dentin. J Dent Res. 1964;43(4):619-25.
5. Markowitz K, Pashley DH. Personal reflections on a sensitive subject. J Dent Res. 2007;86(4):292-5.
6. Gillam DG, Seo HS, Newman HN, Bulman JS. Comparison of dentine hypersensitivity in selected occidental and oriental populations. J Oral Rehabil. 2001;28(1):20-5.
7. Chidchuangchai W, Vongsavan N, Matthews B. Sensory transduction mechanisms responsible for pain caused by cold stimulation of dentine in man. Arch Oral Biol. 2007;52(2):154-60.
8. Ide M, Morel AD, Wilson RF, Ashley FP. The role of a dentine-bonding agent in reducing cervical dentine sensitivity. J Clin Periodontol. 1998;25(4):286-90.

9. Kishore A, Mehrotra KK, Saimbi CS. Effectiveness of desensitizing agents. J Endod. 2002;28(1):34-5.
10. Flecha OD, Azevedo CG, Matos FR, Vieira-Barbosa NM, Ramos-Jorge ML, Gonçalves PF, et al. Cyanoacrylate Versus Laser in the Treatment of Dentin Hypersensitivity: A Controlled, Randomized, Double-Masked and Non-Inferiority Clinical Trial. J Periodontol. 2013;84(3):287-94.
11. Sgolastra F, Petrucci A, Severino M, Gatto R, Monaco A. Lasers for the Treatment of Dentin Hypersensitivity A Meta-analysis. J Dent Res. 2013;92(6):492-9.
12. Sgan-Cohen HD, Livny A, Vered Y. The elmex SENSITIVE toothbrush: effect on plaque reduction and subjective satisfaction after two months. J Clin Dent. 2008;19(1):22.
13. Schiff T, Delgado E, Zhang Y, DeVizio W, Cummins D, Mateo L. The clinical effect of a single direct topical application of a dentifrice containing 8.0% arginine, calcium carbonate, and 1450 ppm fluoride on dentin hypersensitivity: the use of a cotton swab applicator versus the use of a fingertip. J Clin Dent. 2009;20(4):131.
14. Wara-aswapati N, Krongnawakul D, Jiraviboon D, Adulyanon S, Karimbux N, Pitiphat W. The effect of a new toothpaste containing potassium nitrate and triclosan on gingival health, plaque formation and dentine hypersensitivity. J clin periodontol. 2005;32(1):53-8.
15. Schiff T, Dotson M, Cohen S, De Vizio W, McCool J, Volpe A. Efficacy of a dentifrice containing potassium nitrate, soluble pyrophosphate, PVM/MA copolymer, and sodium fluoride on dentinal hypersensitivity: a twelve-week clinical study. J Clin Dent. 1994;5:87.
16. Kimura Y, Wilder-Smith P, Matsumoto K. Lasers in endodontics: a review. Int Endod J. 2000;33(3):173-85.
17. Amid R, Kadkhodazadeh M, Fekrazad R, Hajizadeh F, Ghafoori A. Comparison of the effect of hand instruments, an ultrasonic scaler, and an erbium-doped yttrium aluminium garnet laser on root surface roughness of teeth with periodontitis: a profilometer study. J Period Imp Sci. 2013;43(2):101-5.
18. Amid R, Kadkhodazadeh M, Ardakani MRT, Hemmatzadeh S, Refoua S, Iranparvar P, et al. Using Diode Laser for Soft Tissue Incision of Oral Cavity. J Lasers Med Sci. 2012;3(1):37.
19. Corona S, Nascimento Td, Catirse A, Lizarelli R, Dinelli W, Palma-DIBB R. Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity. J Oral Rehabil. 2003;30(12):1183-9.
20. Gerschman J, Ruben J, Gebart-Eaglemont J. Low level laser therapy for dentinal tooth hypersensitivity. Aust Dent J. 1994; 39(6):353-7.
21. Dilsiz A, Canakci V, Ozdemir A, Kaya Y. Clinical evaluation of Nd: YAG and 685-nm diode laser therapy for desensitization of teeth with gingival recession. Photomed Laser Surg. 2009;27(6):843-8.
22. Orhan K, Aksoy U, Can-Karabulut DC, Kalender A. Low-level laser therapy of dentin hypersensitivity: a short-term clinical trial. Lasers Med Sci. 2011;26(5):591-8.
23. Raichur P, Setty S, Thakur S. Comparative evaluation of diode laser, stannous fluoride gel, and potassium nitrate gel in the treatment of dentinal hypersensitivity. Gen Dent. 2012;61(3):66-71.
24. Gholami GA, Fekrazad R, Esmaiel-Nejad A, Kalhori KA. An evaluation of the occluding effects of Er; Cr: YSGG, Nd: YAG, CO_2 and diode lasers on dentinal tubules: a scanning electron microscope in vitro study. Photomed Laser Surg. 2011;29(2):115-21.
25. Aranha A, Siqueira JAS, Cavalcante L, Pimenta L, Marchi GM. Microtensile bond strengths of composite to dentin treated with desensitizer products. J Adhes Dent. 2006;8(2):85.
26. Umana M, Heysselaer D, Tielemans M, Compere P, Zeinoun T, Nammour S. Dentinal Tubules Sealing by Means of Diode Lasers (810 and 980 nm): A Preliminary In Vitro Study. Photomed Laser Surg. 2013;31(7):307-14.
27. Lier B, Rösing C, Aass A, Gjermo P. Treatment of dentin hypersensitivity by Nd: YAG laser. J Clin Periodontol. 2002;29(6):501-6.
28. Jokstad A. The effectiveness of lasers to reduce dentinal hypersensitivity remains unclear. J Evid Based Dent Pract. 2012;12(3 Suppl):231-2.
29. Ide M, Wilson RF, Ashley FP. The reproducibility of methods of assessment for cervical dentine hypersensitivity. J Clin Periodontol. 2001;28(1):16-22. Epub 2001/01/06.
30. Collins SL, Moore RA, McQuay HJ. The visual analogue pain intensity scale: what is moderate pain in millimetres? Pain. 1997;72(1):95-7.
31. Kelly A. The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. Emerg Med J. 2001;18(3):205-7.
32. Renton-Harper P, Midda M. Nd:YAG laser treatment of dentinal hypersensitivity. Br Dent J. 1992; 172(1):13-6.
33. Kumar NG, Mehta DS. Short-term assessment of the Nd:YAG laser with & without sodium fluoride varnish in the treatment of dentin hypersensitivity-a clinical & scanning electron microscopy study. J Periodontol. 2005; 76(7):1140-7.
34. Dowell P, Addy M. Dentin hypersensitivity- a review. Aetiology, symptoms and theories of pain production. J Clin Periodontol. 1983; 10(4):341-50.
35. Perry R, Carranza FA, General principles of periodontal surgey. In: Newman M, Takei H, Carranza FA. Editors. Caranza's clinical periodontology. 9th ed Philadelphia: WB Saunders. 2002; 55: 734-5.
36. Schiff T, Dotson M, Cohen S, De Vizio W, McCool J, Volpe A. Efficacy of a dentifrice containing potassium nitrate, soluble pyrophosphate, PVM/MA copolymer, and sodium fluoride on dentinal hypersensitivity: a twelve-week clinical study. J Clin Dent. 1994;5:87.
37. Bartold P. Dentinal hypersensitivity: a review. Aust Dent J. 2006;51(3):212-8.
38. Schiff T, Delgado E, Zhang Y, DeVizio W, Cummins D, Mateo L. The clinical effect of a single direct topical application of a dentifrice containing 8.0% arginine, calcium carbonate, and 1450 ppm fluoride on dentin hypersensitivity: the use of a cotton swab applicator versus the use of a fingertip. J Clin Dent. 2009;20(4):131.

39. Sgan-Cohen HD, Livny A, Vered Y. The elmex sensitive toothbrush: effect on plaque reduction and subjective satisfaction after two months. J Clin Dent. 2008;19(1):22.

40. Yilmaz HG, 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.

41. Kienle GS, Kienle H. The powerful placebo effect: fact or fiction? J Clin Epidemiol. 1997; 50(12): 1311-18.

42. Moghareh Abed A, Naghsh N, Birang R, Shafiei F, Yaghini J, Seifi M. Clinical Evaluation of the Efficacy of Neodymium-Doped Yttrium Aluminium Garnet (Nd: YAG) Laser Therapy and Sensikin® in Treatment of Dentine Hypersensitivity. J Lasers Med Sci. 2012;3(2):61-6.