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Effects of Laser Irradiation and Tooth Mousse on Tooth Hypersensitivity after Office Bleaching: A Non-Randomized Clinical Trial

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ABSTRACT

Background: This study aimed to assess the effect of laser irradiation and Tooth Mousse on tooth hypersensitivity (TH) after office bleaching (OB).

Materials and Methods: This clinical trial, parallel-design split-mouth nonrandomized was conducted on 30 patients requiring OB. After scaling and fabrication of a custom tray, 35% hydrogen peroxide was applied on all teeth, and 940 nm diode laser (10 W, Class IV, 110–240 V) was irradiated to the upper and lower right quadrants. Laser in off mode was used for the left quadrants. Bleaching agent was then reapplied. After completion of bleaching, a custom tray containing tooth Mousse was placed on the maxillary arch while the tray was used without the paste for the mandibular arch. A visual analog scale was used to assess the degree of TH at 15 min and 24 h after OB. Data were compared using *t*-test, paired *t*-test, and analysis of variance. Significance level was set at $\alpha = 0.05$.

Results: Comparison of TH at 15 min and 24 h after OB showed a significantly lower TH score in the left upper quadrant (tooth Mousse alone) than right upper quadrant (both laser and Tooth Mousse) ($P < 0.05$). The TH score in the right upper quadrant was significantly lower than that in the right lower quadrant (laser only) ($P < 0.05$). The mean TH score in the left upper quadrant was insignificantly lower than that in the left lower quadrant (no intervention) ($P > 0.05$).

Conclusion: The use of 940 nm diode laser for OB increases the postoperative TH. The application of Tooth Mousse can effectively decrease TH after OB with/without laser irradiation.

Key Words: Clinical trial, laser, tooth bleaching, Tooth Mousse

INTRODUCTION

Dental esthetics and smile attractiveness have significant impacts on personality and self-esteem of individuals; thus, great attention has been directed to esthetic dentistry in today's world.[1,2] By an increase in demand for a beautiful smile, bleaching treatment has gained increasing popularity due to its excellent results and minimal invasiveness. Bleaching agents with different concentrations have been proposed to achieve ideal esthetic results.[3] Bleaching treatment is performed to improve tooth color and increase the satisfaction level of patients with their smile attractiveness. Although smile esthetics depends on a number of factors such as position and shape of teeth and their leveling and alignment, tooth color also plays a pivotal role in this respect.[4]

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Tooth bleaching can be performed by two common methods of home bleaching and in-office bleaching (OB). In-home bleaching, patients use a tray and a low-concentration bleaching agent to whiten their teeth. However, higher concentrations of bleaching agents are used for OB to eliminate pigments. The commonly used bleaching agents for OB include high-concentration carbamide peroxide (35%–37%) and hydrogen peroxide (30%–35%). Recently, light sources such as quartz tungsten halogen light, plasma arc, light emitting diode, and different laser types are used to accelerate tooth bleaching.[5,6] The mechanism of action of bleaching agents is based on the breakdown of peroxide and generation of free radicals that oxidize the pigments and whiten the tooth shade as such.

Tooth hypersensitivity (TH) is among the most common complications of bleaching treatment, which is directly related to the penetration of free radicals into the tooth structure and reaching the vital pulp.[7] Thus, the risk of TH would be lower when greater tooth structure remains, a lower concentration of hydrogen peroxide is used, or the bleaching agent is used for a shorter period.[8]

TH after OB has been reported in over 50% of patients; however, it is often transient and does not continue for more than 2–3 days. However, even temporary TH can cause patient discomfort and is worrisome for patients.[9]

GC Tooth Mousse is a hydrophilic paste that can remineralize dentin and seal the dentinal tubules. It contains casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) which can confer resistance to the enamel and protect it against acid attacks.[10] Accordingly, it can decrease the permeability of tooth structure to free radicals and decrease TH as such.[11] CPP-ACP acts as a calcium phosphate reservoir buffers the activity of free calcium and phosphate ions and helps maintain a super-saturated state of calcium and phosphorous ions, which prevents enamel demineralization and enhances remineralization. CPP-ACP is commonly recommended as a remineralizing agent for patients with active caries, dentin TH, postbleaching TH, and dental erosion.[12,13]

Several studies have evaluated the efficacy of using laser and Tooth Mousse for the alleviation of postbleaching TH. However, the combined effect of laser and tooth Mousse on TH after OB has not been investigated. Thus, this study aimed to assess the effect of laser and Tooth Mousse on TH after OB.

MATERIALS AND METHODS

This study was conducted at the Restorative Dentistry Department of the School of Dentistry, Arak University of Medical Sciences between 2019 and 2020. The study was approved by the ethics committee of this university (IR.ARAKMU.REC.1398.221), and registered in the Iranian Registry of Clinical Trials (IRCT20191115045454N1).

Trial design

A parallel-design split-mouth (nonrandomized) clinical trial was conducted in which, the four quadrants of each patient were subjected to four different combinations of laser and Tooth Mousse. The results were reported in accordance with the CONSORT guidelines.

Participants, eligibility criteria, and settings

The inclusion criteria were the presence of anterior teeth with no restoration, no previous history of bleaching, absence of carious lesions, absence of endodontically treated teeth, and no toothache.

The exclusion criteria were pregnancy or nursing, presence of hypoplastic lesions, presence of tetracycline stains or fluorosis, presence of malposed teeth, history of orthodontic treatment, presence of abrasion, erosion, or abfraction, periodontal disease, and intake of analgesics or anti-inflammatory medications.

The sample consisted of 30 patients presenting to a private office seeking OB treatment.

Interventions

After obtaining written informed consent from the patients, scaling and prophylaxis were performed for the upper and lower teeth by an ultrasonic scaler (Scalex 980 Piezo Ultrasonic-Scaler; Dentamerica, Taipei City, Taiwan) and a prophy brush and prophylaxis paste (Golchai, Karaj, Iran). Next, impressions were made from the upper and lower dental arches using alginate impression material (Zhermack Tropicalgin Alginate Impression Material, Verona, Italy) and a plastic Tray (Clear, 0.120”, 25/Pkg, Pro-form SoftEVA Traymaterial, Shanghai, China) for the fabrication of custom trays. The patients were then instructed on how to use a 0–10 cm visual analog scale (VAS) and were provided with VAS forms to record their

level of TH after bleaching. In this scale, 0 indicated no TH while 10 indicated severe unbearable pain. Furthermore, the pictorial faces helped the patients quantify their level of pain.

In the second session, the patients received dental prophylaxis and then a mouth opener was used to protect the lips, buccal mucosa, and tongue. In addition, a liquid light-cure resin dam (FGM, Santa Catarina, Brazil) was used to protect the gingiva around the teeth, and light-cured. Bleaching was performed by 35% hydrogen peroxide OB gel (light/chemical cure; FGM, Santa Catarina, Brazil) twice, each time for 15–20 min (depending on the level of TH) for all the upper and lower teeth as instructed by the manufacturer. Local anesthesia was not administered before bleaching treatment so that patients could report any pain or discomfort. If patients reported a burning sensation of mucosa, the treatment would be stopped, the light-cure resin dam would be removed, and the soft tissue would be rinsed with copious water. The bleaching product was supplied in two bottles. Hydrogen peroxide in the first bottle was mixed with the concentrating solution of the second bottle in 3:1 ratio, and the mixture was applied to the buccal and proximal tooth surfaces. Diode Laser (940 ± 10 nm, 10 W, 110–240 V, class IV; EpicTM 10, Biolase Technology, Irvine, CA, USA) was irradiated to activate the bleaching agent for 30 s. The laser was irradiated to the right upper and lower quadrants. However, a laser was used in off mode for the upper and lower left quadrants. After twice application of the bleaching agent, hydrogen peroxide was rinsed off from the tooth surface by water spray and then the resin dam was removed from the gingiva by a dental explorer. Next, Tooth Mousse (GC, USA) was applied in the custom tray and used for the maxillary teeth for 10 min while a tray without Tooth Mousse was used for the mandibular teeth. Accordingly, the right upper quadrant was subjected to laser and Tooth Mousse, the left upper quadrant was subjected to Tooth Mousse without laser, the right lower quadrant was subjected to laser alone and the left lower quadrant did not receive any intervention (neither laser nor Tooth Mousse). After 10 min, the Tooth Mousse was rinsed off. The level of TH and dental pain of patients was measured after 15 min and 24 h using a VAS. The pain score of patients was recorded at the dental office at both time points.

Outcomes (primary and secondary)

The main objective of this study was to assess the effect of laser and Tooth Mousse on TH after OB.

Sample size calculation

The sample size was calculated to be 10 in each group according to a previous study[14] assuming alpha = 5%, beta = 10%, and study power of 90% using STATA software version 12 with 95% confidence interval. Considering the presence of two groups in the study and the possibility of dropouts, 30 patients were enrolled.

Interim analyses and stopping guidelines

No interim analyses were performed, and no stopping guidelines were established.

Blinding

The patients were blinded to the group allocation of their jaw quadrants such that laser was irradiated to the right upper and lower quadrants. However, laser was used in off mode for the upper and lower left quadrants. Furthermore, a custom tray containing Tooth Mousse was used for the upper quadrants while an empty tray was used for the lower quadrants, and the patients were not aware of the contents of the trays. The examiner who analyzed the VAS scores of patients and the statistician who analyzed the data were both blinded to the group allocation of quadrants as well.

Statistical analysis

Data were analyzed by STATA 12 (STATA Co. LLC, Texas, USA) using independent *t*-test, paired *t*-test, analysis of variance, and Tukey's *post hoc* test at 0.05 level of significance.

RESULTS

Participant flow

A total of 21 females (70%) and 9 males (30%) were evaluated in this study. The patients had a mean age of 36.78 ± 4.89 years and of all, 60% (n = 18) were below 30 and 40% (n = 12) were over 30 years of age. Figure 1 shows the flow diagram of the study.

Harms

No patients were harmed during the study.

Group analyses

Tooth hypersensitivity after 15 min

As shown in Table 1, in the maxilla, the mean VAS score of in the left quadrant (Tooth Mousse alone) was significantly lower than that in the right quadrant (laser + Tooth Mousse) (P = 0.05).

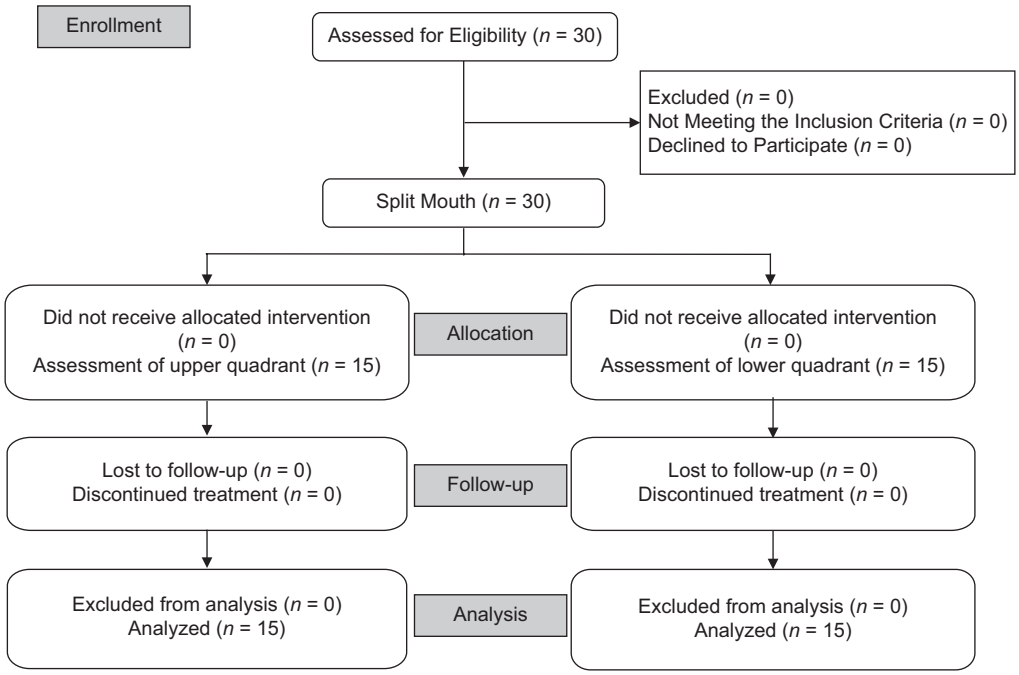

Figure 1: Flow diagram of the study.

Table 1: Mean score of tooth hypersensitivity in the four quadrants at 15 minutes and 24 h after office bleaching

Jaw	Quadrant (cm) (mean±SD)		*P**
	Right (laser)	Left (no laser)	
15 min			
Maxilla (with Tooth Mousse)	2.9±1.72	2.33±1.80	0.05
Mandible (without Tooth Mousse)	3.93±2.51	2.66±1.53	0.001
*P**	<0.001	0.172	
24 h			
Maxilla (with Tooth Mousse)	1.26±1.33	0.8±1.12	0.044
Mandible (without Tooth Mousse)	1.5±1.22	0.53±0.62	<0.001
*P**	0.214	0.233	

**P*-value was calculated by paired *t*-test. SD: Standard deviation

In the mandible, the mean VAS score in the left quadrant (no intervention) was significantly lower than that in the right quadrant (laser alone) ($P = 0.001$).

A comparison of the right quadrants of the maxilla and mandible also revealed that the VAS score in the right quadrant of the maxilla was significantly lower than that of the right quadrant of the mandible ($P = 0.000$).

Comparison of the left quadrants of the maxilla and mandible showed that the mean VAS score in the left quadrant of the maxilla was insignificantly lower than that in the left quadrant of the mandible ($P = 0.172$).

The difference in the mean VAS scores was not significant between the maxillary right and mandibular left quadrants ($P = 0.401$). However, the mean VAS score in the left maxillary quadrant was significantly lower than that in the right mandibular quadrant ($P = 0.001$).

In general, the mean VAS score in the maxilla (application of Tooth Mousse) was significantly lower than that in the mandible (no application of Tooth Mousse) ($P = 0.007$).

Comparison of the right and left sides also showed that the mean VAS score in the left side (no laser) was significantly lower than that in the right side (laser application) ($P = 0.002$).

Tooth hypersensitivity after 24 h

As indicated in Table 1, the mean VAS score in the upper left quadrant was significantly lower than that in the upper right quadrant ($P = 0.044$). In the mandible, the mean VAS pain score in the left side was significantly lower than that in the right side ($P = 0.000$).

Comparison of the upper and lower quadrants revealed no significant difference neither in the right ($P = 0.214$) nor in the left ($P = 0.233$) side in VAS scores. However, the mean VAS score in the lower left quadrant was significantly lower than that in the upper right quadrant ($P = 0.000$). The mean VAS score in the upper left quadrant

was significantly lower than that in the lower right quadrant ($P = 0.029$).

Comparison of the VAS score of the maxilla and mandible, in general, revealed no significant difference ($P = 0.461$) while the mean VAS score in the left side was significantly lower than that in the right side ($P = 0.001$).

DISCUSSION

This study was the first to assess the effect of 940 nm diode laser application with/without Tooth Mousse on TH after OB. The results indicated that laser irradiation increased TH after OB, while the application of Tooth Mousse effectively decreased it. Furthermore, the results showed that TH at 15 min and 24 h after OB in the left lower quadrant (subjected to no intervention) was significantly lower than that in the right lower quadrant (subjected to laser). Moreover, the mean VAS score in the left side (no laser) was significantly lower than that in the right side (laser group). Kossatz *et al*.[15] evaluated the effect of light-emitting diode (LED) on the efficacy of bleaching and occurrence of TH, and showed that the majority of patients in LED-assisted bleaching group had TH even after 24 h while only 26.6% of patients subjected to conventional bleaching without LED reported TH postoperatively. The two groups had similar TH scores immediately after bleaching. However, at 24 h, the LED-assisted bleaching group had significantly higher TH at 24 h after each bleaching session. Their results were in line with the present findings, indicating that light-assisted bleaching causes greater TH compared with conventional bleaching. He *et al*.,[5] in a systematic review on TH after laser-assisted bleaching concluded that light-assisted bleaching results in higher postoperative TH, which was in agreement with the present results. Al-Maliky[16] evaluated the effect of 940 nm diode laser (7 W powers in continuous-wave mode) for OB on postoperative TH and reported that laser irradiation caused a reduction in TH. The difference between their results and the present findings may be due to different methodologies. Furthermore, the assessment time points were different in the two studies since we assessed TH at 15 min and 24 h while they evaluated TH after 6 and 24 h. Moosavi *et al*.[17] evaluated the effect of low-level laser therapy on TH following OB. They evaluated 660 and 810 nm laser (200 mW, 15 s, 12 J/cm^2) and showed that application of low-level laser decreased postoperative TH. The difference between their results and the present findings may be due to the use of different concentrations of hydrogen peroxide (40% in their study versus 35% in the present study), and using a lower wavelength of laser in their study. In addition, they applied the bleaching agent 3 times, each time for 15 min, which was different from the protocol employed in the present study (twice, each time for 15–20 min). Moncada *et al*.[18] evaluated the effects of light activation, concentration of bleaching agent, and thickness of tooth structure on TH after bleaching. They found that TH in the group subjected to bleaching with 15% hydrogen peroxide and light-activated nitrogen titanium dioxide was significantly lower than that in the group subjected to light-activated 35% hydrogen peroxide immediately after treatment. No significant difference was noted in TH between the latter group and the group subjected to bleaching with 35% hydrogen peroxide without light activation. Difference between their results and the present findings may be due to different methodologies, sample sizes, and laser types. Variations in the results of studies can be due to different laser parameters as well. Yahya *et al*.[19] evaluated the effect of sodium fluoride varnish and diode laser on TH after bleaching and concluded that both methods decreased TH after bleaching. Difference between their results and the present findings can be attributed to differences in laser irradiation time, which was 60 s in their study and 30 s in the present study.

The present results showed that the mean VAS score in the right quadrant of the maxilla subjected to laser and Tooth Mousse was significantly lower than the mean VAS score of the right quadrant of the mandible subjected to laser alone at both 15 min and 24 h. Also, the mean TH in the left quadrant of the maxilla (subjected to Tooth Mousse alone) was lower than that in the left quadrant of the mandible that received no intervention, although this difference was not significant. Similar results were reported by Nanjundasetty and Ashrafulla[20] on the efficacy of 5% potassium nitrate, 7% sodium monofluorophosphate, and CPP-ACP. They showed that all desensitizing agents effectively decreased postbleaching TH with no significant difference among them. Moreover, they showed that TH in the maxilla, which was subjected to Tooth Mousse was significantly lower than that in the mandible (not receiving Tooth Mousse) at 1 h after OB. Their results were in accordance with the

present findings. Maghaireh *et al.*[21] also showed the optimal efficacy of 10% CPP-ACP for the reduction of TH following OB. Similarly, Borges *et al.*[22] showed that the simultaneous use of 10% CPP-ACP and high-concentration hydrogen peroxide can successfully decrease TH and morphological changes of enamel in the process of OB.

The present study also compared the effects of laser and Tooth Mousse on TH after OB. The results showed that the mean VAS score in the maxillary left quadrant subjected to Tooth Mousse alone was significantly lower than that in the mandibular right quadrant subjected to laser therapy alone at both 15 min and 24 h. Furthermore, the mean VAS score in the maxillary right quadrant subjected to both laser and Tooth Mousse was significantly higher than that in the maxillary left quadrant subjected to Tooth Mousse alone.

Limitations

Small sample size and lack of randomization were the main limitations of this study. Future randomized studies with a larger sample size and different laser parameters and concentrations of hydrogen peroxide are required.

CONCLUSION

The use of 940 nm diode laser for OB increases the postoperative TH. Application of Tooth Mousse can effectively decrease TH after OB with/without laser irradiation.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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