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To evaluate the effectiveness of the laser diode on bleaching colors changed teeth under laboratory conditions

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ABSTRACT

White teeth, are an important measure of beauty, and today, the use of laser tooth bleaching, is growing. The purpose of this study, is evaluating the effectiveness of laser diodes, on whitening teeth, discolored previously by tea, coffee, and pomegranate juice pigments. In this experimental study, 72 healthy bovine incisors were selected, were prepared, and were divided into three groups of 24 numbers. They were placed in a solution of tea, coffee and pomegranate juice, for two weeks. Each group was divided into two sub-groups of 12, following the first group; both groups were bleached by the bleaching gel 35%, and 940 nm diode laser. Laser was applied to each tooth, with four cycles of 30 seconds, and the power of 7 watts. The second groups were bleached by 35% gel, for 16 minutes as controls. Next, the teeth were stained measured by spectrophotometry. Data were entered into the software SPSS version 20, and were analyzed using descriptive statistics, analysis and t-test, and ANOVA, with a significance level ($p<0.05$). After placement of tooth colored materials (coffee, tea and pomegranate juice), three groups of pigments, creating significant color change (0.000 P-value = in each group), the component (l, a, b). Most discoloration was created in coffee, and any change in the color of pomegranate juice. Effectiveness of whitening discolored teeth, with and without laser diodes, showed no significant statistical difference (P-values≥0.05). In treatment groups, with and without laser, the highest effectiveness of bleaching (13.90 = ΔE with laser), (11.31 = ΔE without laser) in the group tea, and least effective bleaching (6.51 = ΔE with laser), (5.85 = ΔE without laser) was obtained in the group pomegranate juice. Regardless of the type of tooth discoloration, this study suggests that there is a relationship between type of discoloration of enamel, and efficacy of treatment of bleaching. 940 nm laser diodes did not increase the effectiveness of catalytic bleaching.

KEY WORDS: BLEACHING, TEETH WHITENING, LASER DIODES

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INTRODUCTION

Need to bleaching, in the population is growing. Contemporary bleaching systems are primarily based on hydrogen peroxide, or one of its derivatives, which are often established with liquid peroxide which is used in different concentrations (Lagori *et al.* 2014). Bleaching is defined as a way to lighten the color of teeth using organic oxidizing agents of pigment. Increased release of hydroxyl radicals from hydrogen peroxide, with increasing temperature is according to the following equation (Pare and Loganathan, 2012).

$$H2O2+211KJ/Mol \rightarrow 2HO$$

Bleaching reactions, is dependent on the chemical and physical changes, during operation (concentration, temperature, light, pH, co-catalyst, and duration) (Tano *et al.* 2012).

Raising the temperature to C˚ 10 increases the hydrogen peroxide decomposition to x2.21. The use of light sources such as laser (Light Amplification by strengthening and emitting a radiation) light hybrid (HL), halogen, LED, plasma arc, and UV lamps are used to accelerate the release of free radicals.First used wavelengths, were argon laser (480 nm), and CO2 (10600 nm), but today laser Diode (810 and 980 nm), and potassium phosphate Titanil KTP (532 nm) are proposed too. Laser diodes are used as well as pulsed or continuous, and have the wavelengths of 830, 810 and 980 nm. Diode laser has less absorption of water and minerals of the teeth; they are absorbed in pigments and have a lot of depth, in hard tissue of teeth. Clearly, the best laser parameters, such as power, wavelength, frequency, and duration of use in dental treatment, totally depends on, different color themes, tooth type, and change its color depends on the skill and experience of the dentist , which should be considered in reviews, as a key element (Nokhbe alfogahaei *et al.* 2012). Different types of lasers, they create different effects, depending on the wavelength used, and the type of material that causes discoloration, and each wave laser, the whitening effect on a certain type of dye. In fact, a particular type of bleaching gel, when coupled with different lasers and different color elements, creates dissimilar results (different) (Torres *et al.* 2011).

MATERIAL AND METHODS

After preparing freshly extracted teeth of cattle, and washed with water and physiological solution, to split between their teeth. Selected teeth healthy, and was free of any cracks, decay and enamel defects. Root, cut from the junction of the cement enamel, diamond bur, and the pulp was removed. The teeth were kept for a week for decontamination in 0.5% thymol solution. Teeth brushing of the orifice were closed, light-cured composite. The teeth were randomly numbered from 1 to 72, and numbers were recorded in each tooth lingual, by fine milling. Then color parameters were measured in pigments, by a spectrophotometer (spectrophotometer KONIKA MINOLTA Model CS-2000_ Japan) before wrapping teeth (BS).The teeth have been prepared before measuring the color. In this case, the first four points were prepared in Bacall level, just a quadrilateral the dimensions of 5 x 5 mm, and at every step, measuring the color of a part that was fixed between points, done. This is done by milling the fine of turbines. And then, a specific form for each tooth must be prepared, with the proviso that, all templates are the same.

It should be noted that, at any time by spectrophotometer colorimetric, to enhance the accuracy of the study is to determine the color of teeth in each series, three consecutive colors was determined, and the average results achieved in statistical surveys and The evaluation results was done.To stain teeth, 3 different types of dye, tea, coffee, and pomegranate juice were used. Instant tea Tea bags intensity using a number (Golestan-Iran), in 250 ml of boiling water, the tea out of the water, so cooler full of boiling water. 10 grams of soluble coffee using coffee powder (Nestle - Switzerland), which is normally used for consumption, mixed in 250 ml of boiling water, then it was filtered, and

Pomegranate juice, pomegranate seeds by mixing 50 grams in 250 ml of distile water, grains, were crushed well in it, and then filtered solution was obtained (Lagori *et al.* 2014). The teeth were immersed in the solution, so that the numbers 1 to 24 in a mixture of tea, coffee 25 to 48, and 49 to 72 in pomegranate juice, were stored for two weeks at 37 ° C (incubator), and mixed daily. After two weeks, the teeth out of solution and were washed with brushes. Then, they were placed in physiological solution, and again were measured by spectrophotometric color of the teeth (AS).

Bleach the teeth were prepared for the case that the first half of the teeth of each group were white using a laser, and the second half without a laser. In the examples, along with laser bleaching: teeth were dried, and a drop of 35% carbamide peroxide gels Pola office (SDI Australia) were placed on each, and was broadcast by micro-brush, as a uniform layer. Remained gel on the teeth for about 8 minutes, and during this time, it was under the influence of diode laser radiation (laser diode Biolase, model Epic10 940 nm wavelength, and the 7 watt United States), for each tooth, two 30-second cycle with a rest period of one minute (power 7 w). After 8 minutes, the teeth were rinsed with water. And the process was repeated. In total, on each of these examples, the bleaching gel and laser for 2 minutes and 16 minutes were used according to manufacturer's recommen-

dations. In the examples, without using a laser bleaching was: were dried teeth, and bleaching gel was placed on each drop, and it was broadcast by Mykrvbrash, as a uniform layer. Remained gel on the teeth for about 8 minutes. The teeth were washed with water, and the process was repeated. And finally, the re-evaluation was carried out by a spectrophotometer color. Evaluation of color changes, (ΔE) were calculated and obtained by the formula ΔE = (Δ L2 + Δ a2 + Δ b2) 1/2.

RESULTS

To study findings, the color component data were collected, and then entered in SPSS version 20, and then, the analysis was performed assumptions.

Color parameters L, a, b, after exposing the pigment of tea, coffee, and juice, have changed significantly. (P-value = 0) (Table 1, 2, 3) Color parameters L, a, b, changed significantly after the placement of the brown pigment. Color parameters L, a, b, changed significantly after exposure to Pigment pomegranate juice.

After placement of teeth in color, ΔE increased significantly, so that the greatest change was observed in the group coffee, and any change colors in the group

Table 1. compares the color components before and after exposure to tea

Color component	mean	Standard deviation	P-value
L before color L after color	86.20 76.80	1.749 7.066	* 0.0
a before color a after color	0.5036 4.573	0.6422 3.304	* 0.0
b before color b after color	15.92 21.21	2.219 4.019	* 0.0

* Is significant (P-value ≤0.05).
Color parameters L, a, b, tea pigment after exposure, have changed significantly.

Table 2. compares the color components before and after exposure to coffee

Color component	mean	Standard deviation	P-value
L before color L after color	87.98 75.08	2.006 6.046	* 0.0
a before color a after color	0.5480 4.332	0.5403 1.695	* 0.0
b before color b after color	13.96 19.56	2.370 2.914	* 0.0

* Is significant (P-value ≤0.05)
Color parameters L, a, b, after exposing the brown pigment, have changed significantly.

Table 3. compared the relationship between color, before and after exposure pomegranate juice

Color component	Mean	Standard deviation	P-value
L before color L after color	86.90 80.42	2.278 4.186	* 0.0
a before color a after color	0.5453 3.187	0.6840 1.129	* 0.0
b before color b after color	15.65 18.03	2.047 2.498	* 0.0

* Is significant (P-value ≤0.05)
Color parameters L, a, b, after the placement of the pigment pomegranate juice, have changed significantly.

Table 4. Compare, ΔE before and after bleaching the teeth, between the control group and laser Tea

Group	Mean	Standard deviation	P-value
ΔE control	11.31	6.507	* 0.243
ΔE Laser	13.90	3.687	

* Is not significant (P-value ≤0.05)
There was no significant difference in ΔE of teeth discolored by tea, between control and laser, (although ΔE in white with lasers, be higher).

Table 5. compared ΔE, before and after bleaching the teeth, between the control group and lasers, in coffee

Group	Mean	Standard deviation	P-value
ΔE control	10.53	4.102	* 0.099
ΔE Laser	13.80	5.136	

* Is not significant (P-value ≤0.05)
There was no significant difference in ΔE of discolored teeth, by coffee, between control and laser (although ΔE in white with the laser above).

Table 6. compares the ΔE before and after bleaching the teeth, between the control group and laser pomegranate juice

Group	Mean	Standard deviation	P-value
ΔE control	5.851	4.486	* 0.673
ΔE Laser	6.510	2.887	

* Is not significant (P-value ≤0.05)
There was no significant difference in ΔE of discolored teeth, by the PJ, between control and laser (although ΔE, in the White Group with lasers, be higher).

Table 7. Comparison with laser teeth whitening effectiveness among the three color groups

Group		Mean Difference	P-value
tea	Coffee Pomegranate juice	0.108 7.39	0.998 *0.003
coffee	tea Pomegranate juice	0.108 7.29	0.998 *0.004
Pomegranate juice	tea coffee	7.39 7.29	*0.003 * 0.004
*Is significant (P-value ≤0.05)			

pomegranate juice.Also it was observed statistically significant differences in ΔE of teeth discolored by tea, the control group, and laser (p-value <0.05) (although ΔE in white with the laser above). (Table 4). It was observed statistically significant differences in ΔE of discolored teeth, by coffee, between control and laser (p-value <0.05), (although ΔE in the White Group by laser, was higher). (Table 5) There was no significant statistical difference in ΔE of discolored teeth, by Pomegranate between the control group and lasers. (P-value <0.05) (Although ΔE in white with lasers, be higher). (Table 6)

In the group, was done with laser bleaching, ΔE between the three groups, discolored by tea, coffee, and juice will be significantly different. (Table 7); the lowest was in part due to discolored teeth with pomegranate juice, and the most effective, was on teeth discolored by tea, as it will, the difference was pomegranate juice with both pigment of tea and coffee meaningful, and the difference between tea and coffee, was not statistically significant.In the group, was done without laser teeth whitening, ΔE discolored between the three groups, with tea, coffee, and juice, was significantly different (highest color change was observed in the group tea, and any change colors, in the group pomegranate juice). (Table 8)

Table 8. Comparison of bleaching teeth, no laser, the three groups color

group		Mean Difference	P value
tea	Coffee Pomegranate juice	0.783 5.46	0.887 *0.007
coffee	tea Pomegranate juice	0.783 4.68	0.887 *0.023
Pomegranate juice	tea coffee	5.46 4.68	*0.007 *0.023
*Is significant (P-value ≤0.05)			

DISCUSSION

Photons can have a significant impact on the molecule. If a molecule can absorb a photon, it can be irritating or even split apart. The bleaching process, needs to disintegrate, or transform molecules, which cause tooth discoloration. This process can take place, resulting in absorption of photons by molecules, or indirectly, by raising the temperature of the gel and accelerate the production of free radicals, and activate redox chemical reactions, which leads from the disrupting dye molecules. In this process, many free radicals are produced from the decomposition of hydrogen peroxide, which is very active in breaking the double bonds. Hydroxyl radicals (OH) are the most powerful radicals. Many studies have shown that, by increasing the production of hydroxyl radicals, can achieve better results in tooth whiteners. As I was indicating, optical and laser sources, cause temperature rise of hydrogen peroxide, and accelerate the formation of free radicals. Every 10 ° C increase in temperature, accelerate the detachment of hydrogen peroxide bonds 2.2 times (Lagori *et al*. 2014).

On the other hand, we are faced with a multi-criteria decision, to choose an appropriate, the dental bleaching. Although the main objective is to achieve beauty in bleaching, but significant effects on the patients teeth are impossible to ignore. So, dentist in bleaching is always faced with an interaction between beauty and health, which are both important (Nokhbe alfoghahaei, 2012).

In the present study, bovine teeth were used for a variety of reasons. No caries, and a better overall situation, which is consistent with the study. Providing more convenient incisors cattle, towards humans, because humans produce healthy incisor, the high number of working problems. As well as physically for chemical similarity to human teeth (Schilke *et al*. 2000), and (showing similar behavior in the process of bleaching and staining, (Attia *et al*. 2009) Please refer to the source).

In the present study, the colored components, l, a, b after placing the samples in color, significantly changed. Most discoloration (ΔE), was in the group coffee, then tea, and any change in the color of pomegranate juice, the result is similar to the study Lagori G, the biggest change was the color of coffee (Lagori *et al*. 2014). Of course, the shelf life of the dye solution, in the two-week study, which is more than the Lagori G (a week).

In the present study, the use of 940 nm diode laser, it can whiten significantly improved results, with 35% hydrogen peroxide, was not in any of the groups compared to the control group.

This result was similar to the results of previous studies Marson FC), Auschill TM, Sulieman M and Polydorou)

(Auschill *et al*. 2005; Sulieman *et al*. 2005; Marson *et al*. 2008; Polydorou *et al*. 2013). But the result was different with the results of clinical studies Zekonis R and his colleagues, who had applied bleaching agent, for a period of 60 minutes on the teeth (Zekonis *et al*. 2003). Also, it was different from the results Ozgul Baygin, the use of 980 nm diode laser with a power of 0.8 Watt and 1 Watt for 30 seconds, and Whiteness HP was used as bleaching agent, and concluded that, laser bleaching to increase effectiveness. But the study Baygin, the teeth were not dye the material, and the material was bleached and varying concentrations (38%) (Baygin, 2012). According to a study Wetter NU, the effectiveness of laser diode with a bleaching agent Whiteness HP better than Opalescence xtra. Also, 10 minutes had been used in the control group or without laser which in this study; it increased to 16 minutes, which can increase the effectiveness of laser bleaching in groups (Wetter, 2004).

The results Lagori G, was somewhat different with the study, so that the laser diode, only on teeth discolored by coffee was effective, because of this difference, it could be a different wavelength laser diode, in two studies, and use of different bleaching agents (Lagori *et al*. 2014). After bleaching, spectrophotometer, can detect very small differences between the color of the teeth before and after treatment. However, clinical outcomes are not detectable to the eye until the ΔE not be higher than 3. In the present study, in groups with and without laser, in all pigments, after bleaching, ΔE was higher than 3.

The results of this study, the effectiveness of laser bleaching, discolored between the three groups with tea, coffee, and juice, were significantly different. The efficacy was significantly observed in teeth, discolored with pomegranate juice (6.510 = ΔE). There was no statistically significant difference between the effectiveness of whitening teeth discolored by tea (13.90 = ΔE) and coffee (13.80 = ΔE).These results were different from the results Lagori G, which saw the lowest effective whitening laser diode, the Group of pigment coffee, and tea, and the most effective laser diode on the pigment of red fruits, the Department of red fruits of Lagori G, consisting of a combination of pigments strawberries, raspberries, and blueberries, which are not comparable with pomegranate juice in this study. Regardless of colored fruits, laser diode greatest effect was observed on tea pigment, which is similar to the current study (Lagori *et al*. 2014).

The results of this study, the effectiveness of bleaching without the use of lasers, the Group discolored by tea, was the highest, and it was lowest in the group pomegranate juice (statistically significant difference was observed between the groups of pomegranate juice with tea and coffee) the result is similar to the study Lagori G, the following groups of red fruits, the highest efficacy of bleaching was observed in the control group (without laser) in the pigment tea (Lagori *et al*. 2014).

Although pomegranate juice group showed minimal changes in pigment color during storage, after bleaching (with and without laser), which showed the lowest result in improved color. This result could be due to the acidity of pomegranate juice, as reported in previous studies, acidic drinks, causes loss of surface material, and created more rough enamel, which it makes, more stable materials color, and this change could reduce the effectiveness of bleaching the surface (De Araújo *et al*. 2013).

CONCLUSION

1. After making tooth-colored material (tea, coffee and juice), three groups of pigments, creating significant color change (0.0 p-value =, in each group). The greatest change in color was brown, and the lowest color change was observed in the group pomegranate juice.
2. In-all color groups (coffee, tea, and juice) the effectiveness of whitening teeth discolored, with and without laser diode showed no significant difference.
3. In both groups, with and without laser, the lowest efficacy of bleaching was observed in discolored teeth with pomegranate juice, and the most effective whitening, teeth discolored by tea.

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