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EFFICIENCY OF DIFFERENT INTERNAL BLEACHING TECHNIQUES ON DISCOLORED TEETH: IN VITRO STUDY.

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ABSTRACT

Purpose: The aim of this study was to evaluate the efficiency of walking, light, and laser bleaching on discolored teeth by TAP as it was applied internally. **Methods:** seventy extracted maxillary and mandibular permenant incisors were used. All the extrinsic stains and debris were removed using an ultrasonic scaler then the surfaces were polished by pumice and water. Access cavities were prepared in the specimens and irrigated, then the TAP was applied for 21 days. The samples were divided into control group(n=10), walking bleaching(n=20), light bleaching(n=20) and laser bleaching(n=20). **Results:** All groups showed significant discoloration ($p<0.001$) where the highest mean value was in the light group and the lowest was in the laser group. After bleaching all the groups showed significant difference from the discoloration but the highest was the light group where ($p=0.014$) then the laser and the lowest was the walking group. **Conclusion:** The light bleaching technique was the most effective technique among the three techniques.

KEYWORDS: Triple antibiotics paste, walking bleaching, light bleaching, laser bleaching, spectrophotometer.

1. INTRODUCTION

One of the things that play an important role in the physical attractiveness in each person life is the aesthetic appearance of the teeth where tooth discoloration is a common and frequent dental complain associated with aesthetic and clinical findings, there are two types of discoloration either internal or external differ in severity, aetiology, location, composition, appearance and causes.

The internal discoloration has a lot of systemic and local causes that distinct from the external discoloration. One of the common local factors that cause internal discoloration is blood haemolysis due to trauma to the pulp or incomplete pulp tissues removal leading to blood products and iron dissemination into the dentinal tubules which may eventually leading to blood necrosis.[1] Other causes maybe the root canal restorative materials when left in the pulp chamber such as Ledermix.[2] Also the sealers and intra-canal medicaments especially those containing tetracycline or minocycline causes loss of tooth translucency combined with yellowing or dark discoloration of the tooth.[3] Unfortunately, with the era of regeneration endodontic treatment the usage of intra canal medication is increased. This was accompanied by increasing discoloration of treated teeth that why minocycline was replaced by doxycycline in order to decrease the discoloration.[4] Bleaching is a chemical process where decolouration occurs. Most of the tooth stains are organic compounds of conjugated chains of single and double bonds. By applying an oxidizing agent during bleaching, this will produce a free radicals oxygen leading to break up of the double bond of the organic compounds. However the mechanism of the tooth whitening changes according to many parameters as type of the tooth stains, PH, temperature, and lightening. Bleaching is either internal or external, with a new bleaching techniques such as light or laser bleaching a better aesthetics results achieved with a relatively simple and inexpensive procedures and it is easy and speedy procedure.[5,6] Over time and years many of whitening systems and methods were defined to improve the results of bleaching. The whitening systems supposed be divided into home bleaching and in office bleaching which is done by the professional dentists. In office bleaching can be categorized to working parameters such as the type and the form of the whitening agent used, its concentration, time of application and whether it is activated or not using hot instrument, ultra sonic tip, halogen light, LEDS or laser. In order to save time and obtain faster results, the bleaching agent can be activated and catalysed by heat and light. By increasing the temperature of the bleaching agent it will form oxygen free radicals due to composition of the oxidizing agent and this can enhance the release of stain containing molecules. This process of whitening by light called photo-oxidation using plasma arc, halogen lambs and LEDS.[7,8] Laser bleaching still raises a number of concerns, as it sometimes produces poor aesthetic results, due to application of the bleaching gel without specific wavelength of the laser used.[9] It is still debatable

whether the light activation results in superior tooth lightening when compared to non- activated bleaching therapies.[8] By increased the aesthetic needs of the patients the accuracy of tooth shade determination increased this leads to a continuous development of tools and systems in shade measurements based on a scientific theories such as spectrophotometry.[10]

As we get noticed, little is mentioned in the literatures regarding the effect of internal bleaching on tooth discoloration. Therefore the aim of this study is to evaluate the efficiency of three different bleaching techniques (walking, light, and laser bleaching) on changing the colour of discoloured teeth The null hypothesis is that there is no difference between the three bleaching techniques.

2. MATERIALS AND METHODS

2.1. Selection of specimens

Inclusion criteria

Seventy extracted maxillary and mandibular permenant incisors sound teeth which were extracted for orthodontic or periodontal reasons with no coronal restoration, caries, fractures or cracks.

Exclusion criteria

Teeth with cracks, coronal restorations, caries, posterior teeth also teeth extracted on purpose for the study.

2.2. Preparation of specimens

For creation of standardized specimens, the apical part of each root was removed perpendicular on its long axis using diamond disc until 10mm of root remained.[11] Endodontic access cavities were prepared and the shortened root canals were enlarged by #1 to#4 gates glidden drills to simulate open apex and irrigated with 5 ml sodium hypochlorite (2.5%) then by 17 ml EDTA (17%) for 1 minute then root canals were irrigated with 10 ml distilled water using plastic syrinage in order to simulate clinical irrigation then dried using paper points.[12] The root canal apical opening was closed with composite resin.

2.3. Discoloration of the specimens

TAP preparation

TAP was prepared to provoke tooth discolouration.[13]
3 mix- ratio (1:1:1) of Ciprofloxacin 500mg(1 capsule) , metronidazole 500mg(1 capsule), and doxycycline 100 mg (5 capsules) all were mixed with distilled water in ratio 3:1 Distilled water or saline.

TAP application

The TAP paste were applied in the root canal using amalgam carrier just below the CEJ, access cavities were then sealed using cotton pellets and glass[14] ionomer material as a temporary filling material to prevent the leakage. All samples were stored in 100% humidity at 37c for 3 weeks. After 3 weeks, the temporary filling material (glass ionomer) was removed in order to remove the TAP 10 ml of 2.5% sodium hypochloride was used with an ultrasonic file to facilitate the removal.

2.4. Classification of the specimens

Samples (n=70) randomly divided into 4 groups according to the bleaching method.

Bleaching steps

Group1(Walking bleaching)

Carbamide peroxide gel 15% with Potassium nitrate and 0.11% fluoride ion (Opalecence, Ultradent) was applied from the lingual surface of the teeth just below the CEJ about (2mm thickness) according to the instructions of the manufacturer it was applied 4 times with 7 days interval. Between the applications cavities were sealed using glass ionomer. The teeth were replaced in incubator inbetween usage.[15]

Group2(Light activation)

A 2mm thick layer hydrogen peroxide gel 35% was applied using an intraoral tip into the access cavity of each specimen. Then, it was photo activated using White smile device at 3 intervals for 8 mins with a waiting period of 2 min between each bleaching session. Between every interval the bleaching material was removed using cotton pellet immersed in 3% hydrogen peroxide solution the the tooth was rinsed under running water. The used LEDS light had power intensity of 150 W with high intensity blue light (480-520nm). It was kept at a distance of 5mm from the tooth surface. Water saturated gauze pad was placed under each specimen during bleaching procedure to prevent dehydration.[16,17,18]

Group 3 (Laser activation)

A 2mm thick layer of hydrogen peroxide gel(35%) was applied by an intra oral tip of the syrainge into the access cavity just below the CEJ then the fiber optic tip of laser device was passively inserted for 2mm into the cavity. The laser was diode laser (980nm with 1.5 watt power with CW for 50seconds or almost a minute according to the manufacturer's instruction).[19]

2.5. Methods of evaluation

Colour was measured using vita Easy shade 4.0 and was assessed in three times.[20]

Readings were taken

- Discoloration reading
- Bleaching reading

Walking bleaching (after the 4 weeks)
Light bleaching (after the 3rd session)
Laser bleaching(after the activation)

For shade recording, the tip of the device (vita Easyshade) was placed on the cervical third of the tooth from the labial surface of the crown directly.[21] The button pressed for few seconds until the device produce a sound that indicates colour recording (L, a, b) values

which were recorded for every tooth separately to be used later. For calibration the device was returned to its base after each use.

The colour change (ΔE*) of each specimen was calculated using the following equation.

$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$

Where the

L* parameter indicates lightness and ranges in value from 0 (black) to 100 (white),

a* indicates greenness/redness (negative values indicate green and positive values indicate red),

b* indicates blueness/yellowness (negative values indicate blue and positive values indicate yellow).

2.6. Statistical analysis

Data was calculated to check the data distribution to calculate the mean and standard deviation to explore for normality using Kolmogorov-smirnov and Shapiro-wilk tests. Between groups One-way ANOVA followed by Tukey post hoc test was used to compare between them.

3. RESULTS

There were a statistically significant difference between (After discoloration) and (After bleaching) in all groups where walking bleaching was (p=0.041), light bleaching (p=0.014), laser bleaching(p<0.001). where after discoloration the highest mean value was found in (Light bleaching), while the lowest mean value was found in (Laser bleaching). While after bleaching the highest mean value was found in (Light bleaching), while the lowest mean value was found in (Walk bleaching).

Table 3: The mean, standard deviation (SD) values of ΔE bleaching of different groups.

Variables	ΔE bleaching				
	After discoloration		After bleaching		p-value
	Mean	SD	Mean	SD	
Walk bleaching	17.83	2.82	20.07	1.20	0.041*
Light bleaching	26.24	3.61	32.43	2.62	0.014*
Laser bleaching	13.57	2.25	27.11	3.01	<0.001*

*; significant (p<0.05) ns; non-significant (p>0.05)

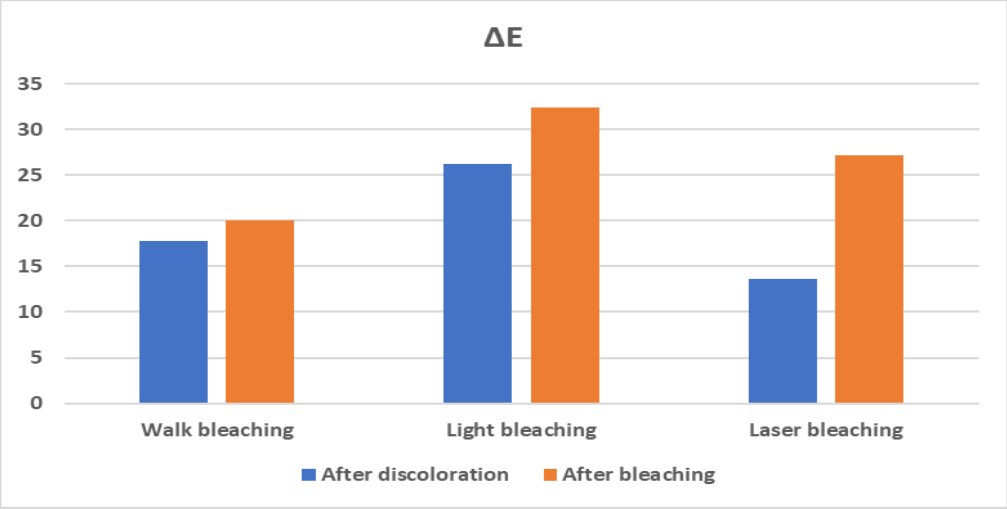

Figure 10: Bar charts representing ΔE bleaching for different groups.

4. DISCUSSION

The goal of this study was to compare the effect of three different bleaching techniques (walking, light and laser)on discoloured teeth that were premedicated with triple antibiotics paste.

The null hypothesis was rejected given shows that there was a significant difference between the three techniques. The light activated bleaching was significantly higher than laser and the walking bleaching techniques. Previous studies compared between the walking bleaching using different bleaching materials with different concentrations[15], or between the light and laser bleaching techniques[22], or between the activation of different bleaching material with different light sources.

Teeth were allocated into three experimental groups to compare the three bleaching techniques. The light technique was more efficient than the two other groups (walking and laser).

The spectrophotometer was used as vita Easy shade to assess the colour as a measurement device was used in this re-search. Vita Easy shade one of the most reliable and accurate devices and very excellent repeatability and it used commonly in the clinics. The device qualifies shades through a system CIELAB (L*a*b*) which

covers the visual[23,24] colour space, before measurement the spectro-photometry was calibrated according to the manufacturer's instructions. The carbamide peroxide was applied for the walking bleaching technique according to the manufacturer's instructions week by week for four times.[15] According to a findings of Lima et al[25], the hydrogen peroxide was more effective in the bleaching effect than the carbamide peroxide and the sodium perborate while another study by Lim et al[26] found that both the hydrogen peroxide and the carbamide peroxide were equally effective in their bleaching effect. The light bleaching was applied for 3 times for 8 mins each. While the laser bleaching was applied for 50 seconds or almost a minute according to the manufacturer's instructions which was introduced to accelerate the bleaching process.

According to carbamide peroxide manufacturer's to leave the material inside the pulp chamber for few days. while in this study, the material was not used under the manufacturer's instructions but the same method as the hydrogen peroxide manufacturer's recommended to aspirate the material then reinsert it for four times in order not to produce another variable between the carbamide peroxide group and the hydrogen peroxide groups which might be a reason for light group overestimation by using the hydrogen peroxide for bleaching and a detrimental results of the walking bleach group by using the carbamide peroxide as a bleaching material.

The walking bleaching technique is a simple procedure to restore the colour of the tooth by using H2O2 or carbamide peroxide hydrogen peroxide. The active agent of bleaching is very unstable and undergoes dissociation, resulting in oxygen and free water radicals. While urea decomposes producing ammonia and carbon dioxide.[27] The whitening mechanism consists of an oxidation reaction with the release of free radicals. Hydrogen peroxide ionization (HOOH) can occur in different reactions and produces various types of ions[25] Because free oxygen radicals can react with the coloured organic materials which can be found within the tooth structures. So, leading to a reduction in colour staining[12] when bleaching intensity appears to be stabilized , the saturation point has been achieved.

In order to achieve faster and more effective treatment, different energy sources have been used to accelerate the oxi-reduction reaction of the whitening gel.[28] In early systems, a heated spatula or a heat lamp[29] were recommended as catalyst. The temperature released by these instruments was very high. So, increasing the risk of cracks on the enamel surface and pulp irritation. For many years, heat or light has been used to speed the breakdown of hydrogen peroxide for a faster whitening result. Many devices such as halogen curing lights, LEDs, diode lasers, argon lasers and plasma arc lamps were used for bleaching purpose.

Using of light activation methods don't produce a considerable amount of heat and able to catalyse the dissociation of H2O2 into water and free oxygen in order to fasten the reaction.[30] Therefore, it's well accepted by the patients as it has an immediate result and shorter treatment time.[31] But also adding a light activating bleaching systems in the office occupying the operator's space and its cost also may be harmful to the gingival tissues and surrounding structures due to the high temperature released by the devices.[32]

LEDS are more cost effective than laser and produce less energy. The efficiency of LEDS is much more effective than the halogen lamps of light curing units. Some studies showed enhanced bleaching effect by laser superior to walking but in this study walking and laser were equal in results and the light was superior to them. Giventhat, laser radiation is a coherent, monochromatic and collimated. When irradiated on the bleaching gel the chromophores in the gel absorbs the light which activates the molecules and improves the tooth discolouration.[33]

Light mediated action was significantly superior in bleaching effect when compared to laser bleaching and walking bleaching. This was in agreement with Hein et al., who showed no difference in the whitening effect of the bleaching gels hydrogen peroxide when activated with the three different light sources (LumaArch, Optilux 500, and Zoom)[34] or without activation. The study concluded that the chemicals which were added to the bleaching gels acted in the bleaching process as a catalyst were responsible for the bleaching and the lights had no influence.

Likewise He et al[35] reported better results using light activated system than a non light system in producing immediate whitening effect using a lower concentrations of hydrogen peroxide. On the other hand, there was no difference in the short term or immediate bleaching effect between the light and non-light activated system after the application of high concentrations of the hydrogen peroxide (25-35%). Also Luk et al. summarized that light application improved the bleaching efficiency obviously by the interaction with the bleaching material.[36]

These findings are in agreement with the studies Torres et al[37] and Luk et al[36] who reported that the whitening efficiency of the bleaching materials was significantly improved after the light application.

Conversely Kugel et al., reported no difference between light and chemically activated teeth bleaching system after a 2 week recall.[38] Bernardon et al summarized similar results when using the in office bleaching technique and light irradiation activation by activating of the 35% of hydrogen peroxide with or without using of LED/Laser to evaluate the clinical performance of HP[39] similarly, Marson et al[40], reported that the bleaching of a vital teeth using an in office bleaching technique by

application of 35% of hydrogen peroxide showed no improvement even with the usage of (halogen light, LED, LED/Laser). Bruzell et al. reported that there was no difference in teeth bleaching efficiency with using of irradiation or not with any of the bleaching products even after the inspection of teeth one week after the bleaching with seven different bleaching products using seven different bleaching lamps.[41]

Heyward R et al. mentioned that other factors can affect the result of bleaching[42] such as base line colour of the teeth, type and concentration of the bleaching product used, also the treatment period and the in-chair period treatment time.

5. CONCLUSION

Using an intracanal medication as TAP provokes an unavoidable tooth discoloration .The light bleaching technique was the most effective technique between the three different techniques also it saves more time and fater in results as well as the laser than the walking bleaching technique.

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6. REFERENCES

1. Attin T, Paque F, Ajam F, Lennon AM. Review of the current status of tooth whitening with the walking bleach technique. Int Endod J, 2003; 36: 313–329.
2. Thomson AD, Athanassiadis B, Kahler B, Walsh L. Tooth discolouration: Staining effects of various sealers and medicaments. Aust Endod J, 2012; 38: 2–9.
3. Sato T, Hoshino E, Uematsu H, et al. In vitro antimicrobial susceptibility to combinations of drugs on bacteria from carious and endodontic lesions of human deciduous teeth. Oral Microbial Immuno, 1993; 8: 172–6.
4. Akcay M, Arslan H, Yasa B, Kavrık F, Yasa E. Spectrophotometric analysis of crown discoloration induced by various antibiotic pastes used in revascularization. J Endod, 2014; 40: 845–848.
5. Eimar H, Siciliano R, Abdallah MN, et al. Hydrogen peroxide whitens teeth by oxidizing the organic structure. J Dent, 2012; 40: e25-e33.
6. Perdigão J. Dental whitening—revisiting the myths. Northwest Dent, 2010; 89: 19-21. 23–6.
7. Sulieman M, Macdonald E, Rees J et al. Comparison of three in-office bleaching systems based on 35% hydrogen peroxide with different light activators. American journal of dentistry, 2005; 18: 194-197.
8. Buchalla W, Attin T. External bleaching therapy with activation by heat, light or laser-a systemic review. Dental Materials, 2007; 23: 586-596.
9. Marcondes M, Gandolfiparanhos MP, Spohr AM et al. The influence of the Nd: YAG laser bleaching on physical and mechanical properties of the dental enamel. Journal of Biomedical Materials Research Part B: Applied Biomaterials, 2009; 90: 388-395.
10. Yılmaz B, Irmak Ö, Yaman BC. Outcomes of visual tooth shade selection performed by operators with different experience. J Esthet Restor Dent, 2019; 31: 500–507.
11. Davis MC, Walton RE, Rivera EM. Sealer distribution in coronal dentin. J Endod, 2003; 28(6): 464-466.
12. Shokouhinejad N, Nekoofar MH, Pirmoazen S, Shamshiri AR, Dummer PMH. Evaluation and Comparison of Occurrence of Tooth Discoloration after the Application of Various Calcium Silicate-based Cements: An Ex Vivo Study. J Endod, 2015; 42(1): 140-144.
13. Hoshino E, Kurihara-Ando N, Sato I, Uematsu H, Sato M, Kota K, et al. In vitro antibacterial susceptibility of bacteria from infected root dentin to a mixture of ciprofloxacin, metronidazole and minocycline. Int Endod J, 1996; 29: 125-30.
14. Plotino G, Buono L, Grande NM, Pameijer CH, Somma F (2008) Nonvital tooth bleaching: a review of the literature and clinical procedures. Journal of Endodontics, 34: 394–407.
15. Feiz A, Barekatain B, Khalesi S, Khalighinejad N, Badrian H, Swift EJ. Effect of several bleaching agents on teeth stained with a resin-based sealer. Int Endod J, 2014; 47(1): 3-9.
16. Carrasco LD, Guerisoli DMZ, Rocha MJA, Pe´ cora JD, Fro¨ ner IC. Efficacy of intracoronal bleaching techniques with different light activation sources. International Endodontic Journal, 2007; 40: 204–208.
17. Kose, C., Calixto, A., Bauer, J., Reis, A. & Loguercio, A. Comparison of the Effects of In-office Bleaching Times on Whitening and Tooth Sensitivity: A Single Blind, Randomized Clinical Trial. Oper. Dent, 2016; 41: 138–145.
18. Mena-Serrano, A. et al. A Single-Blind Randomized Trial About the Effect of Hydrogen Peroxide Concentration on Light-Activated Bleaching.
19. Kiomars N, Azarpour P, Mirzaei M. Evaluation of the diode laser(810nm, 980nm) on color change of teeth after external bleaching. Laser therapy, 2016; 25.4: 267-272.
20. Pleffken ,The application of a low-intensity red laser was effective for activating a bleaching gel with green dye, without any deleterious increases in pulpal temperature. J Esthet Restor Dent, 2012; 24: 126–134.
21. Ozat P.B, Tuncel I, Eroglu E. Repeatability and reliability of human eye in visual shade selection. Journal of Oral Rehabilitation, 2013; 40: 958—964.

22. Wetter NU, Walverde D, Kato IT, Eduardo Cde P. Bleaching efficacy of whitening agents activated by xenon lamp and 960-nm diode radiation. Photomed Laser Surg, 2004; 22: 489–493
23. Seghi RR. Effects of Instrument-measuring Geometry on Colorimetric Assessments of Dental Porcelains. J Dent Res, 1990; 69(5): 1180-1183.
24. Berns RS. Describing color. In: Berns RS, ed. Billmeyer and Saltzman's principles of color technology. 3rd ed., New York: John Wiley & Sons Inc, 2000b; 31–74.
25. Lima, D. A. N. L. et al. In vitro evaluation of the effectiveness of bleaching agents activated by different light sources. J. Prosthodont, 2009; 18: 249–254.
26. Lim MY, Lum SOY, Poh RSC, Lee GP, & Lim K-C. An in vitro comparison of the bleaching efficacy of 35% carbamide peroxide with established intracoronal bleaching agents. International Endodontic Journal, 2004; 37: 483–488.
27. Goldstein GR, Kiremidjian-Schumacher L. Bleaching: Is it safe and effective? J Prosthet Dent, 1993; 69(3): 325-328.
28. GARBER DA. Dentist-Monitored Bleaching: a Discussion of Combination and Laser Bleaching. J Am Dent Assoc, 1997; 128(April): 26S-30S.
29. Rosenstiel, Stephen F.; Gegauff, Anthony G.; Johnston, William M-Duration of Tooth Color Change after bleaching. J Am Dent, 1991; Assoc Volume 122 issue 4.
30. Smigel I. Laser tooth whitening. Dentistry Today, 1996; 15: 32–6.
31. Benjamin SD Dental lasers: part 3. Use of dental lasers on hard tissue. Practical Procedures in Aesthetic Dentistry, 2002; 14: 422–4.
32. Boksman L. Current status of tooth whitening: Literature review. Dent Today, 2006; 25: 74, 76–9.
33. Pick RM. Using lasers in clinical dental practice. J Am Dent Assoc, 1993; 124: 37–4.
34. Hein DK, Ploeger BJ, Hartup JK, Wagstaff RS, Palmer TM, Hansen LD. In-office vital tooth bleaching - what do lights add? Compend Contin Educ Dent, 2003; 24: 340–52.
35. He LB, Shao MY, Tan K, Xu X, Li JY. The effects of light on bleaching and tooth sensitivity during in-office vital bleaching: A systematic review and meta-analysis. J Dent, 2012; 40: 644–53.
36. Luk K, Tam L, Hubert M. Effect of light energy on peroxide tooth bleaching. J Am Dent Assoc, 2004; 135: 194–201.
37. Torres CR, Barcellos DC, Batista GR, Borges AB, Cassiano KV, Pucci CR. Assessment of the effectiveness of light-emitting diode and diode laser hybrid light sources to intensify dental bleaching treatment. Acta Odontol Scand, 2011; 69: 176–81.
38. Kugel G, Papathanasiou A, Williams AJ, 3rd, Anderson C, Ferreira S. Clinical evaluation of chemical and light-activated tooth whitening systems. Compend Contin Educ Dent, 2006; 27: 54–62.
39. Bernardon JK, Sartori N, Perdigão J, Ballarin A, Lopes GC, Baratieri LN. Clinical performance of vital bleaching techniques. Oper Dent, 2010; 35: 3–10.
40. Marson FC, Sensi LG, Vieira LC, Araujo E. Clinical evaluation of in-office dental bleaching treatments with and without the use of light-activation sources. Oper Dent, 2008; 33: 15–22.
41. Bruzell EM, Johnsen B, Aalerud TN, Dahl JE, Christensen T. In vitro efficacy and risk for adverse effects of light-assisted tooth bleaching. Photochem Photobiol Sci, 2009; 8: 377–85.
42. Hayward R, Osman Y, Grobler SR. A clinical study of the effectiveness of a light emitting diode system on tooth bleaching. Open Dent J, 2012; 6: 143–7.