Comparison of two professional tooth whitening methods: preliminary results

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ABSTRACT

Introduction: Tooth whitening, with a growing commodity market, is a non-invasive procedure to improve smile aesthetics. The objective of this study was to evaluate the effectiveness of two professional treatments: a 6% hydrogen peroxide treatment (in-office) and a 16% carbamide peroxide treatment (professional home-use).
Material and Methods: Thirty subjects with good oral health were selected and analyzed - before and after the use of both treatments - using spectrophotometric technique. The Shapiro-Wilk test was used to verify the normality of variables. Student's t-test was instead used to investigate any significant differences between variables ($p<0.05$).
Results: Both techniques analyzed in this study were statistically significant in producing a positive ΔE (CIE Lab), with improved tooth color; specifically, a ΔE of 1.70 for the in-office method and 3.21 for the home-use method. Both treatments increased tooth brightness and reduced red and yellow tones, resulting in tooth color modification.
Conclusion: The professional home-use method, due to treatment continuity, proved to be more effective; however, the "in-office" method, both for the results obtained and the time and application method, is an extremely interesting professional whitening technique to propose to patients after being duly informed of the achievable results.

Keywords Dentistry, Tooth Bleaching, Hydrogen Peroxide, Carbamide Peroxide, Spectrophotometry

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INTRODUCTION

The smile plays a fundamental role in social interactions. Since smiling involves revealing one's teeth, dental aesthetics and their good health status are essential for self-esteem and self-confidence(1,2). A smile should also communicate strength and confidence. Consequently, a "perfect" smile is sought not only by adolescents and young people, but also by leaders and people working in the public sector. The literature highlights how a light tooth color has greater social appeal compared to smiles showing teeth of a more natural color(3). In particular, it is reported that physical appearance plays a very important role in human social interactions. The face is usually considered the social calling card, and in some cases, an aesthetic defect can be a significant obstacle. Considering the face, the eyes and mouth are the most important elements. People's smiles are thought to be the main component determining the attractiveness of facial aesthetics. It is for this reason that in the dental field, whitening is increasingly requested, with a market growing by 15% every year. To this end, whitening is often proposed as a non-invasive and conservative aesthetic procedure to restore smile balance without damaging dental structure(4).
Tooth color is determined by intrinsic characteristics and is influenced by extrinsic elements, such as pigmentations that can form on the external surface. The intrinsic color of teeth is conditioned by how light is diffused and absorbed on the surface and within the tooth structure. The perception of tooth color is determined by enamel, which is a translucent material that diffuses light. In some cases, enamel is unable to sufficiently cover the underlying dentin; this can influence the overall perception of tooth color.
Whitening can be performed with various methods: the most commonly used are professional in-office whitening performed chairside, and home-use whitening performed at home by the patient using dedicated kits. There are also numerous options regarding product choice and application times, which is why it is necessary to choose the one most suitable for the individual and the dentist's clinical experience(5). Tooth whitening products help improve the aesthetics and whiteness of teeth by improving the intrinsic color of teeth and, in some cases, removing extrinsic stains.
Home-use whitening products treat teeth in a non-invasive but effective manner, thanks to the use of substances based on hydrogen peroxide (HP) and carbamide peroxide (CP).
Although product activation methodologies are not yet clear, defined, and unequivocal (6), the literature agrees that tooth whitening occurs mainly through the gradual dissolution of chromogenic pigments. In other words, oxygen radicals, produced by the decomposition of the aforementioned whitening substances, react with chromogenic pigments through an oxidation process that breaks down the chromogenic component (7).
Hydrogen peroxide is an unstable and highly soluble compound. This agent can be used at different concentrations: lower concentrations (6-20%) are used for home

whitening, while higher concentrations (20-40%) for professional whitening, which requires the use of a liquid dam to protect soft tissues from possible irritation (8,9).
Although the action of hydrogen peroxide and its effect on enamel and dentin are not yet fully understood (6), it appears that its activation triggers a series of oxidative processes that lead to the formation of water and free radicals, which break pigmented molecules creating the whitening effect. To reduce product concentration while maintaining equal treatment efficacy but with greater safety, a photo-catalyst, titanium dioxide (TiO_2), has been incorporated into the compound. This agent, activated by a light source of 450±10nm, enhances the action of hydrogen peroxide (7,10).
Depending on the concentration of the whitening agent and also the gel's action time, the use of such substances at high concentrations is harmful not only to gingival tissues but can also become harmful to the dental pulp, causing sensitivity (10). In this sense, a whitening agent with low hydrogen peroxide concentration represents an interesting alternative as it has a positive aesthetic impact (11) and also provides good clinical results, with fewer side effects compared to high-concentration products (12).
Carbamide peroxide is instead a more stable structural complex. The activation of carbamide peroxide depends on a reaction with water that determines the dissociation of this compound into hydrogen peroxide and urea, and subsequently into oxygen, water, and carbon dioxide, thus performing its whitening phase (4).
Carbamide peroxide-based gels can have different concentrations, the most common of which are 6% and 16%. These have the advantage of promoting a slow and gradual release of hydrogen peroxide, preventing its diffusion through enamel and dentin at high concentrations and allowing an active and prolonged whitening process. For this reason, this technique is considered safer for dental structure. This procedure, however, is also not without risks and could cause sensitivity, which proves to be transitory and ceases with discontinuation of treatment (13-15).
Regarding the use of whitening products, the use of products containing whitening agents with hydrogen peroxide concentrations below 0.1% as adjuvants to therapy is widely used.
The effectiveness of whitening toothpastes is still subject to debate. These products act both chemically, whitening enamel, and physically, removing surface stains by abrasion. In fact, in addition to standard ingredients such as fluoride, whitening toothpastes contain active whitening agents such as hydrogen peroxide, carbamide peroxide, or sodium citrate, and abrasive materials such as silica, calcium carbonate, or alumina. In addition to composition, one must also consider the size of abrasive particles present in whitening toothpastes (RDA). Whitening toothpastes have a higher relative dentin abrasion index compared to traditional toothpastes, which results in greater enamel abrasion, potentially causing irreversible damage (4,8).
However, recent studies have demonstrated that whitening toothpastes containing blue covarine show a whitening effect from first use, with statistically reduced tooth yellowing (16).
Therefore, although numerous techniques, products, and whitening agents exist to improve patient aesthetics, not all whitening treatments are suitable for all patients (17) and should only be used as part of a comprehensive treatment plan developed by a dentist after a thorough oral examination (18).
The objective of this study was to evaluate the effectiveness of two professional treatments: a 6% hydrogen peroxide treatment (in-office) and a 16% carbamide peroxide treatment (professional home-use).

MATERIALS AND METHODS

The study sample consists of 30 subjects, subjected to tooth whitening treatments for various types of discolorations.

The inclusion criteria were as follows:
- age between 18 and 50 years;
- Periodontal Screening Record (PSR) of 1 or 2;
- good oral health status: absence of untreated caries and restorations of frontal elements in both arches;
- absence of previous whitening treatments in the previous 24 months.

The exclusion criteria were as follows:
- presence of systemic diseases;
- patients undergoing pharmacological treatment;
- hypersensitivity to the active ingredient contained in the product;
- anomalies in dentin development or accentuated intrinsic discolorations such as amelogenesis imperfecta, fluorosis, or tetracycline;
- patients with fixed orthodontic appliances or night retainers;
- patients with prosthetic elements;
- smokers (>10 cigarettes/day).

Informed consent was obtained and signed by all participants, explaining all information about the product, procedures performed and possible complications, as well as instructions for product application.
Two whitening methods were proposed. Specifically, a 6% hydrogen peroxide in-office method (Genius pro 6%, White Beauty professional, Miromed, Mendrisio, Switzerland) and a professional home-use technique with 16% carbamide peroxide and individual trays (Whitening Gel 16%, Mendrisio, Switzerland) were proposed.
All patients underwent a professional hygiene session before undertaking the tooth whitening treatment.
The in-office method involved the application of 6% hydrogen peroxide immediately at the end of the professional oral hygiene session for 5 minutes twice. Thanks to its highly viscous consistency, the whitening gel can be distributed homogeneously over the entire tooth surface, thus reducing the risk of ingestion. Additionally, it contains water, which prevents dehydration of dental elements.
The professional home-use technique with 16% carbamide peroxide involved delivery of individual whiten-

ing trays without reservoir or self-modeling trays along with a syringe containing 3 ml of product, to be used for a minimum of 4 hours per day until product depletion, estimated as a suggestion at 1 week.
Each subject was assigned to a different procedure, freely choosing which to perform after in-depth discussion with the clinician about which method was most suitable. Tooth whitening in fact required a preliminary cognitive-behavioral phase in which the patient is instructed on all aspects and benefits of tooth whitening, in addition to expectations and timing, and on how to use the device, behaviors, and side effects.
This phase is of fundamental importance for managing the patient's clinical desires. Good initial communication completes therapeutic success and ensures good patient control where expectations are not completely met or side effects are poorly tolerated.
Color measurements were performed before the whitening treatment (t^0) and at the end of the treatment itself (t^1).
Color was measured on upper incisors (1.1, 1.2, 2.1, and 2.2) and upper canines (1.3 and 2.3). Color was measured with a spectrophotometer (SpectroShade micro, MHT, Italy). This instrument is based on LED technology and is capable of acquiring an image of a tooth, displaying it on the screen, and analyzing it by studying the main color of the tooth or its chromatic mapping in the three thirds of the tooth: incisal, middle, and cervical. Color measurement occurs through a light source that creates the entire spectrum of visible light. The image of the area thus illuminated is then reflected in a black and white CCD sensor positioned at the end of the optical system and capable of reading data in the visible spectrum between 400 and 700 nm. To reprocess the acquired chromatic data, the CIE L*, a*, b* system is used, where L* indicates color brightness from 1 (black) to 100 (white) and corresponds to value, a* indicates the amount of green and red on a scale from -a (green) to +a (red), b* marks the amount of blue and yellow on a scale from -b (blue) to +b (yellow) and corresponds to hue(19(. By applying the following formula, it is possible to calculate the color difference (ΔE) of two spectrophotometer readings: $\Delta E=(\Delta L^2+\Delta a^2+\Delta b^2)$ (1/2), where ΔL is the difference between two L values, Δa the difference between two a values, and Δb the difference between two b values. ΔE expresses the overall color difference between two samples, expressed as the distance between two points in color space, and therefore represents an objective evaluation.
Statistical analysis of results was performed using Jamovi software (version 1.6.14, Jamovi Project, Sydney, Australia). The Shapiro-Wilk test was used to verify the normality of variables. Student's t-test was instead used to investigate any significant differences between variables ($p<0.05$).

RESULTS

Whitening treatments were performed without adverse effects in all patients, excluding dentin hypersensitivity phenomena and some cases of dysgeusia, which resolved spontaneously. In none of the cases was it necessary to discontinue treatment due to the appearance of adverse effects. The entire analyzed sample responded that they were satisfied with the results obtained.

T0			T1		
L	a	b	L	a	b
72,08	3,09	15,97	72,97	14,50	1,70

Tab. 1 CIE L*, a*, b* data after in-office treatment.

T0			T1		
L	a	b	L	a	b
71,97	3,33	17,93	73,57	2,66	3,21

Tab. 2 CIE L*, a*, b* data after professional home-use treatment.

In office			Professional home		
ΔL	Δa	Δb	ΔL	Δa	Δb
+0,88	-0,36	-0,95	+1,61	-0,68	-2,31

Tab. 3 Differences in CIE L*, a*, b* data after in-office and professional home-use treatment.

Whitening mode	Δa
In office	1.70
Professional home	3.21

Tab. 4 ΔE after in-office and professional home-use treatment.

Tables 1 and 2 report the results of L*, a*, b* obtained from spectrophotometry before and after tooth whitening for the in-office method and home-use method, respectively. In particular, Table 3 illustrates the differences between the beginning and end of treatment.
The in-office method showed an increase in the L* parameter of +0.88, a reduction in the a* parameter of -0.36, and in the b* parameter of -0.95. Instead, home whitening shows a greater increase in brightness (+1.61) and a greater reduction in a* and b* parameters, -0.68 and -2.31 respectively.
The results show a homogeneous change in tooth color throughout the sample, with few outliers.
As also detected by our analysis, tooth whitening must lead to an increase in L* (increased brightness) and a decrease in b* (reduction of yellow) and a* (reduction of red) (7,11). All variables showed a statistically significant difference ($p<0.05$).
Table 4 instead shows data relating to the obtained ΔE representing measurements of color difference between t^0 (before whitening) and t^1 (after completion of whitening treatment).
A color variation ΔE is to be considered significantly perceptible from a clinical point of view for values greater than +2.17, as reported by other studies (20). In our sam-

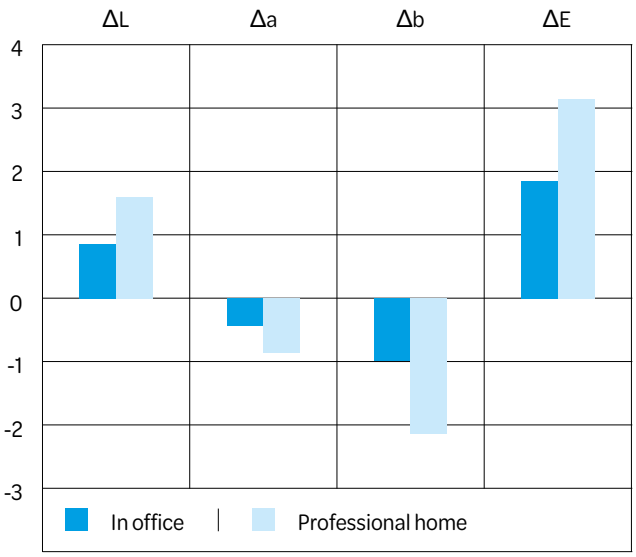

Fig. 1 Comparison graph between the results of the study's whitening methods.

ple, although only home whitening shows a ΔE greater than this limit (3,20), even subjects undergoing in-office whitening obtained a clear improvement in tooth color. The difference between the two modalities was statistically significant ($p<0.05$).
Both treatments were therefore effective in producing a whitening effect, with particular attention to professional home-use treatment. In the ratio of means of obtained differences, the in-office treatment determines a significant improvement in tooth brightness (L) (Fig. 1).

DISCUSSION

Both techniques analyzed in this study were significant in producing a positive ΔE, with a value for the in-office method of 1.70 and 3.21 for the home-use method.
In particular, a significant increase in L* (+0.88) and a reduction in a* (-0.36) and b* (-0.95) parameters were observed in our in-office whitening case series. Instead, for the home-use method, an increase in L* of +1.61 and a reduction in a* parameters of -0.68 and b* of -2.31 were observed. The results highlight that the home-use method proved to be more effective, but this consideration is the result of the fact that carbamide peroxide is present at higher concentration and actively released for a longer time. These premises make it obvious that this exerts a more important action compared to hydrogen peroxide (21).
The collected data highlight an increase in tooth brightness accompanied by a decrease in the amount of red and yellow. Although all three parameters play a fundamental role, the L value appears to be of significant importance for the objective variation of color. In fact, the color of an object is determined by the number of reflected wavelengths: the less an object reflects, the darker it will appear. Therefore, the action of whitening substances, which oxidize the chromogens present, acts precisely by eliminating residual opacity and giving brightness(22).
However, the objective whitening of the tooth is not the only parameter to consider in evaluating the effectiveness of such treatments. In fact, results relating to patient perception, such as satisfaction with dental aesthetics and impact on self-esteem and social behavior, are crucial factors to consider in determining treatment effectiveness(23,24).
It has been found that the degree of patient satisfaction is correlated more with spectrophotometer b* variations rather than L* or a*, therefore Δb, the reduction of yellow or change in hue, is of primary importance for evaluating the effectiveness of whitening products. Thus, while the L* parameter is to be considered the most important for objectively evaluating whitening, the b* parameter proves to be effective for subjective evaluation by the patient.
The results of this study must also be considered with what was observed by the study by Llena et al., which observed how treatment with 16% carbamide peroxide results in effective whitening that remains stable up to 42 months (25). Different application protocols have also demonstrated equal efficacy with application at 48 hours and 72 hours for 6 weeks (26).
Also regarding the 6% hydrogen peroxide method, the literature confirms its effectiveness, with a high safety profile for hypersensitivity and gingival inflammation (27).

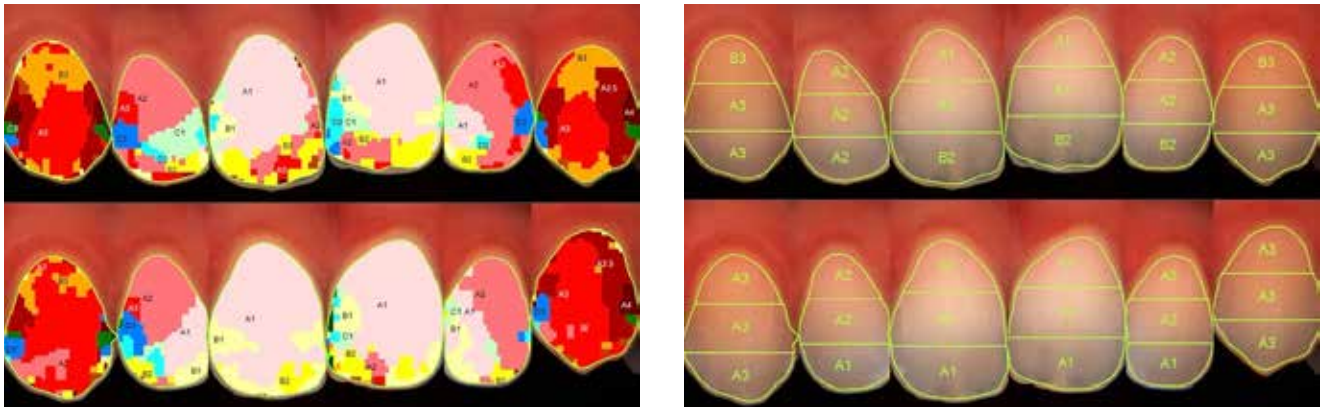

Fig. 2 Example of images of spectrophotometric results after in-office method with 6% hydrogen peroxide. For each image before tooth whitening (above) and after whitening (below).

There are many variables that can influence treatment outcome: age, sex, quality and quantity of dental tissues, diet, oral hygiene, and lifestyle (17). Therefore, to be able to perform such treatment there must be baseline hygiene conditions, and the choice of the best method must take into account the attitudes and personality of the patient at hand. The choice of the best treatment for our patient is the basis for its success.
In conclusion, our study highlighted the effectiveness of the whitening product, which led to an increase in the L* parameter and a decrease in a* and b* in both methods. Furthermore, all subjects enrolled in this study were satisfied with the result obtained (Fig. 2).

CONCLUSIONS

Although research demonstrates that both techniques generate a color modification, it is necessary, when proposing tooth whitening, to precisely define patient expectations in order to correlate them with the actual effectiveness of treatment. Patients often overestimate the effectiveness that whitening treatments could have, with the result that sometimes the achieved result is not subjectively gratifying and satisfactory for the patient. For these reasons, those who wish to whiten their teeth must be subject, before tooth whitening, to a long and thorough sharing of expectations and desires. Subsequently, patients must be informed about actual potential to limit and share the impossibility of unexpected results. This consideration is also necessary if we introduce the theme of limits and responsibility for guaranteeing means or results in aesthetic treatments.
The professional home-use method, due to treatment continuity, proved to be more effective; however, the "in-office" method, both for the results obtained and the time and application method, is an extremely interesting professional whitening technique to propose to patients after being duly informed of the achievable results.
Further investigations are necessary to define the potential of each whitening technique, potential that must be known because it is appropriate to the patient's subjective needs; not all patients desire the best and most effective whitening treatment, all desire the whitening treatment suitable and adequate to their own expectations and desires.

REFERENCES

1. Fiorillo L, Laino L, De Stefano R, et al. Dental Whitening Gels: Strengths and Weaknesses of an Increasingly Used Method. Gels. 2019;5(3):35. https://doi.org/10.3390/gels5030035 PMID:31277412
2. Hashemikamangar SS, Hoseinpour F, Kiomarsi N, Dehaki MG, Kharazifard MJ. Effect of an Optical Whitening Toothpaste on Color Stability of Tooth-Colored Restorative Materials. Eur J Dent. 2020;14(01):085-091. https://doi.org/10.1055/s-0040-1705071
3. Montero J, Gómez-Polo C, Santos JA, Portillo M, Lorenzo MC, Albaladejo A. Contributions of dental colour to the physical attractiveness stereotype. J Oral Rehabil. 2014;41(10):768-782. https://doi.org/10.1111/joor.12194 PMID:24905467
4. Zamudio-Santiago J, Ladera-Castañeda M, Santander-Rengifo F, et al. Effect of 16% Carbamide Peroxide and Activated-Charcoal-Based Whitening Toothpaste on Enamel Surface Roughness in Bovine Teeth: An In Vitro Study. Biomedicines. 2022;11(1):22. https://doi.org/10.3390/biomedicines11010022 PMID:36672530
5. Withening VT. Dent Clin North Am. Published April, 2007.
6. Fernández E, Bersezio C, Bottner J, et al. Longevity, Esthetic Perception, and Psychosocial Impact of Teeth Bleaching by Low (6%) Hydrogen Peroxide Concentration for In-office Treatment: A Randomized Clinical Trial. Oper Dent. 2017;42(1):41-52. https://doi.org/10.2341/15-335-C PMID:27571237
7. Joiner A. The bleaching of teeth: a review of the literature. J Dent. 2006;34(7):412-419. https://doi.org/10.1016/j.jdent.2006.02.002 PMID:16569473
8. Alkahtani R, Stone S, German M, Waterhouse P. A review on dental whitening. J Dent. 2020;100:103423. https://doi.org/10.1016/j.jdent.2020.103423 PMID:32615235
9. Carneiro TS, Favoreto MW, Rodrigues JPF, et al. In-office dental bleaching in adolescents using 6% hydrogen peroxide with and without gingival barrier: a randomized double-blind clinical trial. J Appl Oral Sci. 2024;32:e20230416. https://doi.org/10.1590/1678-7757-2023-0416 PMID:38536995
10. Trevisan TC, Bortolatto JF, Rizzi G, Meloto BT, Dantas AAR, de Oliveira Junior OB. Clinical performance of 6% hydrogen peroxide containing TiO2N nanoparticles activated by LED in varying wavelengths-a randomized clinical trial. Lasers Med Sci. 2022;37(3):2017-2024. https://doi.org/10.1007/s10103-021-03464-1 PMID:34778937
11. Martín J, Vildósola P, Bersezio C, et al. Effectiveness of 6% hydrogen peroxide concentration for tooth bleaching—A double-blind, randomized clinical trial. J Dent. 2015;43(8):965-972. https://doi.org/10.1016/j.jdent.2015.05.011 PMID:26057085
12. Chemin K, Rezende M, Costa MC, et al. Evaluation of At-home Bleaching Times on Effectiveness and Sensitivity with 10% Hydrogen Peroxide: A Randomized Controlled Double-blind Clinical Trial. Oper Dent. 2021;46(4):385-394. https://doi.org/10.2341/20-104-C PMID:34370025
13. Chemin K, Rezende M, Loguercio AD, Reis A, Kossatz S. Effectiveness of and Dental Sensitivity to At-home Bleaching With 4% and 10% Hydrogen Peroxide: A Randomized, Triple-blind Clinical Trial. Oper Dent. 2018;43(3):232-240. https://doi.org/10.2341/16-260-C PMID:29676979
14. Chemin K, Rezende M, Milan FM, Dantas TB, Gomes KDN, Kossatz S. Clinical Evaluation of 10% Hydrogen Peroxide on Tooth Sensitivity and Effectiveness in at Home Dental Bleaching. J Contemp Dent Pract. 2018;19(11):1376-1380. https://doi.org/10.5005/jp-journals-10024-2435 PMID:30602644
15. Tao D, Smith RN, Zhang Q, et al. Tooth whitening evaluation of blue covarine containing toothpastes. J Dent. 2017;67S:S20-S24. https://doi.org/10.1016/j.jdent.2017.10.014 PMID:29233260
16. Sarrett DC. Tooth whitening today. J Am Dent Assoc. 2002;133(11):1535-1538. https://doi.org/10.14219/jada.archive.2002.0085 PMID:12462698
17. Cicciù M, Cervino G, Milone D, Risitano G. FEM Investigation of the Stress Distribution over Mandibular Bone Due to Screwed Overdenture Positioned on Dental Implants. Materials (Basel). 2018;11(9):1512. https://doi.org/10.3390/ma11091512 PMID:30142897
18. Lo Giudice G, Cicciù M, Cervino G, Lizio A, Visco AM. Flowable resin and marginal gap on tooth third medial cavity involving enamel and radicular cementum: a SEM evaluation of two restoration techniques. Indian J Dent Res. 2012;23(6):763-769. https://doi.org/10.4103/0970-9290.111256 PMID:23649060
19. Joiner A, Hopkinson I, Deng Y, Westland S. A review of tooth colour and whiteness. J Dent. 2008;36(suppl 1):S2-S7. https://doi.org/10.1016/j.jdent.2008.02.001 PMID:18646363
20. Levrini L, Paracchini L, Bakaj R, Diaconu A, Cortese S. Dental bleaching during orthodontic treatment with aligners. Int J Esthet Dent. 2020;15(1):44-54. PMID:31994535
21. Takamizawa T, Aoki R, Saegusa M, et al. Whitening efficacy and tooth sensitivity in a combined in-office and at-home whitening protocol: A randomized controlled clinical trial. J Esthet Restor Dent. 2023;35(6):821-833. https://doi.org/10.1111/jerd.13033 PMID:36883730
22. Bachiega-Silva B, Mayer-Santos E, Jurema ALB, Caneppele TMF, Brugnera-Junior A, de Freitas PM. In vitro effectiveness of different dental bleaching protocols using violet LED. Photodiagnosis Photodyn Ther. 2023;42:103245. https://doi.org/10.1016/j.pdpdt.2022.103245 PMID:36640856
23. Tadin A, Galić S, Gavić L. Assessment of Color Change, Esthetic Perception, Treatment Satisfaction, and Side Effects Following the Use of Over-the-Counter Whitening Products. Acta Stomatol Croat. 2023;57(4):300-315. https://doi.org/10.15644/asc57/4/2 PMID:38283316
24. Klaric Sever E, Budimir Z, Cerovac M, et al. Clinical and patient reported outcomes of bleaching effectiveness. Acta Odontol Scand. 2018;76(1):30-38. https://doi.org/10.1080/00016357.2017.1376111 PMID:28893130
25. Llena C, Villanueva A, Mejias E, Forner L. Bleaching efficacy of at home 16% carbamide peroxide. A long-term clinical follow-up study. J Esthet Restor Dent. 2020;32(1):12-18. https://doi.org/10.1111/jerd.12560 PMID:31904193
26. Cantero-Gómez M, Vicente-Sanchez J, Oteo-Calatayud MD, Piedra-Cascón W, Oteo-Morilla C. Comparative Clinical Study of Two Tooth Whitening Protocols. A Randomized Clinical Trial. Part 2. Int J Periodontics Restorative Dent. 2025;45(2):199-207 https://doi.org/10.11607/prd.7106 PMID:38717437
27. de Oliveira MN, Vidigal MTC, Vieira W, et al. Assessment of color changes and adverse effects of over-the-counter bleaching protocols: a systematic review and network meta-analysis. Clin Oral Investig. 2024;28(3):189. https://doi.org/10.1007/s00784-024-05595-5 PMID:38430338