Journal of Pharmaceutical Research International

33(60B): 969-976, 2021; Article no.JPRI.81541
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Causes and Management of Tooth Discoloration: A Review

Ashwag Siddik Noorsaeed [a≡#*], Saba Abdulelah M Lanqa [bω], Rahaf Abdulrhman Alshehri [bω], Sara Abdulelah M Linga [c], Reem Ahmed J. Alzahrani [bω], Yusuf Khalaf M. Al Ghamdi [bω], Aljawharah Aidh Alghamdi [bω], Shaima Fahad Alamri [bω], Rzan Abbas T Zaatari [d], Amjad Alhassan Fathi [eω], Mohammed Abdulrahman Al bi habib [f], Azza Anas Abu Dawood [g] and Maram Bakr Ibrahim [h]

[a] Restorative Dentist, Saudi Arabia.
[b] Vision College, Saudi Arabia.
[c] General Dentist, Taif Specialized Dental Center. Ministry of Health, Saudi Arabia.
[d] General Dentist, Alarak Almutamyzah Medical Company, Saudi Arabia.
[e] King Khalid University, Saudi Arabia.
[f] General Dentist, Saudi Arabia.
[g] KAMC, Obhur PHC, Jeddah, Saudi Arabia.
[h] Ministry of Health/ AGH, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i60B34701

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/81541

Review Article

Received 18 October 2021
Accepted 20 December 2021
Published 23 December 2021

ABSTRACT

Tooth discoloration is a common dental occurrence that is linked to both clinical and aesthetic issues. The treatment of tooth discoloration has grown into highly complex, scientific, and therapeutic field by the twenty-first century. Dental surgeons must understand the etiology of tooth staining in order to provide an accurate diagnosis and thus management. Extrinsic causes produce tooth darkening, whereas intrinsic congenital or systemic influences cause tooth discoloration.

≡ Dr.;
ω Intern;
 # Consultant;
**Corresponding author: E-mail: mailto:ashsns@hotmail.com;*

Tooth bleaching is a safe and effective way to lighten the color of the teeth. Today, the physician has a number of options, including at-home tray-based bleaching treatments with low hydrogen peroxide or carbamide peroxide concentrations. Surgical options include dental restorations which is may be indicated for some cases. This review aims to summarize current evidence regarding causes, classification and management of tooth discoloration. Medline and PubMed public database searches were carried out for papers written all over the world on tooth discoloration. No predictive analytics technology was used.

Keywords: Tooth; teeth; discoloration; bleaching; smoking; aging.

1. INTRODUCTION

The treatment of tooth discoloration has grown into a multibillion-dollar, highly complex, scientific, and therapeutic field by the twenty-first century. The treatment's origins, on the other hand, may be traced back thousands of years to ancient doctors and beauticians who employed simple yet ingenious natural materials to conceal unpleasant teeth discolorations [1]. Dental surgeons must understand the aetiology of tooth staining in order to provide an accurate diagnosis when examining a discolored dentition and to explain the nature of the problem to the patient. In rare cases, the process of staining may have an impact on the treatment outcome and the treatment choices available to the dentist [2].

Tooth discoloration is a common dental occurrence that is linked to both clinical and aesthetic issues. The origin, appearance, content, location, severity, and tenacity of adhesion to the tooth surface are all different. Extrinsic causes produce tooth darkening, whereas intrinsic congenital or systemic influences cause tooth discoloration. If there are enamel flaws, the severity of the stains may be exacerbated. The dental staff has two significant issues when it comes to tooth discoloration. The first task is to figure out what caused the stain, and the second is to treat it [3].

The mouth cavity is engaged in nutrient intake, communication, and host defence, and plays three crucial roles in the prevention and preservation of systemic health. All three functions are performed by the teeth, and dental illnesses can cause a variety of issues, including oral and systemic infections, as well as trouble eating, swallowing, or phonation [1].

Teeth discoloration is a frequent dental disease that can impair not only the patient's self-image and psychological profile, but also their face attractiveness. Such discoloration, which can be localised or generalised, is becoming more well-known. Newer clinical approaches and better dental materials have also enhanced the restoration and repair of this clinical condition. The aetiology of discoloration is examined first since it determines the therapy technique to be used. Patient input and acceptability should be prioritised while considering management concepts [4].

Tooth bleaching is a safe and effective way to lighten the color of the teeth. Today, the physician has a number of options, including at-home tray-based bleaching treatments with low hydrogen peroxide or carbamide peroxide concentrations. On the other side, in-office bleaching systems employ a high concentration of hydrogen peroxide or carbamide peroxide, which is administered by a dentist. Both approaches have been found to be acceptable and safe in previous investigations [5-9]. This review aims to summarize current evidence regarding causes, classification and management of tooth discoloration.

2. METHODS

Study Design: Review article.

Study duration: Data were collected between 1 July and 30 October 2021.

Data collection: Medline and PubMed public database searches was carried out for papers written all over the world on tooth discoloration. The keyword search headings included “tooth, teeth, discoloration, bleaching, smoking, aging", and a combination of these were used. For additional supporting data, the sources list of each research was searched.

Criteria of inclusion: the papers was chosen based on the project importance, English language, and 20 years’ time limit. Criteria for exclusion: all other publications that do not have their main purpose in any of these areas or multiple studies and reviews was excluded.

2.1 Statistical Analysis

No predictive analytics technology was used. To evaluate the initial results, the group members reviewed the data. The validity and minimization of error was double revised for each member's results.

3. CAUSES AND CLASSIFICATION

Intrinsic discoloration: A change in the structural composition or thickness of the tooth hard tissues causes intrinsic discoloration. The blue, green, and pink tints of the enamel establish the usual color of teeth, which is strengthened by the yellow to brown colors of dentine underneath. A variety of metabolic illnesses and systemic variables have been shown to have an impact on the growing dentition, resulting in discoloration. Local circumstances, such as injury, are also taken into account.
Intrinsic tooth discoloration can be caused by a variety of factors. Stain distribution ranges from limited involvement of primary and secondary teeth (e.g., 1 or 2 teeth) to regional or widespread involvement of primary and secondary teeth. Localized discoloration can be caused by preeruptive or posteruptive processes, whereas extensive involvement suggests a divergence from normal tooth development. Understanding the period of tooth production (especially calcification and eruption sequences) might assist to explain why certain teeth are discolored inside [1].

These Factors may include: [2]

- Alkaptonuria
- Congenital Erythropoietic Porphyria
- Hyperbilirubinemia
- Amelogenesis imperfecta
- Imperfect Dentinogenesis
- tetracycline
- Fluorosis
- Hypoplasia of the enamel
- Products of pulpal haemorrhage
- Resorption of the roots
- Ageing

Dental fluorosis is characterised by enamel discoloration caused by subsurface hypomineralization caused by excessive fluoride consumption during enamel formation's early maturation stage [1]. Fluorosis affects both primary and secondary dentitions, causing a variety of clinical signs and symptoms. Fluorosis occurs as thin white lines or streaks on the enamel in its mildest form. Moderate fluorosis is characterised by more visible opaque patches known as enamel mottling, but severe fluorosis is characterised by widespread mottling that easily crumbles and stains, resulting in pitting and brown discoloration [10]. Even in locations with nonfluoridated public water sources, the frequency of mild-to-moderate fluorosis has increased in the United States during the previous decade. Early usage and ingestion of fluoridated toothpaste, improper use of fluoride supplements, and the use of powdered baby formula combined with local water in fluoridated regions all contribute to the tendency. Clinicians can assist prevent fluorosis by educating parents about the benefits of fluoride and how to clean their children's teeth properly [11].

Minocycline is a tetracycline derivative that is semi-synthetic. It can cause green-gray or blue-gray intrinsic staining of the teeth if consumed over an extended period of time. Minocycline causes discoloration during and after the entire creation and eruption of teeth, unlike other tetracyclines. To explain the likely mechanism of this side effect, four ideas have been offered. The first is the extrinsic hypothesis, in which minocycline is assumed to bind to the glycoprotein in acquired pellicle [12]. When exposed to air or as a result of bacterial action, it oxidises. This causes the aromatic ring to degrade, resulting in an insoluble black compound. A demineralization/remineralization event may be responsible for the pigment's incorporation into the dentin. The second is the intrinsic theory, which states that minocycline linked to plasma proteins is deposited in collagen-rich tissues like the teeth [13]. When exposed to light, this oxidises gradually over time. The medication chelates with iron to produce an insoluble complex, which is the third alternative. The fourth hypothesis is that minocycline is deposited in dentin during secondary dentinogenesis, and that this process is expedited in bruxists [14, 15].

Pulpal necrosis is a consequence of acute dental injury that manifests itself as a greyish black staining of the crown of the tooth. This, however, is contingent on the degree and severity of injury to the tooth's neurovascular supply. Trauma to the teeth is most commonly caused by a car accident, a fall, or an accident at home [16]. It's not surprising that pulpal necrosis is the leading cause of intrinsic tooth discoloration, given that a

large number of youngsters (57.3 percent 17 and 93.1 percent 18) leave injured teeth untreated, according to research conducted in Nigeria. Pulpal necrosis, with or without pain, is a complication of untreated injured teeth that have lost their neurovascular supply [17].

Extrinsic Discoloration: Extrinsic stains are those that are generated by topical or extrinsic substances that appear on the outside surface of the tooth structure [1]. This may be separated into two categories: direct and indirect. Direct staining is created by substances integrated into the pellicle layer, and the stain is determined by the chromogen's basic hue. Direct staining is a multi-factorial aetiology, with chromogens generated from the food or items that are often placed in the mouth. On the other hand, indirect staining is induced by a chemical reaction at the tooth surface. It's generally related with metal salts and cationic antiseptics. These agents are either colorless or have a different hue than the stain on the tooth surface [12].
Extrinsic dental stain is classified into three groups by the Nathoo categorization system [1,18]:

- Nathoo type 1 (N1): Colored substance (chromogen) bonds to the tooth surface. Dental stains formed by tea, coffee, wine, chromogenic bacteria, and metals have a similar hue to the chromogen.
- Nathoo type 2 (N2): After attaching to the tooth, N2-type colored substance changes color. The stains are really food stains of the N1 kind that deepen over time.
- Nathoo type 3 (N3): N3-type colorless substance or prechromogen adheres to the teeth and causes a stain through a chemical reaction. Carbohydrate-rich meals (e.g., apples, potatoes), stannous fluoride, and chlorhexidine all create N3-type stains.

The origin of the stain may be:

- Metallic
- Non-metallic

Extrinsic discoloration causes are caused by a variety of factors [12].

- Diet: The deposition of tannins contained in tea, coffee, and other liquids might cause brown stains on the surface of the teeth.
- Hygiene of the mouth: Brown or black stains are caused by the accumulation of dental plaque, calculus, and food particles.
- Tobacco from cigarettes, cigars, pipes, and chewing tobacco generates stubborn dark brown and black stains on the cervical one third to midway of the teeth.
- Influencing medication: After continuous usage, cationic antiseptics such chlorhexidine, cetylpyridinium chloride, and other mouthwashes can induce discoloration.
- Stains are caused by chromogenic bacteria, which are most commonly found along the gingival border of the tooth. A black stain generated by Actinomyces species is the most prevalent. The stain is made up of ferric sulphide, which is created when hydrogen sulphide produced by bacterial activity reacts with iron in saliva and gingival exudates to form ferric sulphide. Fluorescent bacteria and fungus like Penicillium and Aspergillus species are responsible for green stains. Because the organisms can only develop in light, they discolor the maxillary surface of the anterior teeth. Orange stains are formed by chromogenic bacteria such as Serratia marcescens and Flavobacterium lutescens, and are less prevalent than green or brown stains. [1,19,20]
- Extrinsic tooth discoloration has been linked to occupational exposure to metallic salts as well as the use of a variety of metal salt-containing drugs. Teeth staining is commonly reported in those who take iron supplements and iron foundry employees. Copper generates a green tint in mouthrinses containing copper salts, as well as in industrial employees who come into contact with the metal. Potassium permanganate, which is used in mouthrinses, produces a violet to black color; silver nitrate salt, which is used in dentistry, produces a grey color; and stannous fluoride produces a golden brown discoloration. The process of stain formation was previously assumed to be linked to the formation of the metal's sulphide salt. This is rather unsurprising, given that the extrinsic stain was the same color as the metal's sulphide. Those who proposed the concept, on the other hand, did not appear to grasp the complexities of the chemical process required to form a metal sulphide [2,21-26].

The change in color as the condition develops can be used to identify the various phases of caries. In the early stages of dental caries, an incipient lesion localised to the enamel layer is seen. Carious lesions in the early stages are connected with plaque buildup and appear as chalky white regions of discoloration as a result of demineralization. The overlaying transparent enamel displays the color of the underlying caries when caries spreads into the dentin and appears yellowish brown. The color of extensive caries, which involves the deterioration of both enamel and dentin, can range from light brown to dark brown or virtually black [12].

4. MANAGEMENT

The most recent trend in teeth whitening methods is to acquire whiter teeth at home in less time, and trayless bleaching devices are the most common modalities for achieving this goal. Traditional professional bleaching systems are more costly and difficult to operate than trayless bleaching systems. Gels, rinses, dentifrices, strips, and paint-on films or pens containing varied quantities of hydrogen peroxide or carbamide peroxide are examples of trayless products [5,27-30].

The treatment of discolored teeth using high-concentration oxidising chemicals by the dentist chairside is referred to as power bleaching or professional in-office bleaching. In dentistry, many procedures, technologies, and material choices have been employed to correct discoloration with variable degrees of effectiveness. Some cases are better suited for protracted therapy outside the dental office with lower concentrations of peroxide given in bespoke trays, but the look of a badly discolored nonvital tooth may be best treated with the traditional "walking bleach" procedure.

Teeth stained by dental caries or restorative materials require the removal of the caries or restorative materials, followed by effective tooth repair. When bleaching is not needed or the cosmetic outcomes of bleaching do not fulfil the patient's expectations, partial (e.g. laminate veneers) or full-coverage dental restorations can be utilised to correct widespread intrinsic tooth discoloration [12].

In regular dentistry practise, the single discolored tooth is a common clinical concern. There are many different management methods available, and depending on the clinical situation, any of them may be the best option. As a result, general dentistry practitioners must be aware of the many alternatives available, as well as their indications, and should consider using minimally invasive treatments first before going on to more invasive therapies [31].

Patients may have significant visual damage as a result of discoloration of the anterior tooth caused by trauma or endodontic therapy. Full veneers, laminates, crowns, and noninvasive techniques such as bleaching are used to treat postendodontic tooth discoloration. Even though a laminate veneer or a complete porcelain crown is one of the most predictable ways to handle such instances, it requires tooth structure removal. Nonvital bleaching provides a number of advantages, including the fact that it is a noninvasive, cost-effective, and time-saving process. The walking bleach technique, inside/outside bleaching, and in-office bleaching are the three most prevalent nonvital tooth whitening treatments. The walking bleach procedure is a pretty safe and straightforward method. The walking bleach procedure uses a paste made of SP and distilled water or H2O2 that is applied to the pulp chamber [32].

Patients with widespread yellow, orange, or light brown extrinsic discoloration (including chlorhexidine staining) should have essential teeth bleached, while treatment may also assist with minor instances of tetracycline-induced intrinsic discoloration and fluorosis. Currently, carbamide and hydrogen peroxide are the most widely utilised bleaching chemicals. The agents create more substantial bleaching when used in higher concentrations than when used without these precautions [1].

Hydrogen peroxide is an oxidising agent that may form highly reactive free radicals (H_2O+O_2); in its pure aqueous condition, hydrogen peroxide is mildly acidic. The outcome is the most powerful free radical, perhydroxyl (HO_2). Hydrogen peroxide must become alkaline in order to stimulate the synthesis of the ion perhydroxyl; the ideal pH for this is 9.5 to 10. A considerable quantity of H2O perhydroxyl free radicals are detected in the ionisation of hydrogen peroxide buffered by this pH, resulting in a stronger bleaching effect in the same length of time. The most typical hydrogen peroxide concentration is 35%. The capacity of peroxides to penetrate or diffuse into enamel and dentin is

directly connected to the efficacy of the tooth bleaching process [33].

Nonvital bleaching is used to treat teeth that have discoloration as a result of pulpal deterioration. This method entails injecting a 30 percent hydrogen peroxide and sodium perborate solution into the pulp chamber for up to a week. A tooth with an unrestored crown is appropriate for nonvital bleaching. Cervical external root resorption is a risk, particularly in teeth that become pulpless before the patient reaches the age of 25. This unfavourable response can be reduced by special intracanal barrier repair [1].

The walking bleach method is used to whiten teeth that have been treated with root canals. The procedure entails whitening the tooth from the inside out. The materials used to fill the root canal, the breakdown of blood in the root canal, and drugs utilised in the root canal during the treatment, to mention a few, can all cause tooth discoloration. Before beginning the bleaching procedure, it is critical to have a scale and clean. the tooth may not turn out absolutely white and that the process is unpredictable. A radiograph was done prior to treatment to assess the root canal procedure and ensure there is no infection. It's also crucial to check if the fillings are in good shape. Furthermore, it is critical to use a rubber dam throughout the bleaching process to avoid bacterial infection of the root canal.

The inside/outside bleaching: The whitening gel is applied to both the inside and outside of the discolored root-filled tooth. During treatment, the access cavity is left open so that the 10% carbamide peroxide may be replaced conveniently and on a frequent basis. The bleaching substance is kept in and around the tooth using a custom-made bleaching tray. The inside/outside bleaching procedure can be used to treat discolored root-filled teeth. The approach can successfully treat the majority of instances without the requirement for prebleaching endodontic correction. If the endodontic state is a problem, the root filling may need to be revised before the bleaching can begin [34].

Dental Restoration: Teeth stained by dental caries or restorative materials require removal of the caries or materials, followed by effective tooth repair. When bleaching is not necessary or the visual outcomes of bleaching do not fulfil the patient's expectations, partial (e.g., laminate veneers as seen in the image below) or full-coverage dental restorations can be utilised to correct widespread intrinsic tooth discoloration [32, 34].

5. CONCLUSION

Tooth discoloration is a common dental occurrence that is linked to both clinical and aesthetic issues. Dentists have to understand the reason for the discoloration first in order to educate the patient about the cause and thus prevent it, secondly start appropriate management techniques. Luckily there's multiple management options that can be used. Bleaching is one the most popular techniques which can be vital or non-vital. Choosing of appropriate method depends of the nature of the discoloration and the patient statues. Concentrations. Surgical options include dental restorations which is may be indicated for some cases. In this article we'll be looking at tooth discoloration classification, it's causes, and management.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dharti N. Patel. Tooth discoloration treatment & management. Medscape. Available:https://emedicine.medscape.com /article/1076389-treatment
2. Watts A, Addy M. Tooth discoloration and staining: A review of the literature. Br Dent J. 2001;190(6):309-16. DOI: 10.1038/sj.bdj.4800959 PMID: 11325156
3. Hattab FN, Qudeimat MA, al-Rimawi HS. Dental discoloration: An overview. J Esthet Dent. 1999;11(6):291-310. DOI: 10.1111/j.1708-8240.1999.tb00413.x PMID: 10825865
4. Teo CS. Management of tooth discoloration. Ann Acad Med Singap. 1989;18(5):585-90. PMID: 2694916.
5. Ermis RB, Uzer Celik E, Yildiz G, Yazkan B. Effect of tooth discoloration severity on

the efficacy and color stability of two different trayless at-home bleaching systems. J Dent Res Dent Clin Dent Prospects. 2018 Spring;12(2):120-127.
DOI: 10.15171/joddd.2018.019
Epub 2018 Jun 20
PMID: 30087763
PMCID: PMC6076880

6. Kihn PW. Vital tooth whitening. Dent Clin North Am. 2007;51(2):319–31.
DOI: 10.1016/j.cden.2006.12.001.
7. Strassler HE. Vital tooth bleaching: An Update. Cont Ed Insert. 2006;4:1–8.
8. Tay LY, Kose C, Herrera DR, Reis A, Loguercio AD. Long-term efficacy of in-office and at-home bleaching: A 2-year double-blind randomized clinical trial. Am J Dent. 2012;25(4):199–204.
9. Mondelli RF, Azevedo JF, Francisconi AC, Almeida CM, Ishikiriama SK. Comparative clinical study of the effectiveness of different dental bleaching methods - two year follow-up. J Appl Oral Sci. 2012;20(4): 435–43.
DOI: 10.1590/s1678-77572012000400008.
10. DenBesten PK. Biological mechanisms of dental fluorosis relevant to the use of fluoride supplements. Community Dent Oral Epidemiol. 1999;27(1):41-7.
11. Pendrys DG. Risk of enamel fluorosis in nonfluoridated and optimally fluoridated populations: Considerations for the dental professional. J Am Dent Assoc. 2000; 131(6):746-55.
12. Manuel ST, Abhishek P, Kundabala M. Etiology of tooth discoloration-a review. Etiology of tooth discoloration-a review. 2010;18(2):56-63.
13. Gbadebo SO, Ajayi DM. Self reported tooth discolorations among patients seen at dental center university college hospital Ibadan. J West Afr Coll Surg. 2015;5(3): 66-77.
PMID: 27830134
PMCID: PMC5036264
14. Khozeimeh F, Khademi H, Ghalayani P. The prevalence of etiologic factors for tooth discoloration in female students in isfahan high schools. Dent Res J. 2008; 5(1):13–16.
15. Zaleckiene V, Peciuliene V, Brukiene V, Drukteinis S. Traumatic dental injuries: etiology, prevalence and possible outcomes Stomatologija. Baltic Dental and Maxillofacial Journal. 2014;16(1):7–14.
16. Henshaw NE, Adenubi JO. Traumatized anterior incisors in children. West African Journal of Surgery. 1980;4:50–55.
17. Adekoya-Sofowora C, Bruimah R, Ogunbodede E. Traumatic Dental Injuries Experience in Suburban Nigerian Adolescents. The Internet J of Dent Sc. 2004;3(1):15–19.
18. Nathoo SA. The chemistry and mechanisms of extrinsic and intrinsic discoloration. J Am Dent Assoc. 1997; 128(Suppl):6S-10S
19. Hattab FN, Qudeimat MA, al-Rimawi HS. Dental discoloration: an overview. J Esthet Dent. 1999. 11(6):291-310.
20. Reid JS, Beeley JA, MacDonald DG. Investigations into black extrinsic tooth stain. J Dent Res. 1977;56(8):895-9.
21. Addy M, Roberts WR. The use of polymethylmethacrylate to compare the adsoprtion of staining reactions of some cationic antiseptics. J Periodontol 1981b; 52:380–385.
22. Nordbo H, Eriksen H M, Rolla G, Attramadal A, Solheim H . Iron staining of the acquired enamel pellicle after exposure to tannic acid or chlorhexidine. Scand J Dent Res 1982;90:117–123.
23. Waerhag M, Gjermo P, Rolla G, Johansen JR. Comparison of the effect of chlorhexidine and $CuSO_4$ on plaque formation and development of gingivitis. J Clin Periodontol 1984;11:176–180.
24. Dayan D, Heifferman A, Gorski M, Begleiter A. Tooth discoloration – extrinsic and intrinsic factors. Quintessence Int. 1983;2:195–199.
25. Ellingsen JE, Eriksen HM, Rolla G. Extrinsic dental stain caused by stannous fluoride. Scand J Dent Res. 1982;90:9–13.
26. Moran J, Addy M, Pal D, Newcombe R. Comparison of phenolic 0.2% chlorhe-xidine products on the developoment of plaque and gingivitis. Clin Prev Dent. 1991; 13:31–35.
27. Kugel G. Over-the-counter tooth-whitening systems. Compend Contin Educ Dent. 2003;24(4A):376–82.
28. Gerlach RW, Gibb RD, Sagel PA. A randomized clinical trial comparing a novel 53% hydrogen peroxide whitening strip to 10%, 15%, and 20% carbamide peroxide

tray-based bleaching systems. Compend Contin Educ Dent Suppl. 2000;29:S22–8.

29. Freedman GA, Gerlach RW, Greenwall LH. Bleaching. In: Freedman G, editor. Contemporary Esthetic Dentistry. 1st ed. Missouri: Mosby. 2011;341-405.

30. Demarco FF, Meireles SS, Masotti AS. Over-the-counter whitening agents: A concise review. Braz Oral Res. 2009;23(1): 64–70.
DOI: 10.1590/s1806-83242009000500010

31. Barber AJ, King PA. Management of the single discolored tooth part 1: Aetiology, prevention and minimally invasive restorative options. Dental Update. 2014; 41(2):98-110.

32. Almohareb Thamer. Management of discolored endodontically treated tooth using sodium perborate. Journal of International Oral Health 9.3. 2017; 133.

33. Ermis RB, Uzer Celik E, Yildiz G, Yazkan B. Effect of tooth discoloration severity on the efficacy and color stability of two different trayless at-home bleaching systems. J Dent Res Dent Clin Dent Prospects. 2018 Spring;12(2):120-127.
DOI: 10.15171/joddd.2018.019
Epub 2018 Jun 20
PMID: 30087763
PMCID: PMC6076880

34. Neil J. Poyser Martin GD, Kelleher, Peter FA. Briggs. Managing discolored non-vital. Teeth: The inside/outside. Bleaching Technique.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/81541