

**How to Cite:**

Mittal, S., Kaur, H., & Kaur, U. (2021). Bleaching: A review. *International Journal of Health Sciences*, 5(S1), 80–86. <https://doi.org/10.53730/ijhs.v5nS1.5378>

## **Bleaching: A review**

**Sangam Mittal**

Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

**Harleen Kaur**

Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

**Upneet Kaur**

PG student (Final year), Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh

Email: [upneet0011@gmail.com](mailto:upneet0011@gmail.com)

**Abstract**---Aim: This review article will help clinicians improve their understanding of the history of bleaching procedures, bleaching types, components, mechanisms, and their effects on soft tissue, tooth structures, resin composite, and bonding. Methods: The controversial issues about bleaching procedures and their effects are reviewed. Additionally, the consequences of pre- and post-bleaching on the bonding potential of composite resin restorations to tooth structure are discussed. Conclusion: The overall goal of the paper is to help reduce risks for patient

**Keywords**---bleaching, pre-bleaching, post-bleaching, bonding.

### **Introduction**

Tooth discoloration varies in etiology, appearance, localization, severity, and adherence to tooth structure. It may be classified as intrinsic, extrinsic, and a combination of both <sup>1</sup> Intrinsic discoloration is caused by incorporation of chromogenic material into dentin and enamel during odontogenesis or after eruption. Exposure to high levels of fluoride, Tetracycline administration, inherited developmental disorders, and trauma to the developing tooth may result in pre-eruptive discoloration. After eruption of the tooth, aging, pulp necrosis, and iatrogenesis are the main causes of intrinsic discoloration. Coffee, tea, red wine, carrots, oranges, and tobacco give rise to extrinsic stain <sup>1,2</sup>. Wear of the tooth structure, deposition of secondary dentin due to aging <sup>2</sup> or as a consequence of pulp inflammation, and dentin sclerosis affect the light-transmitting properties of teeth, resulting in a gradual darkening of the teeth.

---

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2021.

**Corresponding author:** Kaur, U.; Email: [upneet0011@gmail.com](mailto:upneet0011@gmail.com)

Manuscript submitted: 18 April 2021, Manuscript revised: 9 June 2021, Accepted for publication: 5 July 2021

## History

Reports on bleaching discolored non vital teeth were first described during the middle of the 19th century<sup>3</sup>, advocating different chemical agents<sup>4</sup>. Initially chlorinated lime was recommended<sup>5</sup>, followed later by oxalic acid<sup>6,7</sup> and agents such as chlorine compounds and solutions<sup>8,10</sup>, sodium peroxide<sup>11</sup>, sodium hypochlorite<sup>12</sup>, or mixtures consisting of 25% hydrogen peroxide in 75% ether (pyrozone)<sup>13</sup>. The “walking bleach” technique that was introduced in 1961 involved placement of a mixture of sodium perborate and water into the pulp chamber that was sealed off between the patient’s visits to the clinician<sup>15</sup>.

The method was later modified and water replaced by 30–35% hydrogen peroxide, to improve the whitening effect<sup>16</sup>. An early description (1884) of the use of hydrogen peroxide was reported by Harlan<sup>17</sup>. Superoxol (30% hydrogen peroxide) had been mentioned by Abbot<sup>18</sup> in 1918. Prinz<sup>19</sup> in 1924 recommended using heated solutions consisting of sodium perborate and Superoxol for cleaning the pulp cavity. Some authors proposed using light<sup>20,21</sup>, heat<sup>20,22,23-26</sup>, or electric currents<sup>27,28</sup> to accelerate the bleaching reaction by activating the bleaching agent.

## Types Of Stains

Many types of color problems may affect the appearance of teeth, and the causes of these problems vary, as does the speed with which they may be removed. Therefore, the causes of tooth staining must be carefully assessed for better prediction of the rate and the degree to which bleaching will improve tooth color, since some stains are more responsive to the process than others<sup>29,30</sup>. Discolorations may be extrinsic or intrinsic.

### Extrinsic Causes

The principal causes are chromogens derived from habitual intake of dietary sources, such as wine, coffee, tea, carrots, oranges, licorice, chocolate, or from tobacco, mouth rinses, or plaque on the tooth surface<sup>2,31</sup>

### Intrinsic Causes

Systemic causes are 1) drug-related (tetracycline); 2) metabolic: dystrophic calcification, fluorosis; and 3) genetic: congenital erythropoietic porphyria, cystic fibrosis of the pancreas, hyperbilirubinemia, amelogenesis imperfecta, and dentinogenesis imperfecta. Local causes are 1) pulp necrosis, 2) intrapulpal hemorrhage, 3) pulp tissue remnants after endodontic therapy, 4) endodontic materials, 5) coronal filling materials, 6) root resorption, and 7) aging. Aging is a common cause of discoloration. Over time, the underlying dentin tends to darken due to the formation of secondary dentin, which is darker and more opaque than the original dentin, and when the overlying enamel becomes thinner. This combination often results in darker teeth. Excessive fluoride in drinking water, greater than 1–2 ppm, can cause metabolic alteration in ameloblasts, resulting in a defective matrix and improper calcification of teeth<sup>32</sup>

### **Composition Of Commercial Bleaching Agents**

Current bleaching agents contain both active and inactive ingredients. The active ingredients include hydrogen peroxide or carbamide peroxide compounds. However, the major inactive ingredients may include thickening agents, carrier, surfactant and pigment dispersant, preservative, and flavoring

- (a) Thickening agents: Carbopol (carboxypolymethylene) is the most commonly used thickening agent in bleaching materials. Its concentration is usually between 0.5% and 1.5%. This high-molecular-weight polyacrylic acid polymer offers two main advantages. First, it increases the viscosity of the bleaching materials, which allows for better retention of the bleaching gel in the tray. Second, it increases the active oxygen-releasing time of the bleaching material by up to 4 times<sup>33</sup>.
- (b) Carrier: Glycerin and propylene glycol are the most commonly used carriers in commercial bleaching agents. The carrier can maintain moisture and help to dissolve other ingredients.
- (c) Surfactant and pigment dispersant: Gels with surfactant or pigment dispersants may be more effective than those without them<sup>34</sup>. The surfactant acts as a surface-wetting agent which permits the active bleaching ingredient to diffuse. Moreover, a pigment dispersant keeps pigments in suspension.
- (d) Preservative: Methyl, propylparaben, and sodium benzoate are commonly used as preservative substances. They have the ability to prevent bacterial growth in bleaching materials. In addition, these agents can accelerate the breakdown of hydrogen peroxide by releasing transitional metals such as iron, copper, and magnesium.<sup>34</sup>
- (e) Flavoring: Flavorings are substances used to improve the taste and the consumer acceptance of bleaching products. Examples include peppermint, spearmint, wintergreen, sassafras, anise, and a sweetener such as saccharin.<sup>34</sup>

### **Vital Tooth Bleaching**

There are three fundamental approaches for bleaching vital teeth: in-office or power bleaching, at-home or dentist-supervised night-guard bleaching, and bleaching with over-the-counter (OTC) product.<sup>35,36</sup> First, in-office bleaching utilizes a high concentration of tooth-whitening agents (25–40% hydrogen peroxide). Here, the dentist has complete control throughout the procedure and has the ability to stop it when the desired shade/effect is achieved. In this procedure, the whitening gel is applied to the teeth after protection of the soft tissues by rubber dam or alternatives<sup>35</sup>, and the peroxide will further be activated (or not) by heat or light for around one hour in the dental office. Different types of curing lights including; halogen curing lights, Plasma arc lamp, Xe-halogen light (Luma Arch), Diode lasers (both 830 and 980 nm wavelength diode lasers), or Metalhalide (Zoom) light can be used to activate the bleaching gel or accelerate the whitening effect. The in-office treatment can result in significant whitening after only one treatment, but many more may be needed to achieve an optimum result<sup>37</sup>

Second, at-home or dentist-supervised night-guard bleaching basically involves the use of a low concentration of whitening agent (10–20% carbamide peroxide, which equals 3.5–6.5% hydrogen peroxide). In general, it is recommended that the 10% carbamide peroxide be used 8 h per day, and the 15–20% carbamide peroxide 3–4 h per day. This treatment is carried out by the patients themselves, but it should be supervised by dentists during recall visits. The bleaching gel is applied to the teeth through a custom-fabricated mouth guard worn at night for at least 2 weeks. This technique has been used for many decades and is probably the most widely used<sup>38</sup>.

The at-home technique offers many advantages: self-administration by the patient, less chair-side time, high degree of safety, fewer adverse effects, and low cost. Despite the fact that patients are able to bleach at their own pace, this at-home bleaching technique, with its various concentrations of bleaching materials and regimens, has become the gold standard by which other techniques are judged. However, it is by no means without disadvantages, since active patient compliance is mandatory and the technique suffers from high dropout rates<sup>39</sup>. In addition, color change is dependent on diligence of use, and the results are sometimes less than ideal, since some patients do not remember to wear the trays every day. In contrast, excessive use by overzealous patients is also possible, which frequently causes thermal sensitivity, reported to be as high as 67% .<sup>39</sup>

### **Non-Vital Tooth Bleaching**

There are numerous non-vital bleaching techniques used today, for example, walking bleach and modified walking bleach, non-vital power bleaching, and inside/outside bleaching. The walking bleach technique involves sealing a mixture of sodium perborate with water into the pulp chamber of the affected tooth, a procedure that is repeated at intervals until the desired bleaching result is achieved.

This technique is modified with a combination of 30% hydrogen peroxide and sodium perborate sealed into the pulp chamber for one week; this is known as modified walking bleach. In internal non-vital power bleaching, hydrogen peroxide gel (30–35%) is placed in the pulp chamber and activated either by light or heat, and the temperature is usually between 50 and 60 °C maintained for five minutes before the tooth is allowed to cool for a further 5 min. Then, the gel is removed, the tooth is dried, and the 'walking bleach technique' is used between visits until the tooth is reviewed 2 weeks later to assess if further treatment is needed. Finally, the inside/outside bleaching technique is a combination of internal bleaching of non-vital teeth with the home bleaching technique<sup>40</sup>

### **Complications And Risk**

Bleaching can have adverse effects, both localized and systemic (toxicity, free radical, etc)<sup>41</sup>. Possible localized adverse effects are on dental hard tissues and mucosa, tooth sensitivity when the bleaching material is in contact with vital teeth, interaction with adhesive mechanisms, external cervical resorption risk, damage to composite restorations, And dental material solubility.

One of the most important local adverse effects is the changes in enamel and dentin, in particular the reduction of enamel microhardness <sup>42</sup> One study also reported that bleaching agents were mainly associated with surface changes in the cementum, which exhibited more changes than the other tissues <sup>43</sup> It has been suggested that peroxides might cause a modification in chemistry of dental hard tissues<sup>44-48</sup>, changing the ratio between organic and inorganic components. The free radicals produced from the breakdown of the bleaching molecules might be active against the pigmenting molecules<sup>48-51</sup>. Several studies on vital teeth have shown that these modifications appear not to be permanent <sup>52-53</sup>.

## Summary

The increasing demand for tooth bleaching has driven many manufacturers and researchers to develop bleaching products to be used either in the dental office or at home. However, as with any dental procedure, bleaching involves risks. For that reason, this review article is provided to help clinicians improve their information about the bleaching process and their understanding of the controversial issues regarding the effects of bleaching on teeth, resin composite, and bonding, to help reduce the risks to patients.

To minimize the risks, the involvement of dental professionals, the prevention of using of OTC bleaching products and the reduction of overused of bleaching products are necessary. In addition to that interval of 2 weeks post-bleaching procedure is found to be adequate to avoid adverse effects on the polymerization. Finally, Clinicians should inform their patients about the possible changes that may occur on their dental restorations during bleaching procedure as well as the possibility of replacement of the bleached restorations at the end of bleaching treatment

## References

1. Hattab FN, Qudeimat MA, al-Rimawi HS (1999). Dental discoloration: an overview. *J Esthet Dent*11:291–310.
2. Watts A, Addy M (2001). Tooth discolouration and staining: a review of the literature. *Br Dent J*190:309–315
3. Truman J. Bleaching of non-vital discoloured anterior teeth. *Dent Times* 1864;1:69 –72.
4. Howell RA. Bleaching discoloured root-filled teeth. *Br Dent J* 1980;148:159–62.
5. Dwinelle WW. Ninth annual meeting of American Society of Dental Surgeons: article X. *Am J Dent Sc* 1850;1:57– 61.
6. Atkinson CB. Bleaching teeth, when discolored from loss of vitality: means for preventing their discoloration and ulceration. *Dental Cosmos* 1862;3:74–7.
7. Bogue EA. Bleaching teeth. *Dental Cosmos* 1872;141–3
8. Taft J. Bleaching teeth. *Am J Dent Sci* 1878/1879;12:364.
9. Atkinson CB. Hints and queries. *Dental Cosmos* 1879;21:471.
10. Harlan AW. The dental pulp, its destruction, and methods of treatment of teeth discolored by its retention in the pulp chamber or canals. *Dental Cosmos* 1891;33:137– 41.

11. Kirk EC. Hints, queries, and comments: sodium peroxide. *Dental Cosmos* 1893;35:1265-7.
12. Messing JJ. Bleaching. *J Br Endod Soc* 1971;5:84 -5.
13. Atkinson CB. Fancies and some facts. *Dental Cosmos* 1892;34:968 -72.
14. Dietz VH. The bleaching of discolored teeth. *Dent Clin North Am* 1957;1:897-902.
15. Spasser HF (1961). A simple bleaching technique using sodium perborate. *NY State Dent J* 27:332-334.
16. Nutting EB, Poe GS (1963). A new combination for bleaching teeth. *J So CA Dent Assoc* 31:289-291.
17. Harlan AW. The removal of stains from teeth caused by administration of medical agents and the bleaching of pulpless tooth. *Am J Dent Sci* 1884/1885;18:521.
18. Abbot CH. Bleaching discoloured teeth by means of 30 per cent perhydrol and the electric light rays. *J Allied Dent Society* 1918;13:259.
19. Prinz H. Recent improvements in tooth bleaching. A clinical syllabus. *Dental Cosmos* 1924;66:558-60.
20. Rosenthal P. The combined use of ultra-violet rays and hydrogen dioxide for bleaching teeth. *Dental Cosmos* 1911;53:246 -7.
21. Brininstool CL. Vapor bleaching. *Dental Cosmos* 1913;55:532.
22. Andreasen FM. Transient apical breakdown and its relation to colour and sensibility changes after luxation injuries to teeth. *Endod Dent Traumatol* 1986;2:9 -19.
23. Merrell JH. Bleaching of discoloured pulpless tooth. *J Can Dent Assoc* 1954;20:380.
24. Stewart GG. Bleaching discoloured pulpless teeth. *J AmDent Assoc* 1965;70:325- 8.
25. Caldwell CB. Heat source for bleaching discolored teeth. *Ariz Dent J* 1967;13:18 -9.
26. Hodosh M, Mirman M, Shklar G, Povar M. A newmethod of bleaching discolored teeth by the use of a solid state direct heating device. *Dent Dig* 1970;76:344-6.
27. Kirk EC. The chemical bleaching of teeth. *Dental Cosmos* 1889;31:273- 83.
28. Westlake A. Bleaching teeth by electricity. *Am J Dent Sci* 1895;29:101.
29. Haywood V.B., Heymann H.O. Nightguard vital bleaching. *Quintessence Int.* 989;20:173-176.
30. Jordan R.E., Boksman L. Conservative vital bleaching treatment of discolored dentition. *Compend. Contin. Educ. Dent.* 1984;5(803-805):807
31. Hattab FN, Qudeimat MA, al-Rimawi HS. Dental discoloration: an overview. *J EsthetDent* 1999;11:291-310.
32. Dodson D., Bowles W. Production of minocyclines pigment by tissue extracts *J. Dent.Res.* 1991;70(Spec Iss):424.
33. Rodrigues J.A., Oliveira G.P.F., Amaral C.M.I. Effect of thickener agents on dental enamelmicrohardness submitted to at-home bleaching. *Braz. Oral Res.* 2007;21:170-172.
34. Feinman R.A., Madray G., Yarborough D. Chemical, optical, and physiologic mechanisms ofbleaching products: a review. *Pract. Periodontics Aesthet. Dent.* 1991;3:32-36
35. Powell L.V., Bales D.J. Tooth bleaching: its effect on oral tissues. *J. Am. Dent. Assoc.*1991;122:50-54.

36. Sulieman M. An overview of bleaching techniques: I. History, chemistry, safety and legal aspects. *Dent. Update.* 2004;31:608–616.
37. Sulieman M. An overview of bleaching techniques: 3. In-surgery or power bleaching. *Dent.Update.* 2005;32:101–108
38. Sulieman M. An overview of bleaching techniques: 2. Night guard vital bleaching and non-vital bleaching. *Dent. Update.* 2005;32:39–46.
39. Leonard R.H., Jr., Van Haywood B., Caplan D.J., Tart N.D. Nightguard vital bleaching of tetracycline-stained teeth: 90 months post treatment. *J. Esthet. Restor. Dent.* 03;15:142–152. discussion 153.
40. Setien V.J., Roshan S., Nelson P.W. Clinical management of discolored teeth. *Gen. Dent.* 2008;56:294–300. quiz 301–294
41. Anderson DG, Chiego DJ, Glickman JR, McCauley LK. A clinical assessment of the effect of 10% carbamide peroxide gel on human pulp tissue. *J Endod* 1999; 25:247–50.
42. Attin T, Kielbassa AM, Shwanenbergg M, Helklwig E. Effect of fluoride treatment on remineralization of bleached enamel. *J Oral Rehabil* 1997;24:282– 6.
43. Zalkind M, Arwaz JR, Goldman A, Rotstein I. Surface morphology changes in human enamel, dentin and cementum following bleaching: a scanning electron microscopy study. *Endod Dent Traumatol* 1996;12:82– 8.
44. Haywood VB. History, safety and effectiveness of current bleaching techniques and applications of the nightguard vital bleaching techniques. *Quintessence Int* 1992;23:471– 88.
45. Heling I, Parson A, Rotstein I. Effect of bleaching agents on dentin permeability to *Streptococcus faecalis*. *J Endod* 1995;21:540 –2.
46. Lewinstein I, Hirschfeld Z, Stabholz A, Rotstein I. Effect of hydrogen peroxide and sodium perborate on the microhardness of human enamel and dentin. *J Endod* 1994;20:61–3.
47. Powell LV, Bales DJ. Tooth bleaching: its effect on oral tissues. *J Am Dent Assoc* 1991;122:50–4.
48. Tong LS, Pang MK, Mok NY, King NM, Wei SH. The effects of etching, micro-abrasion, and bleaching on surface enamel. *J Dent Res* 1993;72:67–71.
49. Goldstain RE. The changing esthetic dental practice. *J Am Dent Assoc* 1994; 125:1447–57.
50. Ten Cate JM, Arens J. Remineralization of artificial enamel lesions in vitro. *Caries Res* 1977;11:277– 86.
51. Featherstone JDB, Cutress TW, Rodgers BE, Dennison PJ. Remineralization of artificial caries like lesions in vivo by a self administered mouthrinse or paste. *Caries Res* 1982;16:235– 42.
52. Arends J, Gelhard TBFM. In vivo remineralization of human enamel (1983). In: Demineralization and remineralization of the teeth. Leach SA, Edgar WM, eds. Oxford: IRL Press, 1983:1–16.
53. Attin T, Hartmann O, Hilgers RD, Hellwig E. Fluoride retention of incipient enamel lesions after treatment with a calcium fluoride varnish in vivo. *Arch Oral Biol* 1995;40:169 –74.