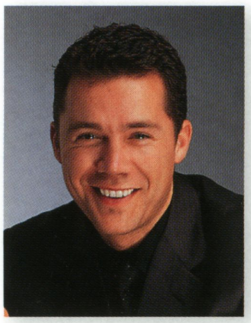
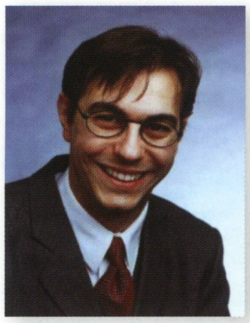
Non-Vital Tooth Bleaching with a Carbamide Peroxide Gel





by
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Non-vital tooth bleaching was first described in the nineteenth century. For decades, it has been and continues to be a well-used method to treat discolorations of root-filled teeth. Provided it is used within the limits of its indications, non-vital tooth bleaching is a valuable completion to the spectrum of esthetic treatments. Nevertheless, some risks are involved and the esthetic long-term potential is limited. This article will describe a method to effectively bleach non-vital teeth using a carbamide peroxide gel.

REASONS FOR TOOTH DISCOLORATION

Discoloration of non-vital teeth is associated with dental trauma and pulp necrosis. In addition, many instances of discoloration are due to iatrogenic reasons. These "dentist-caused" discolorations include false access to the root canal, bleeding during canal instrumentation, endodontic sealers within the coronal part of the crown, and restorative materials.

Figure 1: Initial situation.

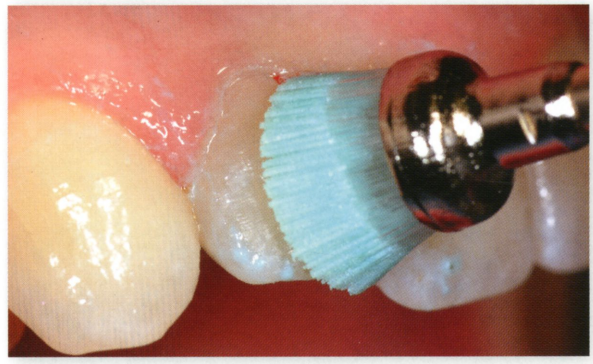

Figure 2: Professional tooth cleaning with an abrasive paste removes extrinsic stains.

TRAY USE

Using a tray to deliver the bleaching agent is a popular modification of the walking bleach method. The tray is manufactured as for vital tooth bleaching. However, facial aspects of the tray are cut out in the area of the adjacent teeth, leaving a full cap only for the tooth to be bleached. The second possibility (Fig 4) is to manufacture only a single tooth tray. As for the walking bleach procedure, an endodontic cavity is prepared. For the bleaching session, the endodontic cavity is filled with the bleaching agent. The custom-made tray is filled with bleaching agent as well, and is placed over the tooth. After the bleaching session the tray is removed and the patient must rinse the cavity with the aid of a syringe with a blunt cannula.

It is important to ask the patient whether the discolored tooth has sustained a traumatic injury.

The advantage of this method is that the tooth is bleached both externally and internally, therefore accelerating the procedure. However, the patient must be extremely compliant in keeping the endodontic cavity meticulously clean and rinsed after every meal.

NON-VITAL BLEACHING WITH CARBAMIDE PEROXIDE

STEP BY STEP

First appointment

- **Patient information**

  The patient must be informed about the following:

  1. Treatment plan, alternatives, and costs.
  2. Possibility of insufficient color change.
  3. Possibility of color remission.
  4. Enhanced fracture risk during bleaching procedure.
  5. External resorption.
  6. Restorations do not change their color and may be have to be redone after bleaching.

- **Medical history**

  It is important to ask the patient whether the discolored tooth has sustained a traumatic injury. Traumatic injuries can be associated with external root resorption. This information, together with the patient information might become of forensic importance later on.

- **Clinical and radiographical inspection** (Fig 1)

  The patient should not have active carious lesions. Furthermore, active periodontitis is a contraindication to bleaching. If the tooth that is to be bleached shows insufficient, leaking restorations, these must be sealed or replaced by a temporary prior to bleaching. Clinical symptoms of apical inflammation must not be present. A current radiograph must not indicate any signs of root resorption or apical inflammation. The root canal treatment must be in accordance with national standards.

- **Professional tooth cleaning** (Fig 2)

- **Color registration**

  A photograph would be the ideal way to document the initial discoloration. Shade guides usually do not offer a color that matches the discolored tooth, and are therefore inadequate. However, color registration is not that important, as the patient can easily check the bleaching progress by comparing the tooth color with the adjacent teeth.

- **Impression taking**

  Simple alginate impressions of the upper and lower jaw will do.

- **Stone models**

  The area of interest is the tooth. Therefore the base of the model can be trimmed into the muco-labial fold. To enhance adaptation of the

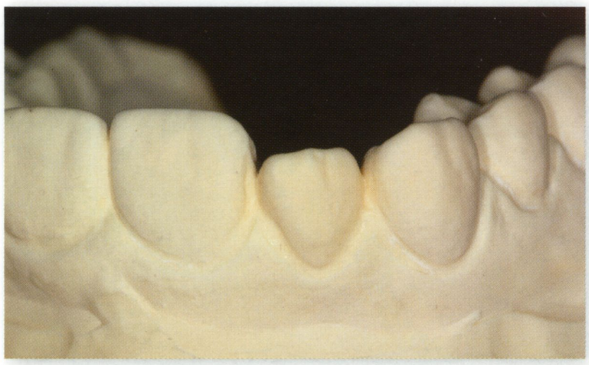

Figure 3: Shallow grooves will enhance the adaptation of the tray.

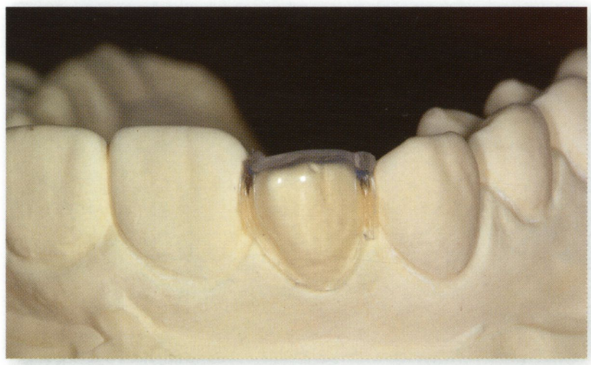

Figure 4: Finished tray.

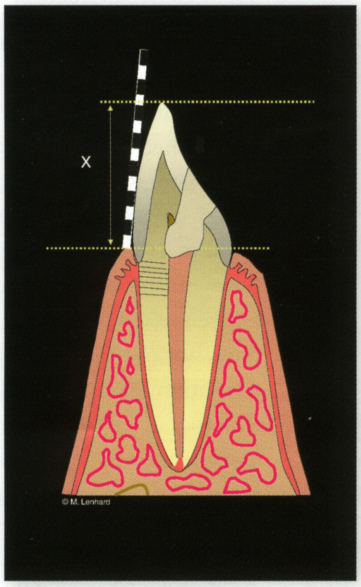

Figure 5: The facial length of the clinical crown is measured.

Figure 6: The length is measured using a PCPUNC 15 periodontal probe.

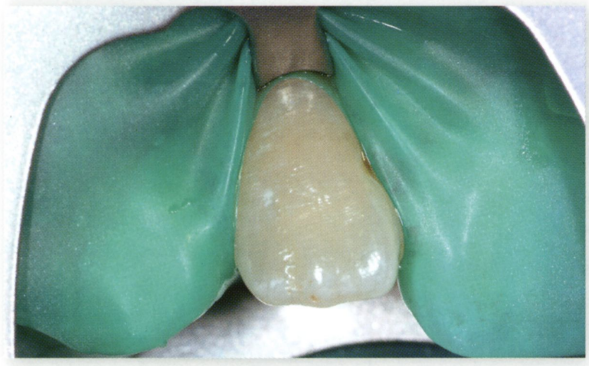

Figure 7: Single tooth isolation with rubberdam.

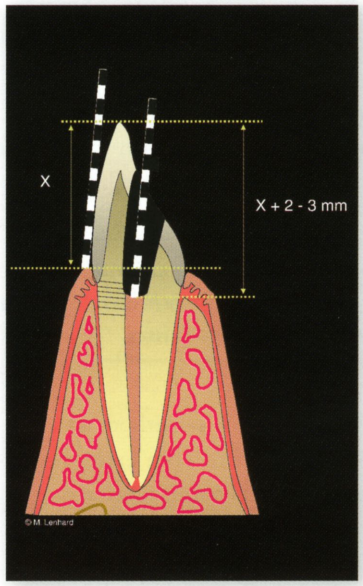

Figure 8: Determination of the depth of the endodontic cavity.

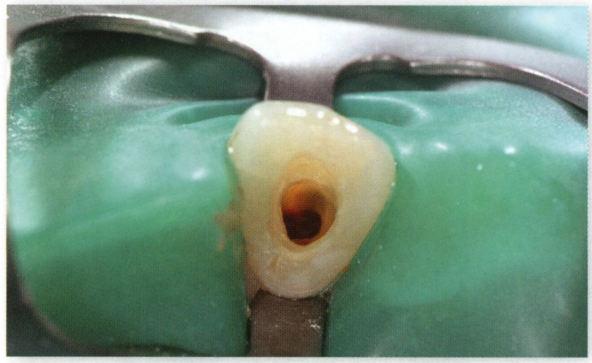

Figure 9: Endodontic cavity.

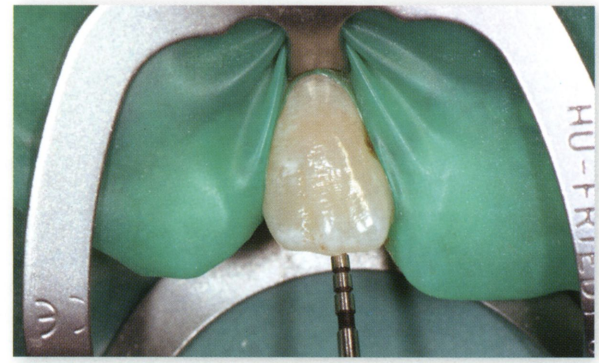

Figure 10: Checking the correct depth of the cavity.

tray, a shallow groove can be drilled in the cervical area along the marginal gingiva, but without removing the gingiva (otherwise there is a risk of gingival retraction during the treatment). Shallow grooves also may be prepared on the interproximal facial aspects of the adjacent teeth in order to enhance the adaptation (Fig 3)

It was often described that a block-out material should be applied to the labial surfaces of the teeth, before the tray was formed; the idea was to create a reservoir for the bleaching agent in the tray. It was believed that the higher availability of bleaching agent in the tray would speed up the whitening process. Nevertheless, it was shown that a reservoir does not give any additional value.[1] Therefore, it seems that reservoirs will only lead to a waste of material.

- **Tray manufacturing**

  The tray is manufactured in a vacuum former. After the forming process, it is helpful to highlight the cervical groove with a ballpoint pen. This facilitates cutting out the tray. The tray may not exceed the gingival margin of the tooth, so as to avoid direct contact of the gel with the gingival tissue (Fig 4).

Second appointment

- **Check fit**

  The correct fit of the tray must be checked meticulously, not only on the model but also in the patient's mouth. This is to prevent the material from flowing out of the tray so that the patient swallows as little material as possible. Sharp edges and over-extension are a common source of gingival irritation and inflammation.

- **Measure**

  Measure the length of the clinical crown from gingival margin to incisal edge (Figs 5 & 6). This is most easily done using a periodontal probe with a millimeter scale (PCPUNC 15).

- **Place rubberdam** (Fig 7)

- **Prepare endodontic cavity**

  The depth of the endodontic cavity can be determined by adding 2–3 mm to the length of the clinical crown and transferring this into the cavity (Figs 8–10).

- **Place base material**

  This is probably the most important step of the procedure. The correct positioning of the base is as crucial for the esthetic result as it is for avoiding external resorptions.

On the facial aspect of the cavity, the base material should be placed up to a level that is 1 mm below the facial gingiva margin (Fig 11). Again, this must be controlled by measuring with a periodontal probe. Hence, the distance from incisal edge to base equals the length of the clinical crown plus 1 mm (Figs 12 & 13). More material can be placed at the oral aspect of the endodontic cavity, as the oral aspect of the crown is not of esthetic concern.

Again, it must be emphasized that the position of the base should be controlled most carefully. If the base material is placed too far coronally, the dentin tubules that lay under the cervical enamel will be sealed. This will obstruct the penetration of the bleaching agent in the cervical area and result in a compromised esthetic result (Fig 14). If the base is placed too far apically, hydrogen peroxide might penetrate through dentinal tubules into the periodontal ligament and trigger an inflammatory resorption (Fig 14).

The best way of handling the positioning of the base material is to apply a surplus of material, which can afterward be reduced to the correct level using a small round bur, while repeatedly checking with the periodontal probe.

Figure 11: Base material. Note that the base extends to a higher level on the lingual aspect.

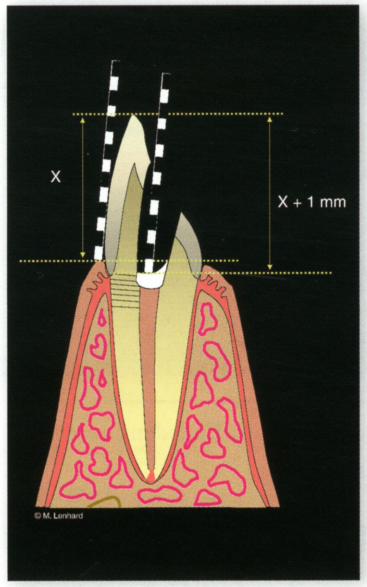

Figure 12: Determination of the correct position of the base material.

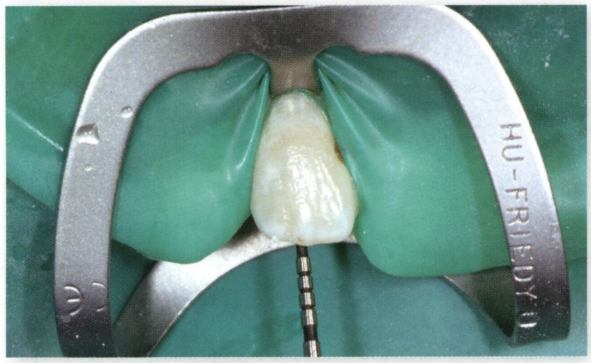

Figure 13: The base is located 1 mm below gingival margin.

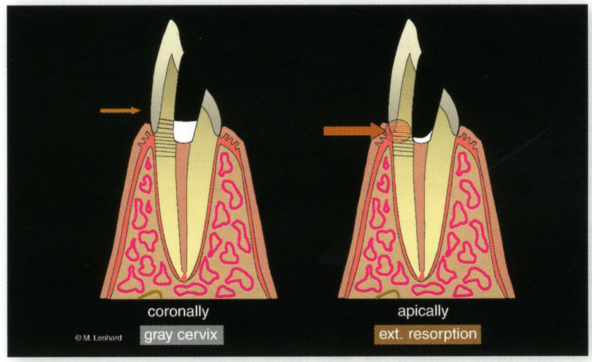

Figure 14: False position of base material.

Figure 15: Tray in place with a 10% carbamide peroxide gel.

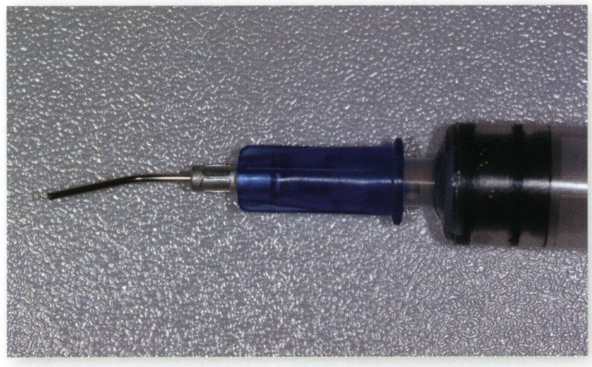

Figure 16: The patient has to keep the cavity clean by means of the syringe with a blunt cannula.

Figure 17: Situation after 1 day.

Figure 18: Situation after 3 days. Note gingival inflammation. The patient did not dare to brush the tooth. Consequently the patient was advised one more time to brush and floss all teeth.

Figure 19: Situation after 6 days. Gingival inflammation is virtually gone.

Figure 20: Temporary restoration.

The correct positioning of the base is as crucial for the esthetic result as it is for avoiding external resorptions.

Choice of base material: Research has shown that there is no material that seals the root perfectly.[2] Although adhesive resin base materials would probably result in the best seal, they are not the material of choice because the application of the dentin adhesive would seal all dentinal tubules, thereby hampering the penetration of the hydrogen peroxide into the dentin. We prefer a zinc-phosphate cement or a fiber-reinforced zinc-oxide-eugenol cement.

- **Acid-etch cavity with phosphoric acid for 5–10 seconds**

  This will remove the smear layer and open dentinal tubules, thus facilitating the penetration of the bleaching agent into the dentin. With this last step, the tooth is ready for the bleaching procedure.

- **Patient instruction**

  The patient must be shown how to use the bleaching system. The first application should be done in the office by the patient under the dentist's supervision. The patient must be able to apply the carbamide peroxide gel in the endondontic cavity, to fill the tray, and to place it on top of the tooth (Fig 15). Excess gel must be removed with the fingers or a toothbrush. The patient also must be able to rinse the endodontic cavity with water by using a syringe with a blunt cannula (Fig 16).

  Patients should be advised to bleach the tooth every day for 2 hours. Patients also must be instructed as to what they should avoid during the treatment period (e.g., citrus fruits and beverages, smoking, coffee), and how long this period is going to last (usually 6–8 days).

Figure 21: Light will be reflected at the light, opaque resin surface.

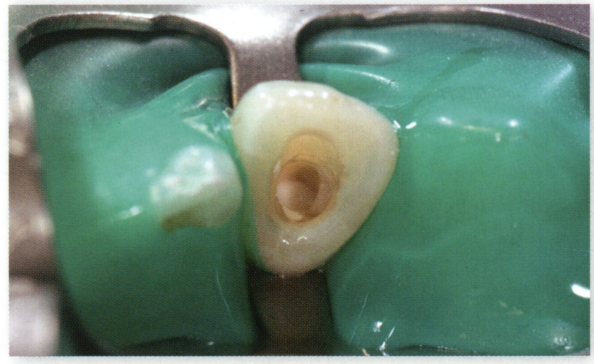

Figure 22: In order to achieve a highly reflecting inner surface, the cervical area is coated with a white, highly opaque composite stain.

Figure 23: Restoration done in incremental technique, using a very white and opaque composite.

Figure 24: Finished restoration.

Figure 25: Final situation.

- **Recall the patient regularly**

  Check the patient's color change and gingival health. We usually ask the patient to come back on the third and sixth day, or whenever the patient experiences side effects or thinks the color change is adequate (Figs 17–19).

Final bleaching appointment

Usually, one can see some slight color remission after the first week after bleaching is finished. It therefore is a good idea to slightly overbleach the tooth.

If the color matches the desired esthetic result, the bleaching agent is removed, and the cavity is restored with a temporary restoration (Fig 20). The final restoration should be done in the total etch-total bonding technique using composite resin materials. However, due to interactions between residual hydrogen peroxide and adhesive resins, the final restoration must be postponed for 1 week after the final bleaching appointment.

Final restoration of the endodontic cavity

An adhesive restoration done in the total etch-total bond technique is the treatment of choice to stabilize the tooth. Endodontic cavities have an unfavorable C-factor, resulting in high shrinkage stresses caused by the polymerization shrinkage of the composite resins. Therefore, it is helpful to place the material in an incremental technique using more—but thinner—increments than usual.

As some color remission can be expected, it might be helpful to use a light-colored, opaque composite shade. More light will be reflected from the restoration, giving the tooth a lighter appearance (Figs 21–25).

SUCCESS RATES

Initial success rates of internal bleaching are reported to be in the range of 83–91 %.[3-5] However, within 1 to 6 years after bleaching, the success rates drop to 35–50%.[3-7] Therefore, as with external bleaching, internal bleaching is usually not a permanent solution. After a certain time, there is a high probability that re-treatment will be necessary. Re-treatment, however, does not necessarily include the preparation of a new endodontic cavity and internal bleaching. When the restoration is adequate (light, opaque color; no marginal leakage) and factors that can cause ongoing discoloration can be excluded, re-treatment can be performed by external bleaching exclusively. This way, there is no further loss of tooth structure.

SIDE EFFECTS

The reported side effects associated with internal bleaching are limited; however, some of these are severe and can include:

- enhanced fracture risk
- reduced bond strength
- external root resorptions.

Usually, one can see some slight color remission after the first week after bleaching is finished. It therefore is a good idea to slightly overbleach the tooth.

ENHANCED FRACTURE RISK

Based upon observations and reports of anecdotal nature, it was believed that bleaching with hydrogen peroxide would enhance the fracture risk of teeth. It was reported in-vitro that bleaching with carbamide peroxide reduced the fracture toughness of human enamel.[8] However, this result could not be confirmed for internal bleaching.[9] Clinically, no evidence can be found that supports the hypothesis that bleaching procedures per se, whether external or internal, enhance the fracture risk.

Nevertheless, more teeth that are bleached internally do fracture. This phenomenon, however, seems to be associated with excessive removal of stained dentin by the dentist and is not a consequence of the chemical bleaching process. Furthermore, during the internal bleaching period the tooth with its endodontic cavity lacks a stabilizing restoration, making it more prone to fracture.

REDUCED BOND STRENGTH

Interactions between residual hydrogen peroxide and radicals formed during radical polymerization result in reduced bond strength. This is an effect that is limited in time, so that after 1 week the usual bonding procedures can be applied.[10-12]

EXTERNAL ROOT RESORPTIONS

This is the most severe possible side effect of internal tooth bleaching, and may lead to tooth loss. It is believed that penetration of hydrogen peroxide through the dentinal tubules into the periodontal ligament, associated with a drop of the pH-value, may trigger an inflammatory resorption in the cervical area of the roots. The process is usually asymptomatic.[13]

It has been shown that cervical areas with cementum defects demonstrated greater penetration.[14] However,

the condition of the dental hard tissue in the cervical area is unpredictable and irregular for any type of tooth and on any one individual tooth.[15]

Certain risk factors for external root resorption have been identified. Some of them, such as trauma or orthodontic treatment, do not relate to bleaching.[16] Others are associated with internal bleaching, like the use of high concentrations of hydrogen peroxide, thermocatalytic techniques, and the lack of a base material.[16-18] The use and the correct position of the base material on top of the root canal filling seems to be of special importance.[14,18]

The recommendations to minimize the risk of external resorption can be summarized as follows:

- Do not use thermocatalytic techniques.
- Avoid high concentrations of hydrogen peroxide.
- A base material should be placed with reference to the attachment level in all cases.
- Teeth that suffer from active periodontitis should not be bleached.

Although bleaching should be a safe procedure when following these guidelines, the patient must still be informed about the risk of external resorption.

Even so, external resorption might still occur, as it also can result from traumatic or idiopathic reasons. Therefore, the occurrence of a cervical resorption after bleaching might simply be just an unfortunate coincidence. However, as it is afterward impossible to identify the real reason of the resorption, the dentist is put in a difficult position.

REFERENCES

1. DS Javaheri, JN Janis: The efficacy of reservoirs in bleaching trays. *Oper Dent* 25(3):149-151, 2000.
2. DM Brighton, GW Harrington, JI Nicholls: Intracanal isolating barriers as they relate to bleaching. *J Endod* 20(5):228-232, 1994.
3. G Brown: Factors influencing successful bleaching of the discolored root-filled tooth. *Oral Surg Oral Med Oral Pathol* 20:238-244, 1965.
4. RA Howell: The prognosis of bleached root-filled teeth. *Int Endod J* 14:22-26, 1981.
5. G Holmstrup, AM Palm, H Lambjerg-Hansen: Bleaching of discoloured root-filled teeth. *Endod Dent Traumatol* 4:197-201, 1988.
6. B Feiglin: A 6-year recall study of clinically chemically bleached teeth. *Oral Surg Oral Med Oral Pathol* 63(5):610-613, 1987.
7. S Friedman, I Rotstein, H Libfeld, A Stabholz, I Heling: Incidence of external root resorption and esthetic results in 58 bleached pulpless teeth. *Endod Dent Traumatol* 4: 23-26, 1988.
8. RR Seghi, I Denry: Effects of external bleaching on indentation and abrasion characteristics of human enamel in vitro. *J Dent Res* 71(6):1340-1344, 1992.
9. M Lenhard, HJ Staehle: Fracture: Toughness of human enamel after external and internal bleaching. *J Dent Res* 74:(special issue, abstract #268):994, 1995.
10. HO Heymann: Non-restorative treatment of discolored teeth: Reports from an international symposium. *J Am Dent Assoc* 128(4) Suppl: 1-2, 1997.
11. EJ Swift: Restorative considerations with vital tooth bleaching. *J Am Dent Assoc* 128(4) Suppl: 60-64, 1997.
12. FF Demarco, ML Turbino, AG Jorge, E Matson: Influence of bleaching on dentin bond strength. *Am J Dent* 11(2):78-82, 1998.
13. M Trope (1997). Cervical root resorption. *J Am Dent Assoc* 128(4), Suppl: 56-59.
14. JJ Smith, CJ Cunningham, S Montgomery: Cervical canal leakage after internal bleaching. *J Endod* 18(10):476-48, 1992.
15. L Neuvald, A Consolaro: Cementoenamel junction: Microscopic analysis of external cervical resorption. *J Endod* 26(9):503-508, 2000.
16. GS Heithersay: Invasive cervical resorption: An analysis of potential predisposing factors. *Quintessence Int* 30(2):83-95, 1999.
17. S Madison, R Walton: Cervical root resorption following bleaching of endodontically treated teeth. *J Endod* 16(12):570-574, 1990.
18. AM MacIssac, CM Hoen: Intracoronal bleaching: concerns and considerations. *J Can Dent Assoc* 60(1):57-64, 1994.

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