Whitening of a non-vital tooth: A case report

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The search for an aesthetically pleasing smile is becoming more and more present in the dental practice. Seeking aesthetically-focused approaches, patients constantly inquire about dental whitening.

Dental whitening can be performed on either vital or non-vital teeth. In vital elements, whitening can be performed at the dental practice, at home, or using a mixed approach. For home bleaching, custom trays are fabricated by the dentist or a laboratory, the patient is thoroughly instructed on how to dispense the gel and weekly follow-up appointments are necessary until the conclusion.

On the other hand, when performing an in-office whitening treatment, a gingival barrier is placed in order to protect soft tissue. The whitening gel is then placed over the teeth. A mixed whitening approach employs both methods, complementing one another.

Numerous studies on the whitening of non-vital teeth have emerged during the past century. In 1950, non-vital teeth were bleached with heat and hydrogen peroxide by Pearson.1 In 1976, Nutting and Poe introduced a new approach called “walking bleach”, where hydrogen peroxide and sodium perborate were used for the same purpose.2 According to Kirk (1889), bleaching occurs by the oxidation reaction promoted by the bleaching agent on the pigmented substrate.3

According to Carrasco et al, the most current methods and approaches employed in internal tooth whitening aim to preserve the dental structure, the oral mucosa and most importantly, the patient’s health.4 In addition, whitening as close as possible to the original tooth colour should be quickly achieved.

Diverse techniques have also been developed, including etching the tooth surface with phosphoric acid before inserting the whitening gel,5 removal of the smear layer,6 ultra-sound7 or heat.8,9

Here, we report a case where a non-vital tooth that had been stained for 13 years was treated using the “walking bleach” technique.

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Case report

A 48-year-old female patient, whose non-vital tooth #23 had maintained a dark appearance for the past 13 years, was selected for this study. The clinical work took place at the Specialization Program on Endodontics, Graduate and Bioresearch - THUM - for a total of four months (From March to August).

The patient subsequently signed the term of consent form, authorising the procedure and the use of clinical documentation for this study.

Photographic registration was performed throughout the entire treatment.

Month 1

The pulp chamber was first accessed with a spherical diamond burr, 3mm of gutta-percha was removed and capped at the cervical region with glass ionomer cement. The internal walls of the tooth were left free of any restorative material. A glass ionomer was used to create a palatine barrier and the remaining chamber left accessible to the 35% hydrogen peroxide whitening gel (Opalescence, Ultradent). After placement of the gel, the tooth was temporarily restored with glass ionomer cement. After three days, the seal was removed, the gel washed away, the pulp chamber thoroughly rinsed with distilled water and then filled with calcium hydroxide (Ultracal, Ultradent).

Month 2

A month later, the same protocol was repeated. The patient was scheduled to return three days after this second appointment, but returned after two days, because the temporary glass ionomer restoration had fallen out. The tooth was then temporarily restored with a calcium hydroxide paste (Ultracal, Ultradent) and again, temporarily restored with glass ionomer cement.

Month 3

For the third month, the exact same procedure of the first and second months was repeated. A follow-up appointment was scheduled for three days after application of the gel. This time, however, the restoration was found intact. The glass ionomer restoration and the whitening agent were then removed, the chamber rinsed with distilled water and then filled with calcium hydroxide (Ultracal, Ultradent).

Month 4

During the fourth month, the whitening agent was left in the pulp chamber for three days, following the same protocol and materials. After three days, it was removed and the pulp chamber was then filled with the calcium hydroxide paste (Ultracal, Ultradent).
The procedure was repeated one last time in an attempt to whiten the tooth even more. After three days, with no colour alteration observed, the gel was removed and the chamber was filled once again with calcium hydroxide (Ultracal, Ultradent).

Month 5

Removal of the calcium hydroxide paste and final composite restoration performed with shade A2 Charisma (Heraeus Kulzer). Our treatment goals in this case were to whiten tooth #23 and achieve an aesthetically pleasing result, bringing back the patient’s self-esteem.

Month 6

Ultimately, our results show that internal bleaching of a non-vital tooth significantly improved the aesthetics of the smile and helped to raise the patient’s self-esteem.

Results
Discussion

Teeth might become darkened and lose their original colour due to reasons ranging from trauma, endodontic materials or byproducts of pulpal necrosis, thus requiring custom whitening techniques.

For the whitening of non-vital teeth, the literature describes the “walking bleach” technique, a combination of internal and external bleaching, with or without heat activation (LEDs, Laser, etc.).

Activated bleaching utilizes light sources such as lasers, LEDs or halogen lamps. This activation energizes the whitening gel by increasing the reactivity of the oxidizing ions. Carrasco did not find any difference in the dentin permeability when either light source was used.4

In all techniques, hydrogen peroxide showed equal efficacy and promoted a similar increase in dentin permeability, regardless of the light source.10 However, Camargo et al showed a difference in the penetration of oxidative radicals from the outer surface to the pulp chamber under different light sources.11

The same group also claimed that bovine teeth are not a suitable model of choice due to larger dentinal tubules, which allow a greater ion exchange. They hypothesize that human teeth might actually allow a high ion exchange due to the high organic content of the dentin when compared to bovine teeth, also reported by Palo et al.13-14

The present study chose to utilize the “walking bleach” technique, mainly because at our program in Endodontics, clinical work is limited from Saturdays to Tuesdays. The whitening agent chosen was a 35% hydrogen peroxide gel, which remains active in the pulp chamber for a three-to-five day period. On the last day of each module, the patient was evaluated, the gel removed and the chamber filled with a hydrogen peroxide paste. This step aimed to promote alkalization of the root surface on the cervical region, in order to avoid reabsorption.15 A study by Campos utilized calcium hydroxide in order to neutralize the acidic pH of the whitening gels.16 However, our study used Opalescence Endo, which has a pH of 6.5.

Glass ionomer cement was the material of choice for the cervical barrier, being the material which shows better sealing to ion exchange.17 Cervical barriers were constructed by completely filling the pulp chamber, then by removing the vestibular wall, while maintaining the mesial, distal and lingual walls. This approach aimed to decrease any possibility of oxidation in the external cervical region and external resorption.

Rodrigues et al. (2009) observed that 38% hydrogen peroxide is able to affect the dentin permeability at the vicinity of the pulp chamber.18 According to Palo et al. (2010), all bleaching agents penetrate the external surface of the roots starting from the pulp chamber, with a direct correlation between the potential for the agent’s penetration and the presence of oxidative agents.19 The authors found that sodium perborate in distilled water was the less aggressive bleaching agent. In a different study, the same authors found that when placed in the pulp chamber, hydrogen peroxide was able to penetrate dentinal tissue, reaching the external surfaces and the periodontal ligament.14 Compared to enamel and dentin, the least permeable structure was the cementum.

According to the original protocol, the temporary restorations would be replaced three times, but an additional restoration was required, due to retention failure. Detachment of the temporary restoration was unexpected, since glass ionomer cement was the temporary material of choice, which previous studies showed as the most stable against oxidation. To improve marginal sealing, a fragment of a sterile mask was used in order to prevent any contact between the gel and the cavity margins, leaving adhesion and sealing undisturbed.

Teeth with cracks or severe degrees of wear and abrasion are more susceptible to the penetration of the bleaching agent. Hydrogen peroxide has a higher penetration rate in the enamel and dentin of cracked teeth when compared to teeth displaying only surface abrasion.19

A highly satisfactory result was achieved after the first application, but still below our expectations, despite the patient’s enthusiasm with the initial results. Therefore, further applications were planned.

References

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The pulp chamber was kept filled with calcium hydroxide between appointments and we could clearly observe an additional degree of whitening taking place. This additional bleaching was likely due to the reduced dehydration of the enamel prisms during each session, which took place under rubber dam isolation and the likely ionic balance reached between the amount of oxidative ions and dentin. After this initial reversion, the tooth colour stabilized. In addition, the inhibitory effect played by oxygen on the adhesion strength of composites makes it highly important to wait for seven days after a whitening procedure before performing any restorative procedure, for ideal adhesion and accurate colour selection.

The remaining oxidative ions left in the organic portion of the dentin constitute a challenge when restoring teeth that have undergone whitening treatment. The higher the gel concentration, the higher the hydrogen peroxide levels are found in the pulp chamber, especially in restored teeth. Thus, a minimum wait time of seven days before performing additional restorative procedures must be observed (Lorenzo et al., 1996), so all residual oxygen is released, minimizing the chances for a decreased adhesion force of the restoration. In this case, 30 days was the interval before the final restoration was performed.

Chng et al. (2002) reports that hydrogen peroxide alone has a more negative effect on the biomechanical resistance than sodium perborate or when both were combined. Another study evaluated the residual resistance to fractures of these teeth and concluded that they can be normally restored with composite alone, since pins and posts did not increase such resistance.

Once the tooth colour reached stability, the applications ended. The patient was instructed to avoid food and drinks with pigment that might interfere with the obtained result and warned that colour changes could take place. A six-month follow-up appointment was then scheduled.

**Conclusions**

Under the intrinsic limitations present in this case, we could conclude:

- Non-vital teeth can be whitened with satisfactory results;
- The use of hydrogen peroxide gel in high concentrations is a valid alternative;
- However, in high concentrations, hydrogen peroxide should be used with caution for appropriate timeframes.
- Time required for ideal results depends on the pigments present at the surface of the tooth and the dentin structure.

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