Case Report

Minimally invasive technique for non-vital tooth bleaching using traditional Japanese paper

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Abstract: The purpose of this case report is to describe a minimally invasive technique for non-vital tooth bleaching using traditional Japanese paper, known as washi. Non-vital tooth bleaching with a mixture of sodium perborate and 30% hydrogen peroxide rolled in Japanese paper showed satisfactory stability in the bleaching effects and did not show any problems in the traumatically injured tooth. The use of Japanese paper for non-vital tooth bleaching may minimize damage to discolored non-vital teeth.

Keywords: dental atraumatic restorative treatment, root canal therapy, rubber dams, tooth bleaching

Introduction

Anterior tooth discoloration can pose an esthetic problem, and thus tooth bleaching has become increasingly popular in recent years. The first reports of bleaching for non-vital discolored anterior teeth go back to the mid-19th century using different chemical solutions [1]. In 1951, hydrogen peroxide was first used for non-vital tooth bleaching, and sodium perborate in conjunction with hydrogen peroxide in various concentrations is currently one of the most widely used methods for non-vital tooth bleaching.

When performing tooth bleaching procedures, it is critical for the clinician to develop a correct diagnosis of the etiology of tooth discoloration, because that is one of the most important considerations in determining an optimal treatment plan. Tooth color is generated by a combination of many factors associated with light and the optical properties of the tooth [2]. Basically, dentin provides the color of the tooth and tooth color is modified by intrinsic and extrinsic coloration. Intrinsic color is determined by the optical properties of teeth and their interaction with incident light.

During endodontic therapy, blood contents, such as hemosiderin, hemine, hematin, and hematoidin, and their reaction products may penetrate into the dentinal tubules. Various iron containing compounds which diffuse into the dentin and release oxygen when the bleaching agent is in direct contact with tooth substrates. It is believed that hydrogen peroxide can penetrate the dentin and release oxygen when the bleaching agent is in direct contact with tooth substrates. These results in damage to organic and inorganic components of the dentinal tubules, and the peroxide also reaches periodontal tissues [5]. It has been reported that interleukins released during inflammation can lead to increases in the levels of markers of osteoclastic activity, such as the receptor activator of nuclear factor kappa B ligand (RANK-L), leading to periodontitis and root resorption [6]. Thus, it is possible that bleaching agents act to cause root resorption through the stimulation of inflammation in periodontal tissue.

Traditional Japanese paper is known as Washi, and the word “Washi” comes from “Wa” meaning “Japanese” and “Shi” meaning “paper”. Japanese paper is made using fibers from the inner bark of the gampi tree, the mitsumata shrub (Edgeworthia chrysantha), or the paper mulberry (kozou) bush [7]. It is used for some medical products in Japan such as disposable bed linen, tapes for acupuncture and bandages, although there are almost no clinical reports of its use in dentistry. It is also used in food packaging, and is known to be safe for use in humans under normal conditions. It has unique characteristics including the capability to retain liquid and prevent desiccation. Therefore, Japanese paper may be able to stay wet within the pulp chamber and release the material slowly when compared to direct application of bleaching agent, providing an effective bleaching treatment.

The aim of this case report is to show a minimally invasive technique for non-vital tooth bleaching using sodium perborate mixed with hydrogen peroxide placed in Japanese paper inside the chamber.

Case Report

A 24-year old female patient presented with tooth staining and requested a veneer (Fig. 1a, b, Shade: C4, April 13, 2014). The patient was referred by an endodontist after having endodontic therapy on tooth #11. She had a traumatic injury to the tooth, and thus needed endodontic treatment in two sessions. The patient had vitality tests and was given a diagnosis of irreversible pulpitis. The tooth was isolated with a rubber dam. After creating the access opening, the pulp tissue in the chamber and pulp, along with bacteria and related debris, was removed. Then, the working length for the treatment measured by means of an electronic apex locator and root canal preparation was performed. The root canal was filled with AH plus root canal sealer (Dentsply Sirona, Milford, DE, USA) and gutta-percha point using the lateral condensation technique. After completion of this endodontic treatment, the patient was referred to us for further treatment to address color change in the tooth.

The patient was informed about minimally invasive treatment with non-vital tooth bleaching, which could be effective without the need to remove tooth structure for a veneer or full coverage crown. The patient accepted the minimally invasive treatment plan using traditional Japanese paper. Ethical approval for use of Japanese paper was received from the IRB of the Centro de Estudios Odontológicos de Queretaro C.E.O. (DENT/060119-153). A rubber dam (Dental Dam, Nic Tone, Bucharest, Romania) was placed to isolated teeth from #15 to #25, and retained with clamps (Clamp #00, Hu-Frideric, Chicago, IL, USA). The pulp chamber was...
opened using a diamond bur. Measurement of the desired length of 3 mm below the cemento-enamel junction was made (Fig. 2a) and the chamber was cleaned with a spray of water and 29 µm aluminum oxide particles (AquaCare, Velopex International, London, UK) in the pulp chamber, to remove any remnants of pulp tissue in the pulp horns (Fig. 2b). The chamber was etched with 37% phosphoric acid (Total Etch, Ivoclar Vivadent, Schaan, Liechtenstein) for 5 sec to remove the smear layer and then rinsed and air dried (Fig. 2c).

Sodium perborate was mixed with 30% hydrogen peroxide (Fig. 3a) to produce a paste-like consistency (Fig. 3b). This mixture was placed in a traditional Japanese paper (Washi Arts, Blaine, WA, USA) (Fig. 3c) and rolled (Fig. 3d). Then the rolled material for bleaching was inserted into the intra-coronal chamber space (Fig. 4a) and placed (Fig. 4b). The access hole was sealed with a resin modified glass ionomer cement (RMGIC, Fuji II LC, GC, Tokyo, Japan). The patient was seen again 2 weeks later. The same protocol was repeated during the second appointment. RMGIC and sodium perborate were removed, and the chamber was cleaned with water, 29 µm aluminum oxide particles and phosphoric acid, and a new mixture of sodium perborate with 30% hydroxyl peroxide in the Japanese paper was placed in the chamber and sealed with RMGIC. After the second round of internal bleaching was completed, the mixture material as removed. The chamber was then sealed with dentin and enamel shades of resin composite (Miris, Coltene, Altstätten, Switzerland, Shade: A1). Then, conventional in-office vital-tooth bleaching was performed with 35% hydrogen peroxide (Polaoffice, SDI, Bayswater, Victoria, Australia) placed on the teeth for 20 min and then suctioned off with an aspirator tip. This process was repeated 3 times and then the hydrogen peroxide was completely removed with a water spray. The vital-tooth bleaching treatment was repeated one week later. The patient came back to the office 2 weeks later with a satisfactory result. The final shade (Shade: A1) fulfilled the patient’s esthetic desires. Five-year follow-up showed satisfactory color stability (Fig. 5a, b, Shade: A2, June 16, 2019).
Discussion

Discoloration of anterior teeth due to endodontic treatment or traumatic injury may pose severe esthetic challenges. The clinical management of non-vital tooth discoloration includes a wide variety of approaches such as full crowns, veneers, or non-vital tooth bleaching [8]. Although veneers or crowns can provide predictable results, those types of treatments require the removal of healthy tooth structure. Non-vital tooth bleaching is beneficial as a minimally invasive technique. However, with non-vital tooth bleaching there have been reports of localized or systemic side effects [9]. Localized effects include possible external root resorption, and damage to tooth substrates through dentinal tubules [10]. Sufficient sealing and slower penetration of hydroxyl peroxide to tooth substrates through dentinal tubules may minimize the occurrence of external root resorption.

Traditional Japanese paper, which includes longer fibers than cotton pellets, was used because it is resistant to breakage and serves as a vehicle for placing the bleaching material into the chamber. In addition, it is possible to maintain moisture in the mixture of sodium perborate and hydrogen peroxide in place for a long time, preserving its effect. Further, Japanese paper consists of bidirectional cellulosic fibers, thus the capillary effect might help the gradual release of bleaching agents across the entire surface. Japanese paper is made with mucilage and long fibers in the Nagashi-zuki method, resulting in relatively thin, strong sheets with smaller gaps compared to Western paper used currently [7]. This paper can stay wet within the pulp chamber and release the ingredients slowly, providing an effective bleaching treatment. The clinical case presented in this report highlights the effectiveness of sodium perborate mixed with hydrogen peroxide using Japanese paper for non-vital tooth bleaching followed with in-office bleaching to achieve a successful, minimally invasive and predictable esthetic outcome.

A 5-year follow-up showed no signs of relapse of the discoloration or root resorption. It can be concluded that a combination of non-vital tooth bleaching with sodium perborate mixed with hydrogen peroxide using traditional Japanese paper and in-office bleaching is a possible treatment for a highly discolored non-vital tooth.

Conflict of interest
The authors have no conflict of interest to declare.

References
1. Attin T, Paqué F, Ajam F, Lennon AM (2003) Review of the current status of tooth whitening with the walking bleach technique. Int Endod J 36, 313-329.
2. Weiger R, Kuhn A, Lost C (1994) In vitro comparison of various types of sodium perborate used for intracoronal bleaching of discolored teeth. J Endod 20, 338-341.
3. Plotino G, Buono L, Grande NM, Pameijer CH, Somma F (2008) Non-vital tooth bleaching: a review of the literature and clinical procedures. J Endod 34, 394-407.
4. Joiner A, Luo W (2017) Tooth colour and whiteness: a review. J Dent 67S, S3-S10.
5. Zimmerli B, Jeger F, Lussi A (2010) Bleaching of nonvital teeth. A clinically relevant literature review. Schweiz Monatsschr Zahnmed 120, 308-320.
6. De Oliveira LD, Carvalho CA, Hilgert E, Bondioli R, De Araujo MA, Valera MC (2003) Sealing evaluation of the cervical base in intracoronal bleaching. Dent Traumatol 19, 309-313.
7. Hubbe M, Bowden C (2009) Handmade paper: a review of its history, craft and science. BioResources 4, 1736-1792.
8. Meyenberg K (2013) The ideal restoration of endodontically treated teeth - structural and aesthetic considerations: a review of the literature and clinical guidelines for the restorative clinician. Eur J Esthet Dent 8, 238-268.
9. Dahl JE, Pallesen U (2003) Tooth bleaching—a critical review of the biological aspects. Crit Rev Oral Biol Med 14, 292-304.
10. Plotino G, Buono L, Grande NM, Pameijer CH, Somma F (2008) Nonvital tooth bleaching: a review of the literature and clinical procedures. J Endod 34, 394-407.