

At-home vital bleaching: a comparison of hydrogen peroxide and carbamide peroxide treatments

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ABSTRACT

Tray bleaching of vital teeth performed at home by the patient under the dentist's supervision, whether alone or in combination with any of the in-office techniques, provides an interesting alternative to other methods employed in this type of dental treatment. This bleaching procedure applies low-concentration peroxides to the enamel by means of a custom-made mouth tray specifically designed for this purpose. The aim of this study is to examine and compare two commercially-available bleaching products, at equivalent concentrations, for use in this technique: VivaStyle (Vivadent) and FKD (Kin); the former is a 10% carbamide peroxide and the latter a 3.5% hydrogen peroxide formulation. It examines the parameters that must be monitored during the application of this type of procedure and presents 6 cases (3 treated with one of the above-mentioned products and the other 3 with the other), establishing the bleaching power of the products and the appearance and intensity of post-operative hypersensitivity. The results obtained show that both products are effective for the purpose for which they were designed. In general, dental hypersensitivity was minimal.

Key words: At-home tray vital bleaching, carbamide peroxide, hydrogen peroxide.

RESUMEN

El blanqueamiento de los dientes vitales que realiza el/la paciente domiciliariamente con férulas bajo supervisión del/de la dentista es una alternativa interesante entre las que integran este tipo de terapéutica odontológica, ya sea, de forma aislada o combinada con alguna de las modalidades de tratamiento en la consulta. En este procedimiento blanqueador se usan peróxidos de baja concentración que se aplican sobre el esmalte dentario mediante una cubeta individualizada especialmente diseñada para ello. El objetivo del presente trabajo es analizar y comparar dos productos blanqueadores comerciales de diferente concentración indicados para esta técnica, VivaStyle (Vivadent) y FKD (Kin); el primero de ellos es un peróxido de carbamida al 10%, mientras que el segundo es un peróxido de hidrógeno al 3,5%. Se analizan los parámetros que deben ser controlados durante la puesta en práctica de este tipo de procedimiento y se presentan 6 casos (3 de ellos tratados con uno de los productos mencionados y los otros 3 con el otro) en los que se constata su capacidad blanqueadora y la aparición y la intensidad de hipersensibilidad postoperatoria. Los resultados obtenidos muestran que ambos productos son eficaces para la función para la que han sido desarrollados. En general, la hipersensibilidad dentaria es mínima.

Palabras clave: Blanqueamiento vital domiciliario, peróxido de carbamida, peróxido de hidrógeno.

INTRODUCTION

Many patients nowadays are interested in aesthetic dental treatments for a variety of reasons, from personal satisfaction to work-related needs (1, 2). The canon of dental aesthetics in our society is determined by various factors and one of the greatest causes of dissatisfaction is a tooth colour defect or a shade that does not meet the patient's expectations (3). Dental bleaching is a therapeutic procedure that enables dental discolouration to be removed, thus giving a colour in keeping with the patient's aesthetic demands. The treatment is therefore presented as a non-invasive, conservative procedure that also favours periodontal health and hygiene (4) and does not alter the natural shape of the teeth, suitable for teeth affected by colour problems which present no other dental or periodontal pathology and retain a correct anatomy and appropriate position in the arch (1, 2, 5). It can be conducted alone or as a complementary technique within a global aesthetic dentistry treatment and the results largely depend on the type of discolouration, its causes and the time that has elapsed since it occurred.

Various agents can be used to whiten teeth: some have an oxidant effect, some act through erosion, some are abrasive and others use a combination of these methods (6). The oxidant agents are the most effective as they have the ability to penetrate into the enamel and the dentine; once there, they oxidise the molecules of the substances responsible for the dental discolouration (7). The agents of this type most commonly used nowadays are hydrogen peroxide, at concentrations ranging from 3% to 50%, and carbamide peroxide, also known as urea peroxide, which is usually used at between 1% and 45%. Both can be encountered in different commercial presentations: gels, mouthwashes, toothpastes or varnishes.

The different tooth bleaching techniques can be classified according to whether they are applied to vital teeth or to teeth which, for different reasons, have previously been subjected to endodontic treatment. They can also be divided into in-office and at-home treatments (6).

In 1989, Haywood and Heymann (8) developed the at-home technique of dental bleaching using 10% carbamide peroxide in plastic nightguards; they recommended 6-8 hour applications. This type of treatment achieved satisfactory whitening in 2-6 weeks. In 1991, these same authors reviewed the studies published to date on the safety and side-effects of this technique and reached the conclusion that it is as safe as other dental bleaching procedures provided it is carried out properly (9). Since then, at-home tray bleaching has become one of the most frequently used whitening techniques, whether as a stand-alone treatment for slight to moderate discolouration or, in the case of more severe discolouration, to complement an in-office bleaching technique, in which case the term employed is combination bleaching (10).

Howard later published a clinical trial (11) of 10% carbamide peroxide using the same bleaching technique. He concluded that it was an effective treatment but that the final results depended on different variables such as the guide employed to measure the colour and the monitoring carried out, among others. He also highlighted that in all the cases the adverse effects on the teeth and soft tissues were mild and reversible.

The aim of the present study is to establish and compare the clinical behaviour of two bleaching products containing different bleaching agents and concentrations applied by means of the at-home tray vital bleaching technique.

MATERIALS AND METHODS

6 patients were selected from those who came to the Unit with discolourations that could be treated by the chosen technique and products. They were randomly assigned to the two treatment groups.

Two different products were used. One, FKD® (Kin), is based on 3.5% hydrogen peroxide and the other, VivaStyle® (Ivoclar Vivadent), on 10% carbamide peroxide. Both are suitable for at-home tray-based tooth bleaching treatments.

At the first visit, each patient was given a thorough examination and clinical and radiological diagnosis and was assessed for the suitability of the treatment in question. After being given a detailed explanation of the bleaching therapy he/she would be following, each patient signed an informed consent form. Prior to treatment, custom-fitted trays for both arches with 1 mm bleaching agent reservoirs for the teeth to be bleached (right canine to left canine) (12) were made from Sof-Tray® sheets (Ultradent). The hydrogen peroxide product was applied for 3 hours a day and the carbamide peroxide product for 2 hours a day. At the start of treatment and at each check-up the patients were given a card on which each day they had to write down the product application time and any sensitivity they perceived and were instructed in the need to comply with normal standards of oral hygiene and the importance of not smoking or ingesting pigment-containing foods or drinks during the treatment in order not to affect its progress.

At each visit, the colour was measured with the Vitapan® Classical shade guide to check the percentage of colour change brought about by the product employed in each case and to compare the results at each stage of the treatment. The final examination was performed one week after concluding the bleaching treatment in order to allow definitive stabilisation of the tooth colour (13).

RESULTS

The first group of patients was treated with 10% carbamide peroxide (VivaStyle). In all cases, the daily length of application was 2 hours. In the first case the treatment lasted for 24 days, there was no pre- or post-operative sensitivity and the tooth shade changed from A4 (canines) – A3.5 (incisors) to A2 (canines) – A1 (incisors). In the second case the duration of treatment was similar (28 days), no sensitivity was shown during treatment and the shade changed from A3.5 (canines) – A3 (incisors) to A1. Case 3 presented a change in shade from A4 (canines) – A3 (incisors) to A2 (canines) – A1 (incisors) after only 20 days; in this case the patient did mention slight sensitivity in the anterior mandibular teeth throughout the treatment.

The second group of patients received the 3.5% hydrogen peroxide (FKD) bleaching treatment. In all these cases the bleaching product was applied for 3 hours a day. In the first

case, the shade changed from the initial A3 (canines) – A2 (incisors) to A2 (canines) – A1 (incisors) in 28 days, with slight tooth sensitivity during the second half of the treatment period. The second case required 26 days' treatment to change from shade A4 (canines) – A3 (incisors) to A2 (canines) – A1 (incisors); no sensitivity was mentioned during the bleaching process. The third case in this group changed from shade B3 to B1 in 47 days and experienced very slight localised sensitivity in the lateral mandibular incisor for one day during the initial stage of the treatment.

In the six patients treated, the changes in colour observed ranged from one to ten shades of the Vita shade guide's brightness-based classification; the "whitening success" percentage was between 31% and 100% on the Jané-Roig scale, which is based on the greatest percentage of whitening that can be achieved in a tooth, depending on its initial colour (14).

Figures 1, 2 and 3 show the digital photographic records of the carbamide peroxide group before whitening and at the examination performed one week after finishing treatment, while Figures 4, 5 and 6 show the same records for the hydrogen peroxide group.



Fig. 1. Case 1 (Carbamide peroxide): Pre-treatment (left side) and post-treatment (right) images.



Fig. 2. Case 2 (Carbamide peroxide): Pre-treatment (left side) and post-treatment (right) images.



Fig. 3. Case 3 (Carbamide peroxide): Pre-treatment (left side) and post-treatment (right) images.



Fig. 4. Case 4 (Hydrogen peroxide): Pre-treatment (left side) and post-treatment (right) images.



Fig. 5. Case 5 (Hydrogen peroxide): Pre-treatment (left side) and post-treatment (right) images.



Fig. 6. Case 6 (Hydrogen peroxide): Pre-treatment (left side) and post-treatment (right) images.

DISCUSSION AND CONCLUSIONS

This study was designed to assess the effects of two whitening products for at-home tray bleaching of vital teeth. For this purpose, one product containing 10% carbamide peroxide and one product containing 3.5% hydrogen peroxide were chosen as equivalent concentrations in order to determine which of the two bleaching agents would achieve better results with the least degree of tooth sensitivity under similar clinical conditions (15).

As regards the length of treatment of each patient, it was decided to apply each product for as long a period as was necessary to achieve the greatest whitening effect and allow the shade to stabilise (the point at which no further lightening took place) rather than using a fixed period of time in all cases, given the different degrees of response of each patient's teeth, which makes it difficult to determine the optimum time required. In the carbamide peroxide treatment group this period ranged from 20 to 28 days and in the hydrogen peroxide treatment group it was 26 days for the first patient and 28 days for the second patient, but the third patient required 48 days owing to the presence of composite resin veneers applied directly to the enamel surface of the teeth to be whitened, which hindered the effect of the bleaching product and the measurement of colour change, thus lengthening the treatment compared to the other two patients. Other than this exception, it was found that the treatment time varied between 3 and 4 weeks in both groups, as initially postulated by Haywood and Heymann (9).

Although 10% hydrogen peroxide was the bleaching agent originally used for this technique, higher concentration products are now available, as are ones that employ different concentrations of carbamide peroxide instead of hydrogen peroxide. This enables the concentration and length of application of each product to be modified in response to the patient's sensitivity (16, 17): at higher concentrations the application time is shorter, at lower concentrations it is longer. In this study, the application time employed for the hydrogen peroxide was 3 hours, as recommended by the manufacturer. The application time of the carbamide peroxide, however, was increased from the manufacturer's suggested one hour period to two hours, as it was considered that the product's activity in the tray after two hours' treatment was sufficient to justify this move (18).

The results of this study are not entirely comparable with those of other works that have employed the same technique but used products that are not identical, with different compositions and concentrations. Nonetheless, it is appropriate to review the results obtained by other authors using the same procedure. Mokhlis et alii conducted an *in vivo* double blind study in which they compared a product containing carbamide peroxide, in their case 20%, with a 7.5% hydrogen peroxide product, obtaining similar results to those presented in this paper (15). Matis et alii, who conducted similar clinical research to the above but used 10% carbamide peroxide, established that after 6 weeks' treatment the results were satisfactory (19). Ouellet et alii conducted a further study, also with a double blind structure, comparing 10% carbamide peroxide with a placebo and a toothpaste; after four weeks their results showed a greater

change in colour with the bleaching gel (3 shades) than with the other products (4). Nathoo et alii also carried out a double blind study in patients treated for one week with 5% and 10% carbamide peroxide respectively and found both agents to be equally effective in terms of their ability to modify tooth colour (20). In an *in vitro* study comparing the effects of different concentrations of carbamide peroxide (5%, 10% and 16%), Leonard et alii concluded that greater concentrations achieved faster bleaching but that the results were equivalent if the lower concentrations were used for a greater length of time (21). Barnes et alii assessed the effectiveness of another bleaching agent containing 10% carbamide peroxide, carbopol, sodium hydroxide and water and registered an average 6.96 colour shade change using the Vita shade guide (22). Goo et alii studied patients using 10% carbamide peroxide for 2 weeks and found that the bleaching effect increased in proportion to the length of treatment time (23). Kihn et alii used another double-blind study to compare two products with different concentrations of carbamide peroxide (10% and 15%); after one week's treatment they too found that the bleaching effect achieved was similar but that the results at the end of the treatment were better at the higher concentration (24). Heymann et alii carried out an *in vivo* blind analysis for a week to study different bleaching products containing 10% carbamide peroxide and also obtained similar results, both after five days' treatment and after one week (25). Lastly, a clinical trial by Amengual et alii verified the efficacy of a carbamide peroxide based product applied by alternating two different concentrations (16% and 22%) for two weeks, which achieved an average 3.55 shade lightening, measured with a colorimeter (16).

The bibliographical review of at-home tray bleaching using 10% carbamide peroxide published by Niederman et alii found that a noticeable change in colour (2 tones on the Vita shade guide) had been achieved in practically all the cases treated (26).

As regards the tooth sensitivity presented by the patients in the present study, it was slight, disappeared spontaneously without requiring the treatment to be interrupted or the product administration schedule to be modified and was in keeping with that described by other authors under similar conditions (13, 15, 22, 27). Nonetheless, Nathoo et alii (20), Leonard et alii (21) and Kihn et alii (24) all showed that higher concentrations of hydrogen peroxide are associated with greater sensitivity. Leonard et alii therefore recommended using low concentrations of carbamide peroxide, as they found that although these increase the total length of treatment, they are associated with lower sensitivity (21).

From an examination of the results obtained, it may be stated that the clinical behaviour of the two bleaching products was similar under the conditions in which this study was conducted, achieving a degree of whitening that satisfied both the patient and the dentist and generally did not cause any significant tooth sensitivity.

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