

Influence of plastic custom tray containing desensitizing dentifrice on reducing sensitivity caused by in-office dental bleaching

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• **Conflicts of interest:** none declared.

ABSTRACT

Objective: to evaluate clinically the use of desensitizing dentifrice, applied through a plastic custom tray, in pain reduction and colour variation caused by in-office dental bleaching. **Material and Methods:** for the study were selected 24 volunteers who were submitted to in-office dental bleaching in 3 clinical sessions with one week of interval, using bleaching gel (hydrogen peroxide - 35%). On the night of each bleaching session, volunteers used a plastic custom tray for 4 hours containing one of the dentifrices relative to the experimental groups: (1) Sucralose (S); (2) Sodium Phosphate (FS) and Calcium Silicate (SC) (NR-5 Technology). The pain was evaluated before the use of the plastic custom tray with dentifrice (S1, S3, S5) and after (S2, S4, S6) for 4 weeks using the analogue numerical scale with scores from 0 to 10. For colour variation (ΔE), a spectrophotometer (Easyshade) was used. **Results:** the FS and SC groups presented pain reduction in relation to the other groups ($p < 0.05$). There was a reduction of pain after the use of the dentifrice on the custom tray (S2, S4, S6) for 4 hours and there was no difference of ΔE between the experimental groups after the bleaching treatment ($p = 0.91$). **Conclusion:** the use of desensitizing dentifrice with FS and SC (Technology NR-5) in plastic custom tray was efficient for reduction of pain caused by in-office dental bleaching and the use of desensitizing dentifrice did not influence the effectiveness of bleaching treatment.

Keywords: Tooth bleaching; Hydrogen peroxide; Postoperative pain.

Introduction

Bleaching of vital teeth is a conservative and non-invasive alternative for aesthetic smile alteration when compared to other clinical techniques such as enamel microabrasion, direct restorations, ceramic veneers, and prosthetic crowns.¹⁻³ In addition to tooth whitening, conservative technique, has also shown a high success rate in the treatment of darkened teeth.^{4,5}

Among the limitations of dental whitening techniques, gingival irritation and dental sensitivity are the most frequently reported side effects during treatment, although they are usually mild and transient.^{2,4-9} However, these side effects may be more intense and even motivates patients to give up bleaching treatments.¹⁰⁻¹²

Among the most accepted explanations for dental sensitivity is the “hydrodynamic theory of Brännström”, which suggests that dental sensitivity would be caused by the movement of fluid in the dentinal tubules.¹³ This fluid movement in the dentinal tubules would activate the nociceptors and result in the perception of pain.² In addition, the diffusion of hydrogen peroxide through the enamel and dentin to the pulp and the acid pH of the bleaching gel can cause transient pain sensitivity.^{11,14,15}

Some techniques can be used to eliminate these adverse effects, among them are the reduction of the concentration

of hydrogen peroxide, the administration of analgesics and the use of desensitizers.^{4,10,16,17} However, these techniques are mostly applied in the dental office and no alternative treatments are prescribed for the patient to perform at home in order to minimize the effects of postoperative pain sensitivity.^{4,10}

There are some toothpaste addressed to reduce the dental sensitivity, although during oral hygiene the toothpaste remains for a short time in contact with the teeth, which may not be enough to eliminate or reduce the sensitivity caused by the technique of dental bleaching office. Thus, it is necessary to use adjuvant methods to complement brushing with dentifrices, aiming to reduce dental sensitivity.^{4,10,16,17}

Recently, a type of dentifrice named REGENERATE™ Enamel Science has been launched on the market, which has a desensitizing effect, promoting the formation of a new layer of enamel mineral deposited on the tooth and with the same chemical and structural composition of the hydroxyapatite mineral.¹⁸⁻²¹ Nevertheless, there are no studies evaluating the action of this product in relation to the sensitivity caused on the patients, as well as their effects on sensitivity after dental bleaching. Thus, this study evaluated the use of the REGENERATE™ Enamel Science dentifrice, associated with a plastic custom tray, seeking to evaluate the effects on sensitivity after tooth whitening.

Material and Methods

Twenty-four volunteers (n=24) were selected at the post-graduate dental clinic and extension of the Piracicaba School of Dentistry - UNICAMP to perform this randomised double-blind placebo-controlled clinical trial. Criteria for inclusion of volunteers: age 18 or older, good oral and general health, healthy anterior teeth with chroma greater than A2 on the Vita Classica color scale (VITA Zahnfabrik, BadSäckingen, Germany). The exclusion criteria were: smokers, pregnant or lactating, volunteers who had previously undergone dental bleaching, presence of parafunctional habits, dentin sensitivity, anterior teeth with restorations or dental caries, non-vital tooth browning and posterior restorations unsatisfactory.

The clinical evaluation of the volunteers was made through an anamnesis in which questions were asked about socioeconomic and health conditions followed by a physical examination in which a mouth mirror and dental probe were used, and radiographic examination of the teeth that presented dental sensitivity and/or restorations using interproximal and periapical radiographs. From this evaluation, it was analysed whether the volunteers fulfilled the inclusion requirements in the research, forming a sample of 24 volunteers.

After the selection of the research volunteers and signed the consent form (approved by the Research Ethics Committee of FOP-UNICAMP), the adequacy of the oral environment was performed in these patients through supra-gingival scraping of calculi with periodontal curettes and root straightening with polishing cups in low spin and a pumice mixture. Afterwards, an alginate impression was done to obtain a stone model, which was used to make a plastic custom tray in order to be used in association with desensitizing dentifrices and control after dental bleaching sessions.

One week prior to the start of the experiment, toothbrush, standard dentifrice (Colgate Total 12, Colgate-Palmolive, São Paulo, Brazil) were provided to each volunteer and oral hygiene guidelines were given; in addition, recommendations were made to use exclusively this toothpaste and brush during oral hygiene performed until the beginning of the bleaching sessions.

The colour evaluation was performed as an objective evaluation using a spectrophotometer (Easyshade, Vident, Brea, CA, USA). The colour was analysed with the hydrated teeth before the start of the first bleaching session and one week after the bleaching was completed. In order to make the colour evaluation with the spectrophotometer always in the same position, a guide was prepared. For the preparation of the guide, a dental im-

pression with addition silicone was performed (Express XT Pasta Densa Soft, 3M ESPE, Sumaré, SP, Brazil), and after polymerization, we created an opening in the vestibular face of the upper and lower central incisors which were evaluated at the middle third by means of the tip of the spectrophotometer that was placed in this area. The colour was determined using the EasyShade device parameters, which indicate the following values: L*, (a*) and (b*), in which L* represents the tooth value on a scale from 0 (black) to 100 (white), and a* and b* represent the shadow, being (a*) the measure along the red (a* positive) to green axis (a* negative), and (b*) is the measure along the yellow (b* positive) to blue axis (b* negative). The colour comparison before the first session and after the last treatment session was determined by the difference between the two colours (ΔE), calculated using the equation: $\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$.

Clinical procedures were performed under relative isolation with the aid of a labial retractor (Arcfles, FGM, Joinville, SC, Brazil), and cotton rollers of the 1st right molar to the 1st left molar of the upper and lower arch. The application of the barrier to gingival protection (Top Dam, FGM, Joinville, SC, Brazil) was inserted over the gingival margin and papillae corresponding to the areas that received the bleaching gel with approximately 3 mm in height and photopolymerized for 20 seconds at each group of three teeth. The photoactivation was done by high power LED (light intensity = 600mw / cm²) (Radical, São Paulo, SP, Brazil).

The desensitizing gel, 5% potassium nitrate based on 2% sodium fluoride (Dessensibilize KF 2%, FGM, Joinville, SC, Brazil) was applied with the help of a micro-brush applicator. The product remained for 10 minutes on the vestibular face of the 1st right molar to the 1st left molar of the upper and lower arch. The desensitizer was then removed using a water jet and disposable plastic suction cannula.

The manipulation of hydrogen peroxide followed the manufacturer's recommendations, which consisted of mixing 3 drops of 35% hydrogen peroxide and 1 drop of thickener, sufficient mixture for application for at least three teeth. The gel was applied and remained in contact with the vestibular face of the teeth (from the 1st left molar to the 1st right molar of the upper and lower arch) for 15 minutes, being removed with the help of a suction cannula and washed with water jet. This procedure was performed three times per clinical session. The volunteers underwent three clinical bleaching sessions, with a one-week interval between sessions.

Among the clinical bleaching sessions, volunteers used

an unidentified dentifrice corresponding to their experimental group, which was previously defined by means of a lottery by a professional who was not involved in the research. They were divided into two groups: control - placebo dentifrice in gel consistency (Thickening Gel, Biotype Pharmacy of Manipulation, Piracicaba, Brazil) and treatment dentifrice based on NR-5™ with sodium phosphate (FS) and calcium silicate (Regenerate Enamel Science, Unilever, São Paulo, Brazil). Thus, the dentist who supplied the dentifrice and the patient did not know which group belonged each patient (double blind).

After the first office whitening session, volunteers received their plastic custom trays and instructions for the dentifrice use, as described below:

- **Use of the dentifrice associated with the plastic custom tray:** the dentifrice was placed in small quantities on the vestibular side of the plastic custom tray in the region corresponding from the 1st right molar to the 1st left molar of the upper and lower arch. Then, the plastic custom tray was placed into the oral cavity and pressed on the vestibular surface of the teeth until the contact of the toothpaste contained in the custom tray with the tooth structure was established. Excesses of dentifrices were removed and the volunteer used the custom tray with dentifrices for 4 hours on the same night of each bleaching treatment session performed. The next morning the patient performed the oral and the custom tray hygiene, dried the custom tray and conditioned it within the provided case. Guidelines have been given to use the tray containing the specific dentifrice for its experimental group only on the night of the bleaching session.

- **Use of the toothpaste associated with the brushing:** the same toothpaste used in the plastic custom tray was placed in small quantities on the soft bristles of the brush given to the patient by the researcher for tooth brushing, which was repeated 4 times a day (after breakfast, after lunch, after dinner and before going to bed). Guidelines were given to use only the specific dentifrice for their experimental group in all tooth brushings performed during the bleaching treatment.

Sensitivity assessment was performed at six times: in the first session (S1: sensitivity before custom tray placement, S2: sensitivity after custom tray placement), in the second session (S3: sensitivity before custom tray placement; S4 sensitivity after custom tray placement) and in the third session (S5: sensitivity before custom tray placement; S6: sensitivity after custom tray placement), in which the analogue numerical scale with scores from 0 to 10 was used.

Statistical Analysis

For the sensitivity analysis, the multivariate analysis of variance (MANOVA) with repeated measurements was used, as well as the Lambda Wilks test at a 5% probability level to show differences between Control (C) and Regenerate (R) groups at the evaluation times (S1, S2, S3, S4, S5 and S6).

One-way ANOVA was applied for colour variation (ΔE) in relation to the dentifrices C and R used in the plastic tray.

Results

At the end of 4 weeks, the 24 participants completed the study, and there was no dropout throughout the study (Figure 1).

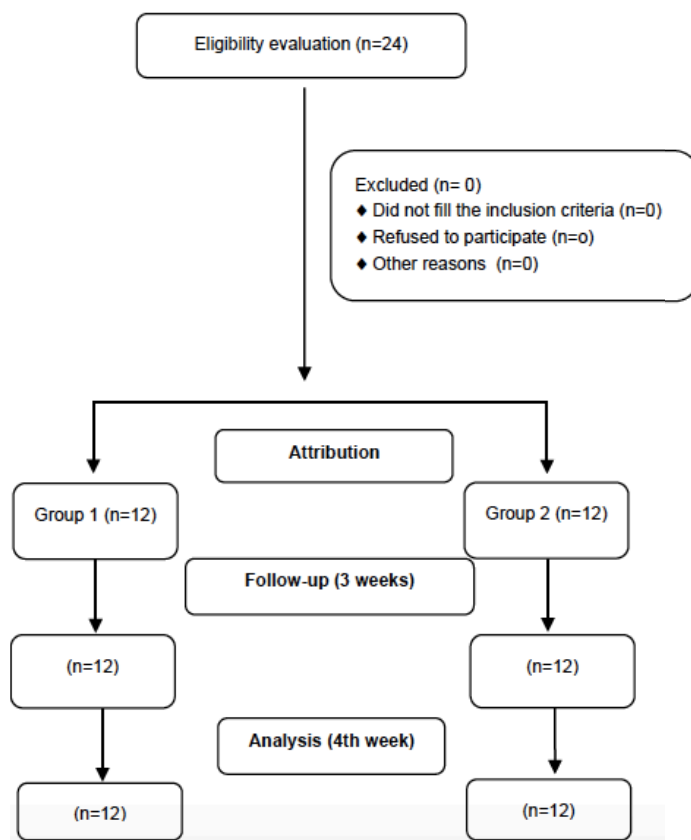


Figure 1. Consort flow chart

The groups were compared, and the result showed a statistically significant difference between Control (C) and Regenerate (R) groups ($p=0.012$).

Figure 2 shows the sensitivity (0 to 6) per time function (S1, S2, S3, S4, S5 and S6) of each dentifrice. Through this graph, it can be observed that after the use of the Regenerate dentifrice, containing the active principle NR-5 (R), there was a significant reduction of the sensitivity when compared to the control dentifrice.

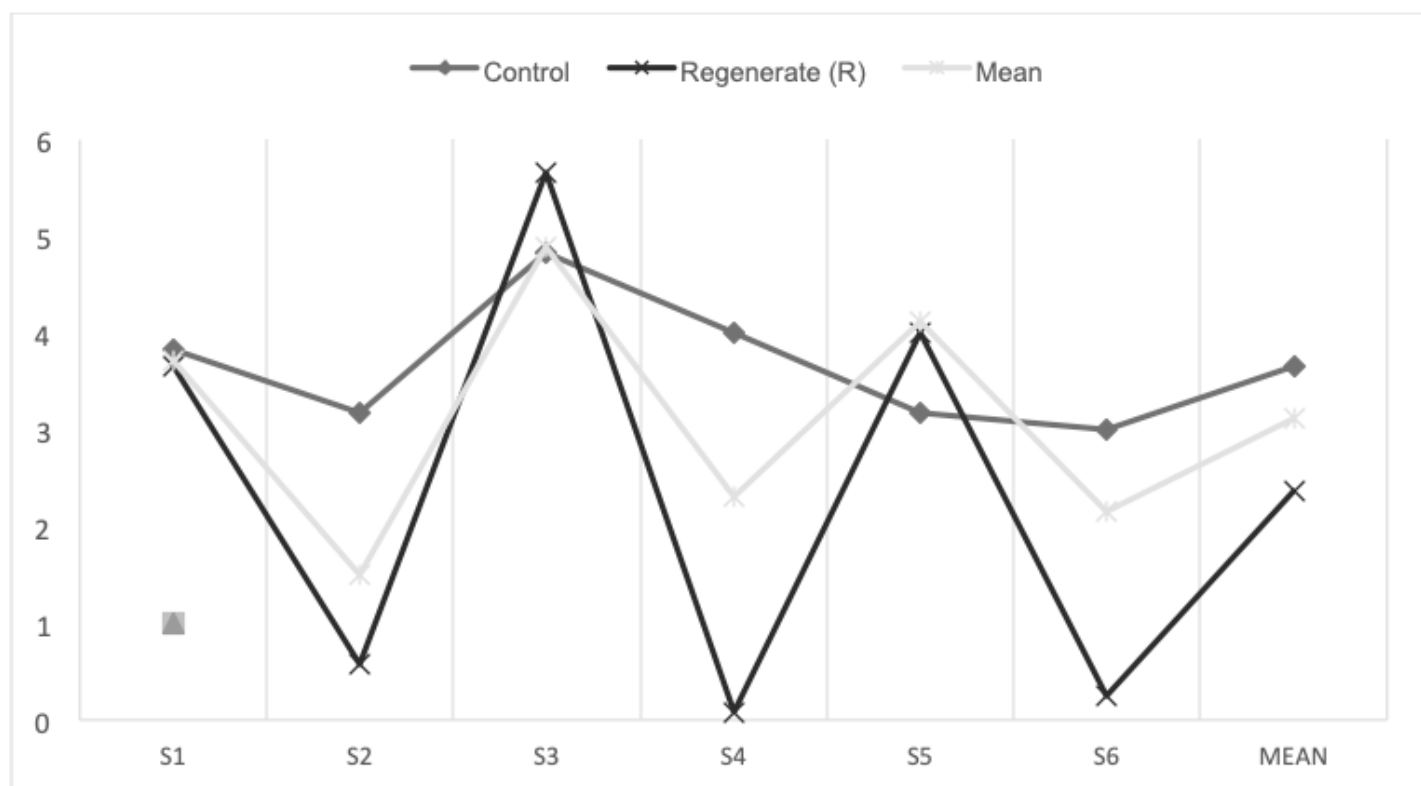


Figure 2. Mean, standard deviation to the interaction of dentifrice in terms of time

It was also observed that for the sensitivity analyses relative to the application time, a significant reduction of the sensitivity after the placement of the plastic custom tray with the dentifrice was observed after each bleaching session: the first (S2), the second (S4) and the third (S6) sessions when compared to the times of application before the custom tray: the first (S1), the second (S3), and the third session (S5).

ANOVA was applied for colour evaluation concerning each toothpaste and showed that there was no significant colour difference after bleaching ($p=0.918$) (Table 1).

Table 1. Mean, standard deviation and One-Way ANOVA for colour variation (ΔE)

Dentifrice	Colour Variation (ΔE)*
Control (C)	4.70 (2.83) ^a
Regenerate (R)	4.97 (1.79) ^a

* Equal letters show that there is no significant difference between the means of colour variation.

Discussion

Regarding dentifrice and sensitivity, it was observed that the Regenerate (R) dentifrice was effective in reducing sensitivity when compared to the Control (C) group.

This reduction in sensitivity is explained by the NR-5TM, which acts by recovering the chemical and structural composition of mineral composite of the tooth (hydroxyapatite),¹⁸⁻²¹ obliterating the dentinal tubules, and consequently

reducing the sensitivity caused by in-office bleaching.

The use of the plastic custom tray with the Regenerate (R) dentifrice has become an efficient procedure in reducing the sensitivity caused by in-office dental bleaching. The evaluation of the sensitivity considering the time of application showed that the values after the placement of the plastic custom tray S2, S4 and S6 were significantly smaller when compared to the times S1, S3 and S4 before custom tray were placed. This happened because the use of the plastic custom tray allowed a longer contact of the Regenerate (R) dentifrice with the dental surface, increasing the time of action and inhibiting pain sensitivity.^{16,22}

The dentifrices used did not influence the results of the bleaching treatment, since there was no significant difference between the groups evaluated. In other studies in which the colour variation was also evaluated with the use of desensitizing dentifrices, Colgate Sensitive Pro-relief (Arginine and calcium carbonate) was mentioned, which could influence the diffusion of the bleaching gel, due to its mechanism of action, which is similar to Regenerate (Sodium Phosphate and Calcium Silicate), both of which promote obliteration of dentinal tubules and modification of enamel permeability.^{16,24} However, the hydrogen peroxide molecule is very small, penetrating the interstitial spaces between the enamel prisms, not influencing the coloration.

This study showed an efficient alternative for the reduction of the sensitivity associated to the in-office dental

bleaching treatment, with the use of a plastic custom tray. Possible limitations of the technique are related to the need of close observation of the volunteers over a long period to evaluate their sensitivity and colour stability after bleaching treatment.

Conclusion

The use of the Regenerate™ Enamel Science dentifrice,

containing the NR-5™ technology [sodium phosphate (FS) and calcium silicate (SC)], when associated with the plastic custom tray was efficient in reducing the sensitivity caused by in-office dental bleaching.

The dentifrices used in this study did not affect the efficacy of the carbamide hydrogen used at-home bleaching, so there was no difference in colour in the bleaching performed by the two groups.

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