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Assessment of the Effect of Casein Phosphopeptide–amorphous Calcium Phosphate on Postoperative Sensitivity Associated With In-office Vital Tooth Whitening

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Clinical Relevance

Tooth sensitivity is the most frequent adverse effect of in-office vital tooth whitening. The use of a desensitizing gel after tooth whitening may reduce the incidence and severity of in-office vital tooth-whitening sensitivity.

SUMMARY

The aim of this study was to evaluate the efficacy of tooth mousse containing 10% casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) in reducing tooth sensitivity associated with in-office vital tooth whitening. In-office tooth whitening was performed for 51 participants using 35% hydrogen peroxide gel in a single visit. After the procedure, each participant was randomly assigned to one of three groups: gel without desensitizing agent (n=17), gel with 2% sodium fluoride (n=17), gel with 10% CPP-ACP (n=17). A small amount of the desensitizing gel assigned for each participant was applied directly on the labial surfaces of teeth and left undisturbed for three minutes. The participants were asked to apply the gel assigned to them for three minutes twice daily after brushing their teeth, and to continue this for 14 days. The participants were asked to return for follow-up visits after 24 hours and on days 3, 7, and 14, at which time teeth shade changes were assessed by one evaluator using a value-oriented Vita classic shade guide. The incidence, duration, and intensity of tooth sensitivity experienced was

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self-assessed on a daily basis for the 14-day study period using a visual analog scale (VAS). The effect of the three gels on tooth sensitivity was assessed using one-way analysis of variance and a χ^2 test (α=0.05). The general linear model was used to compare intensity-level differences in the three studied groups and for shade stability over the follow-up period. The results of this study showed that all three gels decreased the intensity of sensitivity associated with tooth whitening. The intensity of sensitivity was lower in the fluoride group than in the other two groups; however, it was not statistically significant (p=0.112 and p=0.532 on day 1 and day 2, respectively). The average shade change was 6.8. None of the tested materials affected the efficacy of tooth whitening, but the shade change among the fluoride group showed more color stability than that of the other two groups. This study suggested that using a gel after tooth whitening can reduce the intensity of tooth sensitivity associated with in-office whitening procedures without affecting the efficiency of tooth whitening. However, it failed to demonstrate that using a 10% CPP-ACP could provide additional therapeutic benefits.

INTRODUCTION

Tooth discoloration is a frequent dental finding, associated with clinical and esthetic problems. Invasive esthetic restorative dentistry includes many treatment modalities, which range from the routine placement of composite resin restorations to porcelain veneers, all-ceramic full and partial coverage restorations, and porcelain-metal restorations. Veneers and crowns are relatively difficult to make and are technique sensitive. Consequently, simpler, faster, and successful conservative whitening procedures have gained wider acceptance.[1,2]

Discoloration arises from a variety of causes, discolored teeth differ widely in appearance, severity, and modes of treatment. Detailed clinical examination and a review of the patient's oral hygiene practices; dietary habits; and history of exposure to chemicals, trauma, and infection are essential in making a final diagnosis of the cause of tooth discoloration and consequently the type of tooth whitening.[3] Vital tooth whitening is typically classified into three types: The first type is in-office procedures in which high concentrations of hydrogen peroxide are used to achieve an immediate result. The second type is tray whitening, an outgrowth of in-office procedures, in which carbamide peroxide is used as the whitening agent. The third type is over-the-counter products such as whitening strips and whitening toothpastes that contain low concentrations of hydrogen peroxide.[4,5]

Whitening is an oxidation reaction. Contemporary whitening systems are based primarily on hydrogen peroxide or one of its precursors, notably carbamide peroxide, and these are often used in combination with an activating agent such as heat or light.[6] Whether a tooth-whitening system contains carbamide peroxide or hydrogen peroxide, the mechanism of action of these systems involves hydrogen peroxide. Carbamide peroxide is broken down by salivary enzymes to release hydrogen peroxide and urea. Hydrogen peroxide converts colored materials into noncolored materials by oxidizing organic compounds within enamel and dentin.[7]

Tooth-whitening sensitivity is the most frequent adverse effect of vital tooth whitening.[8] It presents as a generalized hypersensitivity but may also occur as a spontaneous, sharp, shooting or tingling pain or zinger limited to one or a few teeth.[9] The incidence of tooth-whitening sensitivity can be as high as 60%.[10] The greatest sensitivity generally occurs with in-office tooth whitening because of the high concentrations of peroxide applied. The sensitivity can be so painful that some dentists premedicate their patients with nonsteroidal anti-inflammatory drugs to minimize it.[11] Numerous studies have examined various agents in an attempt to reduce the incidence and intensity of whitening sensitivity. A number of desensitizing agents have proven effective in reducing whitening sensitivity, but others only reduced the intensity of pain.[12,13] Although a large number of treatment modalities have been introduced for night guard–associated whitening, few studies have examined in-office whitening.[8]

Tooth mousse is a sugar-free water-based cream that contains 10% casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and has a polishing, cleaning, and dentinal tubule sealing effect.[14] It has been proposed that CPP-ACP can exert a rapid desensitizing effect through immediate protein binding followed by the deposition of calcium and phosphate compounds within exposed dentin tubules.[15] Adding CPP-ACP to home whitening agents resulted in a significant reduction of whitening sensitivity during and after treatment.[16] On the other hand, Tang and Millar[17] failed to prove a therapeutic benefit of Recaldent chewing gum (0.6% CPP-ACP) in reducing sensitivity of vital in-office

Table 1: *Inclusion and Exclusion Criteria*

Inclusion Criteria	Exclusion Criteria
Eight maxillary anterior teeth were present	Active caries and/or periodontal diseases (gingivitis and recession) or wasting diseases
The selected teeth had a mean shade of C2 or darker (Vitapan Classical, Vita-Zahnfabrik, Säckingen, Germany)	Smoker
	Previous whitening procedures
No restorations or carious lesions on the buccal surfaces of the anterior teeth to be whitened	Moderate or severe tetracycline stains or fluorosis
No history of tooth sensitivity	Pregnant or lactating
No use of a desensitizing agent or desensitizing toothpaste in the past six months	No schedule availability

tooth whitening. This outcome may be related to the low concentration of CPP-ACP and the short exposure time between teeth and CPP-ACP.

Therefore, the main aim of this study was to evaluate the efficacy of 10% CPP-ACP in reducing sensitivity associated with in-office vital tooth whitening as there is no consensus regarding its effectiveness. In addition, this study aimed to compare the effectiveness of 10% CPP-ACP with fluoride gel and a gel without desensitizing agent with regard to incidence, intensity, and duration of tooth sensitivity and, finally, to investigate how these agents affect tooth-shade stability.

METHODS AND MATERIALS

This study protocol was approved by the Institutional Review Board of Jordan University of Science and Technology (JUST). The volunteers were students, staff, and patients who worked on or attended the dental clinics at the faculty of dentistry at JUST and who expressed an interest in whitening their teeth. Fifty-one of the volunteers who met the inclusion and exclusion criteria (Table 1) signed a consent form containing all the information regarding the risks and benefits of the treatment and completed the study to the end. Before dental examination, a case sheet and a history form were completed for each participant to record all information regarding age, sex, medical and dental history, dentifrice being used, history of any habits (especially smoking), history of sensitivity or previous whitening, and presence of wasting disease. All participants received a complete oral prophylaxis by a dentist two weeks before the whitening appointment. Participants were randomly assigned to one of three study groups (Table 2).

Tooth shade evaluation was performed using the Vitapan classical shade guide (Vita Zahnfabrik, Bad Sackingen, Germany) by matching the middle third of the maxillary anterior teeth. The 16 shade tabs in the shade guide were numbered from 1 (highest/ lightest value, B1) to 16 (lowest/ darkest value, C4), and the total tab change was calculated by subtracting the tab number corresponding to the baseline shade from that the tab number of the shade at each evaluation. One evaluator recorded the shade of the participants' teeth at baseline (before whitening), directly after whitening, and at days 3, 7, and 14 after whitening. Photographs were taken using a digital camera (Camedia C-5060 5.1 MP Digital Camera w/4× Optical Zoom, Olympus, Tokyo, Japan) immediately after the whitening and at each shade evaluation to document results.

A lip and cheek retractor was placed. The gingival tissues of the teeth to be whitened were isolated using a light-cured resin dam (Top Dam, FGM, Joinville, Brazil) to prevent the whitening gel from coming into contact with the gingival tissue. Participants' lips were painted with vaseline, and protective eyewear was used. To aid in the isolation process, a plastic suction tip with high suction power was used.

A whitening agent with 35% hydrogen peroxide (Whiteness HP Maxx, FGM, Joinvile, Brazil) was applied on the labial surfaces of the upper teeth selected for whitening using an applicator. The whitening agent was washed away and refreshed every 15 minutes during the 45-minute application period, as instructed by the manufacturer. After

Table 2: *Experimental Groups*

Material	Description and Manufacturer
Gel without desensitizing agent	Experimental
Gel with 2% sodium fluoride	Frutti Flúor Gel 214826 and Frutti Fluor Gel Neutro, , Biodinamica, Ibipora, Brazil
Gel with 10% CPP-ACP	GC Tooth Mousse Recaldent (CPP-ACP), GC Corporation, Tokyo, Japan

completion, the whitening agent was removed with cotton rolls and then the gingival barrier was removed. Teeth were rinsed thoroughly, and the post-whitening shade was determined using the Vita oriented shade guide tab (Vitapan Classical, Vita-Zahnfabrik, Säckengin, Germany). Participants were scheduled for lower arch whitening after 14 days.

A small amount of the gel assigned for each participant was applied directly on the labial surface of each tooth and left undisturbed for three minutes; care was taken to cover the entire labial surface, and the gel was carried interproximally as much as possible. Participants were asked to expectorate thoroughly and avoid rinsing, eating, or drinking for half an hour after gel application. Each participant was given the assigned gel in an unmarked syringe and was instructed to use the gel in a similar manner twice daily, once in the morning and once at night, after brushing their teeth with the supplied dentifrice (Colgate toothpaste maximum cavity protection 100 mL, Colgate-Palmolive Arabia, Dammam, Saudi Arabia) for 14 days.

Post-whitening sensitivity was evaluated by relying on patient's feeling of pain. All participants were given a sensitivity sheet to record the post-whitening sensitivity of the whitened teeth on daily basis according to the visual analog scale of pain (VAS). The VAS is a horizontal line containing 10 numbers from 0 to 10; zero indicates no pain and 10 indicates the worst pain. Participants were asked to mark the number that indicated their level of pain. The participants were also asked to record the stimulus that caused sensitivity, including hot, cold, or other. The duration of pain, whether seconds, minutes, or hours, was also recorded for the 14-day follow-up period. For descriptive analysis purposes, the intensity results were categorized according to the following scale: 0 = none, 1-3 = mild, 4-6 = moderate, and 7-10 = severe.

Data analysis was carried out using the Statistical Package for Social Science (SPSS version 15, SPSS Inc. Chicago, IL). Descriptive analysis of the demographic data, the incidence, the stimulus and the duration of tooth sensitivity for each study group was calculated. Means and standard deviation for each group were also calculated with regard to the intensity levels of tooth sensitivity as well as tooth shade stability during the follow-up period.

One-way analysis of variance (ANOVA) was used for statistical analysis. A χ^2 test was used to find the effect of gender and age as well as the effect of different desensitizing agents on the intensity of sensitivity. The probability value was set at ($p \leq 0.05$). The general linear model was used to compare intensity level differences among the three studied groups and for shade stability over the follow-up period.

RESULTS

Fifteen men nd 36 women, ranging in age from 18 to 38 years old participated in this study. Mean age was 23.1 years.

Incidence of Tooth Sensitivity

Tooth sensitivity occurred in 50 participants on the first day after whitening. Sensitivity was reported by 22 participants on day 2 and 9 participants on day 3. During the 14-day follow-up period, the sensitivity among the fluoride gel group lasted up to day 10 after whitening. In the CPP-ACP gel group, sensitivity was reported by participants up to day 4 after whitening. In the gel without desensitizing agent group, some days the participants experienced sensitivity and sometimes they did not over the 14 day period.

Intensity

To statistically compare the intensity of pain among the tested groups, only the data collected from the first two days of the follow-up period were taken into consideration because of the larger number of patients who reported sensitivity in that specific period compared with the remaining follow-up days. Despite the fact that the participants in the fluoride gel group experienced lower intensity of sensitivity than those in the gel without desensitizing agent group or the CPP-ACP gel group, these differences were not statistically significant (Table 3). The predominant level of sensitivity among participants on day 1 was moderate in all tested groups, but the level of sensitivity was mild on day 2 and day 3. The sensitivity that persisted after post-whitening day 3 was mild or nonexistent (Figure 1).

Table 3: *Means and Standard Deviations and p Values of Intensity Levels on Day 1 and Day 2*

Day	Gel Without Desensitizing Agent (Mean ± SD)	Gel With 2% Sodium Fluoride (Mean ± SD)	Gel With 10% CPP-ACP (Mean ± SD)	*p*
1	5.47 ± 2.2	4.24 ± 1.8	5.76 ± 2.5	0.112
2	1.24 ± 1.6	0.71 ± 1.4	1.29 ± 2.0	0.532

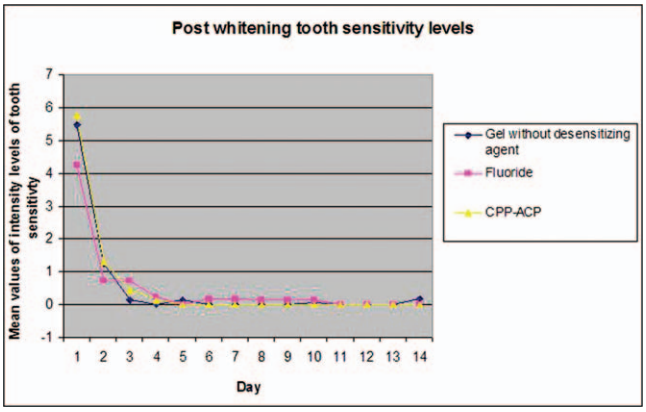

Figure 1. *Post-whitening tooth sensitivity levels in the three study groups during the study period.*

Stimulus of Sensitivity

The sensitivity reported by participants in all groups was mainly spontaneous; there was no provoking stimulus on day 1. Although most participants reported no pain on day 1, the remaining reported pain that was either spontaneous or provoked by a stimulus, as shown in Table 4.

Duration of Tooth Sensitivity

On day 1, nine participants of the gel without desensitizing agent group reported that the duration of pain was seconds, four reported minutes, and the remaining four reported hours. The experienced pain durations with the fluoride group were 10 participants having a pain episode that lasted seconds, three for minutes, and three for hours; one participant had no pain. In the CPP-ACP group, nine participants reported pain that lasted for seconds, six reported duration of minutes, and two reported pain duration of hours.

On day 2, among the gel without desensitizing agent group, four participants had pain that lasted for seconds, two for minutes, and one for hours; 10 had no pain. In the fluoride group, four participants experienced pain that lasted for seconds but one had pain lasting minutes, and 12 had no pain. Among the CPP-ACP group, six participants had pain lasting seconds, one for minutes, and one for hours; nine had no pain**.** The duration of sensitivity in all the groups throughout the 14-day period is shown in Table 5.

Tooth Shade Stability

The recorded shades using the Vitapan shade guide showed that the smallest number of shade tab changes was three tabs, and the largest was 11 tabs. None of the tested materials affected the efficacy of tooth whitening, but the shades among the fluoride group showed more color stability than that of the gel without desensitizing agent and the CPP-ACP groups. The mean and standard deviation of shade unit difference on days 1, 3, 7, and 14 are presented in Table 6. There was an improvement in the shade on day 3, with relapse on day 7 and day 14, but on day 14 the shade was the same as on day 1 (Figure 2).

DISCUSSION

Faster tooth whitening is increasingly required; hence, higher concentrations of whitening agents and in-office tooth-whitening regimens are used.[18,19] Although rapid lightening is the main advantage of in-office tooth whitening,[20] rapid relapse also occurs with most in-office products. Moreover, transient and sometimes intolerable sensitivity is the main drawback associated with in-office tooth whitening.[4,21] As the concentration of the peroxide increases, greater insult to the pulp occurs; hence, the incidence and severity of sensitivity increase.[22] To overcome this drawback of tooth whitening, several investigators have conducted studies on different

Table 4: *Stimulus of Sensitivity Reported in the Three Study Groups on Day 1 and Day 2*

Stimulus	Gel Without Desensitizing Agent n (%)		Gel With 2% Sodium Fluoride n (%)		Gel With 10% CPP-ACP n (%)	
	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
No pain	0 (0.0%)	10 (41.2%)	1 (5.9%)	13 (76.5%)	0 (0.0%)	9 (52.9%)
Spontaneous pain	14 (82.4%)	3 (17.6%)	12 (70.6%)	2 (11.8%)	9 (52.9%)	3 (17.6%)
Hot	0 (0.0%)	0 (0.0%)	1 (5.9%)	0 (0.0%)	1 (5.9%)	1 (5.9%)
Cold	3 (17.6%)	3 (17.6%)	1 (5.9%)	0 (0.0%)	4 (23.5%)	3 (17.6%)
Hot and cold	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (5.9%)	0 (0.0%)
Cold and spontaneous pain	0 (0.0%)	1 (5.9%)	1 (5.9%)	1 (5.9%)	0 (0.0%)	0 (0.0%)
Hot and spontaneous pain	0 (0.0%)	0 (0.0%)	1 (5.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
All stimuli	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (5.9%)	2 (11.8%)	1 (5.9%)

Table 5: *Duration of Sensitivity Among Participants Over the 14-day Follow-up Period*

Group	Gel Without Desensitizing Agent (n=17)				Gel With 2% Sodium Fluoride (n=17)				Gel With 10% CPP-ACP (n=17)			
	No Pain	S	Min	H	No Pain	S	Min	H	No Pain	S	Min	H
Day 1	0	9	4	4	1	10	3	3	0	9	6	2
Day 2	10	4	2	1	12	4	1	0	9	6	1	1
Day 3	15	2	0	0	14	2	1	0	14	3	0	0
Day 4	17	0	0	0	10	0	1	0	16	1	0	0
Day 5	15	2	0	0	16	1	0	0	17	0	0	0
Day 6	17	0	0	0	16	1	0	0	17	0	0	0
Day 7	17	0	0	0	16	1	0	0	17	0	0	0
Day8	17	0	0	0	16	1	0	0	17	0	0	0
Day 9	17	0	0	0	16	1	0	0	17	0	0	0
Day 10	16	1	0	0	16	1	0	0	17	0	0	0
Day 11	17	0	0	0	17	0	0	0	17	0	0	0
Day 12	17	0	0	0	17	0	0	0	17	0	0	0
Day 13	17	0	0	0	17	0	0	0	17	0	0	0
Day 14	16	1	0	0	17	0	0	0	17	0	0	0

Abbreviations: S, Seconds; Min, Minutes; H, Hours.

desensitizing agents in an attempt to prevent, or at least reduce, the intensity to an acceptable level for patients.[13,16,23]

Tooth Sensitivity Evaluation

Incidence of Tooth Sensitivity—Most of the participants (98.0%) were able to complete the treatment, although one participant had two applications instead of three because of intolerable pain. Almost all participants experienced sensitivity (98.0%) after tooth whitening. Our results are in agreement with those of other studies in that the occurrence of sensitivity is usually high after concentrated peroxide-based whitening. Tang and Millar[17] reported that 85.2% of their study participants had sensitivity after in-office whitening using 15% hydrogen peroxide. Tay and others[8] used the same whitening product used in the current study, with the same concentration, and reported that 66.8% of their participants experienced sensitivity.

The present study recorded sensitivity occurrence until day 14 after whitening. The results showed that in the three groups, most participants experienced sensitivity during the first two days. Few participants in the fluoride group experienced sensitivity that lasted up to day 10, whereas in the gel without desensitizing agent group, one or two participants experienced sensitivity on some days and sometimes did not up to day14. Several studies reported that in-office tooth-whitening sensitivity usually lasts up to one day after the procedure; for instance, Tang and Millar[17] reported that no patients had lingering pain after 24 hours. Reported sensitivity was similar in the study by Tay and others,[8] where most of the participants had sensitivity on the first day and about 15% had pain that continued until the second day.

When comparing the sensitivity among the fluoride group and the gel without desensitizing agent group, there was no statistically significant difference in the incidence of pain. The lack of difference in the incidence of pain in the current study is in agreement with Armênio and others,[13] where the use of 1.23% sodium fluoride for 4 minutes after the application of 16% carbamide peroxide did not reduce or eliminate the incidence of sensitivity compared with the placebo group. Moreover, similar findings were reported by Jorgensen and Carroll,[24]

Table 6: *Vita Classic Tab Values (Means and Standard Deviations) at Each Evaluation*

Group	Day 1 (Mean ± SD)	Day 3 (Mean ± SD)	Day 7 (Mean ± SD)	Day 14 (Mean ± SD)
Gel without desensitizing agent	6.59 ±1.7	7.06 ±1.1	7.00 ±1.2	6.65 ±1.5
Gel with 2% fluoride	7.29 ±1.4	7.94 ±1.5	7.76 ±1.4	7.53 ±1.5
Gel with 10% CPP-ACP	6.47 ±1.7	7.29 ±1.7	6.76 ±1.4	6.53 ±1.4

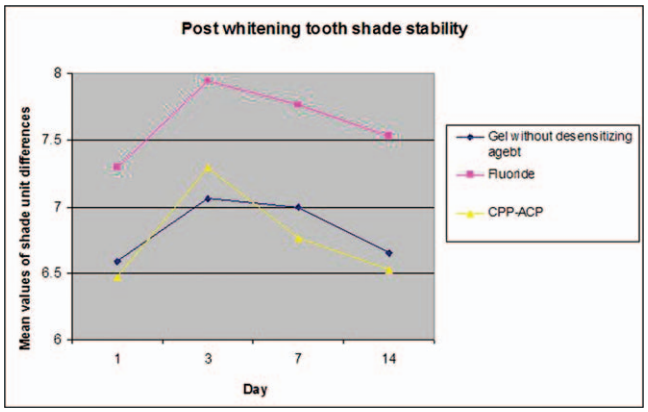

Figure 2. *Post-whitening tooth-shade unit differences in the three study groups over the study period.*

where patients using 15% carbamide peroxide with 0.11% fluoride had similar incidence levels as the placebo group.[24]

In the current study, there was no statistically significant difference in the incidence of tooth sensitivity between men and women. Most studies did not point out the relation between men and women, perhaps because of the lack of a significant difference, although it has been reported that women seem to have a higher incidence of sensitivity.[10]

Intensity—The intensity of sensitivity was lower in participants using the fluoride gel than those in the gel without desensitizing agent group and the CPP-ACP group. However, the difference was not statistically significant on day 1 or day 2 (p=0.112 and p=0.532, respectively). The results of this study are in agreement with the findings of Tang and Millar,[17] who studied the effect of using a sugar-free chewing gum containing 0.6% CPP-ACP on the intensity of sensitivity reported by participants. The results showed that chewing sugar-free gum can help reduce tooth sensitivity regardless of the presence of CPP-ACP; in contrast, not using a post-whitening agent was accompanied by a significantly higher intensity of sensitivity compared with the other groups. The results of our study are also in agreement with Jorgensen and Carroll,[24] where participants using 15% carbamide peroxide with 0.11% fluoride had no significant difference in sensitivity levels compared with participants who used a placebo gel; both groups reported mild sensitivity. Although the gel without desensitizing agent that was used in the current study had no active desensitizing agent, it may have stimulated salivary flow, which might have reduced the sensitivity given that dehydration is one of the causes of sensitivity.[25]

However, Tay and others[8] found that the intensity of sensitivity was significantly higher in the placebo gel group than in a group of participants who used fluoride/potassium nitrate gel. This might be attributed to the fact that the desensitizing gel was applied for 10 minutes before the whitening procedure; in addition, there was a possible dual effect of using both fluoride and potassium nitrate. The results of the present study contrast with the findings of Armênio and others,[13] where 1.23% sodium fluoride had a significant effect in lowering sensitivity intensity compared with the placebo group when applied in the tray for four minutes after 16% carbamide peroxide whitening. This difference may be due to the higher concentration (35% hydrogen peroxide) of the whitening agent used in our study, in addition to the time-release approach of carbamide peroxide, which is essentially associated with lower pain intensity than hydrogen peroxide.[22]

Giniger and others[16] found that the use of 0.5% CPP-ACP with 16% carbamide peroxide mixed immediately before application proved to be significantly effective in reducing the intensity of tooth sensitivity during treatment and five days after treatment. Another study, done by Borges and others,[23] where 22% carbamide peroxide with 10% CPP-ACP was used, showed reduction in sensitivity levels compared with the placebo group; however, this was based on clinical reports where only five patients were enrolled. This result could be attributed to the lower concentration and type of the whitening agent used compared with the in-office agents.

Stimulus of Sensitivity—In this study, pain was mostly spontaneous, which is comparable with reports that sensitivity actually does occur in healthy intact teeth without any provoking stimulus.[27] On the other hand, the study of Browning and others[26] reported that cold stimulus was the most painful stimulus, followed by gingival sensitivity and then sensitivity due to hot stimuli in patients using 10% carbamide peroxide with potassium nitrate and sodium fluoride as desensitizing agents.

Duration of Tooth Sensitivity—It has been reported that sensitivity associated with in-office tooth whitening usually peaks within one to six hours after whitening.[11] In the current study, it was found that in all test groups more than half of the participants had sensitivity for only seconds on day 1. Furthermore, equal numbers of subjects had pain for minutes and hours in the gel without desensitizing agent group and the fluoride groups, whereas in

the CPP-ACP group, the number of participants who had pain for minutes was higher than those who experienced pain for hours.

Browning and others[26] found that sensitivity on average was short lived when using 10% carbamide peroxide with potassium nitrate and sodium fluoride. Tang and Millar[17] found that the duration of sensitivity varies greatly from participant to participant; however, overall it was short-lived, with a mean value of 4.9 hours and a range of 0 to 12 hours. In our study, sensitivity was mainly reported in the first 48 hours, and the tingling sensation lasted mainly for seconds.

Tooth Shade Stability

Participants in this study had a significant shade improvement: an average of 6.8 units of shade change. It was found that participants in the fluoride gel group had a better shade stability compared with the CPP-ACP group and the gel without desensitizing agent groups. It was observed that the shade improved on day 3 among all groups, probably because of the temporary dehydration effect, which lasts up to 72 hours.[28] This was followed by minor relapse on day 14 in the gel without desensitizing agent group and the CPP-ACP group; the shade relapse was less noticeable in the fluoride group. This could be due to the teeth taking water back from saliva, and thus the shade becomes darker again,[28] which in this study occurred on day 7. It has been shown that fluoride increases enamel hardness and renders it less permeable,[29] which can explain why the participants in the fluoride group had a better shade stability.

The results of the current study indicate that application of a 2% sodium fluoride or 10% CPP-ACP or a gel without desensitizing agent does not hinder the whitening efficacy of 35% hydrogen peroxide, as the shade recorded on day 1 was approximately the same as the one recorded on day 14. This is in agreement with previous studies that used fluoride,[8] CPP-ACP materials,[16] or potassium nitrate and sodium fluoride.[25]

CONCLUSION

Under the imitations of this study, the following conclusions can be drawn:

1. There was no statistically significant difference among the gel without desensitizing agent, 2% sodium fluoride, and 10% CPP-ACP on reducing the intensity of tooth sensitivity associated with in-office tooth whitening. All three gels reduced sensitivity to a moderate level. This indicates that the use of 10% CPP-ACP may reduce sensitivity associated with in-office tooth whitening to a level comparable with that of fluoride, which is a well-established therapeutic agent used to minimize tooth sensitivity.
2. Using sodium fluoride was accompanied by better shade stability compared with the gel without desensitizing agent and the 10% CPP-ACP gel.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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