

Effects of the combined action of a desensitizing gel and toothpaste on dentin hypersensitivity due to dental bleaching

Massimo Amato,¹ Paola Carratù,² Giuseppe Pantaleo,³ Bruna Borelli,⁴ Roberto Sorrentino⁵

Abstract

Objectives: The present study is aimed at evaluating the effectiveness of a fluoride- and potassium nitrate-containing gel and toothpaste in reducing dentinal hypersensitivity due to dental bleaching. **Materials and methods:** Specific inclusion and exclusion criteria were used to recruit patients for the study. They were randomly allocated to a test or a placebo control group. Patients underwent a treatment of home dental bleaching with 10% carbamide peroxide. Dental shades were evaluated in a standardized environment and dentinal hypersensitivity was valuated by means of evaporation stimuli. A nominal scale was used to score the painful reaction. The patients were recalled 8, 15 and 28 days after the baseline for both shade and sensitivity assessment. Statistical analysis was performed using the Student's T-test. **Results:** The patients recall rate was 96.9%. The statistical analysis demonstrated a significant reduction of the painful symptoms in the experimental group ($p=0.031$) while no statistically significant differences were evidenced in the control group at any follow-up recall ($p>0.05$).

Discussion: The tested agents proved to be safe and effective in the short term. Neither pigmentations nor interferences with the bleaching action of peroxides due to the desensitizing agents were observed. The compliance of the patients to the proposed protocol as well as the motivation to maintain good oral hygiene were paramount in the achievement of the reported results.

Conclusions: The use of a desensitizing gel and toothpaste containing fluoride and potassium nitrate was effective in reducing dentinal hypersensitivity due to dental bleaching and did not interfere with the bleaching action of peroxides.

Clinical significance: Desensitizing gels and toothpastes containing fluoride and potassium nitrate can be considered safe and effective in the control of tooth sensitivity after dental bleaching.

Short title: Treatment of dentin hypersensitivity due to dental bleaching

Key words: Tooth sensitivity, dental bleaching, toothpaste, carbamide peroxide

Introduction

Dentinal hypersensitivity, presenting as a brief and acute painful sensation, represents an excessive reaction to non-noxious tactile, chemical, thermal, electrical, osmotic and evaporative (dehydration) stimuli.¹⁻³ Moreover, dentinal

hypersensitivity is not related to any concomitant dental pathology.⁴⁻⁶ The prevalence of such condition is slightly higher in females between 20 and 40 years old (8-57%).⁷⁻¹¹ The relationship between the permeability of dentinal tubules and painful symptoms was described by Brännström with the dentinal hydrodynamic theory.¹² Any of the above mentioned stimuli may cause a disturbance of the dentinal tubular fluid and thereby stimulate the baroreceptors of the pulpal nerves responsive to pain.¹³⁻¹⁵ The permeability of the outer dentinal tubules is due to the mechanical (abrasion) or chemical (erosion) removal of the intratubular smear layer.¹⁶

Dentinal hypersensitivity is one of the disadvantages of dental bleaching most frequently reported by patients after the use of peroxides. According to several studies, the more concentrated the peroxides, the higher the incidence of dentinal hypersensitivity.¹⁷⁻²⁰

Different materials and techniques were proposed to treat

¹ Massimo Amato, MD, DDS, Department of Medicine and Surgery, University of Salerno, Salerno, Italy

² Paola Carratù, MD, DDS, Department of Oral and Maxillofacial Sciences, University "Federico II" of Naples, Naples, Italy

³ Giuseppe Pantaleo, DDS, Department of Oral and Maxillofacial Sciences, University "Federico II" of Naples, Naples, Italy

⁴ Bruna Borelli, DDS, PhD Student, Department of Oral and Maxillofacial Sciences, University "Federico II" of Naples, Naples, Italy

⁵ DDS, MSc, PhD, Department of Oral and Maxillofacial Sciences, University "Federico II" of Naples, Naples, Italy

Corresponding Author

Dr. Roberto Sorrentino

Via Generale Giovanni De Bonis, 75 - 80123 Napoli (Italy)

Tel: 0039.3453599075 • Email: errestino@libero.it

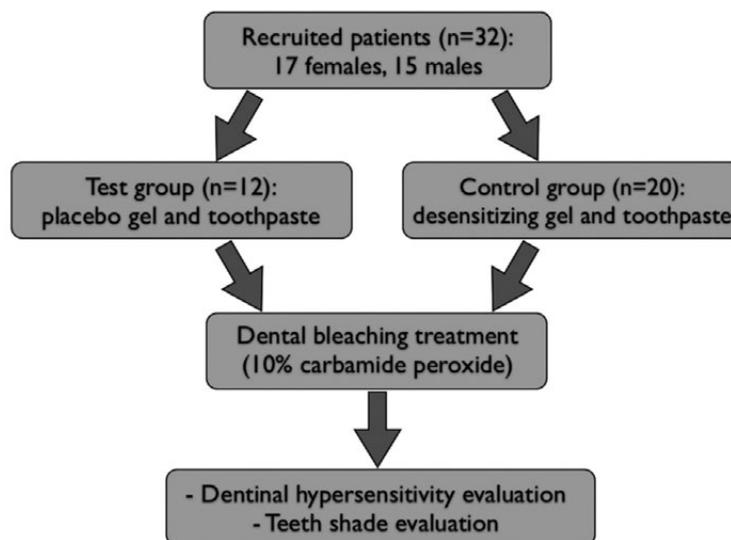


Figure 1 – Sample collection and study design.

such a condition, obstructing the tubules and inducing dentinal sclerosis. The ideal dentinal desensitizer should present the following characteristics: pulp protection, easy handling, absence of pain, rapid action, permanency and absence of tooth pigmentation.²¹⁻²⁵

The present placebo-controlled clinical study is aimed at evaluating the effectiveness of a fluoride- and potassium nitrate-containing gel and toothpaste in reducing dentinal hypersensitivity due to dental bleaching.

The tested null hypothesis stated that there was no difference in the decrease of dentinal hypersensitivity due to dental bleaching using gels and toothpastes with and without desensitizing agents.

Materials and methods

The present prospective clinical study was performed in the Department of Oral and Maxillo-Facial Sciences of the University "Federico II" of Naples (Italy). According to the methodologies described in the literature to evaluate dentinal hypersensitivity, the study was designed as randomized, placebo-controlled and single-blind.

The patients were collected according to the following inclusion criteria:

- absence of dentinal hypersensitivity at the baseline (T0);
- absence of concomitant dental pathologies potentially correlated to the onset of dentinal hypersensitivity (caries, periodontitis);
- maxillary central incisors with A3,5 or darker shade according to the Vita scale (Vita Lumin Vacuum Shade Guide, Vita Zahnfabrik, Spitalgasse, Bad Sackingen, Germany).

Thirty-two patients (17 females and 15 males) whose age

ranged between 18 and 60 years-old, were recruited for the study. They were all in good general health and were not or had not been subjected to any pharmacological therapy, which could possibly act as a confounder in the clinical diagnosis and management of dentinal hypersensitivity, as well as in the evaluation of the results of the present investigation.

Conversely, the following patients were excluded from the study:

- subjects previously treated by means of dental bleaching agents;
- subjects with extended restorations in the maxillary anterior region;
- subjects with fractured enamel and/or highly compromised anterior areas;
- subjects with severe or tetracycline-induced pigmentations;
- subjects with evident signs of bruxism and/or para-functional habits;
- subjects with ongoing severe oral pathologies;
- subjects allergic to the molecules to be used in the study;
- pregnant and/or lactating women.

The recruited patients were randomly allocated to the test group (n=20), using a fluoride- and potassium nitrate containing gel and toothpaste (Emoform Actisens Sensitive Teeth, Polifarma Benessere, Rome, Italy), or to the control group (n=12), using a placebo gel and toothpaste without any desensitizer or active molecules (Fig 1).

All the patients underwent a treatment of professional oral hygiene and motivation performed by the same experienced dental hygienist. Moreover, they were asked not to smoke and to avoid chromogenic food and beverages for the whole experimental period.

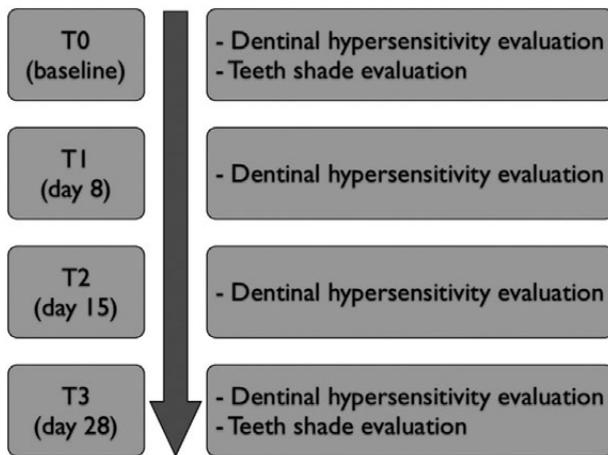


Figure 2 – Study timing.

All the patients were subjected to home dental bleaching treatment with 10% carbamide peroxide not containing any desensitizer. The bleaching agent was used by means of individual thermo-formed vinyl trays worn by patients for 8 hours per night for a total period of 4 weeks. Furthermore, patients were requested to use the toothpaste 3 times per day (after breakfast, lunch and dinner) and the gel by means of the above mentioned individual trays for 1 hour twice per day (morning and evening before applying the bleaching agent).

All the patients were examined at the baseline (T0) by the same experienced operator skilled in evaluating dental shades. The baseline examination and the follow-up evaluations were made in the same environment and with the same illumination conditions, in order to standardize shade assessment. The Vita shade scale was used as reference for dental color. In addition, dental hypersensitivity was evaluated by means of evaporation

stimuli through a standardized air syringe. The following nominal scale was used to score the painful reaction to such stimulus:

- Score 0 = absence of pain;
- Score 1 = light pain;
- Score 2 = moderate pain;
- Score 3 = severe pain.

The patients were recalled 8 (T1), 15 (T2) and 28 days after the baseline and dental hypersensitivity was recorded (Fig 2).

The Student's T-test (95% CI) was used to statistically analyze the recorded data of both groups at each follow-up recall. The p-value was set at 0.05.

Results

One patient allocated in the placebo group was lost at follow-up; consequently, the recall rate was 96.9%.

Neither pigmentations nor interferences with the bleaching action of peroxides due to the desensitizing agents were observed.

In the test group, Score 3 was noticed in 15% of the patients at T1 but such percentage decreased to 0% at T3. On the contrary, in the control group, 18% of the patients reported Score 3 at T1 but this value raised to 36% at T3 (Fig 3). At T1, Score 2 was noticed in 10% of the patients in both experimental groups. Similarly to severe pain response, at T3 Score 2 decreased to 5% in the test group but raised to 18% in the control group (Fig 4).

The absolute perception of pain (calculated as the sum of all the scores of each group at T1, T2 and T3s) was significantly reduced over time in the test group. At the end of the study, 75% of the patients of the test group showed complete absence of pain while the remaining 25% showed light pain. Conversely, 45% of the patients of the control

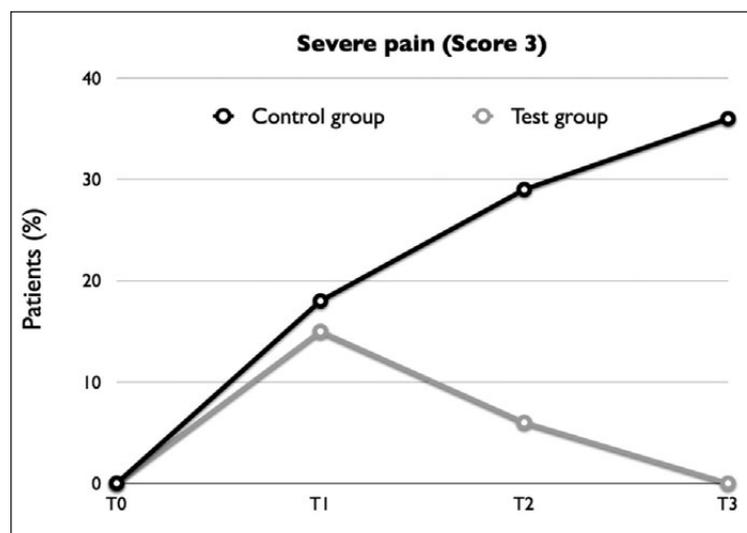


Figure 3 – Severe pain score.

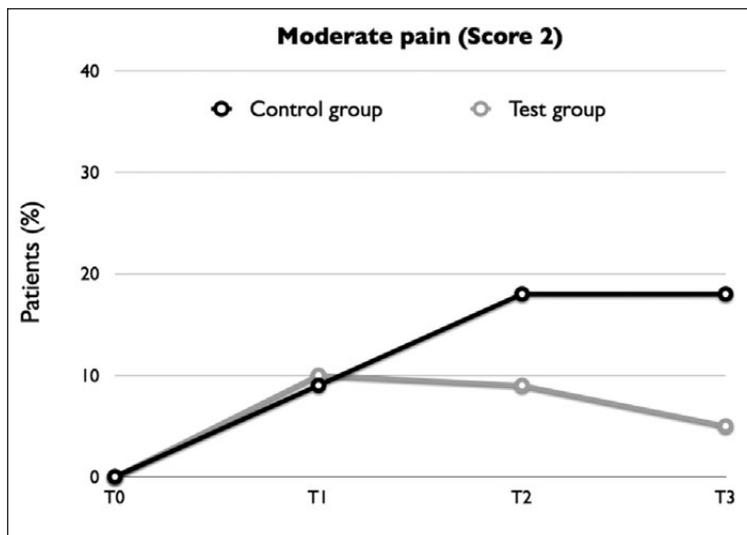


Figure 4 – Moderate pain score.

group showed light pain at the end of the study whereas the remaining 55% showed increased pain over time (Fig 5).

The Student's T-test demonstrated a significant reduction of the painful symptoms in the experimental group ($p=0.031$). In particular, dentinal hypersensitivity was significantly reduced between T2 and T3 ($p=0.028$). No statistically significant differences were evidenced in the control group at any follow-up recall ($p>0.05$) (Table 1). According to the statistical results of the present study, the null hypothesis was rejected.

Discussion

The perception of pain is a multifactorial experience and is strongly influenced by subjective feelings. Such a

phenomenon may act as a confounder in the objective clinical diagnosis and interpretation of dentinal hypersensitivity.^{26,27}

The choice of the evaporative stimulus to evaluate the severity of dentinal hypersensitivity was based on a revision of the most recent literature, although its clinical reproducibility is still controversial.²⁸⁻³¹

As reported by different studies,¹⁷⁻²⁰ the 10% carbamide peroxide used in the present study to perform home dental bleaching proved to be safe and effective. Nevertheless, in the control group dentinal hypersensitivity increased over time in most of the patients. Conversely, the tested combined use of the gel and toothpaste containing fluoride and potassium nitrate significantly reduced the painful

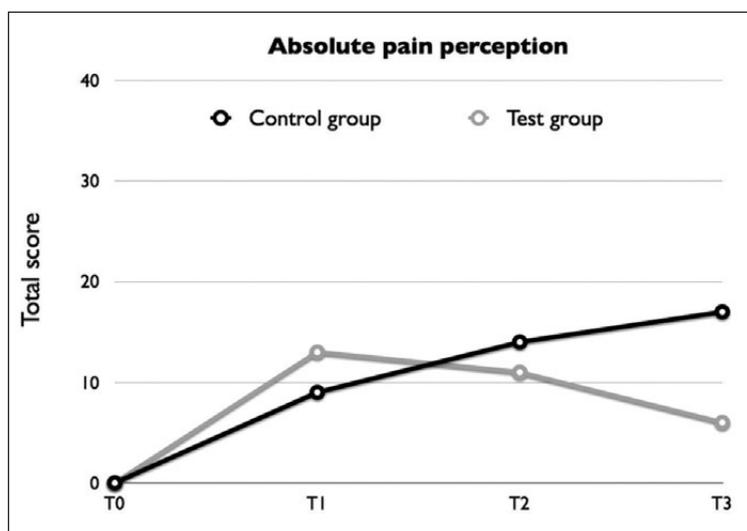


Figure 5 – Absolute pain perception.

Table 1: Student's T-test for paired samples

Paired Samples Test										
		Paired Differences								
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)	
					Lower	Upper				
Pair 2	Ctr_T1 - Test_T1	-,45455	,82020	,24730	-1,00556	,09647	-1,838	10	,096	
Pair 3	Ctr_T2 - Test_T2	,45455	1,57249	,47412	-,60187	1,51096	,959	10	,360	
Pair 4	Ctr_T3 - Test_T3	,90909	1,51357	,45636	-,10774	1,92592	1,992	10	,074	
Pair 5	Test_T0 - Test_T1	-,65000	1,18210	,26433	-1,20324	-,09676	-2,459	19	,024	
Pair 6	Test_T0 - Test_T2	-,55000	,88704	,19835	-,96515	-,13485	-2,773	19	,012	
Pair 7	Test_T0 - Test_T3	-,35000	,58714	,13129	-,62479	-,07521	-2,666	19	,015	
Pair 8	Test_T1 - Test_T2	,10000	,71818	,16059	-,23612	,43612	,623	19	,541	
Pair 9	Test_T1 - Test_T3	,30000	,80131	,17918	-,07503	,67503	1,674	19	,110	
Pair 10	Test_T2 - Test_T3	,20000	,41039	,09177	,00793	,39207	2,179	19	,042	

symptoms in the patients of the test group.

The compliance of the patients to the proposed protocol as well as the motivation to maintain good oral hygiene were paramount in the achievement of the reported results.

The tested desensitizing agents did not interfere with the bleaching effect of 10% carbamide peroxide and no pigmentations attributable to fluoride or potassium nitrate were recorded.

According to the results of the present study, the use of gels and toothpastes containing fluoride and potassium nitrate could also be useful in the treatment of dentinal hypersensitivity caused by dental wear (abrasion/erosion), exposure of root cement or secondary to calculus removal.

The present investigation was performed to assess the effectiveness of the tested gel and toothpaste in the short term; clinical trials with prolonged observation period could be useful in evaluating the efficacy of such agents over time. Furthermore, further investigations would be necessary to evaluate the effectiveness of the tested desensitizing agents during treatments with concentrations of carbamide peroxide higher than 10% or with different bleaching agents.

Conclusions

Within the limitations of the present study, the following conclusions can be drawn:

- the use of a desensitizing toothpaste, together with the application of a gel containing fluoride and potassium nitrate, three times per day for a period of at least 2 weeks was effective in reducing dentinal hypersensitivity due to dental bleaching;
- the desensitizers did not interfere with the bleaching action of peroxides and did not cause any pigmentations of teeth.

References

1. Curro FA. Tooth hypersensitivity in the spectrum of pain. *Dent Clin North Am.* 1990; 34:429-437.
2. Dababneh RH, Khouri AT, Addy M. Dentine hypersensitivity – an enigma? A review of terminology, epidemiology, mechanism, aetiology and management. *Br Dent J.* 1999; 187: 606-611.
3. Walters PA. Dentinal hypersensitivity: a review. *J Contemp Dent Pract.* 2005; 6: 107-117.
4. Trowbridge HO. Mechanism of pain induction in

hypersensitive teeth. In: Rowe NH, eds. Hypersensitive dentine: origin and management. Ann Arbor University of Michigan, 1985; pp:1-10.

5. Narhi M, Kontturi-Narhi V, Hirvonen T, Ngassapa D. Neurophysiological mechanisms of dentin hypersensitivity. Proc Finn Dent Soc. 1992; 88:15-22.

6. Dowell P, Addy M, Dummer P. Dentine hypersensitivity: aetiology, differential diagnosis and management. Br Dent J. 1985; 158:92-96.

7. Graf H, Galasse R. Morbidity, prevalence and intraoral distribution of hypersensitive teeth. J Dent Res. 1977; 56:162. Abstr 479.

8. Fischer C, Fischer RG, Wennberg A. Prevalence and distribution of cervical dentine hypersensitivity in a population in Rio de Janeiro, Brazil. J Dent. 1992; 20:272-276.

9. Irwin CR, McCusker P. Prevalence of dentine hypersensitivity in a general dental population. J Ir Dent Assoc. 1997; 43:7-9.

10. Liu HC, Lan WH, Hsieh CC. Prevalence and distribution of cervical dentin hypersensitivity in a population in Taipei,

Taiwan. J Endod. 1998; 24:45-47.

11. Oyama T, Matsumoto K. A clinical and morphological study of cervical hypersensitivity. J Endod. 1991; 17:500-502.

12. Dowell P, Addy M. Dentine hypersensitivity--a review. Aetiology, symptoms and theories of pain production. J Clin Periodontol. 1983; 10:341-350.

13. Matthews B, Vongsavan N. Interactions between neural and hydrodynamic mechanisms in dentine and pulp. Arch Oral Biol. 1994; 39:875-955.

14. Pashley DH. Theory of dentin sensitivity. J Clin Dent. 1994; 5:65-67.

15. Orchardson R, Collins WJ. Clinical features of hypersensitive teeth. Br Dent J. 1987; 162:253-256.

16. Absi EG, Addy M, Adams D. Dentine hypersensitivity. A study of the patency of dentinal tubules in sensitive and non-sensitive cervical dentine. J Clin Periodontol. 1987; 14:280-284.

17. Hasson H, Ismail AI, Neiva G. Home-based chemically-induced whitening of teeth in adults. Cochrane Database Syst Rev. 2006; 18:CD006202.

18. Sulieman MA. An overview of tooth-bleaching techniques: chemistry, safety and efficacy. *Periodontol* 2000; 2008; 48:148-169.

19. Burrows S. A review of the safety of tooth bleaching. *Dent Update*. 2009; 36:604-614.

20. Goldberg M, Grootveld M, Lynch E. Undesirable and adverse effects of tooth-whitening products: a review. *Clin Oral Investig*. 2010; 14:1-10.

21. Scherman A, Jacobsen PL. Managing dentin hypersensitivity: what treatment to recommend to patients. *J Am Dent Assoc*. 1992; 123:57-61.

22. Trowbridge HO, Silver DR. A review of current approaches to in-office management of tooth hypersensitivity. *Dent Clin North Am*. 1990; 34:561-581.

23. Canadian Advisory Board on Dentine Hypersensitivity. Consensus-based recommendations for the diagnosis and management of dentine hypersensitivity. *J Can Dent Assoc*. 2003; 69:221-228.

24. Addy M. Dentine hypersensitivity: new perspectives on an old problem. *Int Dent J*. 2002; 52:367-375.

25. Holland GR, Narhi MN, Addy M, Gangarosa L, Orchardson R. Guidelines for the design and conduct of clinical trials on dentine hypersensitivity. *J Clin Periodontol*.

1997; 24:808-813.

26. Addy M, West NX, Barlow A, Smith S. Dentine hypersensitivity: is there both stimulus and placebo responses in clinical trials? *Int J Dent Hygiene*. 2007; 5: 53-59.

27. Alexander JI. Biochemical, physiological and psychological aspects of pain and pain assessment. In: Addy M, Embery G, Edgar WM, Orchardson R, eds. *Tooth wear and sensitivity*. London, Martin Dunitz, 2000; pp:267-281.

28. West NX, Addy M, Jackson RJ, Ridge DB. Dentine hypersensitivity and the placebo response. A comparison of the effect of strontium acetate, potassium nitrate and fluoride toothpastes. *J Clin Periodontol*. 1997; 24:209-215.

29. Yates RJ, Owens J, Jackson R, Newcombe RG, Addy M. A split-mouth placebo-controlled study to determine the effect of amorphous calcium phosphate in the treatment of dentine hypersensitivity. *J Clin Periodontol*. 1998; 25: 687-692.

30. Gillam DG, Bulman JS, Newman HN. Comparison of two desensitising dentifrices with a commercially available fluoride dentifrice in alleviating cervical dentine hypersensitivity. *J Periodontol*. 1996; 67:737-742.

31. Ide M, Wilson RF, Ashley FP. The reproducibility of methods of assessment for cervical dentine hypersensitivity. *J Clin Periodontol*. 2001; 28:16-22.