

Original Research

Effectiveness of Potassium Nitrate as Desensitizing Toothpaste and Mouthwash in the Treatment of Dentin Hypersensitivity

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ABSTRACT:

The aim of this study is to evaluate the effectiveness of potassium nitrate (KNO₃) desensitizing agent used as toothpaste and mouthwash in the treatment of dentinal hypersensitivity. **Methods:** 40 patients with hypersensitive teeth of both sexes were included and divided randomly in Group 1(toothpaste containing 5% potassium nitrate) and Group 2(mouthwash containing 3% potassium nitrate) Each hypersensitive tooth was isolated and tested with a blast of compressed cold air delivered from a three-in-one syringe. The patient was then asked to indicate a sensitivity score using the visual analog scale (VAS) from 0 to 10. Patients received application of desensitizing toothpaste containing 5% potassium nitrate (KNO₃) (Group 1) and the others with desensitizing mouthwash containing 3% potassium nitrate (KNO₃) (Group 2). The teeth were tested after 2weeks and 4 weeks with compressed cold air, and the patients were asked to report the VAS again. **Results:** The results indicated that potassium nitrate toothpaste as well as mouthwash showed statistically significant decrease in the sensitivity score on a Visual Analogue Scale. Thus potassium nitrate was effective in reducing the symptoms of dentinal hypersensitivity when used either as toothpaste or as a mouthwash. But, there were no statistically significant differences between the groups, although both were effective in the treatment of hypersensitivity.

Keywords: Dentine hypersensitivity, Mouthwash, Toothpaste, 5% potassium nitrate.

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INTRODUCTION

Dentinal hypersensitivity, an important oral health problem is not an independent disease, but a common symptom of many dental diseases¹. Dentinal hypersensitivity pain has a negative effect on oral health-related quality of life^{2,3} and is an exaggerated response to a sensory stimulus that usually causes no response in a normal healthy tooth⁴. Dentinal Hypersensitivity (DH) is characterized by short sharp pain arising from exposed dentin in response to stimuli typically thermal, evaporative, tactile, osmotic or chemical—that cannot be ascribed to any other dental defect or disease⁵.

The prevalence of DH varies from 45 to 57 percent.⁶ These variations are likely due to differences in the populations studied and the methods of investigation

(for example, questionnaires or clinical examinations). While DH mostly occurs in patients who are between 30 and 40 years old, it may affect patients of any age. It affects women more often than men, though the sex difference rarely is statistically significant. The condition may affect any tooth, but it most often affects canines and premolars.^{6,7}

The cause for dentinal hypersensitivity can be improper tooth brushing, premature occlusal contacts, gingival recession, and the existence of a large amount of exogenous and endogenous acids in diets. Patients with periodontal disease are at particularly high risk, and studies have reported that as many as 70% of periodontal patients experience dentin hypersensitivity⁸The condition can last for days, weeks or indefinitely unless treatment is provided.

The impact of dental hypersensitivity ranging from minor inconvenience to the patient, limiting dietary choices, impeding effective oral hygiene, negatively affecting appearance, and significantly affecting individual's quality of life⁹.

In regard to the pain pathogenic mechanism, several theories have been proposed. Currently, explaining dentinal hypersensitivity favours the hydrodynamic theory originally postulated in the nineteenth century and developed later by Brannstrom in 1963.^{6,7} This theory states that dentine hypersensitivity may be caused by movement of the dentinal tubule contents. An increased outward fluid flow causes a pressure change across the dentine, distorting the A- δ fibres by a mechanoreceptor action, causing sharp, shooting pain. Microscopic examination reveals that patent dentinal tubules are more numerous and wider in hypersensitive dentin than in non-sensitive dentin.^{10,11} An understanding of the hydrodynamic mechanism of dentin sensitivity provides a basis for developing desensitizing therapies.

The management of dentin hypersensitivity generally encompasses treatment that addresses its etiological and predisposing factors. A correct diagnosis is based on history and examination. The signs and symptoms must be compatible with the clinical description of dentin hypersensitivity, and must be distinguishable from other conditions that can give rise to similar symptoms. Treatment for secondary conditions that induce symptoms similar to hypersensitivity should also be provided¹². Etiological and predisposing factors such as incorrect tooth brushing and corrosive dietary habits should be identified. Individualized oral hygiene instruction and dietary advice and analysis should also be provided. Treatment should aim to alleviate the pain and concern of the patient¹³.

Classifying treatments for DH can be challenging because its modes of action often are unknown. It can be simpler to classify treatments according to their mode of delivery. Treatments can be self-administered by the patient at home or be applied by a dental professional in the dental office. At home methods tend to be simple and inexpensive and can simultaneously treat generalized DH affecting many teeth.¹⁴ The disadvantages of these treatments include compliance, difficulty of delivery to specific sites, slow onset of action, and requirement of continuous use. In-office treatments are more complex and generally target DH localized to one or a few teeth. Various agents have been used as desensitizers for hypersensitive teeth including silver nitrate, fluoride, formaldehyde, strontium chloride and potassium nitrate.¹⁵⁻¹⁷ Dentifrices containing potassium ions have been shown by several clinical studies to be effective in reducing dentine hypersensitivity and the American Dental Association Council on Dental Therapeutics has granted a Seal of Acceptance to dentifrices containing 5% potassium nitrate (Council on Dental Therapeutics 1986). Potassium ions are

thought to act by blocking the action potential generated in intradental nerves.^{18,19}

Potassium nitrate is used either as a toothpaste or as a mouthwash. And, there is always a dilemma regarding whether it is effective when delivered as toothpaste or as a mouthwash. There has been evidence in literature which shows that both the formulations have therapeutic potential to alleviate dentinal hypersensitivity. But, the studies which compare the effectiveness of toothpaste and a mouthwash are rare. The present study is designed to compare the effectiveness of desensitizing toothpaste and a mouthwash, both containing potassium nitrate for the treatment of dentinal hypersensitivity. The effectiveness of any desensitizing agent also depends on patient compliance. As the toothpaste and mouthwash are two different modes of delivery we also can appreciate to which mode of delivery patient are more compliant.²⁰ Thus in this study we tried to evaluate the effectiveness of potassium nitrate when delivered as toothpaste or as a mouthwash in the treatment of dentinal hypersensitivity.

AIMS AND OBJECTIVES

- To evaluate the effectiveness of potassium nitrate when delivered as toothpaste on dentinal hypersensitivity.
- To evaluate the effectiveness of potassium nitrate when delivered as mouthwash on dentinal hypersensitivity.
- To compare effectiveness of potassium nitrate when delivered as toothpaste or as a mouthwash on dentinal hypersensitivity.

METHODOLOGY

SAMPLE SIZE

40 Subjects comprising of both the sexes, visiting outpatient Department of Periodontology, Govt. Dental College and Hospital Srinagar, with a chief complaint of tooth sensitivity were considered for the present clinical study after meeting inclusion and exclusion criteria. The study protocol and consent form were approved by the Institutional Ethical Committee.

INCLUSION CRITERIA

The criteria for inclusion in the study were:-

1. Subjects age ranging between 20 – 50 years.
2. Systemically healthy subjects.

EXCLUSION CRITERIA

1. Teeth with dental caries or extensive restoration (involving more than 50% of the tooth structure), which might have an abnormal pulpal response;
2. Destructive periodontal diseases;
3. Tooth mobility greater than grade I;
4. Orthodontic treatment within 12 weeks;
5. Abutment teeth for a fixed or removable partial denture;
6. Periodontal surgery in the preceding 12 weeks;

7. Vital tooth whitening within the previous 12 weeks;
8. Ongoing treatment with antimicrobials and/or anti-inflammatory medication;
9. Current desensitizing therapy;
10. Pregnancy or lactation;
11. Smoking or alcohol abuse;
12. Allergy to the agents used in the study.

Only the patients who gave written consent and fulfilled all the qualifying criteria were taken up for the study and randomly divided into two groups .The desensitizing agents to be studied were grouped as:

Group I – Patients who used toothpaste containing 5% potassium nitrate

Group II- Patients who used mouthwash containing 3% potassium nitrate

A single examiner was involved in examining the subjects and assessing sensitivity. All patients were given oral hygiene instructions. Patients were advised to use a new soft brush for brushing. Patients were randomly divided into group I and group II. Patients under group I were given self-applied toothpaste to be used twice daily and were instructed to brush with allocated toothpaste for 2-3 minutes. The tooth paste was to be used only in the areas which were sensitive. Patients under group II were given a self applied mouthwash to be used twice daily and were instructed to brush with non fluoridated toothpaste for 2-3 minutes twice daily, followed by rinsing with 1ml of water for 1 minute and then using 10ml of the allocated mouthwash for 1 min before spitting out. All patients were asked to return the mouth wash bottles and toothpastes at 2 and 4 weeks, at which time replacement products were provided. All patients were recalled after 2 weeks and 4 weeks for follow up and evaluated for sensitivity.

TREATMENT PROTOCOL

The participants teeth were subjectively assessed by means of a VAS(Visual Analogue Scale) .The VAS was a 10-cm line with the anchor words “no pain” (0 cm) and “intolerable pain (10 cm)” at the opposite ends. Each participant was asked to place a vertical mark on the VAS to indicate the intensity of his or her level of sensitivity after receiving stimuli.

AIR BLAST TEST: An air blast from a dental unit syringe (at 40 to 65 psi) was applied 1 cm away from the affected teeth for 10 seconds to determine the participant’s baseline response.

STATISTICAL ANALYSIS: In our study, descriptive statistics was presented as mean ±standard deviation (SD) based on the 10-cm Visual Analogue Scale (VAS). Students unpaired‘t’ test was used to compare the differences in scores between two groups. ANOVA test (Fishers’s test) calculated the mean decrease in VAS score for both groups at three point data collection time. Bonferroni multiple comparison(with repeated measures) was made to calculate the mean difference in VAS scores at different time points i.e. at baseline, at week 2 and week 4.

RESULTS

Table 1 shows the mean VAS scores for the two treatment groups after receiving air stimuli (VAS-A) at baseline, at week 2 and week 4. At baseline the mean VAS score in group I was 7.3±3.7 in response to air stimuli. And in Group II, the mean VAS score was 5.5±3.3 in response to air stimuli. After using the desensitizing agent, we found that all VAS scores from the post treatment periods were significantly lower in both the groups in response to air stimuli . While comparing group I and group II there was no significant difference in VAS scores in all three time periods. Thus both tooth paste and mouthwash are effective in treating the condition. Table 2 shows the mean VAS scores of the group using Paste (5% KNO₃) (group I) and group using Mouthwash (3% KNO₃) (Group II) in subsequent evaluation for air stimuli compared with baseline data.The results showed significant decrease in VAS scores as compared to baseline in week 2 as well as in week 4 in both treatment groups with air stimuli.In group I VAS score to air stimuli(VAS-A) decreased from 7.6±3.7 at baselineto 3.3±2.3 at week 4.In group II patients VAS score to air stimuli(VAS-A) was 6.5±3.3 at baseline which decreased to 2.7±2.1 at week 4.

Table 3 shows mean difference in visual analogue scale in both groups in response to air stimuli (VAS-A) by Bonferroni multiple comparisons,at baseline (B) at week 2 (W2) and at week 4(W4).However, the mean difference in sensitivity between week 2 and week 4 in group I and group II in response to air stimulation was 2.94 and 2.32 respectively which was statistically not significant.

Table 1. The mean VAS scores for the two treatment groups after receiving air evaporative stimuli (VAS-A) at baseline , at week 2 and at week 4.

Group	N	Mean ± SD	T	P value
VAS-A baseline I	20	7.3±3.7	0.120	0.465
II	20	6.5±3.3		
VAS-A week 2 I	20	5.2±3.1	1.695	0.222
II	20	4.1±2.7		
VAS-A week 4 I	20	3.3±2.3	1.269	0.352
II	20	2.7±2.1		

Table 2. The mean VAS scores of the group using Paste (5% KNO₃) (group I) and group using Mouthwash (3% KNO₃) (Group II) in subsequent evaluation for air stimuli compared with baseline data.

Group		Mean±SD	F	P
I VAS-A	baseline	7.6±3.7	14.166	<0.002
	week 2	5.2±3.1		
	week 4	3.3±2.3		
II VAS-A	Baseline	6.5±3.3	16.248	<0.002
	Week 2	4.1±2.7		
	Week 4	2.7±2.1		

Table 3. Mean difference in visual analogue scale in both groups in response to air stimuli (VAS-A) by Bonferroni multiple comparisons, at baseline (B) at week 2 (W2) and at week 4 (W4).

Group	Dependent variable	I (Time)	(J) Time	Mean difference (I-J)	p
I	VAS-A	B	W2	3.09	0.043
		W2	W4	5.03	<0.002
		W4	W4	2.94	0.063
II	VAS-A	B	W2	3.39	0.004
		W2	W4	4.72	<0.002
		W4	W4	2.32	0.296

DISCUSSION

Dentin hypersensitivity is a prevalent oral problem that can last for days, weeks or indefinitely unless treatment is provided ⁴. Incorrect tooth brushing method and gingival recession due to periodontal disease are some reasons for tooth hypersensitivity ²¹. Various studies have found a significant immediate pain reduction from tooth hypersensitivity after using desensitizing potassium nitrate to tooth dentine. This study was conducted to evaluate and compare the efficacy of toothpaste containing 5% potassium nitrate,

and a mouthwash containing 3% potassium nitrate as main ingredient in the treatment of dentinal hypersensitivity.

Previous studies have reported that dentifrices containing potassium ions are effective in reducing sensitivity and the American Dental Association Council on Dental Therapeutics has granted its Seal of Acceptance to dentifrices containing 5% potassium nitrate (Council on Dental Therapeutics 1986).⁽¹³⁾ ²²

The results of our clinical study showed that both desensitizing toothpaste and mouthwash are equally effective in reducing sensitivity within 4 weeks evaluation period, despite the different application procedure. This is in agreement with the result of study of Sharma et al.²⁰

In the study the VAS score in response to air stimulation demonstrated a significant difference in sensitivity scores over a four weeks study period. This demonstration of effectiveness of 5% potassium nitrate and 0.2% sodium fluoride toothpaste as effective desensitizing agents is in accordance with the studies of Tarbet et al²³ and Nagata et al²⁴.

As very few studies are being reported that suggest the effectiveness of mouthwash containing 3% potassium nitrate. The result of our study

correlates with the findings of study by Pereira et al. 2001.²⁵

In our study, we found that both mouthwash and toothpaste were effective in reducing dentinal hypersensitivity, as indicated by VAS scores. To determine the participants' sensitivity levels in our study, we translated the subjective feedback to air stimuli into objective data using VAS, which is the most appropriate method to use to diagnose pain levels.²⁶

CONCLUSION

It can be suggested that rinsing twice daily with a 3% potassium nitrate/sodium fluoride mouthwash or brushing twice daily with a 5% potassium nitrate/sodium fluoride toothpaste may help reduce discomfort arising from dentinal hypersensitivity. But, there were no statistically significant differences between the groups, although both were effective in the treatment of hypersensitivity. For future prospects long-term studies to facilitate better understanding of the performance of these desensitizing agents are advocated.

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