

Evaluation of efficacy of arginine calcium carbonate Vs potassium nitrate paste in the treatment of dentinal hypersensitivity .

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Abstract

Background and Aim: Dentin hypersensitivity (DH) is a common oral health problem affecting one or more teeth of many adult individuals globally. It is characterized by a sharp pain which arises from exposed dentin in response to an external stimulus, and cannot be explained by any other form of dental pathology. Several agents and treatment modalities have been used in the treatment of this condition. The present study was conducted to compare the efficacy of arginine calcium carbonate paste (Test group) versus potassium nitrate (Control group) in the treatment of dentinal hypersensitivity.

Subjects and Methods: A total of 66 cases were randomly divided into two groups based on the toothpaste given: Test group - toothpaste containing 8% arginine and calcium carbonate, Control group - toothpaste containing 5% potassium nitrate. The patients' DH scores for tactile stimuli was recorded on a visual analog scale and airblast stimuli was recorded on a Schiff Cold Air Sensitivity scale at baseline, immediately post scaling after application of desensitizing paste, 1 month after commencing the use of desensitizing paste, and 1 month following cessation of its use .

Statistical Analysis: The data was analyzed using Independent t test ($P < 0.05$).

Results: Both the toothpastes were effective in relieving dentinal hypersensitivity. However, toothpaste containing 8% arginine and calcium carbonate showed a better clinical response at the end of 2 months evaluation.

Conclusions: The desensitizing paste containing 8% arginine and calcium carbonate showed instant and long lasting reduction in the symptoms of DH.

Key Words: Dentinal hypersensitivity, 8% arginine and calcium carbonate, potassium nitrate, visual analog scale, Schiff Cold Air Sensitivity scale.

Introduction

Dentinal hypersensitivity (DH) is a short, exaggerated, painful response when opened dentine tubule orifices are exposed to thermal/mechanical/chemical stimuli. This unpleasant feeling is due to stimulation of A-beta fibers and A-delta fibers in the tooth. It is a common clinical symptom with a prevalence rate of 4-57%, seen in adults with age range of 20-49 yrs, with highest incidence at 30-39 yrs and also with female predilection. Hypersensitivity causes include periodontal disease conditions like gingival recession, wasting diseases, faulty brushing and sometimes after flap surgery.[1,2,3]

Although several hypothesis were proposed, Hydrodynamic theory which is based on fluid movement in the dentinal tubules was widely accepted (Brannstrom and Astroem, 1964). Theory states that exposed dentin possess wider tubules with thin/under calcified smear layer, in -

creases the centrifugal fluid movement that activates the nerve endings at the end of the dentinal tubules or at the pulp-dentin complex, resulting in sensitivity and unpleasant condition, when compared with unexposed dentin.[4]

Management of DH though well-established has been a challenge to dentist in alleviating the discomfort to the patient. Many methods have been used and still new abrasives are being introduced to market with new ingredients, yet the potentiality of these was questionable in completely eliminating the sensitivity.[5] The management of dentinal hypersensitivity targeted sealing the dental tubules with different molecules/ingredients. Among these commonly used were potassium nitrate and others. Recently, Arginine calcium carbonate was found to be efficient in managing DH.

Till date literature on efficacy of potassium nitrate versus arginine calcium carbonate in alleviating the

dentinal hypersensitivity was minimal. Hence, this study aims to evaluate the efficacy of these components in managing DH.

Materials and Methods

This was a single blind, parallel group randomized clinical trial done in the department of Periodontics, GITAM Dental College And Hospital during the period December 2019 till February 2020. Institutional Ethical Committee approval was obtained before the commencement of the study. A total of 66 patients were considered and were randomly divided into control and test group with 33 patients each. Initial examination was done at baseline, and immediately post scaling, following the topical application of abrasive, 1 month after using toothpaste and 1 month after discontinuation of toothpaste.

Patients with age range from 18-70 years with at least two teeth showing hypersensitivity to hot, cold, or sour stimuli were selected. Systemically healthy patients having good periodontal health with probing depth < 3 mm and no other conditions that might explain their apparent DH were included.

Individuals with chipped teeth, defective restorations, fractured teeth or teeth with deep dental caries, orthodontic appliances, dentures, or bridgework that would interfere with the evaluation of hypersensitivity and who underwent periodontal surgery within the previous 6 months were excluded from the study.[6] Evaluation of hypersensitivity was done using tactile test by visual Analog Scale (VAS) and airblast test (Schiff cold air sensitivity scale).[7]

Procedure

Two different toothpastes, one containing 8% arginine and calcium carbonate (Colgate Sensitive Pro-Relief - Colgate-Palmolive Co., New York, NY, USA) (Test group) and another containing 5% potassium nitrate (Sensodent K - Indoco Remedies Ltd) (Control group) were used in the study.

During the study period, the use of other oral hygiene products or considering any other dental treatment for hypersensitivity was not permitted. Drugs that may alter the perception of pain were not permitted within 24 hours of the assessment. Both the groups after baseline evaluation of sensitivity received supragingival scaling with hand instruments. The dentrifice was then applied with fingertip directly on the buccal cervical area of exposed dentin and the sensitivity values were scored after 5 min following application. Each group was provided with that particular dentrifice and were advised to brush their teeth in the Usual manner (modified bass technique) for 3

min, twice daily, with soft bristle toothbrush. They were recalled after 1 month and the sensitivity scores were recorded. Patient was advised to discontinue the prescribed dentrifice and recommended to continue with a fluoridated toothpaste. Thereon patient was asked to report back after one month for the assessment of tooth sensitivity.

Statistical Analysis

Intergroup comparison of groups with respect to sensitivity scores at different time points was carried out by Independent t-test with significance level was set at $P < 0.05$.

Results

No adverse effects were observed in any of the cases enrolled in the study. Mean VAS values for tactile stimulus that were assessed for both the pastes (Table 1).

In Test group there was a decrease in sensitivity values from 2.47 ± 0.28 at baseline to 1.90 ± 0.30 post scaling after application of desensitizing paste. It further reduced to 1.09 ± 0.42 after one month of paste use and 1.06 ± 0.44 one month following cessation of its use. In Control group there was a decrease in sensitivity values from 2.57 ± 0.27 at baseline to 2.21 ± 0.34 post scaling. It further reduced to 1.39 ± 0.34 after one month of commencing the use of desensitizing paste and was 1.59 ± 0.48 one month following cessation of its use. Mean Schiff Cold Air Sensitivity scale value following air stimulus that were assessed for both the groups (Table 2).

In Test group there was a decrease in sensitivity values from 7.34 ± 0.41 at baseline to 6.38 ± 0.39 post scaling. It further reduced to 4.97 ± 0.61 one month after commencing the use of desensitizing paste and was 4.85 ± 0.59 one month following cessation of its use. In Control group there was a decrease in sensitivity values from 7.66 ± 0.51 at baseline to 6.93 ± 0.64 post scaling. It further reduced to 5.80 ± 0.61 after one month of commencing the use of desensitizing paste and was 6.08 ± 0.67 one month following cessation of its use.

Discussion

DH is relatively a common hitch seen in regular dental practice and is characterized by a sharp, transient unpleasant response to a stimulus like eating, drinking, brushing of teeth, and breathing thus leaving an impact on the quality of life through. As individuals retain their dentitions for longer and as diets change, it is reasonable to

Table - 1. Comparison of Tactile Sensitivity

Parameters	Group	Mean ± SD	P-value
Baseline	Test	2.47 ± 0.28	0.17
	Control	2.57 ± 0.27	
After application of desensitizer	Test	1.90 ± 0.3	<0.01
	Control	2.21 ± 0.34	
One month of commencing the use of desensitizer	Test	1.09 ± 0.42	<0.01
	Control	1.39 ± 0.34	
One month after cessation of desensitizer	Test	1.06 ± 0.44	<0.01
	Control	1.59 ± 0.48	

aunts related to dentin hypersensitivity and with that an increase in requests for treatment.[8]

The hydrodynamic mechanism of dentin sensitivity provides a basis for developing desensitizing therapies. The difficulty found in treating DH is expressed by the enormous number of techniques and therapeutic alternatives to relieve it.[9] According to their mode, treatments can be self administered by the patient at home which is simple, inexpensive and more compliant or can be applied by a dental professional in the dental office. However disadvantages of these treatments include compliance, difficulty in delivery to specific sites, slow onset of action, and requirement of continuous use. Though in-office treatments are more complex and generally target DH localized to one or a few teeth they provide immediate effect might be useful for providing instant relief of hypersensitivity.[10] Hypersensitivity negatively affects the patient's compliance especially during the initial post-scaling weeks.⁷ However, patients who have had received periodontal therapy are four times more at risk of developing hypersensitivity than the general population.[8]

Holland et al. in their guidelines for the design and conduct of clinical trials on dentinal hypersensitivity stated that trials should last for at least 8 weeks.[11] The present study also evaluated tooth hypersensitivity over a period of 8 weeks. Furthermore, in the present study, the most and validated stimuli tests for assessing tooth sensitivity, i.e, tactile test and air blast test were used, which are both physiological and controllable. Tarbet et al. and Clark and Troullous stated that these two methods were accurate for the examination of hypersensitivity levels.[12] In the present study, there was a significant decrease in sensitivity scores at all time intervals in both the groups with more alleviated sensitivity in test group when compared to control group.

Table - 2. Comparison of Airblast Sensitivity

Parameters	Group	Mean ± SD	P-value
Baseline	Test	7.34 ± 0.41	<0.01
	Control	7.66 ± 0.51	
After application of desensitizer	Test	6.38 ± 0.39	<0.01
	Control	6.93 ± 0.64	
One month of commencing the use of desensitizer	Test	4.97 ± 0.61	<0.01
	Control	5.80 ± 0.61	
One month after cessation of desensitizer	Test	4.85 ± 0.59	<0.01
	Control	6.08 ± 0.67	

ProArgin technology as elucidated by Kleinberg et al was firstly, arginine physically adsorbs onto the surface of calcium carbonate, thereby forming positively charged agglomerate. This agglomerate binds to the dentinal surface and tubules. Secondly, the pH of this agglomerate is alkaline to allow mineral deposits of calcium and phosphate on the dentinal surface. A major advantage of the ProArgin technology is its ability to offer instant relief.[13] studies using confocal laser scanning microscopy (CLSM) and high resolution scanning electron microscopy (SEM) images by Lavender have demonstrated that the arginine calcium carbonate is highly effective in occluding the open dentin tubules and further stated that the occlusion achieved is resistant to acid challenge. This acid resistance effect produced by arginine is lasting thus aids in immediate relief.[14]

However in the present study, hypersensitivity scores using Test Group containing arginine calcium carbonate were decreased from baseline to application of the paste after scaling. There was a further decrease in sensitivity after one month of commencing the use of the desensitizing paste and sustained even after one month of cessation of its use. The results obtained were in accordance with a study by Schiff et al. which demonstrated that single application of in-office desensitizing paste containing 8% arginine and calcium carbonate provided instant and lasting relief of dentin hypersensitivity that is significantly better than that of the control pumice prophylaxis paste.[15] A meta analysis report by Zheng-yan Yang et al stated that arginine containing toothpaste led to significantly improved results on the tactile sensitivity test at 4 & 8 weeks compared to toothpastes containing other desensitizing components, thus indicating a superior therapeutic effect of arginine-containing desensitizing toothpaste.[16] Kleinberg et al in their study showed that application of the arginine-calcium carbonate in-office de-

sensitizing paste to teeth exhibiting sensitivity following dental prophylaxis resulted in instant relief from discomfort and lasted for 28 days after a single application.[17]

In a study by Hamlin et al there is a statistically significant reduction in dentin hypersensitivity compared to a control pumice prophylaxis paste when applied as a single pre-procedural treatment to a professional dental cleaning procedure. They also mentioned that the occlusion led to highly significant reductions in dentin fluid flow by forming a tubule plug which is resistant to normal pulpal pressure.[18]

Potassium nitrate was introduced as a desensitizing agent by Hodosh and it acts by reducing the excitability of the interdental nerves in the pulp by depolarizing them. Potassium ions have to traverse the length of the dentinal tubule in sufficient quantity to cause depolarization.[19] Wilchgers, Ermert and Kim stated that the desensitizing effect of potassium nitrate is due to the increase in concentration of extracellular potassium around the nerve fibres which cause their depolarization, avoids repolarization and blocks the axonic action. This blocks the passage of nerve stimulus, resulting in inactivation of the action potential. Potassium nitrate does not diminish dentine hydraulic conductivity, or promote obstruction of dentinal tubules by the deposition of crystals.[9]

In the present study, there is a decrease in hypersensitivity values following scaling and application of paste in Control group however these sensitivity values were less when compared with test group. There is further decrease in sensitivity after one month of using the paste but the decreased sensitivity values did not sustain after one month of discontinuing the paste. Hodosh stated that topical applications of 1–15% potassium nitrate (KNO₃) or a paste containing 10% KNO₃ was effective in reducing dentinal hypersensitivity with no pulpal change.[20] A study by Nagata et al revealed that 5% potassium nitrate performed better than prophylaxis paste at 4, 8 and 12 weeks. [21] Purra et al in their study stated that at the end of 5 minutes after treatment, the concentration of potassium ions in the dentinal tubules was not sufficient to make the nerves inexcitable and it takes longer time for the potassium ions to reach the nerves. The effect of desensitization achieved by potassium ions decreased with time and this could be attributed to a decrease in concentration of the ions in dentinal tubules which could be the reason for increase in sensitivity after discontinuing the control paste.[19] In the present study the reduction in sensitivity scores was comparatively more with test group at all time intervals when compared to control group. The results obtained

were in accordance with a study by Ayad et al. which showed that the instant sensitivity relief benefit afforded by direct topical self-application of the 8.0% arginine toothpaste. This was maintained by subsequent regular twice-daily brushing for at least a period of three days performed better than 2% potassium nitrate and control paste containing 1450 ppm MFP.[22] A study by Elias Boneta et al stated that arginine-containing regimen provided significantly faster dentine hypersensitivity relief compared to the potassium nitrate containing regimen.[2]

Conclusion

After 2 months of clinical evaluation, both the treatments showed alleviated sensitivity values compared with baseline, independent of their different modes of action. This study demonstrated that the arginine carbonate group (Test group) showed significantly better results compared to potassium nitrate (Control group) by providing instant relief and the obtained relief effect sustained even after discontinuation of paste.

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How to cite: Anusha B, Murthy KRV. Evaluation of efficacy of arginine calcium carbonate Vs potassium nitrate paste in the treatment of dentinal hypersensitivity. Ind J Clin Res Dent 2020;1(2): 24-29