ORIGINAL ARTICLE

DOI:10.33897/fujd.v2i2.303

Efficacy of Dentifrice containing 8.0% Arginine on Reduction of Dentinal Hypersensitivity

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Received: 21 April 2022 / Revised: 24 June 2022 / Accepted: 26 June 2022 / Published online: 27 July 2022

ABSTRACT

Objective: To determine the efficacy of toothpaste containing 8.0% arginine in controlling dentinal hypersensitivity.

Materials and Methods: This cross-sectional study was conducted in the Altamash Institute of Dental Medicine, Karachi from January 2021 to august 2021. A total of 50 subjects with clinically diagnosed hypersensitivity who met the inclusion criteria were selected. Air hypersensitivity test was performed, and the response of patients was recorded using the Visual Analogue Scale (VAS). The subject's response was recorded at three-time intervals i.e., at baseline, immediately (after 1-minute) and ten days after the application. Paired sample and independent sample t-test was performed to analyse the results using SPSS version 24.

Results: Among 50 subjects with mean age of 26.52 ± 4.74 years, 26 (52%) were male and 24 (48%) were female. The mean score of air hypersensitivity test for 8.0% arginine at baseline, immediately after application and after usage for ten days was 8.26 ± 0.66, 4.24 ± 0.47 and 4.10 ± 0.51 respectively. Comparison of VAS scores showed significant decrease ($p < 0.01$) in hypersensitivity immediately after application and 10 days after application of 8.0% arginine.

Conclusion: Within the limitations of this study, it is concluded that a significant reduction in the dentinal hypersensitivity was observed with the use of 8% arginine containing toothpaste.

Keywords: Dentine, Dentifrice, Hypersensitivity

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How to cite this Article:

Abbasi MS, Mansur A, Minallah S, Shah R. Efficacy of dentifrice containing 8.0% arginine on reduction of dentinal hypersensitivity. Found Univ J Dent. 2022;2(2):117-121.

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INTRODUCTION

Short, sharp pain arising from exposed dentine in response to a thermal, osmotic or tactile stimulus is called dentin hypersensitivity.[1] It is a common condition generally observed in buccal cervical areas of canines and premolars. Exposure of dentinal tubules occurs either due to removal of enamel layer as a result of wear, abrasion, erosion or abfraction or due to periodontal conditions resulting in exposure of root dentine.[2]

Three theories explaining the pathophysiology of dentinal hypersensitivity have been proposed; direct innervation theory, odontoblast receptor theory and hydrodynamic theory.[3] Brannstrom proposed the hydrodynamic theory which is the most widely accepted today. The theory states that the movement of fluid within the dentinal tubules activates the nerve endings in the pulp-dentine complex causing the sensations of pain.[4] Most common stimulus which triggers fluid movement is cold stimuli.[5]

Research in dentinal hypersensitivity has led to the development of two treatment approaches. First to desensitize the nerve endings and secondly to occlude the dentinal tubules preventing fluid movement. Usually, the first treatment option is the use of desensitizing toothpaste. Most toothpaste contains a salt of potassium (potassium chloride, nitrate and citrate) which increases the nerve threshold thus making it difficult to depolarize. Clinical studies have shown a significant reduction in dentine hypersensitivity with the use of potassium-containing dentifrices. Use of several weeks is advised for full effect.[6,7]

The second treatment option is concerned with the blockage of dentinal tubules. Dentifrices containing fluoride salts form a dentinal plug that provides relief from hypersensitivity. A newer product containing 8% arginine has been introduced which has been shown to have better efficacy than potassium salt containing dentifrices in controlling dentine hypersensitivity.[8-11] The toothpaste works by binding positively charged arginine with the dentine surface and tubules. Studies have shown that the plug formed reaches 2 microns into the tubule and is resistant to erosion from acids.[12]

MATERIALS AND METHODS

The study was conducted at Altamash Institute of Dental Medicine, Karachi with ethical approval from the concerned authorities. A cross-sectional observational study was conducted from January 2021 to august 2021, to check the efficacy of dentifrice containing 8.0% arginine (commercially available). A sample of 50 subjects was selected for this study using a nonprobability consecutive sampling technique. The sample size was calculated using the Open EPI sample size calculator.

The patients presented in the OPD and were diagnosed with dentinal hypersensitivity. Inclusion criteria consisted of both male and female subjects between the age range of 18-40 years, patients with good oral hygiene, no active periodontal disease, more than twenty present teeth and no history of smoking, alcoholism or drug addiction. Exclusion criteria consisted of patients who were pregnant, breastfeeding women and patients with teeth that are restored, chipped, worn or with any dental anomaly.

An air sensitivity test was performed.[13] The tooth selected was a cuspid or bicuspid. A jet of air stream from a triple syringe at ambient temperature was sprayed from a distance of 1 cm on the buccal surface of the selected tooth. Adjacent teeth were shielded by the operator's fingers. The pain response was judged using the Visual Analog Scale (VAS).[14] Teeth with a baseline score of more than 7 were selected.

In the first phase of the study, the patient was instructed to apply pea-sized toothpaste on the selected tooth for one minute. The patient then rinsed properly to remove all the toothpaste from the tooth. An air test was performed, and the results were recorded.

The second phase consisted of at-home brushing with the provided toothpaste for ten days. The patients were instructed proper brushing protocols. After ten days the air sensitivity test was performed and the readings recorded. The data was analysed using Statistical Package for Social Studies SPSS 24.

RESULTS

A total of 50 subjects with mean age of 26.52 ± 4.74 years with clinically diagnosed hypersensitivity were included in this study. Among these 50 subjects, 26 (52%) were male and 24 (48%) were female. Table 1 shows the values of the air hypersensitivity test at baseline, immediately after application and after usage for ten days.

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Table 1: Values of air hypersensitivity test at baseline, immediately after application and after usage for ten days

Treatment	Air sensitivity test scores (Mean ± SD)		
	Baseline	Immediate	10 days
8% Arginine	8.26 ± 0.66	4.24 ± 0.47	4.10 ± 0.51

Paired samples t-test was performed to determine the effect of toothpaste on hypersensitivity by comparing the VAS scores immediately after application and 10 days after application with the baseline scores. Significant decrease in hypersensitivity was noted as show in Table 2.

Table 2: Comparison of VAS scores immediately after application and 10 days after application with the baseline scores using paired sample t test

Comparison Group	VAS Score	*p*-value
	Mean ± SD	
Baseline with immediate application	4.02 ± 0.74	0.00
Baseline with 10 days after application	4.16 ± 0.68	0.00

Paired sample t-test was also applied to the determine the difference in hypersensitivity between immediate application and 10 days after application and significant difference was found with a *p*-value of 0.007. Independent sample t-test was used to determine the difference in decrease in hypersensitivity after 10 days of application among both genders. No significant difference was noted as shown in Table 3.

Table 3: Comparison of VAS scores 10 days after application among both genders using independent sample t test

Gender	Frequency	VAS Score	*p*-value
		Mean ± SD	
Male	26	4.03 ± 0.59	0.375
Female	24	4.16 ± 0.38	

DISCUSSION

The presence of calcium and phosphate in saliva naturally causes occlusion of dentinal tubules by salivary glycoproteins. Saliva transports calcium and phosphate in proximity to dentin tubules to induce occlusion and formation of a protective salivary glycoprotein with the calcium and phosphate The toothpaste containing arginine and calcium mimics the natural process to create a dentinal plug.[13] The purpose of our study was to determine the effectiveness of this mechanism in a patient with the symptoms of dentine hypersensitivity.

Studies conducted show that toothpaste show a significant reduction in hypersensitivity with one performing better than the other under controlled conditions. However, arginine containing toothpaste is more effective than toothpaste containing potassium salts.[9-11] Our study only determined the efficacy of arginine toothpaste. Some studies have shown conflicting results thus reporting no significant difference in the hypersensitivity. Ashley and colleagues found no significant difference in the efficacy of multiple toothpastes including arginine containing toothpaste.[13] Whereas, another author, He T showed that a toothpaste containing only 0.454% stannous fluoride provided much better relief of sensitivity than 8% arginine containing toothpaste.[14]

There is a lot of variation found in the results. This may be due to the duration of the use of the toothpaste. Some tested sensitivity immediately, after three days, two weeks and eight weeks. We tested for reduction of sensitivity immediately after 10 days. Secondly, the research was conducted in different ethnic groups which may lead to different results.[15-17] A lot more research is needed with better methodology and a larger sample size in a single ethnic group to study more accurately the effect of these toothpaste and the difference in their efficacy.

Nevertheless, arginine containing toothpaste has provided relief in decreasing dentine hypersensitivity. More research is needed to study how long the effect remains after discontinuing the toothpaste and whether the enamel is repaired or not. However, the plug formed by the arginine and calcium is resistant to acid attack.[12] This may lead to the long-term effect of the toothpaste.

CONCLUSION

Within the limitations of this study, it is concluded that a significant reduction in the dentinal hypersensitivity was observed with the use of 8.0% arginine containing toothpaste.

DISCLAIMER

None.

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CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

ETHICAL STATEMENT

The ethical approval is provided by the Ethical Review Board at Altamash Institute of Dental Medicine (Ref. No. AIDM/ERC/01/2021/02).

FUNDING DISCLOSURE

The author(s) received no financial support for the research, authorship, and/or publication of this article.

AUTHORS CONTRIBUTION

Conception and design of the study: M.S. Abbasi, A. Mansur

Acquisition of data: S. Minallah

Analysis and interpretation of data: M.S. Abbasi, R. Shah

Drafting of the manuscript: M.S. Abbasi, A. Mansur

Critical review of the manuscript: M.S. Abbasi, A. Mansur

Approval of the final version of the manuscript to be published: M.S. Abbasi, A. Mansur, S. Minallah, R. Shah

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