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Comparison of the Effectiveness of Three Different Desensitizing Toothpastes in Reducing Dentin Hypersensitivity

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ABSTRACT

Introduction: Dentin hypersensitivity has been defined as a short, sharp pain arising from exposed dentin as a result of various stimuli such as heat, cold, chemical, or osmotic, that cannot be ascribed to any other pathology. This study aimed to compare the effectiveness of three desensitizing toothpastes in the treatment of dentin hypersensitivity.

Methods: A total of 90 individuals were considered for this study and randomly divided into three groups, Group 1: treated with desensitizing paste containing potassium salt, Group 2: treated with herbal desensitizing toothpaste, and Group 3: treated with desensitizing paste containing 5% Novamin. Using air stimulus, the sensitivity scores were recorded on visual analog scale (VAS), at baseline, immediately after paste application, then at 2 weeks and compared by using one-way ANOVA test and *post hoc* Tukey's test were used, and $P \leq 0.05$ was considered statistically significant.

Results: There was a significant change in the VAS scores in Group 2 and Group 3 when compared to Group 1. There was a significant difference in the mean change in VAS score from base line to after 2 weeks between Groups 1, 2, and 3.

Conclusion: Desensitizing toothpaste containing 5% Novamin was found to be the most effective followed by natural herbal toothpaste in the reduction of dentin hypersensitivity after a single application up to a period of 2 weeks as compared to potassium salt containing toothpaste.

Keywords: Dentin Hypersensitivity, Herbal, Novamin, Potassium Salt, Visual Analogue Scale

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INTRODUCTION

A short, sharp pain that is caused by exposed dentin in reaction to stimuli that are often thermal, evaporative, tactile, osmotic, or chemical is known as dentinal hypersensitivity and cannot be attributed to any other type of dental pathology or defect.[1]

The incidence is slightly higher in females than in males, ranging from 4% to 74%.It can affect people of any age, but most commonly those between the ages of 20 and 50, with a peak between 30 and 40. Canines and premolars are the teeth most commonly affected. The buccal aspect of the cervical region is the most often afflicted place.[2]

The degree of pain can be quantified either according to categorical scale (i.e., slight, moderate, or severe pain) or using the Visual Analog Scale using air spray method or tactile method on the hypersensitive areas of the tooth.[3]

Though a wide array of treatment modalities are available for the management of dentinal hypersensitivity, desensitizing dentifrices are the most widely used and accepted.[4]

The majority of desensitizing toothpastes contain potassium salt which is believed to work by penetrating the length of the dentin tubule and depolarizing the nerve, interrupting the neural response to pain stimuli.[3]

There has been growing interest among people regarding herbs. Herbal desensitizing toothpaste claimed to give adequate relief of pain due to dentin hypersensitivity.[3]

Novamin is a bioactive glass, when incorporated into a dentifrice particles are deposited onto the dentin surface to mechanically occlude the dentinal tubules.[3]

Novamin is considered as one of the most potential candidates for fulfilling the reduction in pain induced by dentin hypersensitivity. Nevertheless, many herbal toothpastes are alarmingly spread in the market for its reduction of dentin hypersensitivity efficacy. The goal of this study was to examine the effectiveness of desensitizing pastes based on potassium salt, herbal desensitizing paste, and 5 % Novamin in reducing dentin hypersensitivity.

METHODS

This cross-sectional comparison study was done on patients who had complained of hypersensitivity and visited the KIST Medical College Department of Conservative Dentistry and Endodontics in Imadol, Lalitpur. We conducted this study after obtaining ethical approval from KIST Institutional Review Committee (KIST-IRC reference no. 076/077/54). The total duration of study was from July 2020 to January 2022. The participant's consent was taken and filled up in the form before examination.

Participants with the age group of 18-70 years, who had a history of tooth hypersensitivity to thermal, sweet, mechanical or sour stimuli on at least one tooth, defects <1 mm loss of dentin in depth which did not require restorative treatment, patients willing for follow up visits and sign an informed consent form, who had baseline scores of VAS ≥4 were included.

Patients who were currently taking antidepressants, sedatives, or analgesics, who had a history of allergies to any test product, who had received treatment for dentin hypersensitivity on that particular tooth, who had used any desensitizing paste within the previous three months, and who had extensive or flawed restorations, suspected pulpitis, or cracked enamel with the tooth of interest were all excluded from the study.

Baseline examination was carried out using air blast sensitivity assessment. A blast of air from a 3-way dental syringe was directed on affected area of the tooth for 1 second from a distance of one centimeter. Adjacent proximal teeth were shielded from the air blast through the placement of two fingers. The degree of hypersensitivity was reported according to Visual Analog Scale (VAS).Score were given on a 10 cm sensitivity VAS, which had ratings from 0 to 1 no pain, 2-3 for mild pain, 4-6 for moderate, and 7-10 for severe pain.

The participants were allotted by purposive sampling techniques, 30 patients in each group. Sample size calculation for comparison among groups in quantitative data for pain VAS score was calculated as follows:

Sample Size: $2\ SD^2\ (Z_{\alpha/2}+Z_{\beta})^2 / d^2$

SD = Standard deviation of previous study on VAS pain score [6] = 0.78

Level of significance = 5%

$Z_{\alpha/2} = Z_{0.05/2} = Z_{0.025} = 1.96$ (from Z table at 5% error)

$Z_{\beta} = Z_{20}$ (at Power of study = 80%)=0.842 (from Z table)

d= Effect size=difference between mean value of VAS Pain Score[6] = 0.6

Therefore, Sample size = $2\ SD^2\ (Z_{\alpha/2}+Z_{\beta})^2 / d^2 = 2x\ (0.78)^2\ (1.96+0.842)^2 / (0.6)^2 = 26.5$

Hence minimum sample in each group was assigned to be 27. However, the total 30 patients will be enrolled in the study which comprises of three different groups as follows:

Group I: Desensitizing paste containing potassium salt

Group II: Herbal desensitizing paste

Group III: Desensitizing paste containing 5% Novamin

After that each subject topically self-applied a pea sized amount of assigned toothpaste on his hypersensitive teeth using a fingertip by massaging each tooth for 60 seconds. Post application immediate score of air-blast dentin hypersensitivity examination was performed and recorded following the same methodology employed at the baseline examinations. Instructions for the home application of desensitizing paste were given to the patient, which included twice brushing with the desensitizing paste for 2 minutes. Patients were asked to report after 2 weeks. Air-blast dentin hypersensitivity examination was performed and recorded following the same methodology. Software SPSS version 20 was used to analyze the data by applying descriptive statistics and Chi-squared test for categorical data. The intercomparison among groups for quantitative data was analyzed by ANOVA test and *post hoc* Tukey's test. P-value <0.05 is considered statistically significant.

Table 1.Comparison of visual analog scale (VAS) scores at baseline, immediate post treatment and 2 weeks

Variables	VAS score at baseline			
	Mean	**SD**	**F**	**P**
Group 1	6.30	1.81	3.02	0.054
Group 2	5.85	1.72		
Group 3	7.15	2.01		
	VAS score at immediate post treatment			
Group 1	4.85	2.29	0.43	0.65
Group 2	4.52	2.11		
Group 3	5.11	2.60		
	VAS score at 2 weeks			
Group 1	2.78	1.76	1.66	0.19
Group 2	1.81	1.92		
Group 3	2.04	2.36		

Table 2. Comparison of change in visual analog scale (VAS) scores from baseline to 2 weeks

Change in VAS score	Groups	Mean	SD	F	P
From baseline to immediately after treatment	Group 1	1.44	1.15	2.32	0.10
	Group 2	1.33	1.20		
	Group 3	2.04	1.48		
From baseline to after 2 weeks	Group 1	3.52	1.57	5.17	**0.008***
	Group 2	4.04	1.93		
	Group 3	5.11	2.02		

Table 3. Mean of change in the visual analog scale (VAS) scores from baseline to 2 weeks

Change in VAS score	Groups		Mean difference	P
From baseline to immediately after treatment	Group 1	Group 2	0.11	1.00
	Group 1	Group 3	-0.59	0.286
	Group 2	Group 3	-0.70	0.145
From baseline to after 2 weeks	Group 1	Group 2	-0.51	0.92
	Group 1	Group 3	-0.15	**0.007***
	Group 2	Group 3	-1.07	0.11

Table 4. Comparison of time interval within Group 1

VAS Score	Group 1			
	Mean	SD	F	P
At baseline	6.30	1.81	78.34	**<0.001***
Immediate	4.85	2.29		
After 2weeks	2.77	1.76		

Table 5. Mean of time interval within Group 1

Time interval	Duration	Mean differences	P
Baseline	Immediately	1.44	**<0.0001***
Baseline	After 2 weeks	3.51	**<0.0001***
Immediately	After 2 weeks	2.07	**<0.0001***

Table 6. Comparison of time interval within Group 2

VAS Score	Group 2			
	Mean	SD	F	P
At baseline	5.85	1.72	71.86	**<0.0001***
Immediate	4.52	2.11		
After 2weeks	1.81	1.92		

Table 7. Mean of time interval within Group 2

Time interval	Duration	Mean differences	P
Baseline	Immediately	1.33	**<0.0001***
Baseline	After 2 weeks	4.03	**<0.0001***
Immediately	After 2 weeks	2.70	**<0.0001***

Table 8. Comparison of time interval within Group 3

VAS Score	Group 3			
	Mean	SD	F	P
At baseline	7.15	2.31	85.58	**<0.0001***
Immediate	5.11	2.60		
After 2weeks	2.04	2.36		

Table 9. Mean of time interval within Group 3

Time interval	Duration	Mean differences	P
Baseline	Immediately	2.03	**<0.0001***
Baseline	After 2 weeks	5.11	**<0.0001***
Immediately	After 2 weeks	3.07	**<0.0001***

RESULTS

The mean VAS score at baseline, immediately and after 2 weeks was compared among Groups 1, 2, and 3 using the one-way ANOVA test. There was no significant difference in the mean VAS score at baseline, immediately and after 2 weeks among Groups 1, 2, and 3. (Table 1)

The mean change in VAS score from baseline to immediately after treatment, and from baseline to after 2 weeks was compared between Groups 1, 2, and 3 using the one-way ANOVA test. There was a significant difference in the mean change in VAS score from baseline to after 2 weeks between Groups 1, 2, and 3. (Table 2)

Intergroup comparison of mean change in VAS score from baseline to immediately after treatment, and from baseline to after 2 weeks was done using the post hoc Tukey's test. The mean change in VAS score from baseline to after 2 weeks was significantly differ in between Group 1 and Group 3. (Table 3)

The mean VAS score was compared between the different time intervals using the repeated-measures ANOVA test. There was a significant difference in mean VAS score between different time intervals. (Table 4)The inter-interval comparison of the mean VAS score between baseline, immediately and after 2 weeks was done using the post hoc Bonferroni test. The mean VAS score decreased significantly from baseline to immediately post treatment to after 2 weeks (Table 5)

The mean VAS score was compared between the different time intervals using the repeated-measures ANOVA test. There was a significant difference in mean VAS score between different time intervals. (Table 6) The inter-interval comparison of the mean VAS score between baseline, immediately, and after 2 weeks was done using the post hoc Bonferroni test. The mean VAS score decreased significantly from baseline to immediately post treatment to after 2 weeks.(Table7)The mean VAS score was compared between the different time intervals using the repeated-measures ANOVA test. There was a significant difference in mean VAS score between different time intervals. (Table 8)

The inter-interval comparison of the mean VAS score between baseline, immediately, and after 2 weeks was done using the post hoc Bonferroni test. The mean VAS score decreased significantly from baseline to immediately post treatment to after 2 weeks. (Table 9)

DISCUSSION

Since dental pain is a very subjective sensation brought on by dentin hypersensitivity, it requires careful evaluation and ongoing monitoring to achieve effective pain control.[5] The ideal substance for treating dentin hypersensitivity must not irritate the pulp, be painless when applied, simple to use, quick to take effect, long-lasting, and consistent.[6] Desensitizing pastes have been used widely in the past for treating dentin hypersensitivity because of their low cost and ease for the use for the home application.[3] In this study, the efficacy of three different desensitizing dentifrices formulations has been compared.

The herbal paste contains naturally occurring potassium nitrate (Suryakshara), which appears to aid in the desensitization of the dental nerves. Other natural ingredients, such as spinach (Palakya), also contain natural oxalates, which aid in the formation of phytocomplexes and occlude the exposed dentinal tubules, and also the presence of clove (Lavanga) controls pain due to the obtundant action of eugenol.[7]

Novamin is a biocompatible bioactive glass. It has been used for treating dentin hypersensitivity and occludes the open tubules by depositing hydroxycarbonate apatite, a mineral that is chemically and structurally similar to the mineral present in dentin and enamel.[1]
The desensitizing efficacy of dentifrices containing potassium nitrate is thought to be provided by potassium ion, via chemical interference with the transmission of the pain signal in the pulpal nerve fibres.[8]

In comparison to a dentifrice containing 5 % potassium nitrate, Salien et al,[8] Satyapal et al,[9] and Pradeep et al[10] found that a dentifrice with 5 % Novamin provided more quick relief from dentin hypersensitivity in the range of 2 weeks to 6 weeks. This might be caused by Novamin's ability to occlude tubules. Similar to the above mentioned studies there was a significant reduction of hypersensitivity by Novamin than potassium nitrate in our study.

Orchardson et al[11] and Sharma et al[12] have demonstrated that dentifrices containing potassium significantly reduced sensitivity. After the first four days of using potassium nitrate dentifrice, Cuesta et al[13] reported that the responsiveness to evaporative stimulation had rapidly decreased. Acharya et al[14] stated that Novamin and potassium nitrate based dentifrices are equally effective in reducing dentin hypersensitivity over a period of time. On contrary to their study, our study has shown the efficacy of using Novamin for dentin hypersensitivity superior to potassium nitrate.

A study by Joshi, Gautam, and Joshi[15] found that potassium nitrate and Novamin both reduced dentin hypersensitivity to the same extent. Although the verbal evaluation scores for the potassium nitrate dentifrice were superior to Novamin from the beginning through the third week. From the beginning through six weeks, both dentifrices responses to tactile, air, and cold stimuli were highly significant. However, in the present study, Novamin based dentifrice is superior from the beginning to 2 weeks period of time.

According to a study by Bansal and Mahajan[5], there was a noticeable difference in the VAS scores between toothpastes containing 5 % Novamin than those containing 8 % arginine and herbal desensitizing agents which is in agreement with our study. In Kar and co-worker's study[3], herbal desensitizing paste was more effective in reducing dentin hypersensitivity than potassium nitrate-containing toothpaste which was similar to our study.

In Reddy et al[1] study, it was concluded that Biomin, Novamin, Herbal toothpaste and 5% potassium nitrate toothpaste all were effective in relieving dentin hypersensitivity which was similar to our study. Following four days of twice-daily brushing in vitro, a comparative investigation by Parkinson and Willson[16] in 2011 found that calcium sodium phosphosilicate (Novamin) imparted considerable amount of dentinal occlusion with permanent occlusive deposits.

According to West et al[17] in 2011, Novamin was more effective than 8% arginine at occluding patent dentinal tubules under acid challenges. These studies bolster our study in the superiority of Novamin to reduce dentin hypersensitivity.

Other treatment options for dentin hypersensitivity such as laser therapy and iontophoresis are also used. However, they have many disadvantages such as more expensive, more complex, and questionable long-term effectiveness.[3] The further study can be elaborated on these aspects of using therapy for the dentin hypersensitivity to see the effectiveness of the dentifrices which is the limitation in the present study.

CONCLUSION

Desensitizing toothpaste containing 5% Novamin was found to be the most effective followed by natural herbal toothpaste in the reduction of dentin hypersensitivity after a single application up to a period of 2 weeks as compared to potassium salt containing toothpaste.

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