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Original Article

Dentistry Section

Chair Side Application of NovaMin for the Treatment of Dentinal Hypersensitivity- A Novel Technique

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ABSTRACT

Objective: To evaluate the efficacy of calcium sodium phosphosilicate bioactive glass (NovaMin) as a chair side desensitizing agent.

Materials and Methods: The study was conducted on 60 subjects divided into 3 groups of 20 each as follows. Group I (NovaMin application without scaling and root planing), Group II (NovaMin application after scaling and root planing) and Group III (control group). Sensitivity was assessed using air blast and cold water stimulus at baseline, immediately after application, after half an hour and after 8d using Visual Analog Scale (VAS)

Results: Mean VAS (air blast stimulus) for group I was 5.9 at baseline, 3.4 immediately after application, 3.05 after half an hour, and 3.0 after 8 days. In group II VAS score were 6.2, 3.35, 2.9, 2.75 and group III 6.6, 7.0, 7.0, 7.0 respectively. For cold water stimulus in group I VAS score were 5.6, 3.35, 3.15, 3.1, group II VAS score 5.7, 3.35, 3.1, 2.85 and group III 5.8, 6.1, 6.05, 6.05 respectively. VAS scores in between group I and group III and group II and group III were statistically significant (<0.001) immediately after application, after half an hour and after 8days (ANOVA)

Conclusion: Chair side application of calcium phosphosilicate bioactive glass can be a therapeutic adjunct to provide immediate relief for the patient with dentinal hypersensitivity.

Keywords: Dentinal hypersensitivity, Calcium sodium phosphosilicate bioactive Glass, Desensitizing agents

INTRODUCTION

Dentine hypersensitivity is characterized by short, sharp pain arising from exposed dentine in response to stimuli typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other form of dental defect or pathology [1,2]. Dentine may become exposed because of several reasons, viz., attrition, abrasion, erosion, or gingival recession [3]. The role of plaque in the etiology of dentine hypersensitivity is unclear but it can play an indirect role on periodontal tissues [4,5].

The reported prevalence of dentine hypersensitivity (DH) varies from 4 to 57 percent [6,7]. These variations are likely due to differences in the populations studied and the methods of investigation (for example, questionnaires or clinical examinations). The prevalence of DH is between 60 and 98 percent in patients with perioodontitis [8] and mostly occurs in patients who are aged between 20 and 40 years [9].

A number of theories have been proposed over the years to explain the pain mechanism of dentinal hypersensitivity. An early hypothesis was the dentinal receptor mechanism theory which suggests that dentine hypersensitivity is caused by the direct stimulation of sensory nerve endings in dentine [10]. Also, odontoblast transducer mechanism theory proposed by Rapp et al.,[11] suggested that odontoblasts act as receptor cells, mediating changes in the membrane potential of the odontoblasts via synaptic junctions with nerves. The currently accepted hypothesis is the hydrodynamic theory which states that dentine hypersensitivity may be caused by movement of the dentinal tubule contents [12].

Many methods have been used for the clinical treatment of hypersensitive dentine [13,14].

In-office methods provide an advantage over home use of desensitizing agents as they do not require multiple applications, patient compliance is not required and higher concentration of the desensitizing agent can be used that provides better relief from sensitivity. The present study focuses on a method of in-office chair side desensitization using Nova Min. NovaMin is the trade name for a calcium sodium phosphosilicate bioactive glass that has been developed for use in oral health care [23]. NovaMin precipitates calcium and phosphate and has been used to decrease hypersensitivity by occluding exposed dentinal tubules [24]. The mode of action of this material results from interactions with aqueous solutions, when introduced into the oral environment, the material releases sodium, calcium, and phosphate ions, which then interacts with oral fluids and result in the formation of a crystalline hydroxycarbonate apatite (HCA) layer that is structurally and chemically similar to natural tooth mineral [24].

In- Office Agents	At- Home Agents
Iontophoresis with 2% sodium fluoride [15]	Desensitizing toothpastes/dentifrices [13,14] containing strontium salts, fluorides, formaldehyde, potassium salts like potassium nitrate [16], potassium chloride or potassium citrate [17]
Nova Min	Mouthwashes containing potassium nitrate and sodium fluoride [18,19], potassium citrate or sodium fluoride [20] or a mixture of fluorides [21].
5% sodium fluoride varnish	Chewing gum containing potassium chloride 22]
Laser	

The only study reported till now with the use of NovaMin powder with NovaMin-containing toothpaste showed significant hypersensitivity reduction over baseline at all time points [25]. Therefore, the present study was conducted with the objective of evaluating the efficacy of chair side application of NovaMin for reduction of hypersensitivity.

MATERIALS AND METHODS

The present study was a randomized, controlled, single site and double masked clinical trial. The study was conducted from August 2012 to November 2012 and the population was selected randomly from patients attending the outpatient section of the Department of Periodontics, Rajarajeswari Dental College and Hospital, Bangalore, India. Each participant received a detailed explanation regarding the study procedure, and written informed consent was obtained.

	Group A	N*	Mean	Standard deviation (SD)
Baseline	Group I	20	5.90	1.11
	Group II	20	6.20	1.00
	Group III	20	6.60	1.09
Immediate after application	Group I	20	3.40	0.82
	Group II	20	3.35	0.93
	Group III	20	7.0	1.12
After half hour	Group I	20	3.05	0.68
	Group II	20	2.90	0.85
	Group III	20	7.0	1.12
After 8 days	Group I	20	3.0	0.64
	Group II	20	2.75	0.85
	Group III	20	7.0	1.12

[Table/Fig-1]: Mean, SD of dentinal hypersensitivity at baseline, immediate after application, after half hour and after 8 days obtained by air blast test
*N= sample size

	Group A	N*	Mean	Standard deviation (SD)
Baseline	Group I	20	5.6	1.18
	Group II	20	5.7	1.03
	Group III	20	5.8	0.98
Immediate after application	Group I	20	3.3	0.81
	Group II	20	3.3	0.81
	Group III	20	6.1	1.16
After half hour	Group I	20	3.1	0.81
	Group II	20	3.1	0.78
	Group III	20	6.05	1.09
After 8 days	Group I	20	3.1	0.78
	Group II	20	2.85	0.81
	Group III	20	6.05	1.09

[Table/Fig-2]: Mean, SD of dentinal hypersensitivity at baseline, immediate after application, after half hour and after 8 days obtained by cold water test
* significant

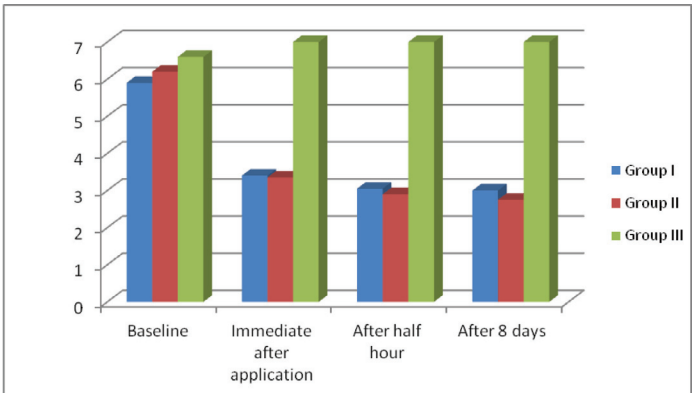
Ethical clearance certificate was obtained by institutional ethical review board. Study was conducted in accordance with the Helsinki declaration (2008).

Criteria for Selection

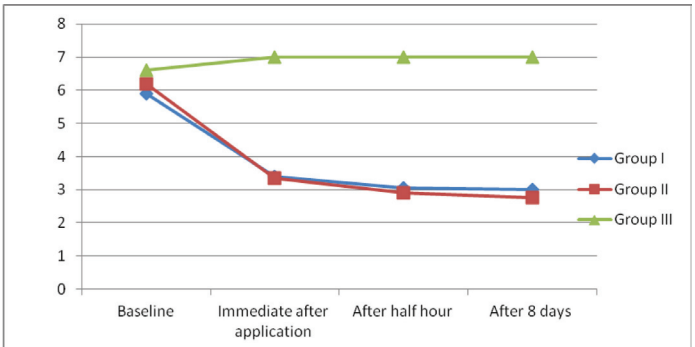
A total of 60 subjects in good systemic health and with hypersensitive teeth either due to wasting disease (attrition, abrasion, erosion) diagnosed as per Tooth Wear Index [26] or due to denudation of the root caused by periodontitis were selected. The following factors should exclude subjects or teeth from the study; current desensitizing therapy; allergies and idiosyncratic responses to product ingredients; excessive dietary or environmental exposure to acids; teeth with restorations like glass ionomer cement, composite etc; subjects with cervical abrasion in whom alternative modes of treatment has been planned; teeth with fluorosis and enamel hypoplasia.

METHODOLOGY

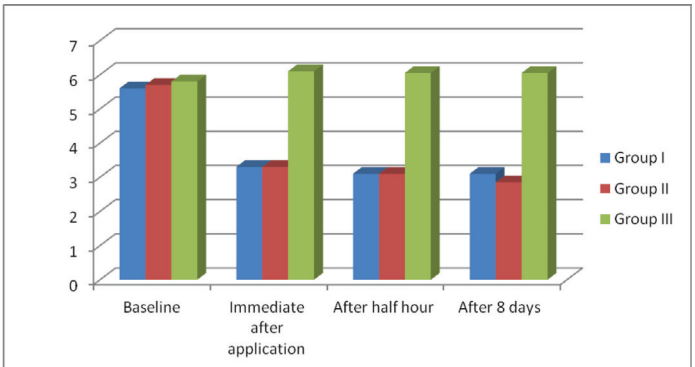
Study population consisted of 60 patients divided into the 3 groups of 20 patients each.



[Table/Fig-3]: Mean VAS score of dentinal hypersensitivity at baseline, immediate after application, after half hour and after 8 days obtained by air blast test



[Table/Fig-4]: Profile plots for air blast test



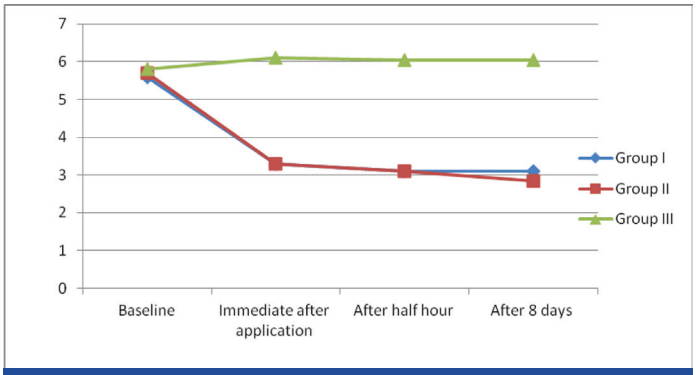
[Table/Fig-5]: Mean VAS score of dentinal hypersensitivity at baseline, immediate after application, after half hour and after 8 days obtained by cold water test

- Group I- Chair side application of NovaMin (without scaling & root planing)
- Group II- Chair side application of NovaMin (after scaling & root planing)
- Group III- Control group (no application of desensitizing agent, NovaMin)

Group II NovaMin was applied after scaling and root planing, to know if the removal of the smear layer would increase the penetration of calcium sodium phosphosilicate bioactive glass.

Testing

Two different stimuli were employed, air evaporative and cold water both of which are relevant to the everyday initiation of sensitivity in subjects. The cold air stimulus was approximately a 1-second blast from the air syringe of the dental unit. The cold air was directed at the exposed surface of the selected tooth that was isolated mesially and distally from adjacent teeth with the investigator's fingers [27]. The response to sensitivity for both the groups for air pressure and for cold water stimulus was noted. The assessment methods were response based using a Visual analog scale (VAS) score [28] completed by the subject rather than a stimulus-based binary response using stimuli of increasing intensity.



[Table/Fig-6]: Profile plots for cold water test

		Sum of squares	Df†	Mean square	F	p-value
Baseline	Between groups Within groups	4.9 65.8	2 57	2.46 1.15	2.13	0.127
Immediate after application	Between groups Within groups	175.2 53.3	2 57	87.6 0.9	93.6	<0.001*
After half hour	Between groups Within groups	216.2 46.7	2 57	108.1 0.8	131.8	<0.001*
After 8 days	Between groups Within groups	227.5 45.7	2 57	113.7 0.8	141.7	<0.001*

[Table/Fig-7]: Inter group comparison of sensitivity by air blast test using ANOVA
*significant ; † degrees of freedom

		Sum of squares	Df†	Mean square	F	p-value
Baseline	Between groups Within groups	0.63 65.5	2 57	0.317 1.15	0.275	0.76
Immediate after application	Between groups Within groups	100.8 50.9	2 57	50.41 0.89	56.45	<0.001*
After half hour	Between groups Within groups	114.1 47.3	2 57	57.05 0.83	68.74	<0.001*
After 8 days	Between groups Within groups	126.7 47.3	2 57	63.35 0.83	76.34	<0.001*

[Table/Fig-8]: Inter group comparison of sensitivity by cold water test using ANOVA

Group I patients were treated with NovaMin powder without scaling and root planing. VAS was noted at baseline. NovaMin powder was mixed with distilled water and the paste prepared was applied with a small cotton pledget to the tooth surface, left for two minutes and then rinsed off. Group II patients were treated with NovaMin powder after scaling and root planing. The reason as to why these subjects were divided into group I and group II was to know if the removal of the smear layer after scaling and root planning would increase the penetration of calcium sodium phosphosilicate bioactive glass and provide better relief from sensitivity and another reason being that scaling itself can increase the sensitivity to some extent.

After application of NovaMin, severity of sensitivity was assessed immediately after application, after half an hour and 8 days using Visual Analog Scale.

Statistical analysis included mean, standard deviation, standard error which was calculated for each of the test groups. Analysis of variance (ANOVA) was used to determine the intergroup and intragroup comparisons. Significance for all the tests was pre-determined at a probability value of <0.05.

RESULTS

The present randomized controlled trial was conducted on a total of 60 subjects who were selected after considering the inclusion and exclusion criteria. Sixty subjects were divided into 3 groups of 20 each. The mean VAS score for air blast and cold water test are presented in [Table/Fig-1-6]. Intergroup comparisons are presented in [Table/Fig-7,8].

Mean VAS score for air blast stimulus before and after application of NovaMin were as follows. In group I it was 5.9 at baseline without scaling and root planing, 3.4 immediately after application, 3.05 after half an hour, and 3.0 after 8 days [Table/Fig-1,3]. In group II i.e. after scaling and root planing VAS score at baseline, immediate after application , after half an hour and after 8 days were 6.2, 3.35, 2.9, 2.75 respectively [Table/Fig-1,3]. Overall, there was an improvement in symptoms of hypersensitivity from baseline to day 8 in both group I and group II whereas in group III there was no decrease in the VAS scores from baseline over a period of 8 days.

Similarly, the mean VAS score for cold water stimulus before and after application of NovaMin are provided in [Table/Fig-2, 5]. Overall, there was an improvement in symptoms from baseline to day 8 in both group I and group II. In group III there was no decrease in the VAS scores from baseline over a period of 8 days.

VAS scores in between group I and group III and between group II and group III were statistically significant <0.001 immediately after application, after half an hour and after 8 days [Table/Fig-4,6-8].

DISCUSSION

Hypersensitivity results when dentin is exposed due to one of the two processes; either removal of the enamel from the crown of the tooth, or denudation of the root surface by loss of cementum and overlying periodontal tissues. Most of the therapeutic modalities proposed to date depend on one of the two major suppressive mechanisms: sealing (blocking) of the dentinal tubule opening or dampening neural impulses.

Interpretation of pain as elicited by visual analog scale (VAS) after single application of NovaMin showed decrease in hypersensitivity immediately after application in group I and II. Group I showed a mean decrease in sensitivity from 5.9 at baseline to 3.4 after the application of NovaMin. On the other hand group II showed a decrease from 6.2 at baseline to 3.35 after application. There was no difference to pain response in the control group III, mean VAS score at baseline noted was 6.6 which remained the same throughout the eight day period.

Reduction in sensitivity in group I and II was due to the penetration of NovaMin into the dentinal tubules which resulted in the occlusion of tubules. In aqueous environments, such as saliva, the sodium ions (Na+) in calcium sodium phosphosilicate particles immediately (within one minute) begin to exchange with hydrogen cations (H+ or H3O+). This rapid exchange of ions allows calcium (Ca2+) and phosphate (PO4) species to be released from the particle structure. A modest localized, transient increase in pH occurs that facilitates the precipitation of calcium and phosphate from the particles and from saliva to form a calcium phosphate (Ca-P) layer on tooth surfaces. As the reactions and the deposition of Ca-P complexes continue, this layer crystallizes into hydroxycarbonate apatite (HCA), which is chemically and structurally similar to biological apatite. The combination of the residual calcium sodium phosphosilicate particles and the HCA layer results in the physical occlusion of dentinal tubules, which will relieve hypersensitivity [23].

Early clinical studies demonstrated that a dentifrice containing NovaMin significantly improves oral health as measured by a reduction in gingival bleeding and reduction in supragingival plaque compared with a negative dentifrice over the six weeks study period [29].

The efficacy of a dentifrice containing calcium sodium phosphosilicate (NovaMin) versus a placebo and a commercially-available strontium chloride ($SrCl_2$) containing dentifrice was evaluated for the treatment of dentin hypersensitivity showed the percent reduction in sensitivity at six weeks for the NovaMin test group was higher than placebo and $SrCl_2$ group [30]. Another NovaMin Research Report compared the use of DenShield (NovaMin) with GC Tooth Mousse (Recaldent) on bovine root surfaces in a pH-cycling model. After 10days, the number of occluded dentinal tubules was greater with the DenShield

product than with the Tooth Mousse. This was determined by SEM evaluation and the counting of occluded tubules [31]. A very recent in vitro study evaluated the effect of NovaMin desensitising toothpaste mixed with 15% carbamide peroxide on tooth bleaching and tubule occlusion. It was found that the addition of NovaMin to 15% Carbamide peroxide occluded the dentinal tubules and that it did not affect the bleaching procedure. They also emphasized its clinical relevance in a dual advantage of desensitizing and bleaching with a single paste system [32]. Recent studies have also demonstrated a potential for NovaMin to prevent demineralization and/or aid in remineralization of white-spot lesions [23].

Reviewing the literature many clinical trials have used NovaMin in dentifrices [23, 29-32], but very little data is available on application of NovaMin powder directly to tooth structure to relieve dentin hypersensitivity. The use of other desensitizing agents in dentifrices needs frequent applications and use of laser equipment is expensive and requires skilled personnel. It requires repeated application and maintenance of excellent quality of home care to achieve the therapeutic results. To overcome the shortcomings, this study attempted to measure the chairside application of NovaMin powder for the management of dentin hypersensitivity. NovaMin is the new product available in the market and has an added advantage of chair-side application.

CONCLUSION

Dentinal hypersensitivity is a relatively common and significant dental problem which can be successfully managed by a very wide variety of procedures, agents and formulations applied locally, either “in office i.e. chairside” or “at home”. This was an in-office procedure and proved to be a therapeutic adjunct to provide rapid precipitation and blocking of tubules and filling in of surface defects with NovaMin, and providing immediate relief for the patient with hypersensitive teeth. Future studies with more sample size carried in different parts of world will authenticate the use of NovaMin as chair side desensitizing agent.

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