

Comparative assessment of effectiveness of Biomin, NovaMin, herbal, and potassium nitrate desensitizing agents in the treatment of hypersensitive teeth: A clinical study

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ABSTRACT

Aim and Objectives: To compare the efficacy of four commercially available toothpastes in the treatment of dentinal hypersensitivity (DH).

Materials and Methods: In a single-centered clinical trial, a total of 160 subjects were divided equally into four groups: group 1 – a toothpaste containing 5% fluoro calcium sodium phosphosilicate with fused silica (Biomin); group 2 – a toothpaste containing 5% CSPA (NovaMin); group 3 – herbal formulation; and group 4 – a toothpaste containing 5% potassium nitrate. The patient's DH scores for tactile, evaporative stimuli were recorded on a visual analog scale at baseline, 2 weeks, and at the end of 4 weeks.

Results: All the four desensitizing toothpastes containing different active agents were effective in relieving DH. However, the Biomin group showed a better clinical response at the end of 4 weeks when compared with others.

Conclusion: The Biomin group showed significantly better results compared with either NovaMin, herbal, and potassium nitrate toothpastes in the treatment of dental hypersensitivity symptoms.

Key words: Biomin, dentinal hypersensitivity, desensitizing tooth paste, NovaMin, potassium nitrate

INTRODUCTION

Dentinal hypersensitivity (DH) is characterized by short, sharp pain arising from exposed dentin 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] Its diagnosis may be


challenging so differential diagnosis is essential to exclude all other dental defects and diseases that might give rise to similar presentations such as a split or broken tooth, dental caries, or periodontal disease. Correct diagnosis is important to develop and implement an appropriate treatment plan.^[2]

DH is described clinically as an exaggerated response to non-noxious stimuli, which is originating from underlying exposed dentin by direct nerve stimulation,

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irritation of odontoblastic processes, and by hydrodynamic flow in open dentin tubules. This theory, originally proposed by Gysi^[3] and later refined by Brannstrom,^[4] describes the most accepted mechanism for explaining the sensitivity response. Various treatment modalities are available for the management of DH such as desensitizing toothpastes, varnishes, fluoride iontophoresis, lasers, and remineralizing agents.^[5]

However, desensitizing dentifrices are the most widely used and accepted. Calcium sodium phosphosilicate, known as NovaMin, which is an inorganic, amorphous melt-derived biocompatible glass compound contains calcium, sodium, phosphate, and silica. The active ingredient is the inorganic chemical calcium sodium phosphosilicate (CaNaO6PSi). Gillam *et al.*^[5] demonstrated that bioglass could occlude dentinal tubules, which react with saliva depositing hydroxycarbonate apatite (HCA) within the demineralized collagen fibrils, thereby occluding dentinal tubules. Scanning electron microscope analysis has shown that the application of bioglass results in the formation of an apatite layer, which occludes the dentinal tubules.

Recently, there has been a growing interest in natural products, and studies have suggested that herbal based toothpastes may be effective as the conventionally formulated dentifrice in the management of dentinal of hypersensitivity.^[6]

Biomin is an inorganic, amorphous melt-derived biocompatible glass compound that contains calcium, fluoride, phosphate, and silica. The active ingredient is the inorganic chemical fluoro calcium phosphosilicate. In addition to fluoride in the glass, it has three times higher phosphate content, which promotes fluorapatite formation and has lower silica and smaller particles than NovaMin, which gives less gritty in texture, reduces abrasion and enamel wear, and penetrates effectively into the dentinal tubules for occlusion.^[7]

The aim of this experimental study was to evaluate and compare the efficacy of four commercially available toothpastes Biomin, NovaMin, Herbal, and 5% potassium nitrate for the treatment of DH.

This is the first study which compared NovaMin and Biomin in the treatment of DH.

MATERIALS AND METHODS

This clinical trial was carried out at a single center. The duration of the study was 4 weeks. The sensitivity scores were recorded at baseline, 2 weeks, and 4 weeks. A total of 160 individuals were selected from the outpatient section of the Department of Conservative Dentistry and Endodontics.

Inclusion criteria

- Patients need to have atleast two sensitive permanent tooth surfaces (buccal/facial aspects of incisors, canines, or pre-molars) [Figure 1]
- Patients within age range of 25–65 years and otherwise healthy patients were included in the study with wasting diseases and/or gingival recession
- Signed informed consent.

Exclusion criteria

- Patients who have undergone active periodontal treatment within last 6 months
- Pregnant or lactating females
- Deleterious habits such as smoking and/or alcohol consumption
- Use of antibiotics within 6 months before the study
- Systemic disease.

Dentifrices used

The four kinds of commercially available toothpastes were tested in this clinical trial: -

1. Group 1 – A commercially available nonaqueous toothpaste containing 5% fluoro calcium sodium



Figure 1: Preoperative picture showing cervical abrasion

phosphosilicate with fused silica (Hydent pro, Group Pharmaceuticals, India).

2. Group 2 – A commercially available toothpaste containing 5% calcium sodium phosphosilicate (CSPS) fused with silica (Sensodyne repair and protect, Group pharmaceuticals, India).
3. Group 3 – Herbal toothpaste (Colgate Swarna Vedashakthi, India), which has herbal extracts such as neem, camphor, cinnamon, and clove.
4. Group 4 – A commercially available toothpaste containing 5% potassium nitrate (RA Thermo seal, ICPA Health Products Ltd, Ankleshwar, India).

Tactile sensitivity test

Before starting the treatment, the teeth were isolated using a rubber dam and the baseline sensitivity values were recorded using the tactile method and the air blast stimuli. Tactile sensitivity was recorded under slight manual pressure using a blunt probe over the hypersensitive areas of the tooth in a mesiodistal direction.

Air blast sensitivity test

Air blast sensitivity was recorded using the controlled air pressure from the standard dental airway syringe at 40–65 psi at room temperature, directed perpendicular to the hypersensitive area from a distance of around 3 mm, with adjacent teeth protected with the gloved fingers to prevent false results.

The record of hypersensitivity was based on the visual analog scale (VAS), the scores were recorded on the 10 cm scale, with stipulated ratings ranging as from

- 0 to 1 with no pain,
- 2-3 with slight pain,
- 4 to 6 with moderate pain, and
- 7 to 10 with severe pain.

Individuals who had baseline scores ≥ 4 were taken up for the study.

Method of application

A total of 160 subjects were divided into four groups of 40 subjects each. Using a disposable applicator tip, an assigned amount (pea size) of toothpaste was applied over the isolated hypersensitive area of the tooth for 10 sec [Figure 2]. Each patient was advised to brush their teeth in the usual manner for 3 min, twice daily, with soft bristle toothbrush, and to apply the toothpaste in an amount equal to about half the length of the bristle head. They were also instructed

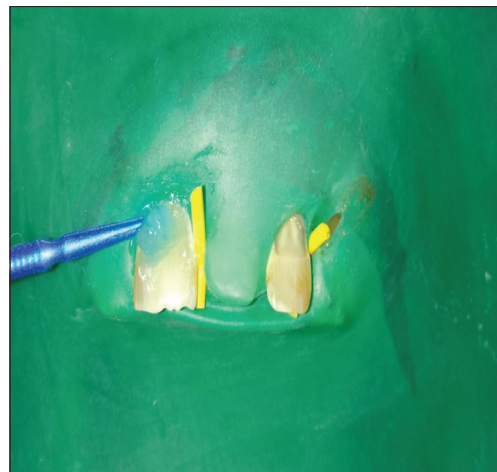


Figure 2: Paste application using a disposable tip

not to eat or drink anything within half an hour of brushing with the dentifrices. They were recalled at 2 weeks and at the end of 4 weeks for the assessment of tooth sensitivity.

Post application immediate, after 1 week, and after 4 weeks score of tactile and air blast, DH examinations were performed and recorded by the same examiner following the same methodology employed at the baseline examination.

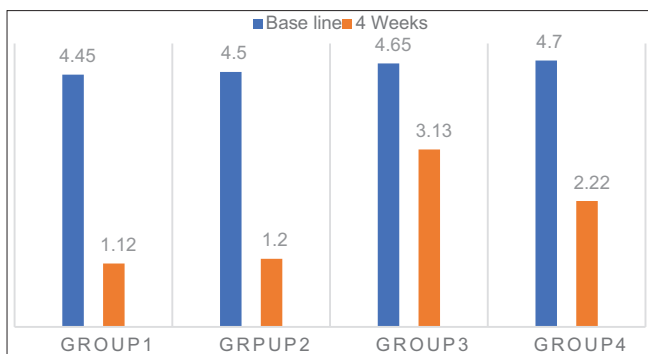
STATISTICAL ANALYSIS

Intergroup comparison of groups with respect to sensitivity scores at different time points was carried out by the Kruskal–Wallis test. Pairwise comparisons were carried out by the Mann–Whitney U test. Intragroup comparisons were performed by Wilcoxon matched test. If $*P < 0.05$, then it was considered statistically significant.

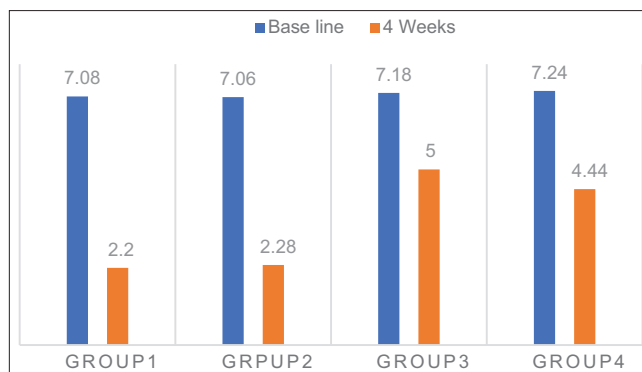
RESULTS

No adverse effects were observed in any of the subjects enrolled in the study. Mean VASs for tactile and air stimulus for all four groups at baseline, 2 weeks, and 4 weeks are shown in Table 1. An intragroup comparison showed that all groups recorded a significant improvement from baseline to 4 weeks [Graphs 1 and 2]. No significant difference between groups at baseline was found for tactile and air stimulus [Table 2].

Group 1 (Biomin) resulted in more improvement with statistical significance difference at all-time



Graph 1: Mean visual analog scale scores at baseline and 4 weeks using the tactile method



Graph 2: Mean visual analog scale scores at baseline and 4 weeks using the air blast method

intervals compared with the other groups for tactile and air blast methods. Group 2 (NovaMin) fared consistently better than group 3 (herbal) and group 4 (thermoseal) at 4 week recall. Group 3 and group 4 exhibited significant differences at 4 weeks.

DISCUSSION

Hypersensitivity results because of exposure of dentinal tubules by either removal of the enamel from the crown of the tooth or denudation of the root surface by the loss of cementum and overlying periodontal tissues, which can be treated by two major suppressive mechanisms: sealing (blocking) of the dentinal tubule opening or dampening neural impulses.^[8]

In this study, to assess tooth sensitivity, the most common and validated stimuli tests, including tactile test, and air blast test were used as these are both physiological and controllable.^[9] The 0-10 numerical rating VAS has been shown to be a more efficacious, simpler in the application and patient comprehension.^[10]

All dental lesions are investigated using a probe tip as a tactile stimulus, which causes the inward movement of the dentinal fluid owing to the compression of the dentin. Thus, mechanoreceptors causing the painful sensation are activated. Air stimulus decreases the temperature at the dentin surface and causes rapid outward fluid flow from opened dentin tubules, which stimulates the painful sensation.^[4]

A standard dental explorer was used as a tactile stimulus and blasts of air from the three-way syringe at 40 psi (± 5 psi) as an evaporative stimulus. All

TABLE 1: SENSITIVITY SCORES (VISUAL ANALOG SCALE) TO TACTILE AND AIR BLAST METHOD FOR ALL GROUPS AT BASELINE, 2 WEEKS, AND 4 WEEKS

Toothpaste groups		Baseline	2 weeks	4 weeks
Tactile method	Group 1	4.45 \pm 0.60	2.40 \pm 0.63	1.12 \pm 0.55
	Group 2	4.50 \pm 0.54	2.86 \pm 0.65	1.20 \pm 0.56
	Group 3	4.65 \pm 0.96	3.72 \pm 1.24	3.13 \pm 1.18
	Group 4	4.70 \pm 0.58	3.92 \pm 0.86	2.22 \pm 0.88
Air blast method	Group 1	7.08 \pm 1.46	4.18 \pm 1.20	2.20 \pm 1.09
	Group 2	7.06 \pm 1.29	4.53 \pm 1.40	2.28 \pm 1.34
	Group 3	7.18 \pm 1.47	6.23 \pm 1.62	5.00 \pm 1.34
	Group 4	7.24 \pm 1.16	6.40 \pm 1.46	4.44 \pm 1.40

TABLE 2: INTERGROUP COMPARISON OF TACTILE, AIR BLAST METHOD AT BASELINE, 2 WEEKS, AND 4 WEEKS

Comparison between groups		Baseline (P)	2 weeks (P)	4 weeks (P)
Tactile method	Group 1 and group 2	0.3918	0.0001	0.0001
	Group 1 and group 3	0.8099	0.0001	0.0001
	Group 1 and group 4	0.0868	0.0001	0.0001
	Group 2 and group 3	0.6168	0.7547	0.1436
	Group 2 and group 4	0.3918	0.0469	0.0269
	Group 3 and group 4	0.2145	0.1410	0.0007
Air blast method	Group 1 and group 2	0.6932	0.0001	0.0001
	Group 1 and group 3	0.6033	0.0001	0.0001
	Group 1 and group 4	0.8211	0.0001	0.0001
	Group 2 and group 3	0.3632	0.0286	0.0204
	Group 2 and group 4	0.8814	0.0013	0.5605
	Group 3 and group 4	0.3607	0.4764	0.2081

the toothpastes could penetrate and occlude the exposed dentinal tubules that are responsible for dental sensitivity through the irritation of nerves.^[11]

A number of treatment regimens have been advocated over the years, and particular attention has been focused on home use dentifrices containing various active compounds, which act by either blocking the hydrodynamic mechanism or the neural response.

NovaMin is a bioactive glass known to be highly biocompatible. Recently, it has been used for treating DH and known to occlude the open tubules by depositing HCA, a mineral that is chemically and structurally similar to the mineral present in dentin and enamel.^[12]

In this study, the higher effectiveness of the Biomin group is in accordance with a study by Gautam and Halwai,^[13] which revealed that fluoro calcium sodium phosphosilicate with fused silica performed better than NovaMin containing toothpaste at 2 and 4 weeks as it is a new bioglass which has some important benefits over the original NovaMin formulation. In addition to fluoride in the glass, the glass has three times higher phosphate content and much lower silica content with smaller particles than NovaMin, which may help the bioglass better infiltration into dentinal tubules to plug access to the tooth nerve, thus Biomin toothpaste offers long-lasting relief and protection from DH.^[7]

The herbal paste (Colgate Vedshakthi) used in this study is effective in the treatment of DH as it contains naturally derived potassium nitrate (Suryakshara), which helps in desensitization of the dental nerves, other natural ingredients, such as spinach (Palakya), contains natural oxalates which help in the formation of phytocomplexes and occlude the exposed dentinal tubules, and also the presence of clove (Lavanga) controls pain because of the obtundant action of eugenol.^[14]

5% potassium nitrate toothpastes are as effective as the conventionally formulated dentifrice in the treatment of DH. The efficacy of thermoseal has been evaluated in previous studies. Hence, it was chosen as the control toothpaste.

Limitations and future prospects of the study

The present short-term (4 weeks) study was carried out to determine which agents provide long-term relief from DH. More numbers of clinical trials over a larger population are essential in future to find out the best treatment strategy.

CONCLUSION

Within the limitations of this study, we can conclude that fluoro calcium phosphosilicate Biomin (group 1) showed significantly better results compared with either potassium nitrate, strontium chloride, or a herbal dentifrice in reducing DH symptoms at the end of 4 weeks.

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Conflicts of interest

There are no conflicts of interest.

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