

Comparative Evaluation Of Dentinal Hypersensitivity By A Nano-Hydroxyapatite And Herbal Formulated Desensitizing Toothpaste In Patients With Dentinal Hypersensitivity”: A Randomized Controlled Trial

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Abstract:

Dentinal hypersensitivity (DH) is one of the common problems observed now-a-days in young and middle-aged people. To relieve DH symptoms, the potential and superiority of n- HA over other materials available to occlude dentinal tubules as an alternate measure is established in, in-vitro studies. The medicinal plants have proven to be an abundant source of biologically active compounds, many of which have been the basis for the development of new chemicals for pharmaceuticals. In Ayurvedic literature, Dashansanskar formulation is documented and widely used as a classical formulation for the treatment of gingivitis and periodontitis, bad breath and other oral diseases. Therefore, these are preferred over those with chemical compositions. 75 patients with dentinal hypersensitivity were divided equally into 3 groups: Group A: Scaling + Herbal formulated toothpaste, Group B: Scaling + Nano Hydroxyapatite toothpaste, and Group C: Scaling + Placebo toothpaste. Clinical parameters (Tactile, Air blast and Cold-water stimuli) were evaluated at baseline, 1, 4 and 8 weeks.

Group A and Group B showed significant reduction in all the tactile stimulus, cold water stimulus and air blast stimulus over the period of 8 weeks as compared to Group C. Herbal formulated toothpaste was as effective as nano hydroxyapatite toothpaste in the reduction of dentine hypersensitivity. It can be alternatively used to treat dentinal hypersensitivity which was as effective as the commercially available toothpaste.

Keywords: Dashansanskar toothpaste; Dentin Hypersensitivity; Herbal toothpaste; Nanohydroxyapatite

INTRODUCTION:

Dentinal hypersensitivity (DH) is one of the common problems observed now-a-days in young and middle-aged people. "It is defined as a common unpleasant pain arising from dentine exposed to a variety of stimuli, which cannot be attributed to any forms of dental pathology" (1). At the International Association for the Study of Pain, Merskey has described that tooth hypersensitivity can qualify the criteria of several pain terms (2). The pain is characterized as classically sharp, short or sudden onset (3). Any potential or actual tissue damage associated with the unpleasant sensory and emotional experience described as pain. This can lead to both physical and psychological problems for the patient. Furthermore, it can have a negative impact on the quality of a person's life, especially with regards to maintaining optimal dental hygiene, dietary selection, and aesthetic aspects (4).

The desensitizing agents have primarily two mechanisms, one is blocking the nerve stimulation by changing nerve ending excitability resulting in depolarization of nerve and second is by occluding dentinal tubules openings resulting in blocking the dentinal fluid movement (5). Another mechanism is the rapid

flow of fluid in the dentinal tubules which activates pulpal fibers and results pain from chemical, mechanical or thermal stimulus (6).

Although DH is a prevalent disorder, the treatments which have been suggested are not sufficient and success rate is also low

(7). The diagnostic accuracy of dentin hypersensitivity is critical, after initial investigation of the medical history of the patient and physical screening examination, the diagnosis can be established. Stimulus to sensation is due to the lesion which is extended to odontoblastic process and formation of dentin-pulp complex.

Numerous desensitizing toothpastes containing potassium nitrate, strontium chloride, arginine, stannous fluoride, and nano-hydroxyapatite (n-HA) have been developed and are available commercially. Toothpastes with bioactive ingredients like Novamin and Biomin, have given promising results in many clinical trials, also n-HA has gained popularity long ago for the treatment of DH. A protective layer, on the surface of dentin on root specimens was proved by n-HA containing toothpastes which physically occlude dentinal tubules. as a measure of their potential to treat dentinal hypersensitivity (8,9).

In recent years, importance has been given to natural products for use in day-to-day life. The natural products derived from medicinal plants have proven to be an abundant source of biologically active compounds, many of which have been the basis for the development of new chemicals for pharmaceuticals (10).

The medicinal plants have proven to be an abundant source of biologically active compounds, many of which have been the basis for the development of new chemicals for pharmaceuticals. In Ayurvedic literature, Dashansanskar formulation is a documented and widely used as classical formulation for treating all types of oral cavity disorders. As per literature this dashansanskar churna has been used for the treatment of gingivitis and periodontitis, bad breath and other oral diseases (11). Very few studies have been conducted on this herbal preparation which so far have lesser side effects than that of chemical.

Therefore, this study aimed to compare and evaluate dentinal hypersensitivity using a nano- hydroxyapatite and herbal formulated desensitizing toothpaste in patients with dentinal hypersensitivity.

MATERIALS AND METHOD:

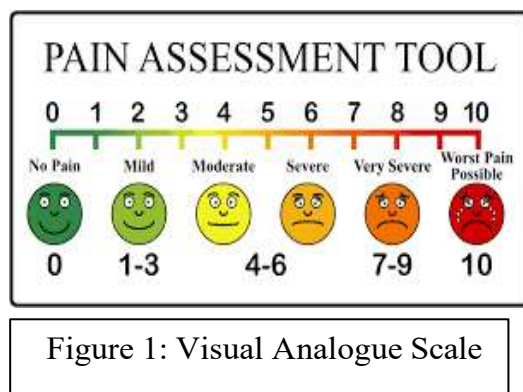
This was a randomized controlled clinical trial. Patients visiting the OPD of the Department of Periodontology of our institute were selected for the study. The ethical clearance was obtained from the institutional ethical committee (MGV/KBHDCH/230/2022). This study was also registered at clinical trials registry of India: (CTRI/2023/05/052295).

All the patients were given specific code numbers as per a computer-generated randomization without them knowing which treatment was assigned for what code. The clinical evaluation by the blinded operator was based only on the patient's code number. Patients were randomly assigned to either of the three groups with a 1:1:1 allocation.

25–50-year-old patients with dentin hypersensitivity in single or multirooted teeth on consumption of cold food stuff, air blast and on slightly moving the probe over the defect surface and with gingival recession, erosion and abrasion on teeth. Patients with sensitivity score > 2 on the visual analogue scale (VAS) and with good general and periodontal health (no probing depth exceeding 4 mm and no bleeding on probing) were included in the study

Patient with dental caries or extensive restoration (involving more than 50% of the tooth structure) as they may have an abnormal pulpal response. Patients who have undergone vital tooth bleaching, orthodontic appliance treatment within the previous three months, or patients who had used desensitizing agents in the past six months were excluded from the study which might alter the results of the study. Patients with pregnancy or in lactating period, medically compromised or patients who smoke and drink alcohol were excluded.

Study Parameters: All the clinical parameters were recorded by a single examiner (S.T). A 10-pointer scale i.e Visual Analogue scale (VAS) which consists of a long horizontal line, was used for evaluation of the severity of clinical parameters. The range was from no pain allotted number 0 (utmost left end) to worst imaginable pain allotted number 10 (utmost right end). (Figure 1)



Clinical parameters-

1. The tactile stimulus was examined using an explorer (# 17/23), passing at a right angle to the Bucco-cervical tooth surface of concern.
2. For air blast stimuli, air was delivered by a three-way syringe from a typical dental unit air syringe at 40 psi (± 10 psi) and 70 °F (± 5 °F). The air flow was aimed at the tooth surface of concern, for 1 sec, from a distance of 1 cm.
3. For cold hypersensitivity assessment, the tooth was isolated using cotton rolls then, a few drops of cold water were delivered to the tooth from a syringe that was previously cooled.



Fig 2: recording of clinical parameters,
a- Tactile Stimulus applied on tooth using explorer by running it over the Bucco- cervical angle of the tooth
b- Air Blast Stimulus applied on tooth using 3-way dental syringe from 1cm for 1 second;
c- Cold Water Stimulus applied on tooth using cold water syringe drop by drop.

For standardization, all the subjects were asked to brush using a soft bristle toothbrush. The subjects were instructed about oral hygiene techniques before the commencement of the study. They were demonstrated with modified bass brushing techniques to use during and after the study. In addition, during the evaluation period, the subjects were asked to not to use any other anti- hypersensitivity products other than the one used in the study.

Herbal toothpaste preparation: It was formulated at Dr. Ved Prakash Ayurved College and Hospital, Jalna, Maharashtra, India.

9 parts of Khatika (25gms), and 1 part(2.5gm) each of saunth, haritaki, nagarmotha, khadirsar, karpur, suparimasi, marish, lavang, and dalchini, were mixed in powdered form with sorbitol (47.2gms), Sodium Lauryl Sulphate (1.5gms), Carboxymethyl Cellulose (1.8gms), methyl paraben (0.5gms) to form a paste. Menthol(1.5gms) was added for flavouring. This toothpaste was dispensed in small plastic tubes for distributing it to the patients.

Nano hydroxyapatite toothpaste: Dente 91 Nano hydroxyapatite toothpaste (Frimline Private Limited, India) was dispensed in empty toothpaste tubes for distributing to the patients. It constitutes of Nano-hydroxyapatite, Lactoferrin, Xylitol, Aqua, Sorbitol, Silica, Glycerine, SLS, Xanthan Gum, Fragrance, Titanium dioxide, Sodium saccharin, Sodium benzoate.

Placebo toothpaste: Placebo toothpaste was prepared using calcium carbonate, sorbitol, sodium carboxymethyl cellulose, sodium lauryl sulphate, menthol, and methyl paraben. This toothpaste was dispensed in small plastic tubes for distributing to the patients.



Figure 3: toothpaste dispensed in tubes

Treatment procedure: All the patients on diagnosis and screening from OPD for inclusion/exclusion criteria were informed about the study design in the language they understand. Written copy of the informed consent was given for voluntary signature. Detailed medical and dental history was taken.

Scaling was performed at the initial visit/Baseline. Following scaling, all the three clinical parameters (tactile stimulus, cold water stimulus and air blast stimulus) were evaluated and recorded using visual analogue scale (VAS) using proforma. The patients were randomized according to the computer-generated randomization. Then the patients were provided with toothpaste tubes which would last them for 1-week until the subsequent visit according to their allocation.

On the next visit i.e after 1 week, all the clinical parameters were recorded and patients were provided with toothpaste tubes according to their group allocation which would again last them till the next visit.

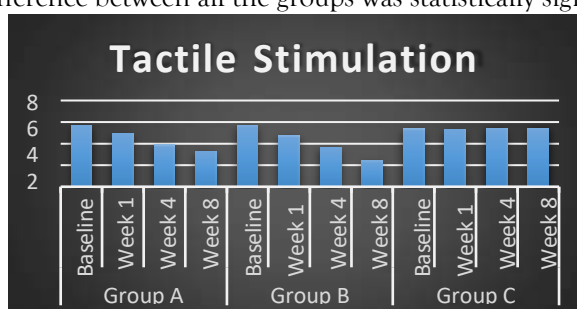
Reassessment of the clinical parameters using the Visual analogue scale and provision of toothpastes was repeated for the succeeding 2 visits which were scheduled after 4 and 8 weeks after the baseline visit. The patients were instructed to use a soft bristled toothbrush and were instructed about modified bass brushing technique. In between the appointments, the patients were asked to refrain from using any other desensitizing agents

RESULTS:

Statistical analysis was done using SPSS (Statistical Package for Social Sciences) software version 21.0, IBM. The data collected was carefully tabulated followed by descriptive and analytical statistics. The statistical analysis for intra and inter-group comparisons was performed using Analysis of variance (ANOVA) followed by multiple pairwise comparisons using "Post hoc Turkey Test".

For Tactile stimulation:

There was a statistically significant ($p < 0.00$) difference between group A and B from baseline to 8 weeks, whereas for group C it was not significant ($p = 0.985$) (Graph 1). When multiple pairwise comparison was done among the three groups at baseline and 1 week, the difference was non-significant. At 4 weeks, the mean difference between Group A & C and also Group B & C was statistically significant ($p = 0.00$). At week 8 the mean difference between all the groups was statistically significant ($p < 0.05$).

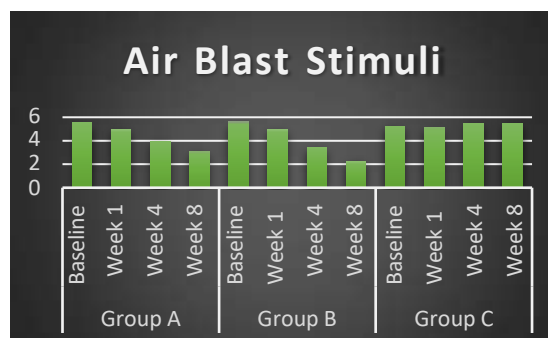


Graph 1: Comparison of Tactile sensation between the three groups.

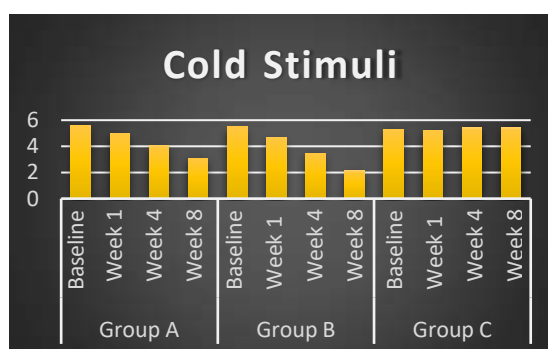
For Cold stimuli:

There was a statistically significant difference between group A and B ($p < 0.00$) from baseline to 8 weeks, whereas for group C it was not significant ($p = 0.88$) (Graph 2). When multiple pairwise comparison was done among the three groups at baseline and 1 week, the difference was non-significant. At 4 weeks, the

mean difference between Group A & C and Group B & C was statistically significant ($p=0.000$). At week 8 the mean difference between all the groups was statistically significant ($p<0.05$).



Graph 3: Comparison of cold stimuli between the three groups.



For Air Blast stimuli

There was a statistically significant difference between group A and B ($p<0.00$) from baseline to 8 weeks, whereas for group C it was not significant ($p=0.719$) (Graph 3). When multiple pairwise comparison was done among the three groups at baseline and 1 week, the difference was non-significant. At 4 weeks, the mean difference Between Group A & C and Group B & C mean difference was statistically significant ($p=0.000$). At week 8 the mean difference between all the groups was statistically significant ($p<0.05$).

DISCUSSION:

Dentin hypersensitivity (DH) is one of the most commonly encountered clinical problems in dental practice. It is defined as pain resulting from exposed dentin in reply to chemical, thermal, tactile, or osmotic stimuli, which cannot be attributed to any other defect or dental pathology. (12). Clinically, it is a localised or generalised, sharp pain of quick beginning and can affect one or several dental surfaces. It can have an adverse effect on the quality of life, especially concerning limitations of diet, tooth hygiene, and daily activities (13). The prevalence of the disease in the age group of 20-50 years is common, more prevalent in the age group of 30-40 yrs. even more prevalent in female individuals. With asking questions to the patients and by applying various stimuli such as heat, cold, tactile, and chemicals, hypersensitivity can be determined, it cannot be diagnosed easily on oral examination.

Desensitising toothpaste can be an effective way to manage dentin hypersensitivity by minimising pain and blocking dentinal tubules. A number of agents are used to treat dentine hypersensitivity. At home use of desensitising toothpastes can be one of the active methods in providing relief to the patients. Although nano hydroxyapatite toothpastes have emerged as the "Gold Standard" and are readily available in the market, which may not be affordable for many patients as they are expensive. Compared to other therapeutic modalities employed against dentine hypersensitivity, herbal formulated toothpaste has no side effects with acceptable taste.

Use of air blast and probing stimulation for assessing dentin hypersensitivity is a simple and reliable method as suggested by Sowinski et al (2001) (14). The dentinal tubular pressure changes are seen after tactile,

cold, air blast stimulus and followed by pain response in patients due to stimulation of myelinated nerves located in the pulp (15). It is recommended to employ more than one stimulus during clinical studies so that researchers can obtain a comprehensive understanding of dentin hypersensitivity (14).

Dashan Sanskar toothpaste is a mixture of 10 unique ingredients constitute, khatika, saunth, haritaki, nagarmotha, khadirsar,

karpur, suparimasi, marish, clove, and dalchini which when used in combination have proved to be effective in reducing dentinal hypersensitivity by preventing fluid flow and occluding the dentinal tubules (16).

Nano Hydroxyapatite toothpaste is attributed to its ability to form a layer of mineral hydroxyapatite as well as hydroxyapatite plugs which occlude dentinal tubules and reduce dentinal hypersensitivity (17).

When we evaluated all the three clinical parameters over a period of 8 weeks, significant decrease was noticed in the group A. Nasser N (2020) (18) compared pro-argin containing toothpaste, calcium sodium phosphosilicate and dashansanskar churna via scanning electron microscope, they found the increase in percentage of dentinal tubule occlusion, resulted in reduction in DH. Camphor acts as a pulpal smoothening agent (19) and Terminalia chebula, terminalia belarica and cinnamon

(20) are considered the powerhouse of bioactive flavonoids which are the main active and reactive agents, capable of stimulating reparative dentine formation

(21). Sudhir et al (2019) (22) and Ana Vilela et al (2021) used herbal toothpastes in DH cases and confirmed that cinnamon bark and clove in combination was useful for the treatment of dentinal hypersensitivity. Eugenol could be a good lternative for reducing DH due to its analgesic activity inhibiting the P2X receptor expressed in the trigeminal ganglion and modulation of immune inflammatory reactions which bring benefits in relation to DH (23).

When nanohydroxyapatite toothpaste was used in our study, there was a significant decrease in all the clinical parameters over the period of 8 weeks. Similar results were found by Vano et al (2014) (24), Amaechi (2021) (25) and Wang et al (2016) (26) over

the period of 4 weeks, 8 weeks and 3 months respectively who found that the use of nano-hydroxyapatite toothpaste resulted in a significant decrease VAS score for tactile sensitivity due to dentinal tubules blocking capacity of the nanohydroxyapatite molecules. Gopinath (2015) (27), Alencar (2019) (28) and Anand (2017) (29) who evaluated and found that the use of nano-hydroxyapatite toothpaste resulted in a same notable reduction in VAS scores for cold sensitivity. Polyakova et al. (2022) (30), found that use of nanohydroxyapatite toothpaste led to significant decrease in Schiff scores due to the dentinal occluding property. Oubenyahya et al (2021) (31), Naini et al (2018) (32) and Alharith et al (2021) (33) who found that nano-hydroxyapatite toothpaste as a desensitizing agent was effective in reducing DH via dentinal tubule occluding property. Jena and Shashirekha (2015) (34) observed that 15% nanohydroxyapatite toothpaste could penetrate and occlude the exposed dentin tubules which was responsible for decrease in dental sensitivity and remineralization of dentin.

While the observations for the placebo toothpaste showed no significant changes for all the clinica parameters. Hu (2019)

(35) in their meta-analysis and Patel et al (2019) (36) revealed that the impact on dentin hypersensitivity was not significant when placebo toothpaste was used due to the absence of any active ingredient in it. Martins (2020) (9), Creeth et al. (2021) (37)

and Vilhena et al. (2020) (38).

CONCLUSION:

Herbal formulated toothpaste was as effective as nano hydroxyapatite toothpaste in the reduction of dentine hypersensitivity. The findings have the potential to impact clinical recommendations and patient choices, leading to improved management of DH through practices supported by evidence. It can be alternatively used in the cases of dentinal hypersensitivity which is as effective as the commercially available toothpaste.

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