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COMPARISON OF EFFICACY OF NANOHYDROXYAPATITE DESENSITIZER, ND:YAG LASER AND THEIR COMBINED EFFECT IN THE TREATMENT OF DENTIN HYPERSENSITIVITY: A CLINICAL STUDY

Dental Science

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ABSTRACT

There are various options for the treatment of dentin hypersensitivity; however, superiority of one modality over others alone has not been currently proven.

Methodology: The study was conducted on 90 teeth with dentin hypersensitivity assessed by tactile and cold air stimuli measured by visual analog scale (VAS). Teeth were randomly divided into three groups, G1 (n=30) treated by Nanohydroxyapatite desensitizing paste; G2 (n=30) treated by Nd:YAG laser and G3 (n=30) received Nd:YAG laser plus Nanohydroxyapatite desensitizing paste. The level of sensitivity was analyzed by VAS at each control. The VAS reduction percentages were calculated and data subjected to statistical analysis.

Result: Comparing the means of responses for the three groups revealed that Nd:YAG laser group and the combination treatment group had a higher degree of desensitization compared to group treated with only desensitizing paste.

KEYWORDS

Dentine Hypersensitivity, Nd:YAG laser, Nanohydroxyapatite

INTRODUCTION

Dentin hypersensitivity is an abnormal response of the exposed vital dentine to thermal, osmotic, chemical or tactile stimuli and which cannot be ascribed to any other dental defect or pathology. Various etiologic and predisposing factors for dentine hypersensitivity include occlusal disequilibrium, attrition, abrasion, erosion, parafunctional habits, anatomic predisposition due to structural deficiency of the enamel–cement junction and root planing.[1] Advancements in dentistry has led to reduction in tooth loss and hence dentin hypersensitivity prevalence is likely to increase in next years as more adults keep their teeth into later life.

A plethora of techniques and products have been proposed for the treatment of dentine hypersensitivity but most of them are either ineffective or effective only for short duration. One therapy that focuses on treatment of DH is application of desensitizing agents containing carbonated hydroxyapaptite nanocrystals that have the ability to seal or occlude the dentinal tubules. It is highly bioactive and biocompatible material and particle diameter is in the nanometer scale which is much less than the diameter of dentinal tubules.[2]

Advent of lasers has provided new dimension to the treatment of dentin hypersensitivity. Nd:YAG laser has shown the ability to obliterate the tubules through a process called "melting and re-solidification," without causing pulp damage or cracks when used with appropriate protocol.[3]

The aim of this study is to compare and evaluate the efficacy of nanohydroxyapatite desensitizer, Nd:YAG laser and their combined effect in management of dentin hypersensitivity.

METHODOLOGY:

The study was conducted on patients aged from 25-60 years and in total of 90 teeth with dentin hypersensitivity assessed by means of both air and tactile stimuli measured by visual analog scale (VAS).

Patient selection

Inclusion criteria for patient:

- Patients with sensitive teeth showing wear or gingival recession with exposure of cervical dentin.

Exclusion criteria for patients:

Teeth with irreversible pulpitis or necrosis, carious lesion, cracked enamel, orthodontic appliances, defective restorations, active periodontal disease, chronic medication use, history of vital bleaching, use of mouthwash or desensitizing agent within past 6 months, pregnant or lactating women, allergy to any of the contents of the treatment.

Written informed consent was obtained from all the participants. During the first visit oral hygiene instructions were given to the patient. Prior to any therapy, prophylaxis of the region was done.

Each selected tooth of each patient received two stimuli:

- A dental probe was used to scratch the surface in a mesial to distal direction.
- Application of air using a dental syringe for 30 sec, 2mm away from and perpendicular to the root surface.

This first measurement was considered as baseline.

Treatment protocol:

After that lesions were randomly assigned to the groups.

- **Group 1 (G1)** (n=30) :nanohydroxyapatite containing paste (Aclaim Group Pharma, India) was applied using a microbrush. Rotating rubber cup was used to polish the paste onto the sensitive areas for 1 min (Fig. 1)
- **Group 2 (G2)** (n=30) : lased by Nd:YAG laser (Sirona, Germany) with the parameters: 1064 nm, 1.5 W, repetition rate of 10 Hz , and 100 mJ of energy in contact mode and using a fibre of 400 µm diameter. Each tooth received 4 irradiations of 15 sec each, total 60 sec of irradiation with 10 sec interval between the irradiations (Fig. 2)
- **Group 3 (G3)** (n=30) : lased with Nd:YAG laser with the parameters as G2 followed by application of nanohydroxyapatite containing paste (Aclaim Group Pharma,India) for 1 min.

Fig 1. Application of nanohydroxyapatite containing paste

Fig 2. Irradiation by Nd:YAG laser

Both air and tactile stimuli evaluations were performed before and after treatment session. The patients were recalled for evaluation after one month. The tactile and air stimuli tests were performed again and results recorded on the VAS. The VAS reduction percentage were valued for each group between the pretreatment and the posttreatment session (immediate -/-). The obtained results were statistically analyzed.

RESULTS

The comparison of mean Air evaluation (Fig. 3) and mean probe evaluation (Fig. 4) Pre, post and after 1 month was done using the One-way ANOVA test. There was a significant difference in mean Air evaluation post and after 1 month between Groups 1, 2 and 3.

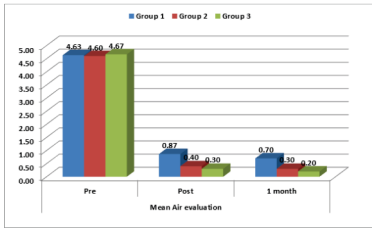

Fig 3. Mean Air evaluation

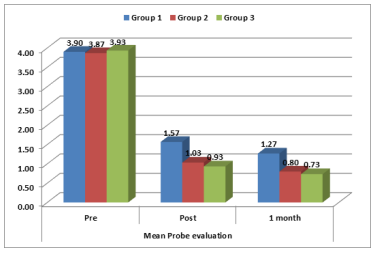

Fig. 4 Mean Probe evaluation

The inter-group comparison of mean Air evaluation (Table 1) and mean probe evaluation (Table2) Pre, post and after 1 month was done using the Post-hoc bonferroni test. The mean Air evaluation and mean probe evaluation post and after 1 month was significantly more among Group 1 in comparison to groups 2 and 3.

Table 1.

Air evaluation	Groups	Groups	Mean Difference	p-value
Difference from Pre to post	Group 1	Group 2	-0.43	0.044*
	Group 1	Group 3	-0.60	0.020*
	Group 2	Group 3	-0.17	1.000
Difference from Pre to post 1 month	Group 1	Group 2	-0.37	0.046*
	Group 1	Group 3	-0.53	0.045*
	Group 2	Group 3	-0.17	1.000

Post-hoc bonferroni test ***Significant difference**

Table 2.

Probe evaluation	Groups	Groups	Mean Difference	p-value
Difference from Pre to post	Group 1	Group 2	-0.50	0.042*
	Group 1	Group 3	-0.67	0.049*
	Group 2	Group 3	-0.17	1.000
Difference from Pre to post 1 month	Group 1	Group 2	-0.43	0.045*
	Group 1	Group 3	-0.57	0.048*
	Group 2	Group 3	-0.13	1.000

Post-hoc bonferroni test *** Significant difference**

The comparison of mean difference in Air evaluation and probe evaluation from Pre to post and from pre to after 1 month was done using the One-way ANOVA test. There was a significant difference between Groups 1, 2 and 3 for air evaluation. There was a significant difference in mean difference in Probe evaluation from Pre to post and from pre to after 1 month between Groups 1, 2 and 3.

The comparison of mean difference in Air evaluation and probe evaluation from Pre to post and from pre to after 1 month was done between Groups 1, 2 and 3 using the Post-hoc bonferroni test. The mean difference in Air evaluation from Pre to post and from pre to after 1 month was significantly more among Groups 2 and 3 in comparison to Group 1. The inter-interval comparison of mean Air evaluation and man probe evaluation was done for all the three groups using the post-hoc bonferroni test. The mean Air evaluation and mean probe evaluation decreased significantly from pre to post and after 1 month for all the three groups.

DISCUSSION

Dentine hypersensitivity is most common complaint reported by the patients due to which they are unable to consume hot or cold beverages, sweets and have difficulty in brushing their teeth. Despite a variety of treatment modalities available, still a standardized clinical protocol for the management of dentine hypersensitivity has not been developed as most of the therapies have failed to satisfy the patient. The objective of the present study is to evaluate the efficacy of nanohydroxyapatite desensitizer and Nd:YAG laser alone and in combination for the treatment of dentine hypersensitivity.

Studies have shown that individuals with dentin hypersensitivity show open dentinal tubules that are wider and are more numerous than nonsensitive surfaces.[2] The concept of treatment for dentine hypersensitivity is related to the interruption of stimuli transmission to the nerve endings of odontoblast processes by reducing the movement of dentinal fluid by creating a barrier that completely or partially obliterates the dentinal tubules (Brannstrom hydrodynamic theory 1986).

The rationale behind the use of n-HA emerged from the fact that it would obliterate the open dentinal tubules and since it is similar to the inorganic composition of the tooth it would blend with it. This principle is in accordance to majority of desensitizing toothpastes available in the market. [2]

The second principle explaining the effectiveness of n-HA toothpaste can be related to the modification or blocking of the pulpal nerve response with potassium ions, which may reduce nerve excitability and could cause depolarization of the pulpal sensory nerves, interrupting the transmission of the pain stimuli. [4-7]

In accordance with the clinical results of the present trial, several in vitro studies showed that n-HA toothpaste resulted in reduction in dentine hypersensitivity probably with obliteration of dentinal tubules, thereby reducing pain levels both for air and tactile stimulus.[2,8]

With the advent of the lasers, a new treatment option appeared for the management of dentine hypersensitivity. Diode laser (908 nm), CO_2 laser (10600 nm) and Er:YAG (2940 nm) have been used for dentine hypersensitivity but literature shows that the results of Nd:YAG(1064 nm) laser are more effective for the reduction in pain in dentine hypersensitivity.[9-15]

Irradiation with Nd:YAG laser leads to dissolution and resolidification of the hydroxyapatite crystals in dentin which causes obliteration of tubules. Nd:YAG laser seals dentinal tubules to a depth of approx. 4 µm within the tubules causing reduction in dentine hypersensitivity.[16]According to the literature only Nd:YAG laser appears to have an additional analgesic effect as compared to other lasers which is due to direct nerve analgesia and suppressive effect achieved by blocking the depolarization of A δ and C fibres.[17] This mechanism explains a decrease in sensitivity levels at the second evaluation period (after 1 month) as compared to immediate after treatment. In the present study, the group treated with Nd:YAG laser showed clinical results that were expected, significantly reducing pain levels immediately and over the course of time. None of the laser treated teeth showed secondary effects which confirms the safety of this treatment modality.

One cannot be sure that Nd:YAG irradiation caused sealing of all the dentinal tubules with the protocol used in the study but Nd:YAG laser when used at power more than 1.5 W may form microcracks, carbonization of the tooth surface and increase in pulpal temperature. This is the reason some patients still had sensitivity even after irradiation with Nd:YAG laser.[18]

The group which showed maximum reduction in hypersensitivity was the one in which Nd:YAG laser was used in combination with nanohydroxyapaptite desensitizer. The dentinal tubules that were not sealed by means of resolidification process of Nd:YAG laser could

have been occluded by means of nanohydroxyapatite desensitizer. The results of our study are in accordance with the study where sodium fluoride varnish when used in combination with Nd:YAG laser showed a synergistic desensitizing effect and it was related to higher sodium fluoride gel adhesion following laser treatment.[19] Lopes et al.[20]demonstrated that when a desensitizing agent Gluma and a low power laser were used alone and in combination, all of the treatment modalities were effective in reducing dentine hypersensitivity but the best results were obtained with combination therapy.

In our study VAS was used to measure the level of pain because according to literature, VAS for assessing pain affect has been shown to be valid and sensitive to treatment effects and to have ratio scales qualities.[21]

Within the limitations of the study, all the treatment modalities were effective in reducing dentine hypersensitivity. Management of hypersensitivity with Nd:YAG laser alone and in combination with nanohydroxyapatite desensitizer promises a noninvasive and safe treatment option provided correct protocols are used.

CONCLUSION:

Our study indicated that irradiation with Nd:YAG laser showed promising results for the treatment of Dentine hypersensitivity. There was no significant synergistic effect of nanohydroxyapatite toothpaste in combination with Nd:YAG lasers. To establish a standard treatment for dentinal hypersensitivity further long term studies on larger populations are required.

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