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Comparative Evaluation of The Efficacy of Diode Laser as an Adjunct to Stannous Fluoride In The Management of Dentinal Hypersensitivity : A Clinical Study

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Research Article

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ABSTRACT

Background: The objective of the study was to clinically evaluate and compare the efficacy of the 0.4% Stannous fluoride gel (SNF) alone and with diode laser in the management of dentinal hypersensitivity (DH).

Materials and Method: 30 patients with DH were selected from the department of periodontology and Oral implantology, ITS-CDSR, Murdanagar Ghaziabad were randomly and equally divided into two groups Group A: 0.4% Stannous fluoride alone, Group B: 0.4% Stannous fluoride plus application of diode laser (wavelength of 980 nm in continuous non contact mode with a power of 0.5 W) for 1 min for three times. Standardized clinical parameters included Plaque index, Gingival index and visual rating scale (VRS) scores of each tooth was tested in response to tactile stimuli, cold water test and Air blast test to determine the reduction of DH in both the groups. Readings were recorded at the baseline (after SRP), 1 week and 2 weeks.

Results: Both Groups have shown significant reduction in DH but 0.4% Stannous fluoride plus diode laser showed better results in the reduction of DH in comparison SNF alone.

Conclusion: It was concluded that diode laser plus SNF was more effective than SNF alone after 2 weeks and there were no adverse effects seen in any group.

INTRODUCTION

Dentinal hypersensitivity (DH) is among the most common problem encountered after any periodontal therapy^[1]. It is defined as short, sharp pain arising from exposed dentin in response to external stimuli, which are typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other form of dental defect or disease, Holland et al. The hyperbolic preponderance of dentin hypersensitivity has hastened the investigation of schemes and agents to insure this phenomenon, and to remineralise dental anatomical structure, such as sodium fluoride, stannous fluoride and argentine containing toothpaste^[2,3]. Many federal agents have been applied to treat dentinal hypersensitivity since 1000's of years. The treatment of dentinal hypersensitivity constitute different kinds of regimens, including dentist applied in-office treatments and patient-applied over-the counter dentifrices^[4]. Advancement of laser engineering science and its growing employment in dental medicine has contributed an additional alterative option for the treatment of DH. In several studies, diverse wavelengths of diode lasers have been utilized and have demonstrated the most beneficial effects in numerous clinical protocols, justified in high grade (DH) subject^[5]. In various clinical trials authors reported that the combination of lasers with various chemical agents have more clinical outcomes as compared to laser treatment alone^[6-8]. Hence the aim of the study was to compare and evaluate the efficacy of topical Stannous fluoride alone and in combination with soft tissue diode laser, commonly used as anti-hypersensitivity agent in the management of DH.

MATERIALS AND METHODS

Single centre, clinical trial was conducted in the outpatient department of Periodontology and Oral Implantology, I.T.S

Centre for dental research and studies for 2 week duration. The experimental protocol was reviewed and approved by the ethical committee of the college. All patients were informed about the procedure and gave the signed written consent before participation in the study (**Figure 1**).

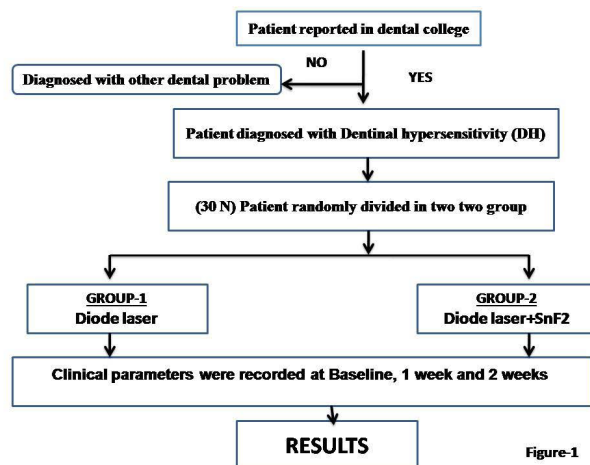


Figure 1. Flow chart indicating the methodology implemented in the present clinical study.

PATIENT SELECTION

30 systemically healthy patients were recruited among patients previously untreated for Dental Hypersensitivity. The patients were between age group of 18-45 years and with at least 2 hypersensitive teeth which were assessed using Visual Analogue Scale (VAS) in response to air-blast stimulus which were included in the study. Subjects on current desensitizing therapy, pregnancy, lactation period, allergy to the medication used in study, systemic conditions causing or predisposing to DH, excessive dietary or environmental exposure to acids, teeth or defects were excluded from the study. The present study was performed in October 2015.

Patients were equally divided into two groups randomly by flip of coin: Group A-0.4% stannous fluoride, Group B- 0.4% stannous fluoride+ diode laser. Prior to the therapy, all patients received thorough supragingival and subgingival scaling, and root planing. Oral hygiene instructions were given to the patients and were asked to perform tooth brushing twice daily using modified bass technique. Following clinical parameters were assessed at baseline, 1 week and 2 weeks. Plaque Index^[8], Gingival Index^[9], (The subjects will place a mark on a 10 cm long line on the VAS that is labelled from “no pain” (0) to “intolerable pain”^[10]).

EVALUATION OF DENTIN HYPERSENSITIVITY

Enrolled patients were evaluated using the three test stimuli. The test site was isolated using cotton rolls and the respective stimulus was applied. The following tests were used:^[11]

Tactile test: Sharp dental explorer (17/23) was used for this test; mechanical stimulation was done on the cervical area, perpendicular to the long axis of the affected tooth.

Air blast test: Dental syringe was used to blast of air at 60 lb/inch 12 pressure was applied onto the affected area of the, for one second from a distance of 10 mm. The score was recorded using the discomfort scale.

Cold water test: Ice-Cold water was used, which was filled in 5 ml disposable syringe, before application, the affected area was isolated with cotton pellet. Time interval between two measures on a given tooth was 10 minutes. VAS Score was used to access the degree of discomfort. At the end of the baseline, 1 week and 2 weeks. VAS scores were collected by the single examiner as the subjects recorded their responses to tactile, air blast and cold water stimulus.

TREATMENT PROCEDURES

Group A:- 0.4% Stannous flouride

Selected teeth were isolated with cotton rolls, and then 0.4% Stannous fluoride (Gel -Kam) was applied with a cotton pellet and painted onto the affected area for 10-20 seconds. After application of the gel to the affected site patients were advised not to rinse for 15 minutes. The teeth were evaluated immediately after treatment, at 1 week interval and at 2 weeks, using the three stimuli test mentioned above.

The treatment was considered as a failure, when the recurrence of VAS score was 2 or higher, was noted for any two of the three test stimuli (**Figure 2**).



Figure 2. Clinical picture showing the application of stannous fluoride (Control Group).

Group B: 0.4% Stannous fluoride+ Diode Laser

For each patient, the sensitive sites were isolated with cotton rolls and 0.4% Stannous fluoride (Gel- Kam) was applied, after the application diode laser (Photon plus®, Zolar co.) having a wavelength of 980 nm in non-contact pulse mode with a power of 0.5 W was used. Each site received three applications of 1 minute each (**Figure 3**).



Figure 3. Clinical picture showing application of stannous fluoride and laser (Test Group).

Recall

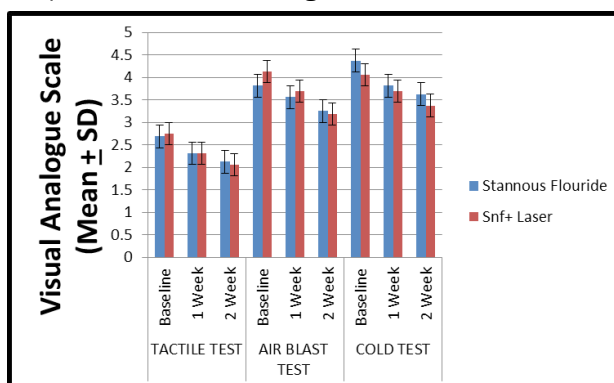
Patients were recalled after 1 and 2 weeks. At each of these visits, the clinical parameters were recorded. At the same time, oral hygiene instructions were reminded at each of the visits. However, no further scaling and root planing were performed at recall visits until the end of evaluation phase. The subjective signs like allergic reaction, burning sensation, ulceration, and taste, along with objective signs like redness of mucosa and staining of teeth were also checked. In case of any significant signs, the subjects were then asked to discontinue the respective desensitizing dentifrices.

STATISTICAL ANALYSIS

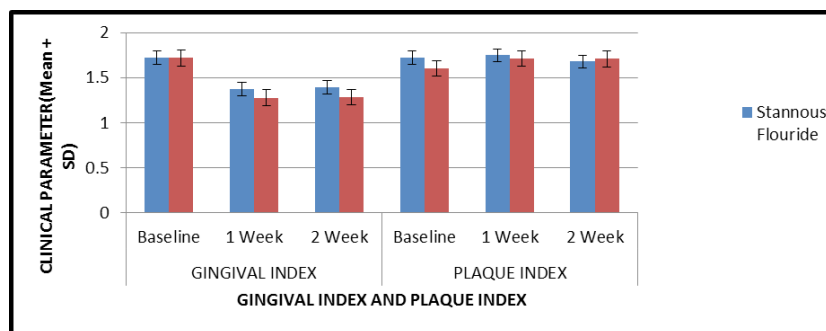
A patient level statistical analysis was performed for each parameter, and then recorded data was used to calculate means and standard deviation by using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 16.0 for windows). One way ANOVA and post hoc test were used to analyze differences in the various treatment groups at various respective intervals. The level of significance was set at $P < 0.05$.

RESULTS

Significant effects of the treatment with stannous fluoride plus diode laser group were seen (Graph-1), which were statistically better at reducing the sensitivity than stannous fluoride after 2 weeks. **Table 1** depicts that when stannous fluoride, stannous fluoride+ laser, were compared for air stimulation, cold test and tactile test, at baseline and 2 weeks, there was a reduction in DH after 2nd weeks for all the two groups, Though stannous fluoride+ diode laser showed significant reduction in DH for all the two groups at 2 weeks for air stimulation, cold test and tactile test (P value=0.025, $P=0.018$, $P=0.07$ respectively). When gingival index was compared for stannous fluoride and Snf + laser, the latter showed statistically significant improvement ($P=0.02$) in regard to the Gingival Index, though Plaque Index showed no significant differences for both the groups (Graph-2).



Graph 1. Variation in VAS with time for different groups incorporated in the study. The results are summarized for a) tactile test b) air blast test and c) cold water test.



Graph 2. Variation in Gingival and Plaque index with time in different groups incorporated in the study.

Table 1. Distribution of Mean ± SD of various clinical parameters.

	Group	Baseline		1 Week		2 Week		ANOVA	p – Value
		Mean	SD	Mean	SD	Mean	SD		
Tactile Test	SnF	2.688	0.5939	2.313	0.4581	2.125	0.4432	2.594	0.098
	SnF + Laser	2.750	0.4629	2.313	0.4581	2.063	0.1768	6.382	0.007*
Air Blast Test	SnF	3.813	0.5939	3.563	0.6232	3.250	0.5976	1.736	0.201
	SnF + Laser	4.125	0.5825	3.688	0.5939	3.188	0.7039	4.447	0.025*
Cold Test	SnF	4.375	0.5825	3.813	0.5303	3.625	0.7906	2.935	0.075
	SnF + Laser	4.063	0.3204	3.688	0.5303	3.375	0.4432	4.900	0.018*
Gingival Index	SnF	1.722	0.2754	1.373	0.2333	1.391	0.2431	4.892	0.018*
	SnF + Laser	1.717	0.2195	1.276	0.2916	1.281	0.2086	8.710	0.002*
Plaque Index	SnF	1.723	0.1226	1.748	0.1096	1.680	0.0966	0.793	0.465
	SnF + Laser	1.6013	0.1475	1.710	0.0948	1.708	0.1609	1.651	0.216

†SD- Standard deviation, SnF- Stannous fluoride, *P≤0.005 significant differences in various groups.

DISCUSSION

Dentinal hypersensitivity (DH) is generally reported by the patient after experiencing a sharp pain caused by one of several different stimuli. The pain response varies substantially from one person to the other. The condition generally involves the facial surfaces of teeth near the cervical aspect and is very common in premolars and canines. The most widely accepted theory of how the pain occurs is Brannstrom’s hydrodynamic theory, fluid movement within the dentinal tubules. The dental professional, using a variety of diagnostic techniques, will discern the condition from other conditions that may cause sensitive teeth. Treatment of this condition can be invasive or non-invasive in nature. The most inexpensive and efficacious first line of treatment for most patients is a dentifrice containing a desensitizing active ingredient such as potassium nitrate and/or stannous fluoride. In addition, the home care recommendations will focus on desensitizing dentifrices.

Stannous fluoride (SnF₂) has been shown to be effective in the prevention of dental caries [12,13] reduction of plaque formation, [14] control of gingivitis [15,16] and as suppression of breath malodor [17]. Research shows stannous fluoride is effective against dentinal hypersensitivity as well [18-20]. The ADA has recognized the desensitizing properties of stannous fluoride gel by granting the ADA Seal of Acceptance to a non-aqueous stannous fluoride gel formulation (Gel- Kam) for the therapeutic prevention of sensitivity and caries [21]. In situ research shows root dentin treated with stannous fluoride exhibits tubule occlusion [22]

Several other studies using analysis by scanning electron microscopy showed that partial or complete occlusion of dentin tubules occurred after treatment with SnF₂ [23,24]. In addition Miller et al. [14] reported a tin-rich surface deposit forms *in vitro* and *in situ* with two weeks use of an anhydrous 0.4% stannous fluoride gel, providing nearly complete surface coverage and occlusion of the tubules. When the tubules are blocked, the stimulation of the mechanoreceptors does not occur, thus, preventing the pain response.

Results of our study were similar to findings by Miller et al. in 1969, who reported less hypersensitivity postoperative in stannous fluoride group as compared to placebo gel [1]. It has been effectively demonstrated that aqueous solutions of stannous fluoride in low concentration can, when properly applied in a home-care program, control this problem. One difficult area has been the chemical changes that occur when stannous fluoride is placed in aqueous solution. Hydrolysis and oxidation of the active ingredient occur with a consequent reduction in effectiveness [25].

More recent research, Thrash et al. [26,27] supported the theory that the time required for a decrease in sensitivity is between two and four weeks from initiation of treatment. Thrash et al. compared a 0.4% stannous fluoride gel to an aqueous 0.717% fluoride solution and a placebo at 2, 4, 8, and 16 week intervals following a twice daily application. The results indicated subjects who applied the 0.4% SNF₂ reported significantly less sensitivity during the four to eight week period. The effect continued throughout the 16 week assessment period. Another demonstration of stannous fluorides effect on sensitivity has been seen with the use of fluoride cavity washes.

The effectiveness of the sole diode laser, was investigated by several research groups. Matsumoto et al. [28] showed an 85% improvement in reducing sensitivity of teeth treated with laser; Aun et al. [29] reported success in laser-irradiated teeth in 98% of their cases; Yamaguchi et al. [30] noticed an effective improvement index of 60% in the group treated with laser compared to the 22.2% of the control non lased group; Kumazaki et al. [31] showed an improvement of 69.2% in the group treated with laser compared to 20% in the placebo group. Gerschman et al. [32] in a double-blind study, found significant values in the laser-treated group. In fact, sensitivity to thermal stimuli was reduced by 67%, whereas the placebo group had a reduction of 17%, sensitivity to tactile stimuli was reduced by 65%, while the placebo group showed a reduction of 21%. Another study carried out by Brugnera et al. [33] showed the immediate analgesic effect using a diode laser.

In a study done by Peterzen et al. [34] tested the theory in a clinical trial, and results indicated the treated tooth was less sensitive at most of the post-operative examinations as determined by patient report and thermal testing, therefore, recommending the use of SnF2 as a cavity wash.

CONCLUSION

The methods used in the present study were safe and satisfactory for the well-being of all the patients. Within the scope of this study, it is safe to conclude that the hypersensitivity treatment modality using 0.4% stannous fluoride plus diode laser proved to be most effective in terms of pain perception as compared to 0.4% stannous fluoride alone method. However, long term follow-ups and variability within the population are warranted for better authentication of the results.

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