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Comparative Evaluation of Sodium Fluoride Varnish, Iontophoresis & Co2 Laser In The Treatment of Dentinal Hypersensitivity: An Original Research

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ABSTRACT

Background: Dentine hypersensitivity (DH) is characterized by pain after stimuli that usually provoke no symptoms. This study compares the effect of desensitizing agent, iontophoresis & diode laser in the treatment of dentinal hypersensitivity for 3 months.

Materials & method: Total 255 teeth with DH were assessed by air, thermal and tactile stimuli measured with Verbal Rating Scale (VRS). Teeth were randomly assigned and equally divided (85 teeth each group) into 3 groups, Group I treated by CO2 Laser, Group II treated by 2% NaF with iontophoresis and Group III treated by 2% NaF varnish. Sensitivity was assessed at baseline, 30 minutes, 24 hours, 1 week, 1 muonth and 3 months interval. Statistical analysis was done using one-way ANOVA test.

Result: There was statistically significant reduction in DH with all 3 groups, but better results were yielded with 2% NaF with iontophoresis. (p value<0.05)

Conclusion: CO2 laser shows efficient reduction in Dentin Hypersensitivity in compare with iontophoresis and varnish.

Keywords: Dentin hypersensitivity, Desensitizing agent, Varnish.

INTRODUCTION

Dentinal hypersensitivity (DH) is defined as 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 disease.[1]Its prevalence ranges from 8% to 74% among adult population.[2]It develops through incorrect tooth brushing, gingival recession, parafunctional habits and other factors.In spite of extensive research over past century and availability of diverse treatment modalities, there is no permanent resolution of DH. Therefore, the present study is projected to compare the effect of three different treatment modalities with same concentration of desensitizing agent i.e 2% sodium fluoride in form of varnish alone, with iontophoresis and co2 laser in the treatment of dentinal hypersensitivity at different time interval.

MATERIAL AND METHOD

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All samples were selected after fulfilling the inclusion & exclusion criteria. Verbal and written informed consent was obtained from all subjects.Inclusion criteria:1)Patient having history of tooth hypersensitivity from thermal, tactile or air stimuli. 2)Cervical abrasion, not involving pulp. 3)Miller's class I, II, III recession.4)Hypersensitive area on facial surfaces of the teeth.5)Good physical health.6)A willingness to participate in the study for 3 months.

Exclusion criteria: 1)Patients who had undergone previous professional desensitizing treatment or had used over-the-counter desensitizing products. 2)Those with chronic use of anti-inflammatory, analgesic, or psychotropic drugs.3)Pregnant and breast feeding females.4)Patients presenting allergies and idiosyncratic responses to product's ingredients- 2% sodium fluoride.5)Systemicconditions that are etiologic factors or predisposing for DH, excessive dietary or environmental exposure to acids.6)Patients who underwent periodontal surgery or orthodontic treatment in the preceding 3 months.7)Teeth or periodontium with pathology or defects, likely to cause pain.8)Teeth that were carious or fractured.9)Teeth that served as abutment for fixed or removable prostheses.10)Teeth that were crowned or had extensive restorations.

Total sample size selected for the study was 255 teeth, equally divided in 3 groups. Group selection was randomly assigned by coin flip method (with 95% confidence interval and 80% power & 10% non-response error).

Group I- 85 teeth treated with Co2 laser.

Group II- 85 teeth treated with 2% neutral sodium fluoride gel with iontophoresis.

Group III- 85 teeth treated with 2% sodium fluoride varnish.

All patient underwent scaling and root planing with oral hygiene instructions. Cervical abrasion and recession were recorded using Smith and knight tooth wear index and miller's classification for recession.Clinical parameters were recorded as follows: [3]Air blast test- The selected tooth was isolated, dried and a jet of air was ejected from 3-way syringe at a distance of 1 cm for 1 second.Tactile test- A sharp dental explorer was lightly passed perpendicular to the affected area of the tooth. Cold water test- A precooled 1 cc disposable syringe was filled with freshly melted ice-cold water. Tooth was isolated and 0.2 ml of the water was slowly expelled from the syringe.Patient responses was be recorded according to the Verbal Rating Scale (VRS)scale.[4]

PROCEDURE

Group I- Tooth surfaces were isolated&1080 nm with output power of 0.5 watt was applied in non-contact mode for 1min at the distance of 1mm approximately. Laser was slowly scanned over the cervical surfaces of teeth in vertical and horizontal manner keeping the intraoral tip perpendicular to the dentin surface. (Figure 1)

Group II- The tray mounted on the active electrode was dampened with the 2% sodium fluoride gel on the saline soaked sponge to be used with iontophoresis and applied to the affected area of the tooth. The positive electrode was firmly held between the fingers of the patient's left hand. The currentwas set at 2.5 mA and applied for 2 minutes. If any painful sensation was felt, the current was reduced to 2mA. Improper isolation may lead to failure of iontophoresis. (Figure 2)

Group III- 2% sodium fluoride was applied using a cotton applicator and left for 30 seconds. The surface was carefully dried with a stream of air until the fluid film disappears and the surface is no longer shiny. (Figure 3)

The teeth were evaluated at baseline, immediately 30 minutes after treatment, 24 hours, 1 week, 1 and 3 months using the three stimuli tests. The treatment was repeated if the VRS score was 2 or more, in more than or equal to 2 stimuli. The affected teeth were retreated for 3 sessions only at baseline, 24 hours and 1 week.

STATISTICAL ANALYSIS

Data of VRS among 255 teeth was collected andanalysed using SPSS software. Descriptive statistics like mean, standard deviation and 95% confidence interval were obtained to summarize the data. One way ANOVA test was carried out for comparison of mean values between groups. Results and significance values were fixed at 5% level.

RESULTS

A total of 255 teeth in 16 patients (11 males, 5 females) affected with DH having cervical abrasion and recession were included in the study. The maximum teeth treated in a patient were 25 and minimum 8 with a mean of 15.94±5.7.Out of 255 teeth, 175 had cervical abrasion, and 80 had gingival recession. There was a dropout of 1 patient with 13 teeth at 1 month follow up period.

On comparing the effectiveness of all 3 groups on hypersensitive teeth having recession, there was no statistically significant difference found. However, in teeth having cervical abrasion statistically significant difference was found at 30 minutes, 1 week, 1 month and 3 months indicating higher reduction in mean discomfort score with group II followed by group I and group III. (Table 1)

Table 1: Comparison of all 3 groups (mean discomfort score with p-value) betweenteeth having cervical abrasion and recession.

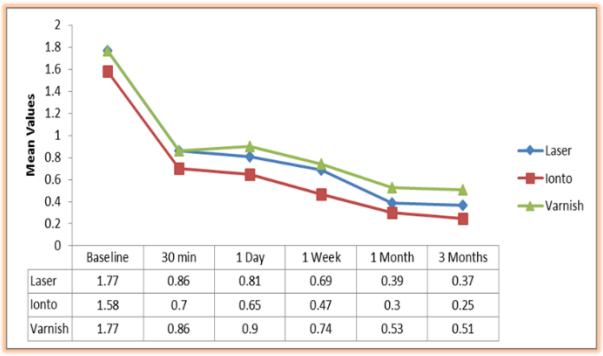
CA	Baseline	30 min	1 day	1 week	1 month	3 months
Group I	1.87	1.19	1.07	0.94	0.65	0.58
Group II	1.82	0.74	0.76	0.53	0.38	0.33
Group III	1.84	0.94	1.05	0.98	0.77	0.75
p-value	0.503	0.018	0.070	0.003	0.018	0.004
Recession	Baseline	30 min	1 day	1 week	1 month	3 months
Group I	1.63	0.58	0.63	0.51	0.25	0.21
Group II	1.56	0.66	0.53	0.41	0.22	0.18
Group III	1.67	0.78	0.79	0.55	0.4	0.31
p-value	0.201	0.477	0.249	0.589	0.218	0.305

When intergroup mean discomfort score was compared among all teeth, group II had a lower mean score than group I and group III. This result was statistically and clinically significant. (Table 2, Graph 1)

Table 2: Comparison of effectiveness of different treatment modalities at different time intervals in hypersensitive teeth.

Groups	Baseline		30 Min		1 Day		1 Week		1 Month		3 Month	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group I	1.77	0.44	0.86	0.58	0.81	0.55	0.69	0.59	0.39	0.45	0.37	0.43
Group II	1.58	0.55	0.70	0.64	0.65	0.59	0.47	0.54	0.30	0.39	0.25	0.33
Group III	1.77	0.53	0.86	0.62	0.90	0.63	0.74	0.56	0.53	0.55	0.51	0.46
p-value	0.162		0.405		0.152		0.079		0.091		0.027	

Graph 1: Intergroup comparison of 3 groups at different time intervals in hypersensitive teeth.



On comparing group I with group II, no significant difference was found. (Table 3). On comparing group II with group III, it was found that till 24 hours there was no significant difference. But, after 1 week, there was statistically significant difference found in both the groups with higher reduction with group II till 3 months. This indicates the long term effectiveness of 2% NaF with iontophoresis.(Table 4) On comparing group I with group III, there was no statistically significant difference found. But, clinically there was better effects with group I as compared to group III. (Table 5)

Table 3: Comparison of mean discomfort level between group I and group II in hypersensitive teeth.

Groups	Baseline		30 Min		1 Day		1 Week		1 Month		3 Month	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group I	1.77	0.44	0.86	0.58	0.81	0.55	0.69	0.59	0.39	0.45	0.37	0.43
Group II	1.58	0.55	0.70	0.64	0.65	0.59	0.47	0.54	0.30	0.39	0.25	0.33
p-value	0.095		0.266		0.214		0.099		0.339		0.182	

Table 4: Comparison of mean discomfort level between group II and group III in hypersensitive teeth

Groups	Baseline		30 Min		1 Day		1 Week		1 Month		3 Month	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group II	1.58	0.55	0.70	0.64	0.65	0.59	0.47	0.54	0.30	0.39	0.25	0.33
Group III	1.77	0.53	0.86	0.62	0.90	0.63	0.74	0.56	0.53	0.55	0.51	0.46
p-value	0.133		0.256		0.067		0.032		0.032		0.006	

Table 5: Comparison of mean discomfort level between group I and group III in hypersensitive teeth

Groups	Baseline		30 Min		1 Day		1 Week		1 Month		3 Month	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group I	1.77	0.44	0.86	0.58	0.81	0.55	0.69	0.59	0.39	0.45	0.37	0.43
Group III	1.77	0.53	0.86	0.62	0.90	0.63	0.74	0.56	0.53	0.55	0.51	0.46
p-value	0.952		0.958		0.509		0.676		0.257		0.218	

In case of failure at the 2-week interval, the affected tooth was retreated with the same solution as before and evaluated again. The group showing maximum mean value in repeat dose is group III with 3.19±1.33 followed by group I with 2.94±0.99 and minimum repeat dose with group II, 2.44±2.96. But, these values were statistically non-significant. (Table 6)

Table 6: Comparison of mean discomfort score between teeth that did or did not require a repeat dose (mean ± SD).

Group	Repeat Dose	No Repeat Dose	p-value
Group I	2.94±0.99	2.38±2.45	0.405
Group II	2.44±2.96	3.06±2.46	0.522
Group III	3.19±1.33	2.00±2.40	0.096

DISCUSSION

VRS was used as subjective assessment of hypersensitivity, as it was more simple, valid, reliable and appropriate for pain assessment.[5]Teeth were exposed to tactile, air blast, and cold water stimulation, as it has been a common methodology used in other studies.[3,6,7]According toClark and Troullos,[8]the tactile test, the least disturbing stimulus, was used first, followed by air blast and then cold water, with a 5-minute gap between these test stimuli.

Sodium fluoride gel was used as a topical desensitising agent in the present study as it is readily absorbed by dental hard tissues[9] and fluorine thus gets adsorbed on the walls of dentinal tubules as well as on the surface of calcium, forming an insoluble compound (CaF). This forms a new physical barrier on the dentin tubule surface, narrows its diameter and reduces its permeability. In our study, 2% Sodium fluoride concentration is used as it formssecondary dentin more effectively compared with other concentrations studied.[10]We obtained significant reduction in hypersensitivity with 2% NaF varnish from baseline to 3 months, with mean value reduction 1.77 to 0.51 ($p<0.05$). Our results were in accordance with Minkow et al[11] and Lutin et al.[12]Contrasting to our result, Kern et al,[13]found no significant difference at post treatment evaluation of 2% sodium fluoride solution at 3 and 6 months. The possible reason could be that re-application was not done in this study.

Iontophoresis with topical desensitising agent is a conventional method widely used for treating DH. One mechanism described by Lefkowitz et al[14]involves the formation of reparative dentin which inhibits the passage of stimuli from exposed dentin to the pulp. Another possible explanation is that the electrical current produces paresthesia by altering the sensory mechanism of pain conduction.[15] A third, alternative is that the concentration of fluoride ions could cause microprecipitation of CaF that may act to block hydrodynamically mediated pain inducing stimuli.[14]

This treatment modality was highly significant in reduction of VRS for dentinal hypersensitivity ($p<0.05$) at all follow up periods with minimum repeat dosage required. These results were in accordance with other studies.[3,11,16]Contrasting to our result, Kern et al[13] found recurrence in sensitivity at 3 and 6 months because single application was used is his study.

In this study CO2 laser with output power of 0.5 W was applied in a contact mode for for 10 sec in continuous mode was able to seal the dentin tubules.[17,18]The efficiency of CO2 laser on dentinal hypersensitivity showed significant reduction in VRS score from baseline to 3 months (1.77 to 0.37) with p value<0.05. These findings are in agreement with other studies.[19,20]A synergistic relation exist between laser and topical fluoride as the laser energy causes greater adhesion of NaF gel, deeper penetration of fluoride ions into the dentinal tubules facilitating the precipitation of CaF. It also induces occlusion for superficial melting of protein denaturation into dentin fluid, maintaining the occlusion of tubules for longer time, lessening the discomfort from cervical dentinal hypersensitivity.[21]

In our study, there has been reduction of sensitivity in all 3 groups due to the use of 2% NaF, but amongst these groups better results were observed in 2% NaF with iontophoresis. This is explained by in-vitro analysis of *Manglekar et al,*[16]where SEM photomicrographof the dentin samples showed a drastic reduction in the number of open dentinal tubules.Diode laser of 810nm is middle output laser causing nerve analgesia and partial occlusion of dentinal tubules,[12]which reduced dentinal hypersensitivity but required multiple dosage, while iontophoresis was mostly effective in single application. Also, diode laser was technique sensitive as more exposure of laser could result in hyperemia of pulp causing more pain. There was no statistically significant difference between 2% NaF with diode laser and 2% NaF varnish. But, clinically 2% NaF with diode laser was observed to be better as it required lesser repeat dosage.

The case selection for our study included cervical hypersensitive teeth with cervical abrasion and recession. At the baseline, there was no statistically significant difference indicating same level of sensitivity in both the variables. But, with the treatment modalities, teeth having recession showed same level of improvement with all 3 groups. While, in teeth having cervical abrasion 2% NaF with iontophoresis was more effective than other two. Also, clinically it was noted that teeth

having cervical abrasion required maximum repeat dosage as compared to recession. This difference was found because of morphology of lesion, SEM analysis of teeth having cervical abrasion showed greater depth and width of the lesion as compared to recession. In cervical abrasion, enamel was thin or absent and dentin showed wider tubule diameter and microfractures.[22]Also, root dentin has lesser dentinal tubules as compared to crown. Therefore, better results were obtained with recession as compared to cervical abrasion.

The limitation of this study is the lack of in-vitro analysis of 2% NaF with iontophoresis and diode laser to come to concrete analysis of efficiency of iontophoresis over co2 laser in causing occlusion of dentinal tubules. The possibility of bias may have been inevitable when the method and interpretation of pain assessment to various stimuli and variability in patient's response was elicited. Thus, in such studies the result of hawthrone effect where patients are aware of being observed, could not be avoided. A larger sample size could have been beneficial in minimizing the above shortcomings.

CONCLUSION

Dental hypersensitivity can be managed by wide variety of procedure, agents and formulations. The synergistic effect of desensitising agent along with laser or iontophoresis is more effective than the use of desensiting agent alone. There was no statistical difference between 2% NaF with iontophoresis and laser. But iontophoresis is shown to be better clinically as it requires minimum repeat dose and is usually effective in single dose. Iontophoresis is cost effective, reliable, easy to use treatment modality.810nm diode laser is also clinically and statistically effective method in reducing dentinal sensitivity and can be a reliable option due to its multi-purpose usage.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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