



Comparative evaluation of Diode Laser, NaF Iontophoresis and Arginine Containing Toothpaste in the Management of Dentin Hypersensitivity- A Clinical study

Dr.Parvathy D Kumar,Dr.Rejula F,Dr.Mali G Nair

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ABSTRACT

Aim : To compare the effect of Diode Laser, NaF Iontophoresis and Arginine containing Toothpaste in the management of Dentin Hypersensitivity.

Material and method : 60 patients were selected for this study. The patients were randomly allotted into three groups. Group 1: 20 patients assigned to use dentifrice containing arginine. Group 2: 20 patients assigned for NaF iontophoresis treatment. Group 3: 20 patients assigned for diode laser treatment. Two stimulus tests- tactile test and air blast test was performed at 5-minute interval on the tooth to be tested. Subjects scoring greater than 2 on VAS were subjected to therapy. VAS score was recorded before treatment, immediately after treatment, again at 1st week, 1st month, 3rd month and 6th month

Results : All the treatment groups showed statistically significant reduction in VAS score across the different time period tested. Diode laser shows higher percentage of reduction in sensitivity compared to other groups. Anterior have higher chances of getting sensitivity cured. It was found that there was a statistically significant association between tooth group and treatment success.

Conclusion : All the treatment groups are effective in the treatment of DH. Diode laser showed higher percentage of reduction in sensitivity. Long term studies with larger sample size are warranted for more conclusive results.

KEY WORDS: Dentin hypersensitivity, arginine, diode laser, iontophoresis

I. INTRODUCTION

Dentin hypersensitivity (DH) is a commonly occurring clinical condition. It has been defined as short, sharp pain arising from exposed dentin as a result of various stimuli, such as heat, cold, chemical or osmotic, which cannot be ascribed to any other form of dental defect or pathology (Holland et al 1997). Its prevalence ranges from 2.8% to 74% (1).

Higher incidence of DH is reported in females than in males. While DH can affect the patient of any age, most affected patients are in the age group of 20–50 years, with a peak between 30

and 40 years of age (2). Canines and premolars of both the arches are the most affected teeth. Buccal aspect of cervical area is the commonly affected site (3).

DH is a symptom complex, rather than disease, and a persisting problem, which without proper management can have a significant impact on sufferer's quality of life (4). DH hence needs to be addressed in order to provide patients with better oral comfort and quality of life. A large number of treatment options exist for managing DH.

Pro-Argin technology, combination of arginine, bicarbonate, a pH buffer and calcium carbonate, is a relatively novel breakthrough. It was introduced by Kleinberg in 2002 and first used in commercial products in 2009(5). Dentifrices containing arginine can provide a significant reduction in DH (6).

Iontophoresis is the technique in which desensitizing agents can be transferred under electric pressure into the tooth structure to manage hypersensitivity (7). The method of Iontophoresis was described by Pivati in 1747. It is a safe and effective treatment option to treat dentinal hypersensitivity (8).

A new treatment modality for DH was developed with the advent of laser technology that is increasingly used in dentistry (9). Low-level laser therapy (LLLT) can occlude dentinal tubules by increasing the cellular metabolic activity of odontoblasts that promote tertiary dentine production (10). GaAlAs diode laser application could be suitable for routine clinical treatment of DH because of the rapid and long-term clinical effectiveness without adverse reactions. Laser desensitization has shown to be efficient alternative for the immediate treatment of hypersensitivity.

Presently there is no standard protocol exists for treatment of DH. Treatment methods that provide instant and sustained relief from DH and economically viable is required. So, this study was carried out with the objective to identify the more effective treatment among diode laser, iontophoresis and topical application of 8% arginine in the management of DH.



II. MATERIALS AND METHODS

The study setting was the Department of Conservative Dentistry and Endodontics, Govt. Dental College, Thiruvananthapuram. The Institutional Ethics Committee approved the conduct of the research project. The reference population was patients suffering from DH, reporting to outpatient section of the Dept. of Conservative Dentistry & Endodontics constituted the source population. The study population was selected from the source population, who satisfied the inclusion criteria and were willing to provide informed consent.

INCLUSION CRITERIA

1. Patients between 20-45 years of age
2. Patients with minimum of two hypersensitive teeth.
3. Defects <1mm loss of dentin in depth which did not require restorative treatment.
4. Preoperative VAS score ≥ 2
5. Willing to give informed consent

EXCLUSION CRITERIA

1. Teeth with caries, defective restorations, occlusal restorations, chipped teeth.
2. Deep periodontal pockets, periodontal surgery within 3 months, and subjects with orthodontic appliance or bridge work.
3. Use of desensitizing paste in the last 3 month.
4. Any gross oral pathology.
5. Subject on analgesics
6. Uncontrolled systemic disease.
7. Persons with mental health issues.
8. Pregnant or lactating females.
9. People with pacemaker
10. Patients undergone bleaching

Patients getting these interventions from the hospital are selected based on inclusion and exclusion criteria. They are enrolled into 3 groups consecutively till the desired sample size is attained. The tooth to be tested was isolated using cotton rolls. To identify a tooth with DH, two stimulus tests were performed with an interval of 5 minutes between the tests.

1. Tactile test: An explorer was gently run across the affected tooth surface
2. Air blast test: A blast of air from a three-way dental syringe for one second

The subjects were asked to score the elicited pain based on the VAS and those indicating a score greater than 2 were included in the trial.

60 patients were selected for this study. The patients were randomly allotted into three groups.

Group 1: 20 patients assigned to use dentifrice containing arginine

Group 2: 20 patients assigned for NaF iontophoresis

Group 3: 20 patients assigned for diode laser treatment

The selected tooth was dried and isolated using cotton rolls. VAS score was recorded before the procedure.

In group 1, 1cm of toothpaste was then expressed on the tooth surface for two minutes and rinsed off. Patients were provided with toothpaste to be used at home regularly for 6 months. They were asked to use the toothpastes for a period of 6 month and no other tooth paste was to be used during this period. They were given proper oral hygiene instructions including tooth brushing techniques and instructed to brush twice daily, using the specified amount of paste.

In group 2, NaF gel was applied. Iontophoresis unit was switched on and circuit was completed. Current is applied for 2 minutes or till the patients feels tingling sensation.

In group 3, Diode laser was irradiated in noncontact, continuous mode. 3 applications of 1 min each was done. While working with the laser, both the therapist and the patient wore protective goggles, and work space was appropriately designated and marked.

VAS score was recorded immediately after treatment to assess the relief from DH. Also again at 1st week, 1st month, 3rd month and 6th month.

III. STATISTICAL ANALYSIS

One way ANOVA was done to found out the difference in VAS score across different time periods. Post Hoc test was done to assess the mean change in VAS score across the treatment groups. Chi square test was done for assessing the association of various factors with treatment success. Multiple logistic regression was done for odds for curing sensitivity.

IV. RESULTS

Out of 60 patients. 11 patients were lost to follow up. Recall rate was 81.6%. Patients were in the age group of 20-45 years. Descriptive statistics (mean and standard deviation) of the baseline variables were calculated. Minimum age was 22 years and maximum were 45 years. Mean age group was 35.37 (SD =6.760). The study group consisted of 21 males and 28 females. Tooth type in the study consist of 31% anteriors, 22% molars and 47% molars.



Mean VAS score before treatment was 4.08 ± 1.623 and after 6 month it was 1.38 ± 1.497 in tooth paste group. In iontophoresis group, VAS score before treatment was 3.49 ± 1.249 and after 6 months it was 0.62 ± 0.945 . In diode group, VAS score before treatment was 3.02 ± 1.325 and after 6 month it was 0.59 ± 1.002 . There was statistically significant difference in VAS score in 3 groups during different time intervals. Also, there was statistically significant difference in all tooth groups across different time periods.

There was no statistically significant difference between toothpaste and both

iontophoresis and diode group in mean change in VAS score. But there was statistically significant difference between iontophoresis and diode group. Anteriors - premolars shows statistically significant difference in mean change in VAS score. Molars compared with other groups does not show any statistically significant difference.

Tooth group had statistically significant effect on treatment success. Among tooth type anteriors has 0.260 chance for curing sensitivity than molars and diode have 2.790 chance for curing sensitivity than toothpaste group.

Comparison of mean VAS scores across the time points.							
	BEFORE (Mean \pm)	AFTER (Mean \pm)	1st WEEK (Mean \pm)	1st MONTH (Mean \pm)	3rd MONTH (Mean \pm)	6th MONTH (Mean \pm)	P value*
Toothpaste (N=40)	4.08 \pm 1.623	3.95 \pm 1.632	3.78 \pm 1.732	3.03 \pm 1.702	2.03 \pm 1.747	1.38 \pm 1.497	<0.0001
Iontophoresis (N=47)	3.49 \pm 1.249	3.13 \pm 1.312	2.23 \pm 1.108	1.04 \pm 1.318	0.64 \pm 0.942	0.62 \pm 0.945	<0.0001
Diode (N=46)	3.02 \pm 1.325	2.54 \pm 1.378	1.70 \pm 1.190	0.74 \pm 1.124	0.59 \pm 1.002	0.59 \pm 1.002	<0.0001

One way repeated measures ANOVA
*P value <0.05 is considered statistically significant

Post Hoc test for the mean change in VAS score across the treatment groups.			
Groups compared	Mean Difference	Std. Error	P value
Toothpaste - Iontophoresis	- 0 . 1 7 2	0 . 1 6 1	0 . 5 3 5
Toothpaste - Diode	0 . 2 6 5	0 . 1 6 2	0 . 2 3 4
Iontophoresis - Diode	0 . 4 3 8 *	0 . 1 5 5	0 . 0 1 5

T u k e y
*P value <0.05 is considered statistically significant



Post Hoc test for the mean change in VAS score across the tooth groups.

Groups compared	Mean Difference	Std. Error	P value
Anteriors - Premolars	- 0 . 4 8 3	0 . 1 4 9	
Anteriors - Molars	- 0 . 2 3 0	0 . 1 8 0	0 . 4 0 9
Premolars - Molars	0 . 2 5 2	0 . 1 6 6	0 . 2 8 7

T u k e y
 *P value <0.05 is considered statistically significant

Association of various factors with treatment success

		F i n a l s t a t u s		P v a l u e *
		Sensitivity not cured	Sensitivity cured	
Tooth type	Anteriors	8 (19.5 %)	3 3 (8 0 . 5 %)	0 . 0 0 6
	Premolars	3 1 (49.2 %)	3 2 (5 0 . 8 %)	
	M o l a r s	1 4 (48.3 %)	1 5 (5 1 . 7 %)	
Group	Toothpaste	2 2 (55.0 %)	1 8 (4 5 . 0 %)	0 . 0 5 5
	Iontophoresis	1 7 (36.2 %)	3 0 (6 3 . 8 %)	
	D i o d e	1 4 (30.4 %)	3 2 (6 9 . 6 %)	

C h i s q u a r e t e s t
 *P value <0.05 is considered statistically significant

Variable	B	P value	Crude odds ratio	Adjusted Odds Ratio	95% C.I.for odds ratio	
					Lower	Upper
Tooth group						
Molars(ref)						
Premolars	0 . 0 1 0	0 . 9 8 2	1 . 0 3 8	1 . 0 1 0	0.412	2.476



A n t e r i o r s	1 . 2 8 4	0 . 0 1 9 *	0 . 2 6 0	3 . 6 1 1	1.231	10.591
Treatment Group						
Toothpaste(ref)						
Ionotophoresis	0 . 6 7 2	0 . 1 3 9	2 . 1 5 7	1 . 9 5 8	0.804	4.772
D i o d e	0 . 8 6 1	0 . 0 6 6	2 . 7 9 4	2 . 3 6 6	0.944	5.927

V. DISCUSSION

DH is a commonly encountered clinical problem which has a multifactorial etiology (11). The incidence of DH ranges from 4% to 74% (12). In the present study, affected patients were in the age group of 20-45 years. 57% of patients are females and premolars are the commonly involved tooth.

Two different tests were used, tactile and air blast test using subjective visual analog scale were used to measure the dentin sensitivity in this study. Tactile test followed by air blast test was done based on study design by Holland et al (13).

In the present study, out of 60 patients, 49 completed the 6 month study. All the selected teeth were subjected to 2 different stimuli: tactile and airblast. Each of the test were performed at an interval of 5 min. Patient response was recorded on visual analog scale which is graded from 0 to 10. The teeth rated 2 or more for both the test were selected for the study. Severity of sensitivity was assessed before application, immediately after application, 1st week, 1st month, 3rd month and 6th month after application and VAS score was the criteria used for this study.

Conventional methods of treating DH include topical application of desensitizing agents, either professionally or at home (14). Use of newer treatment modalities for DH such as lasers has increased rapidly in the last 2 decades (15).

3 different methods of desensitization were used in this study. 8% arginine containing commercial toothpaste, 2% NaF iontophoresis and diode laser each having different mechanism of action and studies comparing these 3 methods are very less. There was a progressive decrease on VAS score from the preceding appointment at each of the time intervals tested in the three groups. This indicated that arginine containing tooth paste, 2% NaF iontophoresis and diode laser were effective in the reduction of DH.

Sensitivity was cured in 45% patients in toothpaste group, 63.8% patients in iontophoresis group and 69.6% in diode group. Diode has higher chances of curing sensitiv. Anteriors has higher

chances of reduction in sensitivity. Tooth group has significant effect on treatment success.

Most of the currently available tooth pastes plug the tubules providing only temporary benefit. With regular use, it can build a long and lasting protective barrier that can act as a seal against sensitivity. Arginine, an amino acid naturally present in saliva, works in conjunction with calcium carbonate and phosphate to create a plug in dentinal tubules that prevent fluid flow.

In the present study, there was gradual reduction in VAS score across different time periods. The immediate reduction in VAS score was less and there was no significant difference in reduction in sensitivity as compared to other groups.

The method of iontophoresis was described by Pivati in 1747. Iontophoresis uses a low amperage direct current to introduce ions or ionized drugs into tissues. This procedure allows concentrated application of the drug in a desired localized area. By applying the appropriately charged electric current, ionized drugs can be driven into tissues based on the principle that like charges repel and opposite charges attract. The exact mechanism of this desensitization is not yet clearly understood (8).

According to the present study, iontophoresis can be effectively used for DH. These results were in accordance with the previous studies done by **Modupeola et al in 2002** (16). In this study there was reduction in sensitivity at the end of 1 month. The findings of the present study were in accordance with the results reported by **Shendre et al** (17). **Kern et al** reported a significant reduction in sensitivity to both tactile and air stimulus immediately after application, which began to return baseline levels at 3 and 6 months. But in our study the reduction in sensitivity lasts for 6 months (18).

Concerning laser treatment, mechanisms involved are relatively unknown. The low power laser appears to decrease the neural response to hypersensitive stimuli. Laser treatment has immediate analgesic effect by depressing nerve transmission. According to physiological experiments, this immediate effect of GaAlAs laser



is caused by blocking the depolarization of C fiber afferents (19).

Diode laser is a soft tissue laser with wavelength ranging from 655 to 980 nm. Diode lasers at different wavelengths have been studied by various authors for desensitization (20). According to present study there is marked reduction in DH with diode laser.

According to the reports published by **Asnaashari et al and Aranha et al**, low power laser therapy for DH is an appropriate treatment strategy to promote bio modulatory effects, minimizes pain and inflammatory process (21,22). DH treatment by laser seems to be simple, quick and effective(23).

There is reduction in sensitivity after 1 month which is in accordance with the study done by **Corona et al**(24).

In their study, **Yilmaz et al.** compared the effectiveness of application of sodium fluoride and diode laser in the treatment of DH. They concluded that within their scope of study, GaAlAs laser therapy is effective in the treatment of DH, and is more comfortable and faster treatment than traditional treatments for DH. These results support the results of our study (25).

Based on the results of our study in which a diode laser was used, low power lasers can also provide better results in the treatment of DH, this finding is also supported by the results of research by **Umberto et al** (5).

Our study findings confirm the clinical effectiveness of arginine containing toothpastes, 2 % NaF iontophoresis and diode laser in reduction of DH. The results are in accordance with several studies using different assessment tools.

The main limitation is the short duration of follow-up and small sample size used. Underlying causative factors of DH must be eliminated to obtain long term success. Therefore, long term follow up studies with a larger sample size are needed. Further research is needed to assess long term effects of these therapeutic procedures on a large sample in order to provide recommendations for use in routine clinical practice.

Also, the subjective assessment of response obviously lacks standardized measurability. Better and precise diagnostic test and effective treatment options in the field of DH for which more scientific research is required.

VI. CONCLUSION

Within limitations of the present study, it can be concluded that all the treatment groups are effective in the treatment of DH. Diode laser

showed higher percentage of reduction in sensitivity. Long term studies with larger sample size are warranted for more conclusive results.

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