



COMPARATIVE EVALUATION OF EFFICACY OF LOW LEVEL LASER THERAPY USING DIODE LASER AND IONTOPHORESIS WITH 2% SODIUM FLUORIDE GEL IN THE TREATMENT OF PATIENTS WITH DENTINAL HYPERSENSITIVITY

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ARTICLE INFO

Article History:

Received 10th May, 2017

Received in revised form 5th

June, 2017 Accepted 16th July, 2017

Published online 28th August, 2017

Key words:

Visual analogue scale, iontophoresis, low level laser therapy, air blast method, cold water test and tactile examination

ABSTRACT

Background: Dentinal hypersensitivity is an exaggerated response to non noxious stimuli such as thermal, chemical, evaporative and tactile. Pain is characterized by short sharp pain from exposed dentinal tubules. There are various treatment modalities available such as conventional methods like iontophoresis, desensitizing agents in the form dentifrices, dental varnishes, bonding agents and nowadays concept of laser therapy is being popularized.

Materials and Methods: In the present study, 90 sites were divided into three groups as group 1 (Iontophoresis with NaF), group 2 (Low level laser therapy) and group 3 (control group- saline solution). Pain scores were measured by Visual analogue scale given by Plagmann *et al* in 1997 by air blast method, tactile examination and cold water test at baseline and at 14th day.

Results: After intragroup and intergroup analysis, it has been shown that iontophoresis and LLLT has shown reduction in VAS scores from baseline to 14th day postoperatively but at the same time iontophoresis has shown comparatively more reduction in VAS scores than LLLT group and control group.

Conclusion: Fluoride iontophoresis can be used as a first line treatment, before other therapeutic steps like resin primers and low level laser treatment are considered for the treatment of dentine hypersensitivity.

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INTRODUCTION

Among all the dental problems associated with pain, and of difficult solution, dentinal hypersensitivity is associated with neck of the tooth. The hypersensitivity is an exaggerated response to stimuli that would not cause any effect on a healthy tooth.^{1,2} It is characterized by a short, sharp pain arising from exposed dentine in response to stimuli typically evaporative, tactile, or chemical and that cannot be described as any other form of dental pathology.³ Treatment involves the use of traditional as well as newly advanced procedures. Dentinal hypersensitivity treatment involves use of adhesives, varnishes, bonding agents, restorative materials, iontophoresis, and lasers. Traditional methods of treating dentin hypersensitivity have been clinically evaluated and found to provide some relief to patients, but conventional method of treating dentinal hypersensitivity is not satisfactory.^{4,5} Hence, dental professionals continue to look for more-effective, faster-acting, and longer-lasting treatments, because in-office treatments and home-use

products do not always provide the required results. Desensitizing agents like potassium oxalate, potassium nitrate, and stannous fluoride occludes the dentinal tubules. Other treatment options have been evaluated and an in-office desensitizing paste containing arginine and calcium carbonate has been evaluated recently.⁵

Iontophoresis is a conventional method of treatment for dentinal hypersensitivity which gives long lasting relief from it. Method of Iontophoresis was first used by Pivatti in 1747. The process of influencing ionic motion by electrical current has been termed iontophoresis, electrophoresis or cataphoresis. Iontophoresis therapy is based on the simple principle that similar electromagnetic charges repel each other when sodium fluoride dissolves in solution, the fluoride molecule forms an anion with an extra electron thus becoming negatively charged.⁵ In iontophoresis, fluoride ions which are formed enter the dentinal tubules and occlude the dentinal tubules resulting in relief of pain. Topical fluoride on the other hand causes fluoride uptake from the surface only. Various gels can be used along with iontophoresis such as 2% NaF gel, APF gel and stannous fluoride gel. There are various studies on iontophoresis using topical fluoride gels

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which have already proved their efficacy in treating dentinal hypersensitivity.^{5,6}

Nowadays, use of laser therapy for relief of dentinal hypersensitivity has been popularized. There are different theories for explaining the effect of laser irradiation on dentin, but the most approved one states that sealing of dentinal tubules occurs by melting and re-crystallization of dentin. Apart from high-intensity lasers, low-level laser therapy (LLLT) has also been considered as an alternative treatment option, LLLT provides therapeutic effect for relief from dentinal hypersensitivity.^{7,8,9,10} Kimura *et al.* summarized the current knowledge regarding laser applications for the treatment of dentinal hypersensitivity. Several other studies evaluated the effectiveness of the clinical use of diode lasers, biolasers and LLLT for the treatment of dentin hypersensitivity and reported their use as effective in reducing initial dentinal hypersensitivity.^{11,12,13}

In the present study, effects of application of Iontophoresis using 2% NaF gel and LLLT using Diode laser for the treatment of dentinal hypersensitivity were compared and evaluated after 14 days.

MATERIALS AND METHODS

Patients from the Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental Collage and Hospital, Nagpur were selected under following inclusion criteria –

1. Patients with at least visual analogue scale score ranging from 3 to 7.
2. A history of tooth hypersensitivity.
3. Absence of caries.
4. No recent treatment of any type of desensitization.
5. Absence of systemic disease.
6. Desire to participate in the study for a period of 14 days.

Design of the study - A split mouth comparative study.

In each section the sensitivity degree of each sample was tested by following three methods

1. Air blast method
2. Tactile examination using explorer
3. Cold water test using ice cold water in a syringe

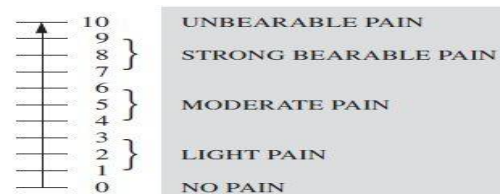
90 teeth sites were randomly selected and grouped into three groups

- Group 1: 30 teeth sites received LLLT therapy using Diode laser.
- Group 2: 30 teeth sites received iontophoresis using 2% NaF gel.
- Group 3: 30 teeth sites received placebo effect using saline solution.

In group 1, teeth sites received LLLT using diode laser approximately 1 cm away from the teeth sites selected for the treatment at 1wt. In group 2, iontophoresis unit switched on with the circuit being completed and progressively increasing current (maximum 2.5 mA) to the tooth until the patient experienced pain or sensitivity or tingling sensations. Once this threshold had reached; the spoon, the electrode in patients mouth and the manual electrode in patients hand were left for as long as the application (fluoride gel 2-3 minutes). Once the treatment was over, the knob was turned off and the spoon

with the electrode and the sponge was removed from the patients dental arch. In group 3, teeth sites were treated using saline solution carried in a syringe (placebo effect) and were considered as control sites.

Based on the subjective answer of the patient, scores from 0 to 10 were recorded, these values were registered with the help of Visual analogue Scale, suggested by Plagmann *et al.*, 1997.



All the teeth sites (total 90 sites) in group 1, group 2 and group 3 for the study were evaluated at baseline and at 14th day. After the application, teeth sites were recoded for visual analogue scale score ranging from 0 to 10 on a special proforma sheet.

RESULTS

Data collected on a special proforma sheet was statistically analyzed using appropriate tests and software. Intragroup comparison was carried out using T tests and intergroup comparison was carried out using one way ANOVA test.

Iontophoresis (Group I) showed significant reduction on dentin hyper sensitivity from baseline to 2 week post treatment on air blast method (p <0.05), tactile examination (p<0.05), Cold water test (P <0.05).

Table no. 1 Results of application of Iontophoresis (group 1) by air blast, tactile and cold water test (T0-VAS scores obtained at baseline); (T1- VAS scores obtained at 14th day/2 weeks).

	Group I					
	Air blast		Tactile		Cold water	
	T0	T1	T0	T1	T0	T1
Mean	4.37	2.9	4.27	4.47	2.23	
SD	0.98	0.22	1.27	0.94	0.16	

LLLT (Low level laser therapy group; group 2) showed significant reduction on dentin hyper sensitivity from baseline to 2 week post treatment on air blast (p <0.05), tactile (p<0.05), Cold water (P <0.05).

Table no. 2 Results of application of Low level laser therapy (Group 2) by air blast, tactile and cold water test (T0-VAS scores obtained at baseline); (T1- VAS scores obtained at 14th day/2 weeks)

	Group II					
	Air blast		Tactile		Cold water	
	T0	T1	T	T1	TO	T1
Mean	4.3	3.3	4.05	2.83	4.27	2.93
SD	0.95	0.18	1.05	0.18	1.2	0.22

Control group (group 3) showed no significant reduction on dentin hyper sensitivity from baseline to 2 week post treatment on air blast, tactile, Cold water test.

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Table no. 3 Results of application of saline solution as placebo (Group 3) by air blast, tactile and cold water test (T0-VAS scores obtained at baseline) ; (T1- VAS scores obtained at 14th day/2 weeks).

	Group III					
	Air blast		Tactile		Cold water	
	T0	T1	T0	T1	T0	T1
Mean	4.13	3.93	3.37	3.33	4.13	3.93
SD	1.07	0.17	1.02	0.184	1.07	0.17

Results obtained after intragroup comparison shows that there is marked reduction in iontophoresis group (group 1) by all three methods-tactile examination, air blast method and cold water test. LLLT (group2) also have shown reduction in VAS score at 14th day by all three methods. But at the same time, when we compared the results of Group 1, group 2 and group 3, it showed that group 1 has shown highest reduction in VAS scores at 124th day as compared to group 2 and group 3.

Table no. 4 Results obtained by tactile examination at 14th day

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD Inference
Group 1 vs Group 2	2.5210	0.1815091	Insignificant
Group 1 vs Group 3	5.0421	0.0017019	** p<0.01
Group 2 vs Group 3	2.5210	0.1815091	Insignificant

Intergroup comparison of all the three groups at 14th day using one way ANOVA test.

Tactile stimulation at 14th day:

Results obtained after intergroup comparison by tactile examination shows that there are no significant results obtained when reduction in visual analogue scale scores when group 1 vs group 2 and group 2 vs group 3 were compared. Significant P value (<0.01) was obtained when group 2 and group 3 were compared.

Cold water test at 14th day

Results obtained after intergroup comparison by cold water test shows that there are no significant results obtained when reduction in visual analogue scale scores when group 1 and group 2 were compared. Significant P value (<0.01) was obtained when group 2 vs group 3 and group 2 vs group 3 were compared.

Table no. 5 results ontained at 14th day by cold water test

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD Inference
Group 1 vs Group 2	2.0507	0.3205607	Insignificant
Group 1 vs Group 3	7.1775	0.0010053	** p<0.01
Group 2 vs Group 3	5.1268	0.0013993	** p<0.01

Air blast method at 14th day

Results obtained after intergroup comparison by Air blast method shows significant results when reduction in visual analogue scale scores compared in case of Group 1 vs Group 2 (P value - <0.05), Group 1 vs Group 3 (P value- < 0.01) and Group 2 vs Group 3 (P value-<0.01).

Table no. 6 Results obtained at 14th day using air blast method.

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inference
Group 1 vs Group 2	4.1309	0.0122305	* p<0.05
Group 1 vs Group 3	8.4414	0.0010053	** p<0.01
Group 2 vs Group 3	4.3105	0.0084862	** p<0.01

Results obtained after intergroup comparison by Air blast method shows significant results when reduction in visual analogue scale scores compared in case of Group 1 vs Group 2 (P value - <0.05), Group 1 vs Group 3 (P value- < 0.01) and Group 2 vs Group 3 (P value-<0.01).



Fig. no. 1 Air blast method for the evaluation of visual analogue scale scores



Fig. no. 2 Tactile examination for the evaluation of visual analogue scale scores

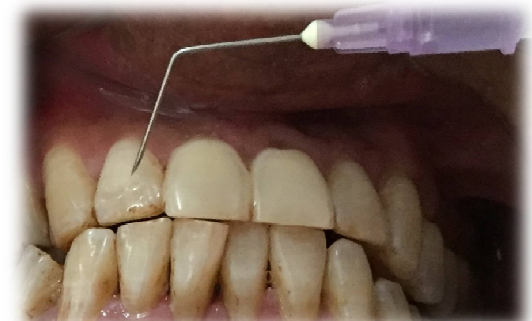


Fig. no. 3 cold water test for the evaluation of visual analogue scale scores



Fig. no 4 Iontophoresis unit switched on with electrodes



Fig. no. 5 fluoride application with 2 % NaF gel in a tray



Fig. no. 6 Fluoride application with iontophoresis (group 1)using NaF gel in a tray with electrode attached to metal ring of tray



Fig. no. 8, 9 Application of saline solution as a placebo gel (control group- Group 3)

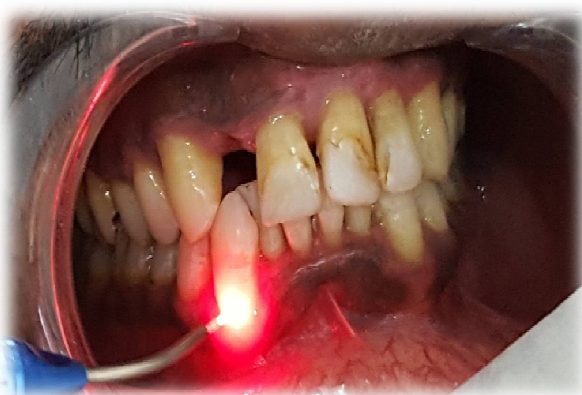


Fig. no. 7, 8 Application of low level laser therapy using diode laser (Group 2)

After the comparison of intergroup and intragroup analysis, it has shown that significant results were obtained only incase of air blast method when all three groups were compared. But at the same time, intragroup analysis shows comparatively

higher reduction in Visual analogue scale scores in case of Iontophoresis group (Group 1) as compared to LLLT(group 2) and control group (group 3).

DISCUSSION

Dental hypersensitivity can be described as an exaggerated response to non-noxious stimuli such as thermal, evaporative and chemical resulting from non carious cervical lesions such as abfraction, abrasion, attrition and erosion, periodontal treatment and root exposures resulting from gingival recession.^{1,2,3}

There are various theories proposed for the mechanism of dentin hypersensitivity such as direct nerve receptor theory, transduction theory, gate control theory and hydrodynamic theory, out of which hydrodynamic theory is the most accepted one.^{3,4}

Iontophoresis is being used from 17th century for the treatment of dental hypersensitivity. Iontophoresis is conventional method of treating dental hypersensitivity. The basic mechanism behind the role of iontophoresis in treating dentin hypersensitivity may be alteration by electrical current resulting in nerve paresthesia, formation of reparative dentin resulting from electric current to dentin and third may be the micro precipitation of calcium fluoride which may block the dentinal tubules.^{4,5,6}

Low level laser therapy is having its benefit over the high intensity lasers and the effects of low level laser therapy are anti-inflammatory, analgesic and biostimulant. Laser therapy is fast, safe and painless. Basic mechanism behind the use of low level laser therapy in the treatment of dentin hypersensitivity is that it blocks the exposed dentinal tubules and causes nerve paresthesia.^{7,8,9}

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In the present study, patients with moderate VAS scores were taken into consideration for the treatment.

Results obtained after visual analogue scale scores shows that iontophoresis showed highest reduction in visual analogue scale scores at 14th day as compared to low level laser therapy group and control group by all three methods-air blast method, cold water test and tactile examination.

David A. Kern *et al* in 1989 evaluated the use of sodium fluoride with and without iontophoresis in the treatment of dentinal hypersensitivity and he found that there was precisely more reduction in visual analogue scale scores in case of application of NaF gel with iontophoresis as compared to NaF application alone.¹⁴ Air blast method was used as for subjective evaluation and tactile examination was used as for the objective evaluation and both the methods have been used previously also and they have been found reliable. M. O. Arowojolu in 2002 compared the clinical efficacy of topical application fluoride along with Iontophoresis and topic fluoride application alone and stated that iontophoresis is comparatively more effective as compared to topical application of fluoride as the electrically charged ions in iontophoresis are deeply driven into the dentinal tubules. On the other hand, topical application with fluoride causes uptake from the surface.¹⁵ Thereza Christinna *et al* in 2004 evaluated the use of low level laser therapy into two groups as red light user group and infrared light user group and results showed that the therapeutic immediate and late effects of the 660 nm red diode laser were greater than those of the 830 nm infrared diode laser.¹⁶

Kaan Orhan *et al* in 2010 conducted a randomized clinical trial over 16 patients and in first group, he applied two layers of desensitizer (Gluma Desensitizer, Heraeus Kulzer, Armonk, NY) containing 2-hydroxyethylmethacrylate, glutardialdehyde, and purified water for desensitization and in second group, he used galium-aluminium-arsenide (GaAlAs) red wavelength low-intensity diode laser (RJ lasers, Vienna, Austria) at 25 mW at a wavelength of 655 nm and at energy density of 4 J/cm² for 160 seconds.¹⁷

Ankur Tailor *et al* in 2014 conducted a study for the treatment of dentinal hypersensitivity using bifluoride 12, diode laser and their combined effect in overall 90 sites and concluded that diode laser is a useful device in the treatment of dentinal hypersensitivity but shows higher efficacy when used in combination with Bifluoride 12.¹⁸ Dr. Shashikant Hegde *et al* in 2015 evaluated the clinical efficacy of acidulated phosphate fluoride gel (APF) gel and a commercially available desensitizing agent- Bifluoride varnish in the treatment of dentinal hypersensitivity and both the agents shows statistically significant reduction in sensitivity as compared with baseline, however APF gel iontophoresis was more effective in reducing dentinal hypersensitivity.¹⁹

In all the above mentioned studies, only subjective criteria of the patient as visual analogue scale was considered for the evaluation of pain from baseline to specific postoperative time period.

As the present study also have shown significant results in case of iontophoresis and low level laser therapy group but still iontophoresis have shown comparatively better results as compared to LLLT in dentinal hypersensitivity. In this study

only the patients with moderate VAS scores ranging from 3 to 6 were taken into consideration. So, basically patients with severe pain of dentinal hypersensitivity were not evaluated. The subjective criteria for the evaluation of VAS scores is itself manual method. Cold water test, air blast method and tactile examination are all the methods and their efficacy depends somewhat on overall patients subjective response, operators skills and other factors. Still, the effects provided by both the methods were temporary, as the proper treatment is necessary for the further evaluation.

CONCLUSION

Both the agents, Iontophoresis and LLLT group, revealed significant reduction in the sensitivity at different time intervals to all the three test stimuli when compared to the baseline. Hence, they both can be considered as potential desensitizers. NaF gel Iontophoresis showed better results in reducing dentinal hypersensitivity in response to tactile stimuli as compared to low level laser therapy at the end of 14th day. It is therefore suggested that fluoride iontophoresis be used as a first line treatment, before other therapeutic steps like resin primers and low level laser treatment are considered for the treatment of dentine hypersensitivity.

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How to cite this article:

Sumit Shende *et al* (2017) 'Comparative Evaluation of Efficacy of Low Level Laser Therapy Using Diode Laser and Iontophoresis with 2% Sodium Fluoride Gel in the Treatment of Patients with Dentinal Hypersensitivity', *International Journal of Current Advanced Research*, 06(08), pp. 5368-5373. DOI: <http://dx.doi.org/10.24327/ijcar.2017.5373.0708>
