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Efficacy of Diode Laser in Management of Dentinal Hypersensitivity: A Comparative Case Series Evaluation

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Abstract

Introduction: Dentin hypersensitivity (DH) is among the most frequently reported dental concerns. It is characterized by short, sharp pain arising from exposed dentine in response to stimuli, typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other dental defect or pathology. There are various treatment modalities available which can be used at home or may be professionally applied. Laser helps in treatment of DH by coagulation and precipitation of plasma proteins dentinal fluid and thermal energy liberated alters intra-dental nerve activity. Various types of lasers, at different wavelengths and application times, reveal the effectiveness of this treatment, both immediately and during follow-up after approximately 6 months from the first treatment.

Aim and objective: The aim of the study is to evaluate the efficacy of diode laser as treatment modality for various types of dentinal hypersensitivity. The objective of the study was to assess the comparative effect of diode laser in wasting disease (cervical abrasion, abfraction, erosion) and Post-SRP , to check various types of stimuli (thermal, cold & tactile) after diode laser therapy and evaluation of visual analogue scale in dentinal hypersensitivity.

Material and method: The study sample consisted of 50 patients of both the genders and diagnosed with hypersensitivity. They were divided into group A and group B. Group A patients were having wasting disease like cervical abrasion, attrition, abfraction and erosion

and Group B patients were having transient hypersensitivity post scaling and root planing. Each group had 25 patients and were informed about the procedure and consent was signed. The aim of the study is to evaluate the efficacy of diode laser as treatment modality for various types of dentinal hypersensitivity and to assess the comparative effect of diode laser, various types of stimuli (cold and tactile) and visual analogue scale.

Results: Results showed that Low-level diode laser has been evaluated and has shown immediate efficacy in reducing root sensitivity compared to sensitivity in teeth affected by wasting diseases. The laser irradiation contributed to the repair of the dentine-pulp complex, preserving the pulpal vitality.

Conclusion: Thus it can be concluded that within the limitation of the study, low level laser therapy can be effective in the management of dentinal hypersensitivity. Immediate results can be observed in management of transient hypersensitivity post scaling and root planning.

Keywords: Transmission, Dentinal, Hypersensitivity, Laser.

Introduction

Dentin is considered as a vital tissue and has the capacity to respond to physiologic and pathologic stimuli. As it is known, dentin is covered by enamel in the crown surface and by a thin layer of cementum in the root surface of the tooth. It is sensitive to stimuli due to the lesion extension of odontoblastic process and formation of dentin-pulp complex[1]. Though dentin and pulp are histologically different, they have the same embryonic origin; ectomesenchymal origin. The formation of dentin-pulp complex causes dentin to be affected by pulp and vice versa. It has very minute tubules which are filled with odontoblastic process. The processes are also surrounded by dentinal fluid which forms about 22% of the total volume of dentin. The fluid is completely filtrated and originates from the blood vessels of the pulp[1].

Dentin hypersensitivity (DH) is among the most frequently reported dental concerns. It is characterized by short, sharp pain arising from exposed dentine in response to stimuli, typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other dental defect or pathology [2].

Management of dentinal hypersensitivity should reduce the fluid flow within the dentinal tubules or block the pulpal nerve response (Holland et al., 1997)[3].There are various treatment modalities available which can be used at home or may be professionally applied. The “at home” desensitizing agents include toothpastes, mouthwashes or chewing gums and they act by either occluding the dentinal tubules or blocking the neural transmission. Products containing stannous, strontium, potassium, arginine, oxalate, and hydroxyapatite ingredients and in-office products and procedures (varnishes, sealants, glass ionomer cements, lasers) that would suggest a degree of efficacy when used to treat DH.

LASER is an acronym for “light amplification by stimulated emission of radiation.” Each type of LASER device emits energy at specific wavelength. Laser helps in treatment of DH by coagulation and precipitation of plasma proteins dentinal fluid and thermal energy liberated alters intra-dental nerve activity. Various types of lasers, at different wavelengths and application times, reveal the effectiveness of this treatment, both immediately and during follow-up after approximately 6 months from the first treatment[4]. Referring to the course of action, it was shown how the low-power lasers,

including the GaAlAs diode laser with a wavelength between 780 and 900 nm, acts on the nervous level, thus eliminating the sensitivity.

For example, the wavelength emitted by diode (Gallium: Arsenide) laser ranges from 635 to 950nm. Diode lasers can be used for a multitude of dental procedures which are predominantly soft tissue surgery, periodontal pocket therapy, peri-implantitis, applications involving hard tissue (teeth). The diode laser is a solid-state semiconductor laser that uses a grouping of Gallium (Ga), Arsenide (Ar), and Aluminum (Al) and Indium (In), to change electrical energy into light.

Materials and Method

This was a clinical study which was conducted at the Department of Periodontics and Oral Implantology, Ahmedabad Dental College and Hospital, Gujarat University, Ahmedabad.

The study sample consisted of 50 patients of both the genders and diagnosed with hypersensitivity. They were divided into group A and group B. Group A patients were having wasting disease like cervical abrasion, attrition, abfraction and erosion and Group B patients were having transient hypersensitivity post scaling and root planing. Each group had 25 patients and were informed about the procedure and consent was signed. The aim of the study is to evaluate the efficacy of diode laser as treatment modality for various types of dentinal hypersensitivity and to assess the comparative effect of diode laser, various types of stimuli (cold and tactile) and visual analogue scale.

All patients were given careful instructions on proper oral hygiene measures. A full mouth supragingival and subgingival scaling & root planning procedure were performed. Patients were divided into two groups,

Clinical parameters were measured at baseline, 1 month and 3 months.

Inclusion Criteria

1. Patient willing to sign the consent form.
2. Patients within age group of 18-65 years.
3. Patients having minimum of a three teeth hypersensitive to tactile, cold or air stimulation in a quadrant.

Exclusion Criteria

1. Patients with uncontrolled systemic conditions.
2. Heavy smokers and tobacco users.
3. Patients who had received any professional treatment with desensitizing agents during past six months.

All selected patients who signed an informed consent form before undergoing the research procedure were included in the study. Subjects satisfying the inclusion criteria were assigned into two groups. SRP was performed in both groups. The operator, patient and the assistant were instructed to wear safety eye wear. Highly reflective instruments or instruments with mirrored surfaces were avoided, as there could be reflection of the laser beam. Care was taken to avoid using laser in presence of explosive gases. Following SRP, adjacent teeth were covered with operator's fingers and/or cotton rolls during dentin stimulation and dentin hypersensitivity was assessed and recorded. A hypersensitive tooth in the selected quadrant was irradiated using soft tissue diode laser: 810nm, power 0.5W in continuous emission form by optic fibre.

Sample Size: 50 Patient (25 Patients In Each Group)

Group A (n-25): Patients having wasting disease

Group B (n-25): Patients suffering from transient hypersensitivity (post-SRP)

Each tooth was irradiated for 2 min in non-contact mode with the laser beam directed perpendicular to the buccal surface of tooth.

The Patients visits are described as follow:

Visit 1(Baseline): Patient recruitment, post-SRP clinical parameters were evaluated.

Visit 2: Clinical parameters and LASER treatment after one week

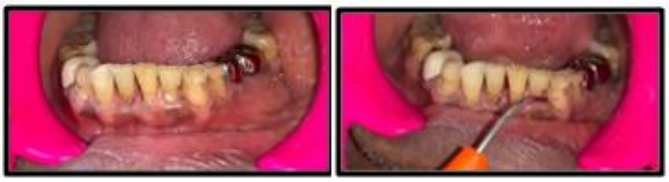
Visit 3: 1 month follow up

Visit 4: 3 month follow up

All the clinical parameters were explained to patients and they were recorded accordingly. The parameters used were Visual analogue scale, Air blast stimulus and tactile stimulus. Air blast stimulus was done by three way syringe and tactile stimulus was done by explorer and patients were asked to mark on the scale accordingly. Patients were discharged with all post-surgical instructions.

All the parameters were recorded and the p-value was calculated using 'SPSS' version 20.0 software.

Group A: Patients having wasting disease



Pre-Operative Laser Application

Figure 1: Group A (wasting disease)

Group B: Patients having transient hypersensitivity (Post SRP).

Laser application

Figure 2: Group B (Post-SRP)

Observation and Results

The present study is a comparative study, conducted at the department of Periodontics and oral implantology in Ahmedabad dental college and hospital. A total of 50 patients were selected for the study of the age ranging 18 years and above, who met the inclusion criteria of the study. The present study was conducted with the aim to compare the clinically efficiency of diode laser in management of dentinal hypersensitivity. Each patient was planned to be examined at baseline, one month and three months. All the measurements were subjected to statistical analysis with the help of 'SPSS version 20.0 software version'. No undesirable effects were noted and the treatment was tolerated by the patients.

Table 1: Tactile Test wise distribution between Group A (Wasting disease) and Group B (POST SRP)

Time period	Teeth	Number	Tactile Test		P Value
			Mean	SD	
Baseline	Group A (Wasting disease)	25	2.32	0.62	
	Group B (POST SRP)	25	2.20	0.64	
1 Month	Group A (Wasting disease)	25	1.52	0.50	≤ 0.05 *
	Group B (POST SRP)	25	1.20	0.50	
3 Month	Group A (Wasting disease)	25	0.96	0.35	≤ 0.05 *
	Group B (POST SRP)	25	0.80	0.40	

Level of Significance P ≤ 0.05, * Significant, ** Non Significant

Table: 2: Cold Water Test wise distribution between Group A (Wasting disease) and Group B (POST SRP)

Time period	Teeth	Number	Cold Water Test		P Value
			Mean	SD	
Baseline	Group A (Wasting disease)	25	7.88	0.72	
	Group B (POST SRP)	25	7.56	1.00	
1 Month	Group A (Wasting disease)	25	6.56	0.71	≤ 0.05 *
	Group B (POST SRP)	25	4.64	0.99	
3 Month	Group A (Wasting disease)	25	3.40	0.81	≤ 0.05 *
	Group B (POST SRP)	25	1.52	0.58	

Level of Significance P ≤ 0.05, * Significant, ** Non Significant

Table: 3: Air Blast Test wise distribution between Group A (Wasting disease) and Group B (POST SRP)

Time period	Teeth	Number	Air Blast Test		P Value
			Mean	SD	
Baseline	Group A (Wasting disease)	25	2.24	0.59	
	Group B (POST SRP)	25	2.28	0.69	
1 Month	Group A (Wasting disease)	25	1.44	0.50	≤ 0.05*
	Group B (POST SRP)	25	1.20	0.59	
3 Month	Group A (Wasting disease)	25	1.04	0.35	≤ 0.05 *
	Group B (POST SRP)	25	0.72	0.52	

Level of Significance P ≤ 0.05, * Significant, ** Non Significant

Discussion

A definitive diagnosis of dentinal hypersensitivity can be challenging and practitioners must rule out other problems, such as caries, fractured or cracked teeth, defective restorations, occlusal trauma, or gingival conditions that could be the underlying cause of the dental pain a patient experiences.

Dentin consists of an organic component containing collagen fibers in a matrix of collagenous proteins and an inorganic component containing hydroxyapatite crystals. Within the dentin, dentinal tubules run from the pulp to the outer dentinal surface and are easily identifiable on scanning electron microscopy images of cross-sections of dentin as either open or plugged dentinal tubules. The number of tubules varies and can be as many as 30,000 in a square millimetre of dentin. The dentinal tubules contain Tomes' fibers, first described by Sir John Tomes in 1850, that extend into the dentinal tubules from the odontoblasts that communicate with the pulp.Three types of nerve fibers (A-delta fibers, A-beta fibers, and C-fibers) are found within the dentin. Characteristics of hypersensitive dentin consist of dentinal tubules open to the oral cavity, large and numerous dentinal tubules, and a thin, poorly calcified (or absent) smear layer. This smear layer is composed of a deposit of salivary proteins, debris from

dentifrices and other calcified matter that helps protect the cementum and dentin. In normal dentin the smear layer covers the openings of the dentinal tubules and reduces the risk that a stimulus for hypersensitivity reaches the dentinal tubules.

There is a wide range in the reported prevalence of dentinal hypersensitivity, with publications citing prevalence of 4% and up to 98% depending on the population group. The highest prevalence are seen in periodontal patients (reported range of 60% - 98%) and in the general population prevalence of up to 57% have been reported. The higher prevalence for this group of individuals may be attributed to the root surface becoming exposed as part of the periodontal disease process and treatment. Between 9% and 23% of patients have reported root sensitivity before root planing, while after root planing approximately 55% of patients have reported experiencing dentinal hypersensitivity. This increase in sensitivity occurred for a one to three week period after the procedure and then slowly decreased over time. Over and above the removal of the superficial smear layer during scaling and root planing that can result in sensitivity, aggressive scaling and root planing can remove layers of protective cementum and dentin, causing sensitivity. When cementum or dentin is exposed these areas are more susceptible to caries, as well as erosion, abrasion, and abfraction. Females tend to be prone to hypersensitivity and it has been hypothesized that this is because females tend to be more frequent attenders for treatment and perform more extensive home care oral hygiene in comparison to males. In the general population prevalence for dentinal hypersensitivity of up to 57% have been reported, and more individuals report hypersensitivity after scaling and root planing than prior to scaling and root planing. Hypersensitivity tends to be most prevalent on the buccal and cervical regions of the teeth.The most common sites for dentinal hypersensitivity are the cervical margins of the buccal and labial surfaces of teeth, with these sites accounting for 90% of sensitive surfaces. These areas of the teeth are a common site for recession and the enamel is also thinner in these areas. Canines and first premolars, followed by incisors, second premolars and molars are commonly affected by recession. Lastly, patients with moderate to severe sensitivity tend to have gingival recession more dominantly on one side of their mouth compared to the contralateral side.

A diagnosis of dentinal hypersensitivity can be a challenge for dental professionals since patients may not report it and it may not be obvious. Definitively excluding these oral conditions first will then lead to the diagnosis of dentinal hypersensitivity. Through the use of radiographs, conversations with the patient, and a thorough clinical exam, the dental practitioner must first exclude these conditions and then define the diagnosis as one of hypersensitivity. Clinical signs and symptoms that a dental professional should be aware of and inquire about include sensitivity or pain when a stimulus is applied (such as hot/cold/sweet/sour/touch), exposed dentin at the site of sensitivity, and in the absence of dental caries, fracture lines, or poor restorations. Patients who have dentinal hypersensitivity may have anxiety with a routine dental cleaning, and can be so anxious about pain that they avoid examinations and routine dental care in general.

In present study, 50 patients were selected with age group ranging 20 to 65 years from the Department of Periodontology and Oral Implantology, Ahmedabad Dental College and Hospital and they were divided into

two groups- Group A (Cervical abrasion, erosion, abfraction, and attrition) and Group B(Post-SRP). Comparison between these two group was taken. The VAS scale for patient satisfaction and other parameters were recorded.

In table 1 there is tactile test wise distribution between Group A and Group B and Statistically, no significant difference was present in tactile test value between Group A (Wasting disease) and Group B (POST SRP) at baseline time period. Mean tactile test value was less in Group B (POST SRP) (1.20 ± 0.50) than Group A (Wasting disease) (1.52 ± 0.50) at 1 month time period. Statistically, significant difference was present in in tactile test value between Group A (Wasting disease) and Group B (POST SRP) at 1 month time period. Mean tactile test value was less in Group B (POST SRP) (0.80 ± 0.40) than Group A (Wasting disease) (0.96 ± 0.35) at 3 month time period. Statistically, significant difference was present in in tactile test value between Group A (Wasting disease) and Group B (POST SRP) at 3 month time period.(Romina Brignardello-Petersen[5])

In Table 2 there is cold test wise distribution between Group A and Group B and Statistically, no significant difference was present in cold water test value between Group A (Wasting disease) and Group B (POST SRP) at baseline time period. Mean cold water test value was less in Group B (POST SRP) (4.64 ± 0.99) than Group A (Wasting disease) (6.56 ± 0.71) at 1 month time period. Statistically, significant difference was present in in cold water test value between Group A (Wasting disease) and Group B (POST SRP) at 1 month time period. Mean cold water test value was less in Group B (POST SRP) (1.52 ± 0.58) than Group A (Wasting disease) (3.40 ± 0.81) at 3 month time period. Statistically, significant difference was present in cold water test value between Group A (Wasting disease) and Group B (POST SRP) at 3 month time period.

In Table 3 there is air blast test wise distribution between Group A and Group B and Statistically, no significant difference was present in air blast test value between Group A (Wasting disease) and Group B (POST SRP) at baseline time period. Mean air blast test value was less in Group B (POST SRP) (1.20 ± 0.59) than Group A (Wasting disease) (1.44 ± 0.50) at 1 month time period. Statistically, significant difference was present in in air blast test value between Group A (Wasting disease) and Group B (POST SRP) at 1 month time period. Mean air blast test value was less in Group B (POST SRP) (0.72 ± 0.52) than Group A (Wasting disease) (1.04 ± 0.35) at 3 month time period. Statistically, significant difference was present in in air blast test value between Group A (Wasting disease) and Group B (POST SRP) at 3 month time period.(Nargesh Naghsh et al.[6])

Low-power lasers do not emit heat and stimulate the normality of cell functions. They act by changing the electrical potential of the cell membrane, activating the Na^+/K^+ ATPase pumps, leading to increased adenosine triphosphate (ATP) synthesis, and bringing about analgesic, potential anti-inflammatory and biomodulation benefits to the cells. There is a possibility that low-power lasers may obliterate the dentinal tubules by the effect of photo biomodulation on dental pulp, due to an increase in cellular metabolic activity of the odontoblasts, so that they intensify the production of tertiary dentin[7]. The laser-assisted treatment of dentine hypersensitivity is a good method to solve immediate and long- term pain. Compared to conventional desensitizing topical agents, the laser treatment, although more expensive, leads to rapid results with less application time and more quickly for the patient. In the

majority of studies, patients have a decrease in VAS from baseline both immediately and over time, till six months after treatment[8]. Low-level diode laser has been evaluated and has shown immediate efficacy in reducing root sensitivity compared to sensitivity in teeth affected by wasting diseases. The laser irradiation contributed to the repair of the dentine-pulp complex, preserving the pulpal vitality[13].

Conclusion

Thus it can be concluded that within the limitation of the study, low level laser therapy can be effective in the management of dentinal hypersensitivity. Immediate results can be observed in management of transient hypersensitivity post scaling and root planning. Results can be observed starting from 15 minutes after the first application of laser and improves within one week to one month. Laser was well accepted by the tissues and showed good tolerability with no side effects by all the subjects in the study. Thus low level laser system is easy to use and non-invasive technique requiring less chair side time. Thus results were proven better.

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