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ORIGINAL ARTICLE

COMPARATIVE EVALUATION OF IMMEDIATE EFFICACY OF DIODE LASER VERSUS DESENSITIZING PASTE CONTAINING 8% ARGININE AND CALCIUM CARBONATE IN TREATMENT OF DENTINE HYPERSENSITIVITY: AN IN VIVO STUDY

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ABSTRACT: BACKGROUND & OBJECTIVES: The aim of the study was to evaluate the immediate efficacy of diode laser versus desensitizing paste containing 8% arginine and calcium carbonate in the treatment of dentine hypersensitivity. **METHODOLOGY:** 50 patients with complain of tooth hypersensitivity were randomly selected for an 8 week clinical trial with the set inclusion and exclusion criteria. Each patient was assigned to one of the two study groups: Group 1 (n=25) - 8% arginine and calcium carbonate paste (Pro-Relief paste, Colgate-Palmolive Ltd, India) and Group 2 (n=25) - Diode laser(AMD, Picasso Diode, Indianapolis, Indiana), who received a baseline evaluation of tactile hypersensitivity with the help of dental explorer and an air blast hypersensitivity. The effectiveness of the therapy was assessed by VAS Scale of 10, along with the hard and soft tissue evaluation, at 4 examination periods: 1) immediately after the application of the diode laser 2) after 15 days 3) after 4 weeks & 4) after 8 weeks. **RESULTS:** 8% arginine and calcium carbonate showed significant results (67.27%) than diode laser (56.55%) at immediate and 4 weeks evaluation by mechanical stimulus and immediate evaluation by air stimulus. Diode laser showed highly significant results in progressive decrease in the dentin hypersensitivity till 8 weeks whereas 8% arginine showed highly significant results till 4 weeks. **CONCLUSION:** The immediate efficacy of 8% arginine and calcium carbonate (Colgate Pro Relief) was higher as compared to diode laser. Diode laser showed progressive reduction till 8 weeks whereas Colgate Pro Relief showed progressive reduction only till 4 weeks.

KEYWORDS: Dentine hypersensitivity, Colgate Pro Relief, Diode laser.

INTRODUCTION: Dentine sensitivity (DS) or dentinal hypersensitivity (DH) is one of the most commonly encountered clinical problems. It is clinically described as an exaggerated response to application of a stimulus to exposed dentine, regardless of its location.[1] The condition has been defined by an international workshop on DH as follows "Dentine hypersensitivity 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]

The Hydrodynamic theory is now accepted by the dental community as the most probable mechanism by which dentin hypersensitivity occurs.

Various in- office and at home treatments for dentinal hypersensitivity have been proposed by different authors for the management of dentinal hypersensitivity.[1,3,4] In order to achieve immediate relief from DS, many treatments with topical products in form of dental creams and varnishes have been offered to the population.[5]

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Various agents like- strontium chloride, sodium monofluorophosphate, sodium fluoride, calcium hydroxide, calcium phosphate, potassium nitrate, potassium citrate, formaldehyde, sodium citrate-pluronic gel, stannous fluoride, glucocorticoids, adhesives, bonding agents and resins, glass-ionomer cements, bioactive and biocompatible glasses, oxalate containing products,[6,7,8] dentifrices containing novamin and CPP-ACP (Caesin phospho peptide - amorphous calcium phosphate),[6,8] iontophoresis[7] and lasers[9,7] have been used.

Saliva can play a critical role in naturally reducing dentin hypersensitivity, by supplying and carrying calcium and phosphate ions into open dentin tubules to gradually bring about tubule blocking and by forming a surface protective layer consisting of precipitated aggregates of a combination of salivary glycoproteins with calcium phosphate.[5]

In 2002, Kleinberg et al at the State University of New York – Stony Brook, reported the development of a new anti-sensitivity technology based on their understanding of the role that saliva plays in naturally reducing dentin hypersensitivity. The essential components of this new technology are Arginine, an amino acid which is positively charged at physiological pH, i.e., pH 6.5-7.5, Bicarbonate, a pH buffer, and Calcium carbonate, a source of calcium.[5] This technology, has been named Pro- Argin.[10]

With technological development and the advent of laser technology and its growing utilization in dentistry, an additional therapeutic option is available for the treatment of dentinal hypersensitivity[11-18]

Hence, the purpose of the study is to compare the evaluation of immediate efficacy of diode laser versus desensitizing paste containing 8% arginine and calcium carbonate in treatment of dentine hypersensitivity In-vivo.

AIM AND OBJECTIVES:

AIM: The aim of the study is comparative evaluation of immediate efficacy of diode laser versus desensitizing paste containing 8% arginine and calcium carbonate in treatment of dentine hypersensitivity.

OBJECTIVES:

1. To evaluate the immediate therapeutic effect of 8% arginine and calcium carbonate paste in treatment of dentine hypersensitivity over 8 weeks.
2. To evaluate the immediate therapeutic effect of diode laser in treatment of dentine hypersensitivity over 8 weeks.
3. To compare the therapeutic effect of 8% arginine versus diode laser over 8 weeks.

MATERIALS AND METHODS:

PLACE OF THE STUDY: This in vivo study was conducted in the Department of Conservative and Endodontics Dentistry, K. M. Shah Dental College and Hospital, Piparia, Vadodara.

Sample Size: 25 patients per study group (Total 50 patients).

50 patients with complain of tooth hypersensitivity, who were seeking treatment in the outpatient Conservative and Endodontic Department of K.M. Shah Dental College and Hospital, Vadodara were recruited randomly for an 8 week randomized clinical trial with the following

inclusion and exclusion criteria. The study was commenced following the approval of the ethical committee of K.M. Shah Dental College and Hospital, Sumandeep Vidyapeeth, Vadodara, India.

Inclusion Criteria:

1. Patients complaining of sensitivity due to mechanical stimuli (Tooth brushing), thermal (Warm, cold) or chemical (Sweet or sour food).
2. Patients with two or more teeth with dentinal hypersensitivity.
3. Patients with non- carious lesions not requiring restoration, like attrition, dental erosion and pathologic dental abrasion.
4. Early non-carious lesions.
5. Patients in the age group of 18-70.
6. Patients ready to sign the consent form and ready to come for follow-ups.

Exclusion Criteria:

1. Teeth with cervical caries.
2. Teeth with non-carious lesions with pulpal involvement.
3. Patients under any medications.
4. Patients having any systemic diseases.
5. Patients already taking any hypersensitivity treatment or had taken within last three months.
6. Teeth with advanced periodontal disease.
7. Crazed or hypoplastic teeth.

METHODOLOGY: 50 Patients with dental hypersensitivity who qualified for participation in the study were treated prophylactically and a double blinded, randomization was done and each patient was assigned to one of the two study groups:

Group 1- 8% arginine and calcium carbonate paste (Colgate sensitive Pro-Relief desensitizing paste, Colgate-Palmolive Ltd, India)

Group 2- Diode laser (AMD, Picasso Diode, Indianapolis, Indiana)

All subjects who meet the inclusion criteria and signed the informed consent form received a baseline:

1. Tactile hypersensitivity evaluation with the help of dental explorer and
2. An air blast hypersensitivity evaluation.

For tactile stimuli, a sharp tip of the dental explorer was stroked perpendicular to the hypersensitive tooth surface with slight pressure.

For air blast, each hypersensitive tooth was isolated by placing the cotton rolls, then air was delivered from a standard dental unit air syringe at 60psi and environmental temperature. The air was directed at the exposed surface of the hypersensitive tooth for 1 second from a distance of approximately 1 cm.

Both the stimuli were recorded on the visual analogue scale (VAS Scale) of 10, along with the hard and soft tissue evaluation.[19]

VAS is a linear scale marked from 0 to 10 to describe the pain experienced.

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The values on the scale are assigned as:

0- no pain.
1 to 3- mild pain.
4 to 6- moderate pain.
7 to 9- severe pain.
10- Unbearable pain.

Patients were instructed to point out the level of sensitivity they felt during tactile and air stimulation on this VAS scale and thus the scores were self-rated by the patients. The test was repeated 3 times and average final score was recorded.

GROUP 1- 8% Arginine and Calcium Carbonate paste (Colgate-Palmolive Co.): After the base line scores were recorded, the product was used by applying the paste to the teeth exhibiting sensitivity using a prophylaxis cup on an angle[5]. The product was applied using low speed and a moderate amount of pressure, in essence burnishing the material into the exposed tubules. Professional product application consisted of two consecutive 3-second applications of the paste using a rotating rubber cup. Rinsing was avoided up to 15 minutes after application to enhance clinical efficacy.

Tactile and air blast hypersensitivity examinations were repeated immediately after 15 minutes of paste application and scores were recorded on the VAS Scale. All subjects were then prescribed with a commercially-available non-desensitizing dentifrice and an adult soft-bristled toothbrush for at-home use and were instructed to brush their teeth for 1 minute, twice daily, for the next 8 weeks. There were no restrictions regarding diet or smoking habits during the course of the study.

Subjects returned to the clinical facility 15days, 4 and 8 weeks after paste application was done, they were refrained from all oral hygiene procedures and chewing gum for 8 hours and from eating and drinking for 4 hours, prior to each follow up visit. Tactile and air blast hypersensitivity measurement using the same VAS Scale was used. All the VAS Scale readings were repeated 3 times and an average score was recorded.

GROUP 2- Diode laser (AMD, Picasso Diode): The test group was treated using a diode laser with a wave length of 810nm, at an output power of 1.5W, continuous wave and delivery fibre diameter 2 mm for 30 seconds. The tooth surfaces were carefully cleaned using water/pumice slurry in dental prophylactic cups, rinsed and gently dried with absorbent paper. A relative isolation was obtained using cotton rolls and teeth were kept free from humidity. The laser beam was directed perpendicular to the tooth for 30 seconds. The effectiveness of the therapy was assessed by VAS Scale at 4 examination periods:

1. Immediately after the application of the diode laser.
2. After 15 days.
3. After 4 weeks.
4. After 8 weeks.

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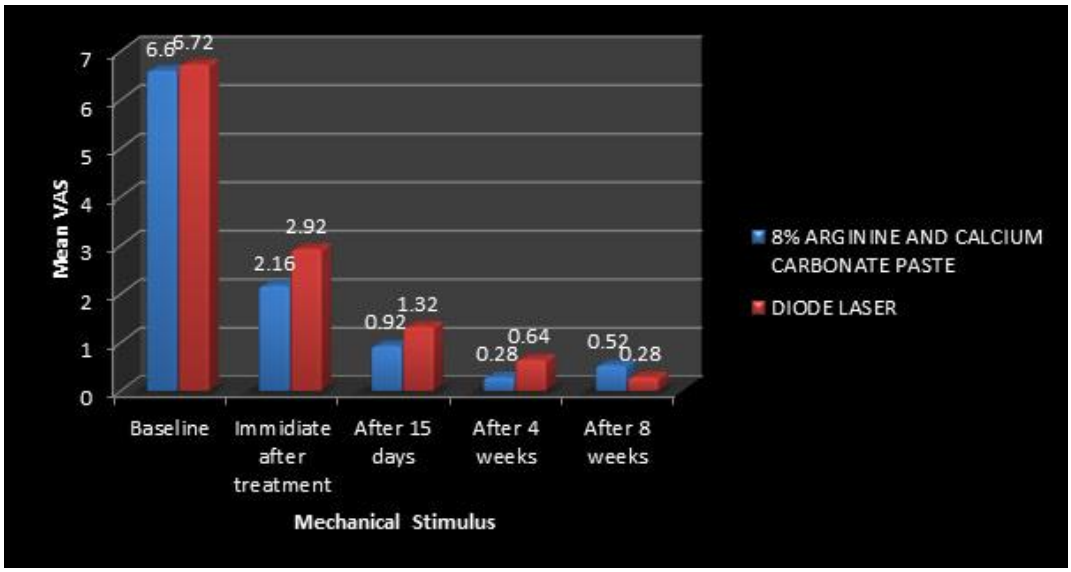
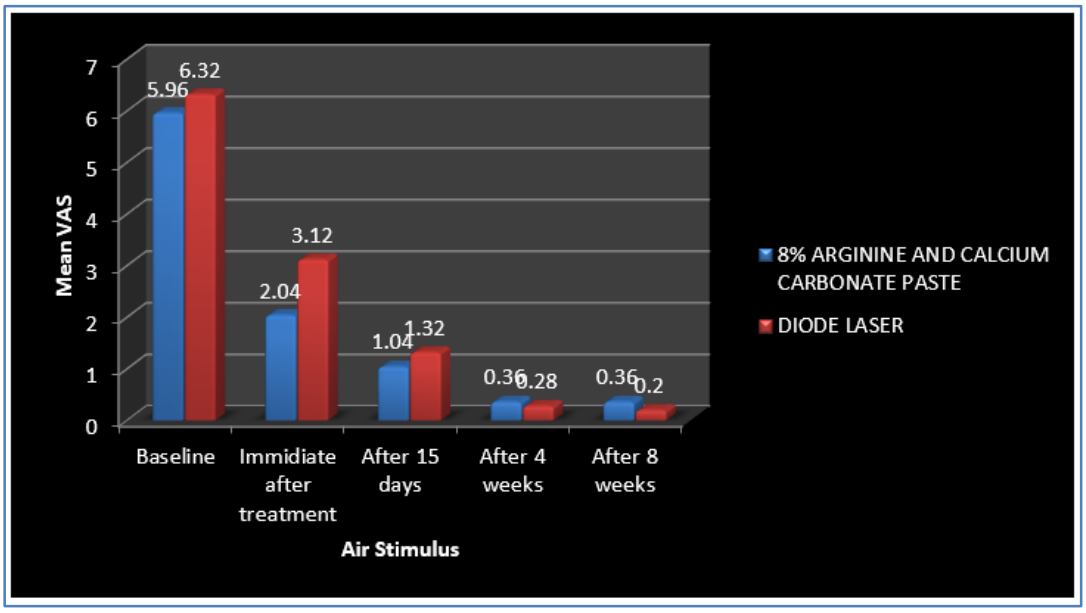


Graph 1

8% arginine and calcium carbonate is more effective in immediate relief of dental hypersensitivity than diode laser.



Graph 2

8% arginine and calcium carbonate is more effective in immediate relief of dental hypersensitivity than diode laser.

DISCUSSION: The term hypersensitive dentine is widely used but poorly defined. A definition for hypersensitivity was suggested in 1983 and, with minor amendment was adopted in 1997 by an international workshop on the design and conduct of clinical trials for treatments of the condition.

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The definition states: "Dentine hypersensitivity 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 form of dental defect or pathology".[20,21,22]

In 1884 Calvo wrote that "there is great need of medicament, which while lessening the sensibility of dentine, will not impair the vitality of the pulp". In spite of the considerable amount of research towards this objective over the past 100 years, the clinical management of hypersensitive teeth is largely empirical.[22,23,24] A survey among oral care professional's reports that dental care providers feel confident about diagnosing dentin hypersensitivity, but not about treating it.[25]

It is important to note that saliva plays a role in naturally reducing dentin hypersensitivity by supplying and carrying calcium and phosphate ions into open dentin tubules to gradually bring about tubule blocking and by forming a surface protective layer consisting of presipitable aggregates of the combination of salivary glycoproteins with calcium phosphate.[26] A recent review of biological approaches to therapy proposed that the ideal dentin hypersensitivity treatment should mimic natural desensitizing processes leading to spontaneous occlusion of open dentin tubules.[20] A novel dentin hypersensitivity treatment technology, consisting of 8% arginine, an amino acid found in saliva, in combination with calcium carbonate, is now available as a desensitizing paste for in-office application.[27,28,29]

State-of-the-art surface techniques were used to assess the mechanism of action and effectiveness of the new Pro-Argin dentifrice. Confocal laser scanning microscopy (CLSM) and scanning electron microscopy (SEM) have been used to assess tubule occlusion. Electron spectroscopy for chemical analysis (ESCA) has been used to identify the composition of the occlusive material. In addition, CLSM has also been used to identify the location of the arginine within the occluded dentin tubule and to demonstrate the resistance of the occlusion to an acid challenge.[28,30]

Confocal laser scanning microscopy showed that there was complete occlusion of the dentin tubules after treatment with the dentifrice, and the tubules were no longer exposed. The SEM analysis shows that treatment with the 8.0% arginine, a high cleaning calcium carbonate and sodium monofluorophosphate dentifrice was highly effective in occluding dentin tubules, confirming the results of the CLSM.

The mechanism of action proposed by Kleinberg suggested that the positively charged arginine is attracted to the negatively charged dentin surface where it helps attract and adhere calcium carbonate to the dentin surface and deep into the tubules.[6] The association of the arginine and calcium carbonate in situ provides an alkaline environment which encourages endogenous calcium and phosphate ions to deposit and occlude the dentin tubules.[10,27,30] Thus this new Pro-Argin desensitizing dentifrice is the latest advance in immediate relief from dentin hypersensitivity.

Low intensity laser therapy has been widely applied in dentin hypersensitivity treatment, minimizing the discomfort caused by this clinical problem. In the long term, this acts at the cellular level, increasing the cellular respiration with production of energy (ATP), thus increasing the production of tertiary dentin and consequently sealing the dentinal tubules.[31]

The pain relief or analgesic mechanism due to laser irradiation occurs when the light acts on the cell membrane, leading to a hyperpolarisation, which is a photo physical change as a result of the biological light/cell interaction. The cytoplasmic membrane permeability increases for the $Ca^{++,}$ Na^{++} and K^{+} ions where there is increase in cell membrane receptor activity. As a consequence, endorphin synthesis and neural cell action potential are increased, while there is decrease in the bradykinin concentration as well as in the activity of the C fibers, which conduct pain stimuli.[31,32]

In addition, laser irradiation in the red spectral band induces photo excitation changes in the reduction potential of the oxidizing C cytochrome and also in the flavin components, leading to other reduction reaction changes (redox) and modulations in biochemical reactions through the cell membrane. Thus for treatment with lasers, two mechanisms have been suggested: reduction-oxidation regulation and ATP intracellular control.[30,31] This sequence of events results in immediate as well as in long term pain relief.[33]

The results of this study indicated that both the agents i.e. A paste containing 8% arginine and calcium carbonate and diode laser caused significant reduction in dentinal hypersensitivity immediately after the application. In the arginine treated group, sensitivity to mechanical stimulus reduced upto 67.27% and air stimulus reduced upto 65.77% where as in the laser treated group sensitivity to mechanical stimulus reduced upto 56.55% and air stimulus reduced upto 50.63%.

Thus Colgate Pro Relief was statistically more effective than laser in immediate relief from dentinal hypersensitivity. There was significant reduction in the sensitivity over a period of 15 days, 4 weeks and 8 weeks respectively. Diode laser showed progressive reduction till 8 weeks whereas Colgate Pro Relief showed progressive reduction only till 4 weeks, which can be justified by the different mechanism of action of both the agents.

The limitation of this study is the absence of the control group, as its absence may limit the assessment of true efficacy of both the test products used in this study.

Though Colgate pro-relief and diode laser both may significantly reduce dentinal hypersensitivity, further research should be done in order to evaluate the effect of both the products for a longer period of time.

CONCLUSION: Within the limitation of the present in-vivo study, it can be concluded that Colgate Pro-relief was statistically more effective than diode laser in immediate relief from dentinal hypersensitivity but diode laser showed progressive reduction till 8 weeks whereas Colgate Pro Relief showed progressive reduction only till 4 weeks.

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Fig. 1: Diode laser (AMD, Picasso Diode, Indianapolis, Indiana)

Fig. 2: Laser application

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Fig. 3: Application of the test paste

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