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"Pain Perception during Enmasse Retraction Irradiated By High Energy Low Level Laser Therapy"

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Abstract
The comprehensive orthodontic treatment is associated with pain during treatment duration,. In the past, many modalities have been proposed to reduce the pain Low-level laser therapy is one such non-invasive modality, which has gained wide acceptance but the evidence regarding its potential pain alleviating effect is contradictory. The present study aims to evaluate the outcomes of low-level laser irradiation on thepain perception at different energy level during orthodontic tooth movement during enmasse retraction.
Material and Methods: *Fourty six patients requiring enmass retraction in 1st premolar extraction space were included in this longitudinal randomized clinical control trial..enmass. Using a split-mouth study design where one side was the experimental side canine was lased using a 810nm semiconductor diode laser operated at an output power of .2W in pulsed mode for 10 seconds using 50joules energy per point which no other study has done earlier.*
Results: *The results indicate that The pain score mean on control side on day one was 4.30+1.69 while as on experimental side was 4.304+1.69 The pain mean score on day 7 was 0.714+ 0.8 while as on control side it was 2.93+1.5 Hence from our experiment it was concluded that LLLT reduces the pain perception during enmass retraction.*

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I. Introduction

The long treatment duration and pain are the main concerns of patients undergoing fixed orthodontic therapy.So fargreat attempts have been made to find approaches for enhancing orthodontic tooth movement and decreasing pain.Although these methods showed successful results in some studies[1],They have their own disadvantages.Non-steroidal anti-inflammatory drugs,Which are usually used to decrease pain resulted from activation of orthodontic appliances,May be associated with deleterious effects and may reduce orthodontic tooth movement.Therefore finding an optimum supplementary approach to achieve faster tooth movement and decrease pain is still considered as a subject of interest.

Low level laser can be used painreduction,Enhancement of wound healing and alleviating inflammation.

International Association for the Study of Pain taxonomy defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage."

Pain is a has subjective response and is dependent on innumerable factors such as age, gender, individual pain threshold, psychological condition, emotional status and stress, cultural differences, and previous pain Experiences[2,3]. Dental procedures are often associated with pain and apprehension[4,5]. Orthodontic pain usually appears hours after the force is applied, spikes at around 12-36 h and slowly declines to the baseline value within 7 days[2,4,6]. Although patients desire orthodontic treatment, the pain accompanying

the treatment procedures has a negative effect and often reduces patient acceptance and compliance, and is a key deterrent to continuation of treatment.[2,5,7] However, tooth movement is possible only through the process of inflammation and pain is an

inseparable part.Of the several methods available to alleviate pain nonsteroidal anti-inflammatory drugs (NSAIDs) have been commonly used. But they decrease osteoclastic activity which reduces tooth movement rate. The alternatives employed for pain relief include vibratory stimulation, chewing gum, anesthetic gel, bite wafers, transcutaneous electrical nerve stimulation, and low level laser therapy (LLLT).[2,3,5] the exact mechanism of pain relief produced by LLLT has ambiguity.

LLLT alters the nerve conduction by influencing the production, release and metabolism of different neurochemicals, including endorphins and encephalin.

Hampering of nerve de-polarization (especially C fibers), reactivation of enzymes targeted at paininductive factors, production of ATPs and increasing the local blood flow and lastly reduction of prostaglandin levels E2 (PGE2) and inhibition of cyclooxygenase have been postulated as mechanism of pain relief.[3,4,6] Optimum dose of LLLT also pilots the growth of new endothelium and vasculogenesis leading to faster healing.A few studies have been conducted across globe to assess use of LLLT in patients undergoing orthodontic treatment and concluded that LLLT was beneficial form of alternative method.[2,8-11]Mehta and Patil (2012)[12]conducted a study in 20 patients.The experimental side received infra red radiation from a semiconductor (AlGaArsenide) diode laser with a wave length of 810nm.The laser regime was applied on days 0,3,7 and 14 in the first month,and thereafter on every 15th day until complete canine retraction was achieved on the experimental side..Pain scores on the experimental sides were significantly lower compared with the control sides HERAVI et al (2014)[13]Studied the effect of low level laser therapy on the rate of tooth movement and pain perception during canine retraction on a group of 20 patients. It was irradiated with a (GaAlAr) laser (810nm,200mW,10points,21.4j/cm^2 per point) and the other half served as the control group.Irradiation was performed just after loading canine retraction forces and on days 3, 7,11,15 over the first month at the 28th day the coil spring was adjusted and the same protocol was continued.The extension of tooth movement and the degree of mesio- distal inclination of canine were measured on the study models prepared at 0,28 and 56 days.The pain perception did not differ significantly between the two groups at any of the treatment appointments .Marines vierira sousa et al (2014)[14]**S**tudied the influence of low level laser on orthodontic movement and pain control in humans,eighteen prospective randomized studies that were selected for detailed analysis.The effective energy input interval of 0.2-2.2 J per point / 2-8 J per tooth at a frequency of application 1-5 days per month to accelerate orthodontic movement .For pain control the recommended energy per point varied from 1-2 J when only one tooth was irradiated to 0.5 to 2.25j per point when all the teeth in the dental arch were irradiated it was demonstrated that LLLT seems demonstrated efficacy

II. Material And Methods

This double-blind longitudinal randomized clinical trial to investigate the effects of low-level laser therapy on the rate and the amount of orthodontic tooth movement was conducted on the patients reporting to the Department of Orthodontics and Dentofacial Orthopedics at Yenepoya Dental college,Derlakatte Mangalore. The sample size for the study included 46 patients (17 males and 29 females) treated with comprehensive fixed mechanotherapy. The study design was approved by the ethical committee of yenepoya university

Inclusion Criteria

The patients who met the following inclusion criteria were recruited for the study:

- Patients requiring enmasse retraction in the extraction space of maxillary 1st premolar.A healthy periodontium with no visible signs of periodontal breakdown.No dilaceration of canine root as assessed on the pretreatment OPG.No history of medical problems, which may interfere with the normal orthodontic tooth movement.

Exclusion Criteria Patients with a history of long-term use of medications like NSAIDs and corticosteroids as these drugs interfere with the normal orthodontic tooth movement.Patients with presence of any occlusal interference, hindering the movement of canine.Patients with skeletal crossbite, one-sided chewing or presence of any parafunctional habit.Periodontally compromised patients were precluded, as the bone quality in such patients is poor, which may have an effect on the tooth movement.Patients with an excessive mobility of canine or 2nd premolar as they may provide false readings.

Determination of Sample Size

The sample size for the study was calculated on the basis of the results of a previous study using SPSS software for Windows (G*POWER3.2.l).[2] Using the values for the standard deviation and keeping the power of the study at 80%, the sample size of the study came out to be 45 patients per group. Keeping in mind, the possible loss of study sample 46 patients were selected

Study design

The study was based on a prospective; double-blind longitudinal study design. A randomly allocated incomplete block split-mouth study design was used to eliminate the bias of individual variations among the patients.

All the patients enrolled in the study received the patient information sheet and were briefed by the investigator regarding the study. The participants of the study consented by signing the informed consent form in the presence of two witnesses

In each patient, a full arch banding and bonding was done with Preadjusted edgewise McLaughlin Bennet Trevisi (MBT) brackets of 0.022" slot. The first molars were banded using custom made or the

commercially available bands. All the patients were bonded using Transbond XT^{TM} light cure adhesive (3M Unitek, California, USA) and curing was done using LED curing light (Bludent, Bulgaria) with an emitted wavelength of 410 - 490 nm [Figure-1]. Depending upon the severity of the malocclusion, sequential wire placement was done to reach 0.019" X 0.025" SS wire (3M Unitek, California, USA) as the main working arch wire in all the cases.

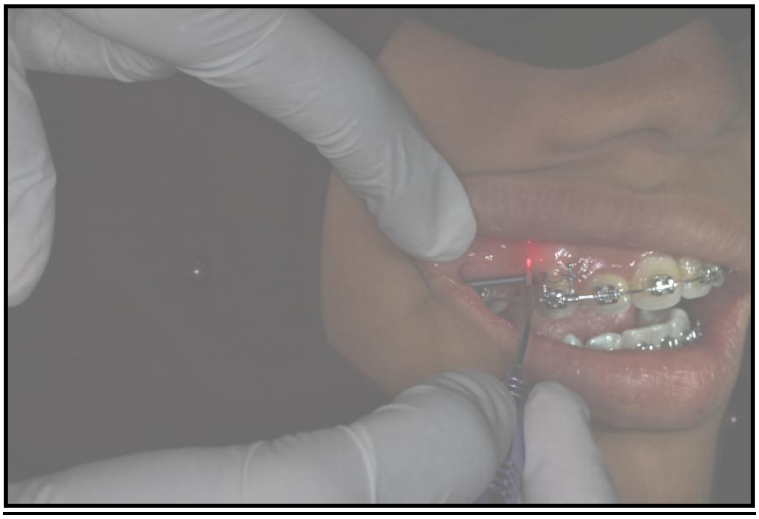
The enmasse retraction was initiated by applying a force of 200gm on both the experimental and control side. The force was applied by using a 12mm Nickel-Titanium closed coil spring (koden orthodontic ,india) on both the sides. The spring was placed from the buccal tube of first molar band to the power arm of the canine bracket either using a 0.009" stainless steel ligature or directly onto the power arms such that the force level of 200gm was maintained [Figure-1]. The force levels were confirmed with the help of an orthodontic dontrix gauge (Dentaurum, Germany) [Figure-1].

Figure:1 measurement of force

Laser irradiation

The experimental side canine was exposed using a Gallium Aluminum Arsenide (GaAlAs) semiconductor diode laser (ZOLAR LASER GERMANY) [Figure-2]. The laser used in this study emitted infrared radiations at a wavelength of 810 ± 15nm.

Wavelength	810 ± 15nm
Laser Type	Semi conductor diode Laser
Mode	Continuous, Biostimulation
Output Wattage	.2W
Time of application / site	10seconds
Energy Density	50J/cm^2/site

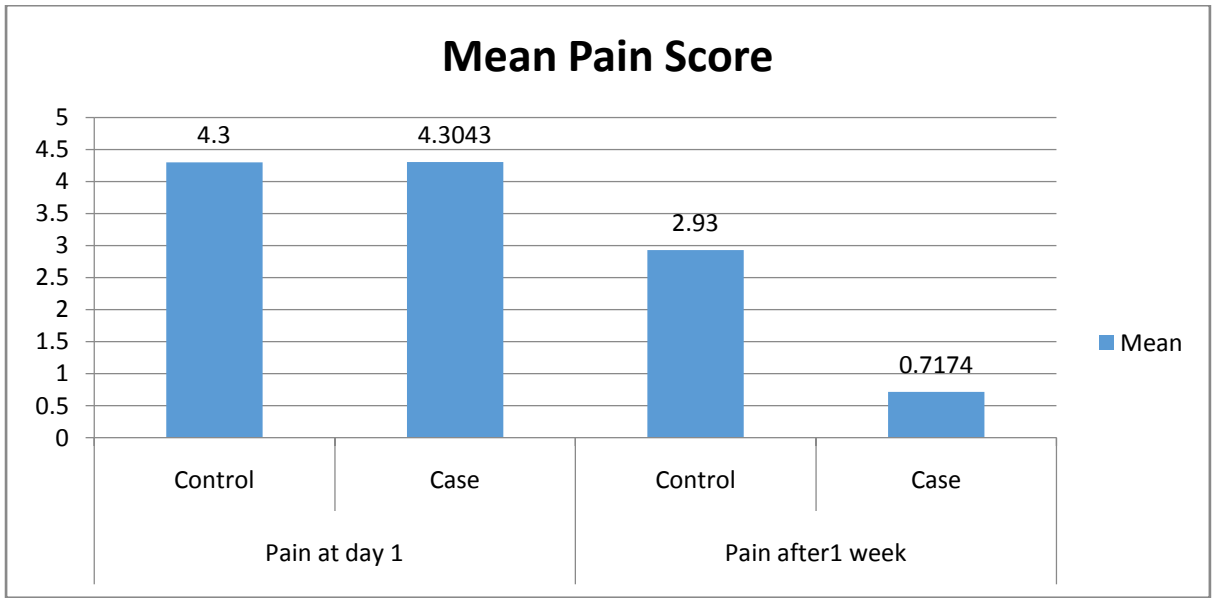


The laser irradiation was started on the same day as that of the start of canine retraction. The experimental side canines were irradiated with low-level laser on the 1st, 3rd, 7th and 15th day of the first month and subsequent irradiations were done once every week

Total Number of Participants	Mean Age (Years)	Sex Distribution
46	19.06 ± 3.97	Males - 17
		Females - 29

Pairs	Group	Mean	Std Deviation	Std Error	Paired t-test	p-value
Pain Score 1	Control	4.30[a]	1.698	.250	----	Not Significant
	Case	4.3043[a]	1.69797	.25035		
Pain Score 2	Control	2.93	1.569	.231	10.200	0.000* (Significant)
	Case	0.7174	.80727	.11903		

Table No.:04. Table given below shows the pair wise mean sample test between case and control in pain score in day 1 and pain score after one week. From the table it conforms that mean pain score among case and control in pain score 1 found not statistically significant difference because mean and std deviation values found same both in case and control group but in the pair wise comparison between of pain score after one week among case and control found significant difference in their mean value at 5% level of significant and p-value less than 0.05.



The pain score mean on control side on day one was 4.30±1.69 while as on experimental side was 4.304+1.69

The pain mean score on while as on day 7 it was 0.714± 0.8 while as on control side it was 2.93±1.5

The difference of mean pain score between two is 2.1±1.1 indicating lesser pain on experimental side

III. Discussion

The laser used in the current study was operated at a power output of .2W. It has been recommended by Sun G *et al* that the best range of power output to produce a sub-thermal effect in the irradiated tissues is 1-500mW.[15] In case a higher power output is used, then the irradiation has to be delivered using a defocussed hand piece. In the present study, a defocused hand piece with a surface area of 1.49 cm^2 was used. The power density of the laser beam was 0.67W/cm^2 which was well within the range specified by Carroll et al.[16] The power output used in the study was higher than the previous reported studies as in these studies the tissue was directly irradiated using a fiber optic hand piece having a lesser surface area. The power output was thus increased to maintain an adequate power density. This is in agreement with the recent study by Caccianiga et alin which, laser with a power output of .1W was found to have a stimulatory effect on the rate of orthodontic tooth movement.[17]Hence a power output of .2W as considered to be appopriate

In the present study, the laser was irradiated on a total of 10 sites (5 buccal and 5 palatal) around the maxillary canine. On the buccal and palatal side, two irradiations were given on the coronal and apical part of the root and one irradiation was given on the center of the canine root This protocol has been favored in the current study so as to cover the maximum area of periodontal fibers and alveolar bone around the canine.

The energy density used in the present study was 50.J/cm^2. There has been a wide variation in the energy density in the previously reported studies and it is considered one of the main factors behind the varying effects of low-level lasers. It is universally accepted that the dosage of the laser follows Arndt - Shultz law. According to this law, there is therapeutic window of the laser dose in which it is stimulatory. A laser with an energy density within this window can have stimulatory effect on the rate at which the tooth moves under orthodontic loads. A dose below this therapeutic window produces no effect on the tissues; while a higher dose is inhibitory in nature.[15] This law has been experimentally proved by Goulart et al, who in their study to investigate the effect of laser on the rate of tooth movement in dogs found that when the energy density of laser was 5.25 J/cm^2 there was stimulation of the orthodontic tooth movement but when the energy density was increased to 35.0 J/cm^2, an inhibitory effect of the laser therapy was seen.[18.]The laser irradiation also follows Bunsen-Roscoe rule, which states that the effect of the laser therapy is determined by the dose of the laser that is irradiated and not by the time needed to deliver that dose. For each wavelength of laser light delivered, there is a dose at which maximum effect of the laser can be seen. In doses above and below it, the effect of the laser is diluted. The effect of the laser therapy has been shown follow a bell shape curve in regards to the energy density showing dose dependency of the laser therapy. Though in the past decade there has been a veritable explosion in the research related to the effect of low-level laser therapy on the rate at which tooth moves under orthodontic load, there is no consensus on the adequate energy density of the laser therapy till date. whereas a gradual decrease occurred in laser group.

The mean pain score of the LLLT group was lower than placebo and control at all-time intervals the difference was statistical significant between the sides.Overall the results solicit to conclude that LLLT can be accepted and used as a novel treatment modality and can be effectually employed for the alleviation of pain in an orthodontic therapy patient and improve the quality of treatment.It is a non-invasive tool and has no side effects like that of non-steroidal inflammatory drugs

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