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EFFECT OF LOW LEVEL LASER THERAPY ON RETRACTION OF MAXILLARY CANINES– A COMPARATIVE STUDY

Dental Science

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ABSTRACT

Objective: Prolonged treatment time during treatment remains the main reason for avoiding orthodontic therapy. The purpose of this study was to assess the effect of Low Level Laser Therapy (LLLT)/ Photobiomodulation on the rate of tooth movement during canine retraction phase

Method: The study included 20 patients requiring first premolar extractions in the maxilla. A split mouth study design was used. Individual canine retraction was performed using NiTi closed coil springs. A gallium aluminium arsenide semiconductor diode laser emitting infra-red radiation at 810nm, for 12 seconds at a continuous wave mode was used. The amount of canine retraction was measured with a digital electronic caliper at the start and on 60thday of canine r etraction and their difference on the experimental and control sides was compared.

Results: Significant difference was found in the amount of canine retracted on the experimental and the control sides. n: The tested LLLT parameter scan be considered to reduce the orthodontic treatment time as it significantly increased the rate of canine retraction

KEYWORDS

Low Level Laser Therapy, Photobiomodulation, Orthodontic Tooth Movement

Introduction

Prolonged treatment duration is one of the main restraints in orthodontics as it causes patients, especially adults to avoid orthodontic treatment by seeking shorter alternative methods[1]. Various treatment modalities to enhance the rate of orthodontic tooth movement have been developed like administration of pharmacologic al agents, surgical procedures and mechanical or physical stimulation. Administration of drugs like prostaglandinsE[2,3], cytokines[4,5], vitaminD[6], osteocalcin[7],and relaxin[8] around the alveolar socket accelerated the rate of tooth movement but had unwanted effects like pain and discomfort during injection delivery and local and systemic effects. Surgical methods are invasive and expensive that reduces their acceptance.

Use of LASERs (Light Amplification by Stimulated Emission of Radiation) has now become common in dental practice. Many studies support that LLLT accelerates the rate of orthodontic tooth movement (OTM) by proliferation of osteoclasts, osteoblasts and fibroblasts.[9]But most of these studies are short term showing differing and inconclusive results. Also, irradiations were given with short intervals between the visits, which led to compliance problems.

Thus, this study aimed of assessing the efficacy of LLLT on the rate of OTM during canine retraction phase.

Methodology

20 patients seeking fixed orthodontic treatment in the Department of Orthodontics and Dentofacial Orthopaedics, Inderprastha Dental College and Hospital, Sahibabad, Ghaziabad, India, who met the case selection criteria were considered for the study.

Inclusion Criteria

- Aged 14 years and above
- Patients who require maxillary bilateral first premolar extractions.
- No history of previous orthodontic treatment.

Exclusion Criteria

- Systemic illness,
- Requiring extractions other than first premolar extractions in the maxilla,
- Angle's class III molar relation,
- Parafunctional habits and severely periodontal compromised.

Prior to the study, patients and guardians were informed about the study and a written consent was taken. A Pre-adjusted edgewise appliance (0.022 slot) was bonded with Grengloo™ (Ormco) and curing was done using LED (IvoclarVivadent). After leveling and alignment and after 30 days of 19X25 SS wire placement, individual canine retraction was started with NiTi closed coil spring positioned from the power arm of canine bracket to the first molar buccal tubehook. The maxillary incisors were consolidated. A constant force of 150gm was maintained and measured with dontrixguage (Morelli Orthodontia). Right side of the maxilla was considered control side without irradiation (Group I) and left side was chosen to be irradiated with the laser (Group II).

A gallium aluminium arsenide (Ga-Al-As) semiconductor diode laser equipment (AMD Lasers, Picasso Lite Dental Diode Laser) **(Figure 1)**emitting infra-red radiation at 810nm, at continuous wave mode with output power of 100mW, dose of 4.0 J/cm^2 and exposure time of 12 seconds was used in the study.

Figure 1

Total 10 irradiations were carried out, 5 on the buccal and 5 on the palatal side of canine on the experimental side **(Figure 2)**. The doses were distributed as: (1) Two irradiation doses on the cervical third (one medial, one distal), (2) Two irradiation doses on the apical third (one medial, one distal), (3) One on the middle third (center of the root). Laser irradiation was done on days 1,3,4,30 and 45 of the canine retraction phase.

Figure 2

The distance between the distal slot of canine bracket and the mesial opening of the buccal tube of first molar was measured with digital electronic caliper. It was measured on day 1 of canine retraction, T_0 and at the end of two months (60^{th} day), T_1. The difference between T_0 and T_1 was calculated as the amount of canine retraction over a period of two months. Amount of canine retraction was compared within the groups using the student's paired *t*-test. The average of rate of canine retraction on the experimental and control sides was compared using the unpaired *t*-test.

Results

The mean amount of orthodontic canine retraction at the end of 2 months was 1.680±0.450mm on the control side and 1.985±0.549 mm on the laser irradiated side. The overall movement of the canine on the laser irradiated side was found to be greater than the control side. **(Table 1).**

Table 1: Paired t-test

Groups	Mean T0 - T1	S.D.	Std. error of mean	t-value	p-value
Group I (Control)	1.680	0.450	0.3264	3.492	0.002*
Group II (Laser)	1.985	0.549	0.1227	16.171	0.001*

Unpaired t – test showed there is a significant difference between the two groups,**(Table 2)** which suggests that the application of laser significantly increased the rate of canine retraction.

Table 2: unpaired t-test

Groups	Mean	S.D.	Mean difference	t-value	p-value
Group I (Control)	1.680	0.450	-0.3050	-1.921	0.049*
Group II (Laser)	1.985	0.549			

Discussion

The biostimulatory effects of LLLT have been studied extensively in orthodontics to assess its effects on OTM. Most of the studies concluded that LLLT causes increase in rate of tooth movement.[10-13] A few studies concluded that it has no effect on OTM.[14-16]Systematic reviews have established that a lack of evidence exists regarding LLLT's effectiveness in accelerating OTM.[17,18]

Significant amount of tooth movement occurred on both experimental and control sides in our study. The laser irradiated side showed significantly greater tooth movement than the control side. This finding is in concordance with most of the previous studies done by Cruz et al.[10], Sousa et al[11], Youssef et al[12], Qamruddin et al.[13], who proposed that LLLT may be effective in accelerating the rate of orthodontic tooth movement.

However, some studies[14,15,16] have shown non-significant differences between the control and experimental groups indicating no changes in the rate of OTM with the application of LLLT. The results may be explained by the variability in wavelength and fluency of those investigations. In Limpanichkulet al.[14] [860nm, 25 J/cm^2] and the Kansal et al.[15] study [904 nm , 4,2 J/cm^2], the laser devices had higher wavelengths in comparison to other published trials by Cruz et al.[10][780nm,5 J/cm^2]; Sousa et al [11][780nm, 20 J/cm^2]; Youssef et al.[12][809nm]. But the study by Heravi et al[16] used a laser device with a wavelength of 810nm and an energy density of 21.4 J/cm^2. The total energy and the total irradiation dosage used in their study was higher compared to those employed by other authors who acknowledged significant difference in the rate of the canine retraction with the application of LLLT which may have been the deciding factor.

The present study showed hopeful results in terms of enhancing OTM with the application of LLLT, even with the reduced number of laser application appointments. Nonetheless, the limitations of the study cannot be annulled. A small sample size and short duration of the study may be limiting factors in this study. Further high quality trials with larger sample size and longer duration will be more emphatic for assessing the effects of LLLT on the rate of orthodontic tooth movement.

Conclusion

The following conclusions can be drawn

1. LLLT increased the rate of canine retraction.
2. It can be used to effectively increase the rate of tooth movement and decrease the overall treatment time.

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