Al-Azhar Journal of Dentistry

Manuscript 1657

Pediatric dentistry and orthodontics Issue (Pediatric Dentistry, Orthodontics)

Assessment of Low Level Laser Therapy Effect on Treatment Outcomes of Bony Supported Distal Jet for Correction of Angle Class II Malocclusion (Randomized Clinical Trial)

Rabab El-Hoseiny

Samir Ibrahim

Fatma Abdelaziz

Wael Attia

Hend S ElSayed

ORIGINAL STUDY

Assessment of Low-level Laser Therapy Effect on Treatment Outcomes of Bony-Supported Distal Jet for Correction of Angle Class II Malocclusion (Randomized Clinical Trial)

Rabab El-Hoseiny [a,*], Samir Ibrahim [b], Fatma Abdelaziz [b], Wael Attia [a], Hend S. ElSayed [a]

[a] Department of Orthodontics and Pediatric Dentistry, Oral and Dental Research Division, National Research Centre, Egypt
[b] Department of Orthodontic, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt

Abstract

Purpose: The following study aimed to evaluate the effect of maxillary molar distalization on the skeletal vertical and sagittal variables and on linear and angular changes of upper first premolar after low-level laser application. **Patients and methods:** This investigation involved 14 adolescent participants (10 females and four males) diagnosed with dental class II malocclusion. These individuals underwent maxillary molar distalization utilizing the Bony-Supported Distal Jet mechanism. Participants were randomly assigned to one of two groups: the experimental group, receiving adjunctive therapy with a Ga-Al-As semiconductor diode laser emitting continuous infrared radiation at a wavelength of 910 nm and a power output of 0.2 W, and the control group, which underwent treatment with the Bony-Supported Distal Jet alone, without laser application. The study employed predistalization and postdistalization cone beam computed tomography scans to evaluate alterations in both skeletal and dental parameters. **Results:** The comparative analysis revealed no statistically significant differences in the skeletal component or the linear and angular measurements of the maxillary first premolars between participants treated with the laser and those in the control group. **Conclusions:** The application of low-level laser therapy in conjunction with the Bony-Supported Distal Jet for the distalization of molars in adolescents with class II malocclusion does not demonstrate a significant advantage in terms of the distal movement and tipping of the maxillary first premolars compared to conventional treatment without laser. This study concludes that while the Distal Jet appliance effectively corrects class II malocclusion in adolescents, the adjunctive use of low-level laser therapy offers no significant additional benefit in altering the dental or skeletal outcomes of treatment.

Keywords: Distal Jet, Distalization, Low-level laser, Low-level laser therapy

1. Introduction

One-third of people around the world are suggested to have angle class II malocclusion with either skeletal, dental, or both components. Class II with a dental component is either treated with first premolar extraction or maxillary molar distalization [1]. More recently, shifting towards nonextraction modalities has been presented strongly as an alternative. Moreover, temporary anchorage devices have enhanced orthodontist control over anchorage, which in turn increased the interest of the idea of nonextraction therapies [2–4].

Maxillary molar distalization could be achieved either with extraoral compliance appliances, including the head gear appliance, or intraoral noncompliance appliances, which in turn are divided into tooth-anchored and bone-anchored distalizing appliances. The advantages of bone-anchored over tooth-anchored appliances are

Received 14 February 2024; accepted 13 November 2024.
Available online 19 February 2025

* Corresponding author at: Department of Orthodontics and Pediatric Dentistry, Oral and Dental Research Institute, National Research Centre, Cairo, Egypt.
E-mail address: dr.rababelhosseny@yahoo.com (R. El-Hoseiny).

https://doi.org/10.58675/2974-4164.1657

shortening the treatment time and the prevention of anterior anchorage loss that may compromise the treatment [5].

Using tooth-anchored units on maxillary first premolars leads to mesial drifting of premolars and increasing anterior over a jet that worsens the class II malocclusion, so Bony-Supported Distal Jet appliance with paramedian insertion mini-screw seems to be a suitable option in most of the cases since they have strategic position away from the roots of the tooth to be distalized [6—8].

In the last decade, the effect of low-level laser therapy (LLLT) on the histochemical pathways associated with orthodontic tooth movement was conducted in many animal and human histologic studies, and they concluded that LLLT had a direct effect on orthodontic tooth movement [9,10].

Thus, this study aimed to evaluate the effect of LLLT on the treatment outcomes of class II malocclusion.

2. Patients and methods

This study included 14 patients. They were recruited from the outpatient clinic of the Orthodontic Department, Faculty of Dental Medicine, Al-Azhar University (Girls' Branch). The age of the participants in this study ranged between 11 and 14 years. The inclusion and exclusion criteria were; inclusion criteria: bilateral angle's class II malocclusion minimum of 1/4 cusped discrepancy, normal or low mandibular plane angle cases, and no history of serious medical illness and exclusion criteria: patients with skeletal class II with retrusion mandibular profile, vertical growth pattern, and steep mandibular plane angle and patients with shallow or anterior open bite.

The study protocol was reviewed and approved by the Ethical Committee of the Faculty of Dental Medicine for Girls, Al-Azhar University, with the code (REC-OR-19-01). Before the beginning of the treatment, the protocol of this study, it was explained in detail to each patient and his guardian, and then patients who approved the procedure signed an informed consent.

The patients were randomly allocated to two groups: the laser group, in which the patients received Bony-Supported (Distal Jet, American Orthodontics Comp, Chicago, USA) with LLLT, and the control group, where the patients received the distalizer without LLLT.

Bony-Supported Distal Jet for both groups was adapted anteriorly on two paramedian-inserted screws using composite resin and attached posteriorly to the lingual sheath of molar bands on both sides. Activation of the appliance was carried out monthly by compressing the bilateral NiTi coil springs along the bayonet assembly that was attached to the lingual sheaths of the maxillary first molars (Fig. 1).

The laser group received LLLT through a semiconducted Al-Ga-Ar diode laser tip of 940 nm wavelength and power output of 0.2 W in a continuous noncontact wave mode on the buccal and palatal sides. Figure 2 compares the pretreatment and posttreatment intraoral photographs.

For assessment of the effect on the first maxillary premolar, cone beam computed tomography (CBCT) scans were taken at the start of treatment and after class I, a molar relation was achieved. CBCT images were viewed and analyzed on Romexis 6 software (Planmeca Romexis@ 6.0; Planmeca Oy, Finland). Measurement of skeletal changes in SNA, SNB, ANB, and SN/GoGn angles and maxillary first premolar sagittal movement and long axis angle were measured in millimeters and degrees, respectively, to detect anchorage loss caused by LLLT application.

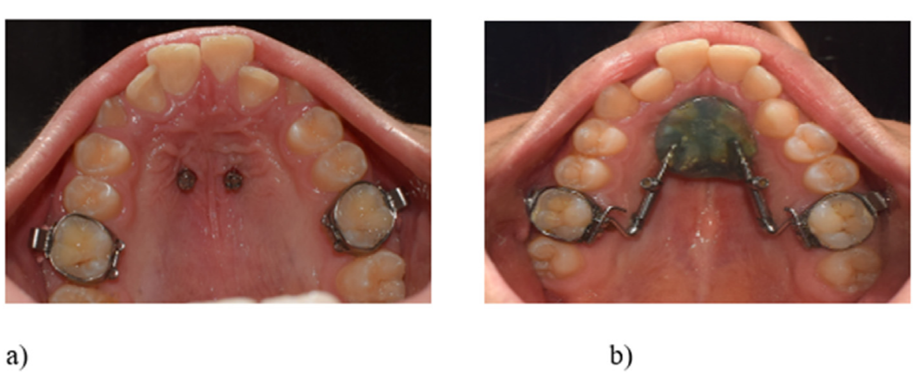

Fig. 1. (a) Two paramedian miniscrews, (b) Bony-Supported Distal Jet in place.

Fig. 2. Predistalization and postdistalization photographs (a, b).

Table 1. Mean ± SD of premeasurement and postmeasurement in laser and control groups regarding the effect of Bony-Supported Distal Jet on skeletal outcomes.

	Laser GP ($N = 7$)		Control GP ($N = 7$)		P value
	M	SD	M	SD	
SNA					
Pre	84	1.63	80.86	4.06	0.15
Post	83.29	1.21	80.14	3.62	0.10
Difference	−0.71	1.25	−0.71	0.76	1
SNB					
Pre	77.57	1.86	75.29	4.19	0.3
Post	76.86	1.67	74.85	4.06	0.35
Difference	−0.71	1.25	−0.43	1.27	1.65
ANB					
Pre	5.86	0.82	5.29	1.11	0.4
Post	5.57	0.54	5.14	1.21	0.48
Difference	−0.29	0.49	−0.14	1.06	0.77
SN/GoGn					
Pre	31.57	4.17	38	2.65	0.02*
Post	31.43	5.51	39.14	1.95	0.01*
Difference	−0.14	1.95	1.14	1.07	0.06

GoGn, gonion–gnathion plane; M, mean; SN, sella–nasion plane.
*Significantly different ($P \leq 0.05$).

3. Results

The statistical analysis of the data was collected, tabulated, and analyzed. The data were explored for normality by Kolmogorov–Smirnov and Shapiro–Wilk tests and presented as means and SD. For comparison between premeasurement and postmeasurement. Paired t test was used; moreover, Student's t test was used for comparison between laser and control groups. The significance level was set at P value less than or equal to 0.05. Statistical analysis was performed with Microsoft Excel (Microsoft Excel for Mac version 16.78).

No statistical significance was found between the control and laser groups in the number of skeletal changes, as shown in Table 1.

No statistical significance was found between the control and laser groups in the amount of maxillary first premolar sagittal movement and tipping angle, as shown in Table 2 and Figs. 3 and 4.

4. Discussion

Maxillary first molar distalization is the noninvasive method of correction of dental class II with maxillary component. Increasing the maxillary arch length to correct increased overjet or relief of moderate crowding has a better success rate before the eruption of the second molar, so the patients of this study included adolescent patients [5].

Tooth-supported molar distalization appliances gain their anchorage from occlusal rests attached directly to first premolars or soldered to their bands, which leads to undesirable side effects represented by anchorage loss at the premolar area; so in this study, distalization was carried out utilizing miniscrews as skeletal anchorage to overcome this side effect and evaluate its effect on the movement of the first premolars [6].

The maxillary molar distalization was carried out in the two arms of our study. Activation of the Bony-Supported Distal Jet was carried out monthly according to manufacture instructions till class I molar relation was achieved on both sides. While in the laser group, patients received a laser photobiomodulation regimen during distalization Bony-Supported Distal Jet.

Table 2. Mean ± SD of premeasurement and postmeasurement in laser and control groups regarding the distance between maxillary first premolar centroid − PTV line and the angle between maxillary first premolar centroid − SN line.

Distance between maxillary first premolar centroid and PTV line						
		Laser GP ($N = 7$)		Control GP ($N = 7$)		P value
		M	SD	M	SD	
PTV/U4 (mm)	Pre	42.30	6.415	38.24	2.839	
	Post	39.65	6.433	36.07	4.044	0.2105
	Difference	2.65	1.775	2.17	2.281	0.6613
	P value	0.0075	0.0454			
Angle between maxillary first premolar centroid and PTV line						
		Laser GP ($N = 7$)		Control GP ($N = 7$)		P value
		M	SD	M	SD	
SN/U4 (degree)	Pre	88.05	10.87	89.89	11.811	
	Post	81.05	11.02	85.05	13.626	0.5492
	Difference	6.64	5.897	4.84	2.42	0.0170
	P value	0.0247	0.0019			

M, mean; PTV, ptregoid vertical line; SN, sella−nasion plane; U4, maxillary first molar.
*Significantly different ($P \leq 0.05$).

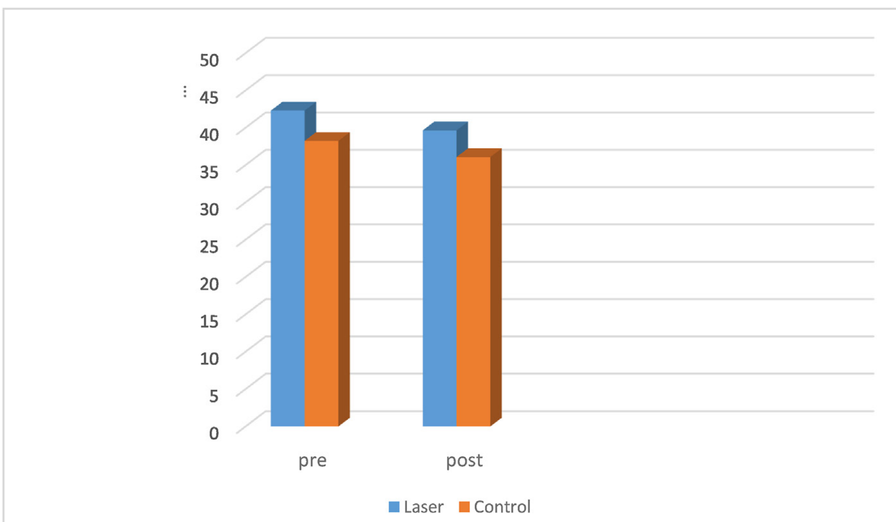

Fig. 3. Premeasurement and postmeasurement in laser and control groups regarding the distance between maxillary first premolar centroid and PTV point.

In this study, both laser and control groups showed improvement in the antero-posterior skeletal relationship by the decrease in SNA and ANB angles by 0.71° and 0.29°, respectively, however; there was insignificance difference between both groups, with an insignificant increase in mandibular plane angle, which came in agreement with other different bony-supported distalizing appliance studies [11–16].

In this study, both laser and control groups showed a significant differences in the amount of upper first premolar distal movement with −2.65 ± 1.77 and −2.17 ± 2.23 mm, respectively, and a significant decrease in tipping angle in both laser and control groups with −6.64 ± 5.9° and −4.84 ± 2.42°, respectively. These findings may be due to the fact that the premolars are allowed to drift distally under the influence of the trans-septal fibers.

This came in agreement with previous studies that showed distal premolar movement ranged from −1.7 to −2.2 mm, and a decrease in distal tipping angle ranged from −2.0° to −8.1° were noted in different distal screw studies [17–21].

This was opposite to a previous study in which the first premolars were mesialized by 0.72 ± 0.78 mm and tipped by 1.15 ± 2.98° in relation to the palatal plane, and the authors mentioned that might be due to the first premolars being included in the anchorage setup of the distal screw [22].

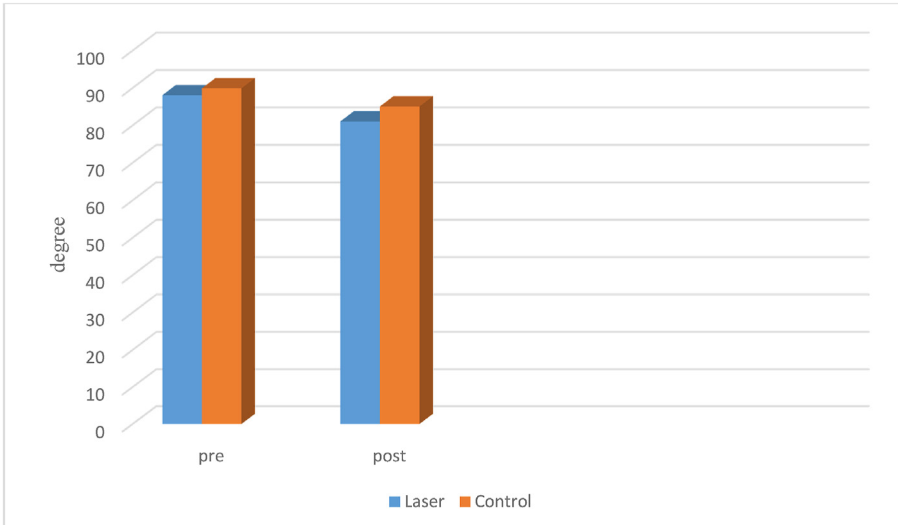

Fig. 4. Premeasurement and postmeasurements in laser and control groups regarding the angle between maxillary first premolar centroid and SN line.

4.1. Conclusion

Bony-Supported Distal Jet was able to achieve class I molar relation without loss of anchorage at the first premolar area. After maxillary molar distalization, the results showed significant distal movement and tipping of the upper first premolars in both the laser and control groups. Both groups had similar distal movement and tipping.

4.2. Recommendations

Further RCT studies are needed with different wavelengths and a larger sample size.

Ethics information

The study protocol was reviewed and approved by the Ethical Committee of the Faculty of Dental Medicine for Girls, Al-Azhar University, with the code (REC-OR-19-01).

Biographical information

The study were done at clinic of the Orthodontic Department, Faculty of Dental Medicine, AlAzhar University (Girls' Branch).

Funding

This study was partially funded by the National Research Centre in Egypt.

Conflict of interest

There are no conflicts of interest.

Acknowledgment

The authors are grateful to Dr Sally Mohammed, Radiology Department, Cairo University, for her effort in CBCT assessment.

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