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Effect of Low-Level Laser Therapy on Twin Block Functional Treatment

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ABSTRACT:
Background: It was postulated that low level laser can stimulate condylar growth and when combined with functional treatment it can obtain enhanced skeletal correction.
Aim: Evaluation of the effect of low- level laser therapy (LLLT) on twin-block functional treatment.
Methods: Twelve patients with skeletal class II showing mandibular retrusion were recruited. All patients received twin-block treatment combined with low-level laser therapy (LLLT) for the first three months of twin-block treatment. Lateral cephalograms were captured for all subjects before treatment and immediately following twin block treatment. Webceph was used to trace all pretreatment and post treatment cephalograms.
Results: LLLT showed no enhancement of skeletal correction following twin-block functional treatment but twin-block appliance is effective in class II correction
Conclusions: The parameters used in this study had no effect on enhancement of skeletal correction, meanwhile Twin block is effective in the treatment of skeletal class II malocclusion.
Keywords: Functional treatment, twin-block, LLLT, mandibular retrusion, skeletal class II.

I. INTRODUCTION:

Skeletal Class II malocclusion happens in 15% to 30% of different populations. McNamara stated that 85% of patients with skeletal class II show mandibular retrusion. They can be treated with a variety of methods such as camouflage and surgical management. In growing patients growth modification can be used to correct the skeletal discrepancy.(1)

Functional appliances are used to treat such cases in growing patients. They aim to stimulate mandibular growth and change its posture to generate forces by stretching muscles and soft tissues. Which changes the surrounding neuromuscular environment. Leading to bone remodeling and modification of growth. Some authors claim that such appliances lengthen the mandible while others believe that their effect is mainly dental. (2)

There are numerous kinds of removable and fixed functional appliances. Twin Block (TB) is a removable functional appliance that relocates the mandible anteriorly, to stimulate condylar growth (3).it has upper and lower blocks with inclined planes. (4)

Numerous methods as low-level laser therapy (LLLT), steroids and ultrasound have been used to stimulate the condylar growth to aid in mandibular advancement(5). Low-level lasers are a type of laser, with low cost and power output range 100-500 mw. It is a clinically applicable treatment that can be useful in many medical services. (6-8)

Many studies have investigated the effect of LLLT on condylar and mandibular advancement. They have shown promising outcomes that laser can stimulate cellular proliferation. (9) In spite of these promising results from animal studies, in literature there is no enough clinical trials evaluating the effect of LLLT on functional treatment of skeletal Class II patients. Therefore, this study aims to evaluate the effect of LLLT on skeletal and dental effects of twin-block treatment.

II. MATERIALS AND METHODS

Twelve patients with skeletal class II due to mandibular retrusion were recruited from the outpatient clinic in Department of Orthodontics Faculty of Dentistry Mansoura university, The committee of research ethics in Faculty of Dentistry Mansoura University "Dental Research Ethics Committee" approved this study(A05041022). Parents of the included patients signed a written informed consent. All selected patients fulfilled the following inclusion criteria: Skeletal class II due to mandibular retrusion, overjet more than 4mm and at cervical vertebrae maturation stage (C3-C4). These were the exclusion criteria: Cleft lip or palate, previous orthodontic treatment, any systemic disease,

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congenital craniofacial deformity, and poor oral hygiene.

Growth assessment was done using cervical vertebrae maturation stages (10). all patients received twin-block functional treatment using the modified design with incisal capping and palatal screw. LLLT was used twice a week for the first 3 months of twin block treatment. Biolase device[1] was used emitting a continuous wave 940 nm laser with power 0.5mw and total energy 22j. the whitening hand piece was used in contact mode. Laser was applied to the condyle, point anterior, point posterior, point above, point below, the masseter muscle and the temporalis.

After the first 3 months of treatment patients were followed up every 4 weeks. When a class I relation was attained twin block therapy was stopped and an anterior inclined plane was inserted as a support phase. Pretreatment and post treatment cephalograms were taken for all patients(fig1) and digital tracing was done using webceph.

Statistical analysis: IBM-SPSS software[2]. Qualitative data (sex) was expressed N (%) and compared by chi-square test. Quantitative data was initially tested by Shapiro-Wilk's test and the boxplots and were expressed as mean (SD). paired-samples t-test was used to compare pre-post data. results were considered as statistically significant if p value ≤ 0.050. Appropriate charts were used to graphically present the results whenever needed.

III. RESULTS

Recruitment began in October 2022.Twelve participants were collected from the outpatient clinic at Department of Orthodontics Faculty of Denristry Mansoura University.

Baseline data**:** ages and baseline cephalometric data are shown in table(1)

Treatment outcomes: table(2) shows cephalometric measurements. Table(3) shows pre post data and mean difference. Paired sample t-test showed a significant increase in SNB, ArGoMe, CoGn, ArGo, IMPA, PFH, TAFH, LAFH and UAFH (P-value= <.001,.009,<.001, .001, .009, <.001, .003,.033 and .009 respectively) and a significant decrease in U1-SN, ANB,OJ and OB(P-value= <.001, <.001, <.001and .004 respectively).Fig (2) shows pre and post treatment photographs.

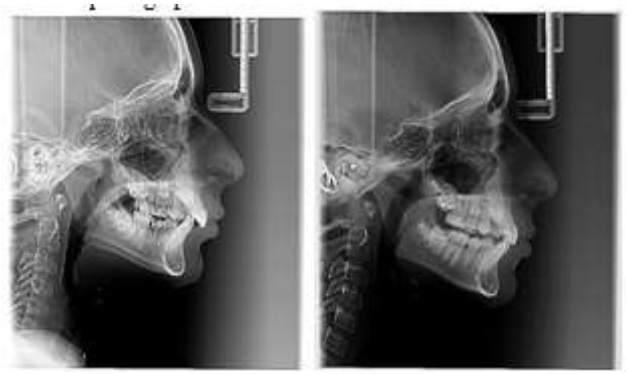

Figure (1) Pretreatment and Post treatment cephalograms

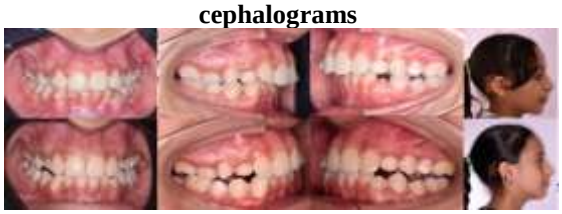

Figure (2) Pretreatment and Post treatment photographs.

Table (1): Demographic data:

Categorical	**N**	**%**
Sex		
Male	2	20
Female	8	80
Numerical	**M**	**SD**
Age	10	0.9

Table (2) Cephalometric Measurements

Measurement	**Definition**
SNA(°)	The angle between point A , Nasion and Sella
SNB(°)	The angle between point B , Nasion and Sella
FMA(°)	The angle between the Frankfort plane and mandibular plane
Ar-Go-Me(°)	Gonial angle. The angle between (Articulare-Gonion) line and (Gonion-Menton) line
Go-Gn	The distance between Gonion and Gnathion
Ar-Go	The distance fromArticulare to Gonion
Co-Gn	The distance from condylion to gnathion (effective mandibular length)
U1-SN (°)	Angle formed between the long axis of the upper

[1]Epic X, BIOLASE,Inc
[2]IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp

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	central incisor and SN.
IMPA (°)	The angle between mandibular plane and the long axis of the mandibular central incisor
ANB(°)	The angle between NA and NB planes
Interincisal angle(°)	Formed between the long axis of the upper and lower central incisors
Overjet	The horizontal overlap between the most prominent maxillary central incisor and the labial surface of the most prominent mandibular incisors
Overbite	The vertical overlap between the most prominent maxillary central incisor and the labial surface of the most prominent mandibular incisors
PFH	Posterior facial height: The distance from Sella to Gonion
TAFH	Total anterior facial heigh :The distance from Nasion to Menton
UAFH	Upper anterior facial height: The distance from anterior nasal spine to menton
LAFH	Lower anterior facial height: The distance between the Nasion and the ANS
Nasolabial angle(°)	The angle is between Columella, Subnasale and Labrale superius

Table (3) shows pre-post cephalometric values and mean difference.

Characteristic	**pre**		**Post**		**Mean difference**	**p-value**
	M	SD	M	SD		
SNA (°)	81.2	2.8	80.94	3.16	-0.23	.511
SNB (°)	75.1	2.9	77.64	3.20	2.55	**<.001**
FMA (°)	25.1	5.8	25.08	5.80	-0.02	.926
ArGoMe (°)	122.9	6.8	126.20	6.65	3.30	**.009**
CoGn(mm)	94.9	5.5	102.78	5.07	7.85	**<.001**
Go-Gn (mm)	60.6	5.3	62.33	4.92	1.75	.151
Ar-Go (mm)	35.6	5.1	40.38	6.53	4.78	**.001**
U1-SN (°)	112.9	7.5	104.51	7.26	-8.38	**<.001**
IMPA (°)	98.7	4.5	103.80	6.01	5.10	**.009**
ANB (°)	6	1.1	3.42	1.73	-2.63	**<.001**
U1-L1 (°)	114.5	8.5	117.62	9.14	3.12	.127
OJ (mm)	8.6	2.7	2.39	1.36	-6.26	**<.001**
OB (mm)	4.2	2.6	1.36	1.32	-2.82	**.004**
PFH (mm)	62.9	5	67.70	6.20	4.77	**<.001**
TAFH(mm)	98.3	4.2	103.92	4.23	5.64	**.003**
LAFH(mm)	56.7	3.2	59.09	3.52	2.36	**.033**
UAFH(mm)	43.7	2.5	45.82	2.64	2.13	**.009**
NLA (°)	109.3	7.4	110.22	8.35	0.94	.806

Notes: M=mean. SD=standard deviation. The test of significance is paired-samples t test.

IV. DISCUSSION:

Class II malocclusion is one of the most prevalent orthodontic problems, affecting roughly 1/3 of the population. The most common diagnostic feature in Class II malocclusion is mandibular retrusion. In such cases a treatment that enhances mandibular growth is recommended. Multiple functional appliances designed to enhance mandibular growth are available.(3, 11)

In this study twin block appliance was used as it is one of the most common removable functional appliances because it is more tolerable, it is smaller than most other functional appliances, it minimally interferes with speech and it allows the use of expansion screw for tooth movement.(4)

In this study treatment age was assessed using CVM stages according to the modified technique of Baccetti et al.(10) The advantage of

this modification is that mandibular skeletal maturity can be determined using one lateral cephalogram. In the current study all subjects were treated at CS3-4 as it is the initiation of peak growth velocity, to achieve maximum treatment effects using twin block appliance.(10)

Low-level laser therapy (LLLT) was proven to stimulate proliferation of fibroblasts and chondroblasts (12). Evaluating the effect of low-level laser therapy on growth of the condyle and mandibular advancement has been a point of interest. Several studies(13-18) have shown that low-level laser irradiation can be used for correction of mandibular retrusion but no agreement on the protocols and parameters was reached for the application of LLLT with functional treatment.In the current study laser parameters were chosen and set according to literature and previous studies.(9, 14, 19-21)

1-Maxillary skeletal effect:

Results of this study showed that twin block treatment had no significant effects on the maxilla similar to the findings of Lund and Sandler(22) and Toth and McNamara(23), but unlike Mills and McCulloch (24)and Sidlauskas (25) they both found statistically significant headgear effect based on reduction of (SNA) angle. O'Brien et al(26) and Sidlauskas (25). both found statistically significant changes in maxillary base length unlike results of the current study.

Lund and Sandler(22) assumed that lingual tipping of the crowns of upper incisors and labial tipping of their roots cased remodeling of A point more anteriorly which could mask the headgear effect which may have happened.

2-Mandibular skeletal effect:

In the present study mandibular growth was responsible for SNB angle to increase significantly, this was in line with the study of Jena et al (27)and Illing et al.(28) but findings of O'Brien et al(26) were contradictory as they found the mandibular skeletal change to be too small to be clinically significant.

This Increase in SNB was similar to average increase by TB appliance(13, 29) this may mean that LLLT had no synergetic effect over mandibular skeletal changes. This is similar to the findings of Mohamed et al (13) who used a semiconductor 635 nm laser with 4.5 j/cm² and 50 mw they found LLLT to have no considerable effect on condylar volume, also(14) Amer et al in their study with 940 nm semiconductor laser, 100mw power output and 3.9j/ cm² energy density found that these parameters didn't add to the effect of twin block appliance. On the other hand Aghili et al (18) found LLLT to have a significant effect on SNB increase this might be because they used a different functional appliance(Farmand). Also Seifi et al.(30) found that gallium arsenide (GaAs) laser irradiation had a significant effect on the increase of mandibular length in rats. These positive effects in animal studies can be explained by easier determination of effective parameters in animals and the difference in anatomy between humans and animals.

Ramus height (Ar-Go) increase was significant. this could be attributed to the photobiostimulatory effect of low -level laser application. This goes with the findings of Aghili et al (18) who also found a significant increase of ramus height in the LLL and farmand group when compared with the farmand only group also this was consistent with the findings of Okasyan et al (15) study on albino rats in which they observed that mandibular growth in the 8 J/cm2 laser in conjunction with the mandibular advancement appliance showed the most mandibular growth. They reached the conclusion that laser can stimulate growth of the condyle.

3-Maxillary dentoalveolar effect:

In the current study there was a significant retroclination of maxillary incisors. This agrees with Mills and McCulloch(24), O'Brien et al(26), Lund and Sandler(22) and Toth and McNamara(23). Clark(4)attributed this retroclination to the presence of a labial bow and advised against it explaining that with retroclination of the maxillary incisors the potential skeletal correction is reduced, but O'Brien et al(26), Toth and McNamara(23) and Mills and McCulloch(24) in their study the twin block design didn't have a labial bow and still the maxillary incisor showed retroclinationToth and McNamara (23)suggested that the retroclination could be due to the pressure of upper lip musculature during functional treatment, which could explain the retroclination in the absence of a labial bow.

4-Mandibular dentoalveolar effect

In this study´s findings mandibular incisors showed significant labial tipping as seen in the increase of IMPA which goes with the results of Mills and McCulloch (24), Toth and McNamara(23) and Lund and Sandler(22). Despite the fact the twin block design in the current study had acrylic capping covering the lower incisors and that of all other studies didn't, this agrees with the findings of Van der Plas(31) that acrylic capping has no effect on lower incisors proclination.

5-Maxillomandibular relation effect:

In the current study Maxillomandibular relation was improved and correction of class II malocclusion was accomplished by reduction of ANB angle .This is similar to the findings of Toth and McNamara(23), Lund and Sandler(22) and Mills and McCulloch. (24)

Results of this study showed a significant overjet and overbite reduction this was similar to Toth and McNamara(23), Mills and McCulloch (24) and O'Brien et al(26) This overjet reduction was the result of both skeletal and dental effects. Baccetti et al (32) among other authors (24, 27)stated that most of this correction is the result of skeletal correction on the other hand Lund and Sandler(22) and O'Brien et al(26) found that dental changes were predominant.

6-Facial height effect:

PFH increase was statistically significant.This increase was in line with the results of Mills and McCulloch (24) who also reported increased PFH with twin block treatment. Findings of the current study also showed that TAFH and LAFH increased significantly, increase of AFH is a consistent finding for twin block treatment. (22, 24, 28)which is mostly due to increased LAFH because of downward and forward movement of the mandible. On the other hand Lund and Sandler and Mills and McCulloch(22, 24) found no vertical changes following twin block treatment.

7-Soft tissue effect:

Nasolabial angle increased insignificantly. This increase was due to retroclination of upper incisors(33)

V. CONCLUSION:

Twin-block appliance is effective in treatment of skeletal class II malocclusion, meanwhile the correction was similar to the average twin block effect which means that LLLT didn't enhance twin block effect.

Recommendations:

It is recommended to include a control group to compare treatment results.

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