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Original Article

Effectiveness of high-intensity laser therapy in patients with myogenic temporomandibular joint disorder: A double-blind, placebo-controlled study

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ABSTRACT

Purpose: The aim of the study is to evaluate the effectiveness of high-intensity laser therapy (HILT) in the short and long term in the treatment of patients with the myogenic temporomandibular joint disorder (TMD).

Methods: This prospective, double-blind, controlled clinical study was conducted on patients with myogenic TMD at a university's oral and maxillofacial surgery clinic. Seventy-six patients were randomized into two groups (HILT, and control group), including 38 patients in one group. The patients were evaluated for pain, the range of motion of the jaw, disability, and quality of life. Assessments were performed before therapy (week 0) and after therapy (weeks 4 and 12). Data were evaluated using SPSS-20 and the level of significance was set at $p < 0.05$.

Results: There was no significant difference between the groups in terms of socio-demographic characteristics of the groups at the beginning of the study. In the 4th week, the VAS pain score was significantly decreased in the HILT group (47%) compared to the placebo HILT group (4%) ($p < 0.001$). The maximum mouth opening was significantly increased in the HILT group (27%) compared to the placebo HILT group (4%) at week 12 ($p < 0.001$). The HILT group showed a significant improvement in Jaw Functional Limitation Scale 20 (JFLS-20) and Oral Health Impact Profile (OHIP-14) compared to the placebo HILT group ($p < 0.001$ and $p < 0.005$ respectively).

Conclusion: As a result of the study, it was concluded that HILT is a highly effective, non-invasive therapeutic method for patients with myogenic TMD.

1. Introduction

Temporomandibular disorders (TMDs) are painful musculoskeletal disorders that include masticatory muscles, temporomandibular joints (TMJs), and other orofacial anatomical structures [1]. Typical clinical symptoms of TMD are idiopathic and episodic musculoskeletal pain and/or TMJ sounds (e.g., clicking, cracking, and crepitating) and/or restricted jaw movements [2]. TMD one of the most common chronic problems including orofacial pain, discomfort, and disability and is the second-most-common skeletal- muscular issue. TMD is a fairly common disease that affects about 5–12% of the general population and is up to four times more common among women [3]. TMD etiopathogenesis remains uncertain. In general, the cause of TMD is thought to be multifactorial, including biomechanical, neuromuscular, biopsychosocial, and biological causes [4]. The mainstay of therapy for TMD is, therefore, a multidisciplinary strategy that involves physiotherapy approaches such as manual therapy, electrotherapy, ultrasound, transcutaneous electrical nerve stimulation (TENS), or laser therapy [5].

Low-level laser therapy (LLLT) was introduced in the early 1960s as a method that reduces pain and inflammation and accelerates healing in target tissues with a bio-modulative effect on tissues. Recently, its use to decrease pain and improving the function in TMD patients have received great attention. The laser changes cellular functions by altering intercellular communication away. Laser light influences the mitochondrial respiratory chain by increasing the activity of certain enzymes such as cytochrome oxidase and adenosine triphosphatase (ATP). It also improves collagen and pro-collagen production and deoxyribonucleic acid (DNA) synthesis and can enhance cell proliferation. Laser therapy is a non-invasive and painless procedure that can be conveniently implemented in treatment units for a wide variety of conditions, but its true efficacy remains controversial [6].

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The pulsed neodymium-doped yttrium aluminum garnet (Nd: YAG) laser, a type of high-intensity laser therapy (HILT), has recently been introduced as a new treatment method. Nd: YAG laser, a form of HILT, works with high peak power (3 kW) and a wavelength of 1064 nm. HILT is a non-invasive and painless treatment method. The latest studies have reported the beneficial effects of Nd: YAG laser therapy in patients with pain. The advantage of HILT over LLLT is that HILT is able to penetrate and stimulate wider and/or deeper areas; thus, considerably more energy may be transmitted to tissue during HILT therapy compared to LLLT [7]. There are no studies in the literature regarding the effectiveness of HILT in TMD. In this randomized, placebo-controlled double-blind study, the effects of pulsed Nd: YAG laser therapy on patients' pain, function, and quality of life were evaluated in patients with myogenic TMD.

2. Material and methods

2.1. Study design and participants

The study design was a prospective, double-blind, placebo-controlled trial to investigate the effect of HILT in people with myogenic TMD. It was calculated that a total of 48 individuals should be taken, with at least 24 subjects from each group when α=0.05 and 1-β=0.80 were taken in the power analysis performed. The number of patients in each group was increased to 38, taking into account possible patient dropouts.

The study protocol was approved by the clinical research local ethics committee of the university(Decision no. 2019/185) and conducted in the oral and maxillofacial surgery clinic of the faculty of dentistry and the physical medicine and rehabilitation department of a university hospital from January 2019 to December 2019. Informed consent has obtained from all patients and the study was carried out in accordance with the principles of the Helsinki Declaration.

The patients were examined clinically and radiologically in an oral and maxillofacial surgery clinic by an experienced oral and maxillofacial surgeon. The diagnosis was made through a standard and comprehensive clinical examination based upon the diagnostic criteria of temporomandibular disorder (DC/TMD) [8]. The study included subjects suffering from myofascial pain with/without limited mouth opening. Subjects with disk displacement (with/without reduction), arthralgia, or osteoarthritis of the temporomandibular joint and those who received analgesic or antidepressant medicine or underwent any other form of treatment for TMD were excluded from the study. Such criteria have been confirmed by patient history, physical examination, and imaging techniques.

Seventy-six consecutive patients (between the ages of 18–70) who presented with TMJ symptoms were evaluated clinically and radiologically for TMD. A total of 6 patients were excluded because 4 patients did not meet the inclusion criteria and 2 patients were reluctant to participate in the study. Patients were randomly assigned to two treatment groups, HILT (n = 35) and placebo HILT (n = 35), using the numbered envelope method. The study was designed as a double-blind study. Researchers who evaluated clinical parameters before and after treatment did not know which treatment the patients received. Patients did not know to which group they were assigned or which treatment they would be offered. The physiotherapist was instructed at the beginning of the study to apply the treatments in a standardized manner. Patients were instructed not to take any analgesics and/or NSAIDs during the treatment and control periods.

2.2. Treatment groups

2.2.1. HILT group

Patients underwent pulsed laser therapy using a HIRO 3 device (ASA Laser, Arcugnano, Italy), five days a week for 3 weeks, and one session a day for 15 sessions in total. The device delivers pulsed emission (1064 nm), very high peak power (3 kW), a high level of fluency (energy density 360–1780 mJ/cm^2), a short duration (120–150 μs), a mean power of 10.5 W, a low frequency (10–40 Hz), a duty cycle of about 0.1%, a probe diameter of 0.5 cm, and a spot size of 0.2 cm^2. A standard handpiece endowed with fixed spacers was used to maintain the same distance to the skin. In each session, a 3-phase treatment program for the TMD region was applied (Table 1). The total energy delivered to the patient during one session was 1029.2 J in three phases of treatment. The first phase included rapid manual scanning (100 cm2 per 30 s) of the TMJ area. Scanning was carried out in both transverse and longitudinal directions over the bilateral TMJ. In this stage, a total energy dose of 498 J was administered. The laser fluence was set to three subphases of 360 mJ/cm^2 (166 J), 410 mJ/ cm^2 (166 J), and 510 mJ/cm^2 (166 J), for a total of 498 J. The second phase included the application of the handpiece with spacers fixed vertically at 90° to the trigger points. This phase was performed bilaterally on three trigger points (total of six points) over the masseter muscle with 10 J, a fluency of 610 mJ/cm^2, and a time of 6 s at each point, for a total of 33.1 J. The third phase included slow manual scanning (100 cm^2 per 60 s) of the TMJ region. The laser fluence was set to three sub-phases of 360 mJ/cm^2 (166 J), 410 mJ/ cm^2 (166 J), and 510 mJ/ cm^2 (166 J), for the total energy of 498 J. Figs. 1 and 2

Table 1
HILT therapy phases.

	Frequency (Hz)	Fluency (mJ/cm^2)	HILT energy dose (J)
Phase 1—fast manual scanning (100 cm^2 per 30 s)	20	360	166
	18	410	166
	15	510	166
Phase 2—trigger point inactivation phase	15	360	6.3
	15	510	9
	14	610	10
	16	360	7.8
Phase 3—slow manual Scanning	20	360	166
	18	410	166
	15	510	166

HILT: High intensity laser therapy.

The processing time for one session was about 15 min; the total energy supplied to the patient during one session was 1.029.2 J. (first phase, 498 J; the second phase, 33.1 J; third phase, 498 J). HILT was applied once a day for 15 days in a period of 3 weeks.

2.2.2. Placebo HILT group

Placebo treatment was administered in five sessions a week for 3 weeks, and a total of 15 sessions without current flow from the device. The same treatment procedure was applied in the placebo group, but the laser device was turned off during applications.

All laser applications were carried out by the same physiotherapist. No adverse effects related to HILT and placebo HILT therapy have been observed.

2.3. Outcomes measurements

The patients were evaluated for pain, range of opening mouth, disability, and quality of life. Assessments were carried out before therapy (week 0) and after therapy (weeks 4 and 12).

Pain intensity: The pain intensity was assessed using a 10-cm visual analog scale (VAS) (0, no pain; 10, worst pain) and recorded in each session.

Jaw function: Jaw function was evaluated using a 10 cm visual analog scale (VAS) (0, no function; 10, function not decreased) and recorded at each session.

Maximum mouth opening: Maximum mouth opening was evaluated in two ways, unassisted and assisted. The maximum unassisted

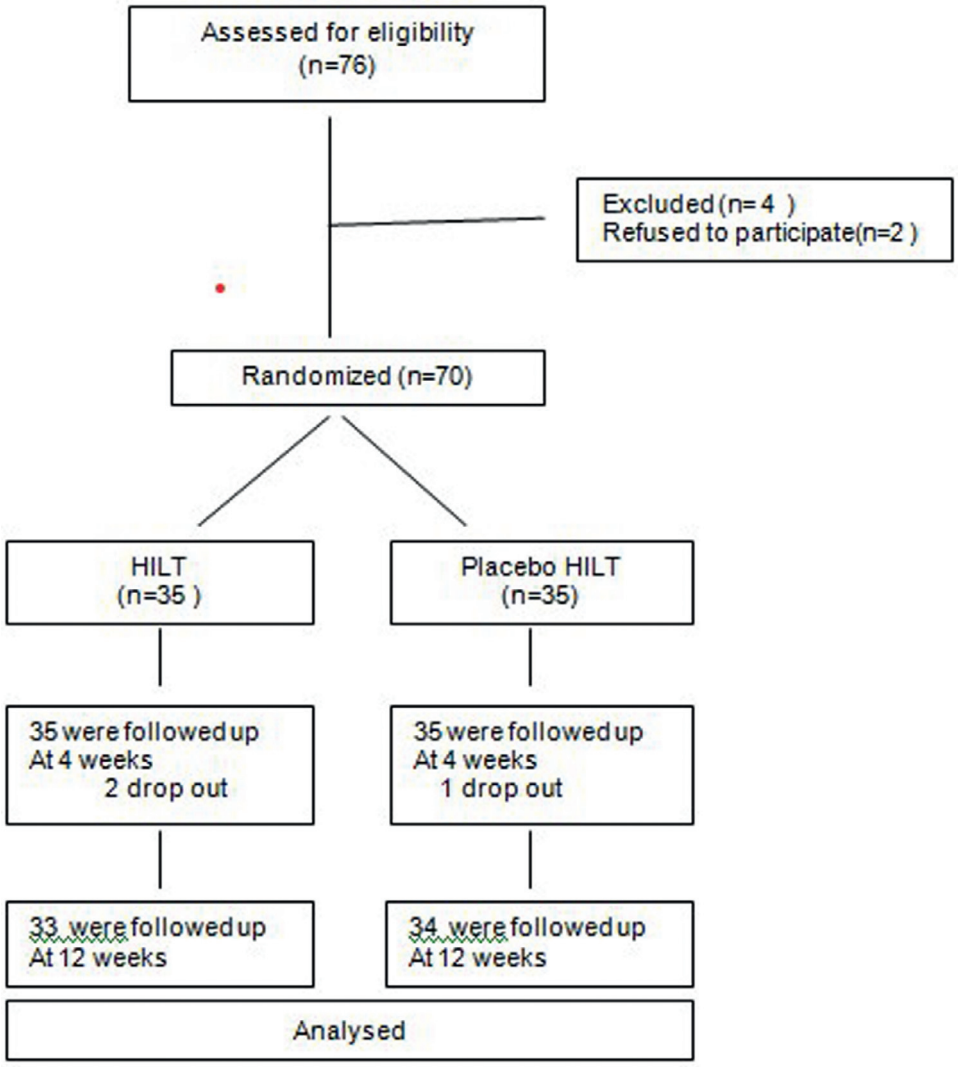

Fig. 1. Flowchart diagram for the participants who were randomized into two groups as receiving HILT and placebo HILT.

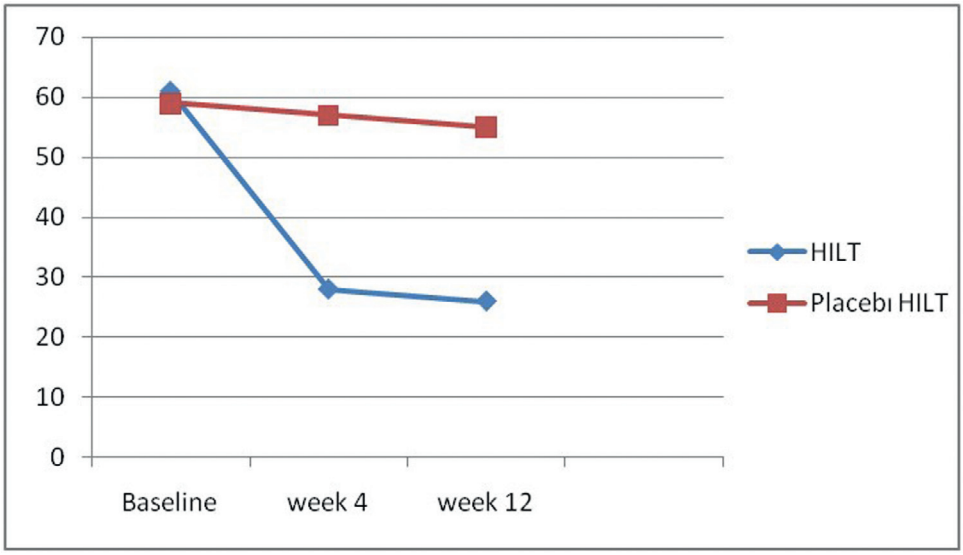

Fig. 2. Mean VAS scores in the HILT and placebo HILT groups.

Table 2
Baseline demographic and clinical characteristics of the patients.

Variables	HILT (n = 33) Mean±SD	PlaceboHILT (n = 34) Mean±SD	P value
Age, years (mean ± SD)	32.39± 12.19	30.68 ± 11.28	0.526
Sex, M/F (n)	7/26	4/30	0.133
Body Mass Index (kg/cm^2)	25.39 ± 4.52	24.31 ± 4.82	0.323
Marital status, married (n,%)	18 (0.54)	19 (0.55)	0.725
Symptom duration, years	2.54 ± 2.30	2.38 ± 2.03	0.750
Max. Mouth open(mm)	31.57 ± 7.98	33.09± 7.08	0.382
Assisted max. mouth open(mm)	35.18± 8.35	38.09 ± 5.89	0.077
VAS -Pain (cm)	60.90±21.98	59.31±20.50	0.745
VAS-Function (cm)	54.54±21.37	46.59±22.09	0.117
OHIP-14			
Functional limitation	1.87± 1.91	1.90±2.33	0.952
Physical pain	4.30±2.27	4.06±2.11	0.642
Psychological discomfort	3.12± 1.91	2.72 ± 2.07	0.397
Physical disability	2.42±2.16	1.84±1.96	0.221
Psychological disability	2.69±2.28	2.15±2.12	0.290
Social disability	2.54±2.30	2.38±2.03	0.750
Handicap	1.30±1.94	1.81±1.89	0.247
OHIP-14 total	45.51±12.17	46.13±10.97	0.818
JFLS-20			
Mastication	24.65±16.37	18.38±13.26	0.069
Mobilization	17.65± 11.12	15.65± 9.82	0.411
Communication	30.15±28.20	19.45±19.79	0.056
JFLS-20 total	72.15±47.16	53.50±33.86	0.060

VAS: Visual analogue scale, JFLS-20: Jaw Functional Limitation Scale-20, OHIP-14: Oral health impact profile-14.
HILT high-intensity laser therapy, Data were presented as mean ± SD or n (%), *: $p < 0.05$.

Table 3
Comparisons of the pretreatment (week 0), and posttreatment (weeks 4 and 12) evaluation parameters in HILT group.

	Baseline(Week 0)	Week 4	Week12	P(Baseline −week 4)	p (baseline-week 12)
Max. Mouth open(mm)	31.57± 7.98	38.75±5.88	41.05±5.28	0.000**	0.000**
Assisted max. mouth open(mm)	35.18± 8.35	41.00±5.67	42.47±5.73	0.000**	0.001*
VAS-Pain (cm)	60.90±21.98	27.72±19.00	26.36±24.40	0.000**	0.000**
VAS-Function (cm)	54.54±21.37	72.27±16.01	73.63±19.40	0.002*	0.000**
OHIP-14					
Functional limitation	1.87± 1.91	1.54±1.67	1.36±1.36	0.001*	0.000**
Physical pain	4.30±2.27	3.15±1.76	3.63±1.96	0.000**	0.000**
Psychological discomfort	3.12± 1.91	2.60±1.61	2.39±1.43	0.000**	0.000**
Physical disability	2.42±2.16	1.63±1.57	1.66±1.61	0.000**	0.000**
Psychological disability	2.69±2.28	2.24±1.85	2.09±1.70	0.000**	0.000**
Social disability	2.54±2.30	2.18±1.97	2.00±1.75	0.001*	0.000**
Handicap	1.30±1.94	1.09±1.60	1.03±1.53	0.006*	0.005*
JFLS-20					
Mastication	24.65±16.37	17.12±10.55	18.93±12.48	0.000**	0.000**
Mobilization	17.65±11.12	11.62±6.69	13.43±8.17	0.000**	0.000**
Communication	30.15±28.20	21.53±17.88	20.06±16.66	0.000**	0.000**

VAS: Visual analogue scale, JFLS-20: Jaw Functional Limitation Scale-20, OHIP-14: Oral health impact profile-14.
Data were presented as mean ± SD,.
* : $p<0.05$,.
** : $p<0.01$.

mouth opening was defined as the maximum distance a subject can open their mouth without feeling any pain. After the patient opened her mouth wide in this way, the mouth opening was measured. The maximum assisted opening was defined as the maximum distance a subject can open their mouth even if they feel pain or discomfort. After the patient opened so wide, the investigator placed his fingers on the patient's maxillary and mandibular central incisors and forced the patient's mouth to open wider. When the patient opened his mouth to the maximum, the distance between the edges of the upper and lower middle incisors was measured in millimeters (mm) using a caliper. In addition, the vertical overlap of the upper incisors on the lower incisors was measured and the active mouth opening of each volunteer was obtained by the sum of the two measurements (mouth opening and vertical overlap).

Functional disability: Jaw Functional Limitation Scale 20 (JFLS-20) was used to measure the changes in functional disability. The JFLS has 3 subcomponents: Mastication, vertical jaw mobility, and emotional and verbal expression. The Jaw Functional Limitation Scale 20 (JFLS20) has a score range of 1 to 200, and high scores indicate worsening jaw function [9].

Quality of life: Quality of life was measured using 14−item OHIP−14 comprising 7 different domains (functional limitation, physical pain, psychological discomfort, psychological disability, physical disability, social disability, and handicap) [10]. Each domain was assessed by two questions, scored using a 5-point Likert scale (0 = never to 4 = very often). The total OHIP−14 score was derived by a summing of the domain scores. A higher score indicates a poorer quality of life.

Patients were evaluated for pain intensity, jaw function, maximum mouth opening, disability and quality of life before and after treatment (week 4 and week 12) by an independent investigator who was blinded for the study. Neither the patient nor the evaluator

Table 4
Comparisons of the pretreatment (week 0), and posttreatment (weeks 4 and 12) evaluation parameters in Placebo HILT group.

	Baseline(Week 0)	Week 4	Week12	P(Baseline –week 4)	P(baseline-week 12
Max. Mouth open(mm)	33.09± 7.08	33.63±6.39	34.15±6.07	0.003*	0.000**
Assisted max. mouth open(mm)	38.09 ± 5.89	38.61±5.42	39.13±5.09	0.000**	0.000**
VAS-Pain (cm)	59.31±20.50	56.81±19.68	55.00±18.83	0.000**	0.000**
VAS-Function (cm)	46.59±22.09	49.09±21.08	51.59±21.50	0.000**	0.000**
OHIP-14					
Functional limitation	1.90±2.33	1.81±2.20	1.79±2.16	0.044*	0.096
Physical pain	4.06±2.11	4.02±1.98	3.97±1.93	0.486	0.210
Psychological discomfort	2.72 ± 2.07	2.61±1.95	2.54±1.83	0.024*	0.010*
Physical disability	1.84±1.96	1.79±1.81	1.70±1.66	0.420	0.057
Psychological disability	2.15±2.12	2.06±1.92	2.00±1.77	0.103	0.051
Social disability	2.38±2.03	2.31±1.88	2.25±1.76	0.083	0.057
Handicap	1.81±1.89	1.75±1.74	1.65±1.55	0.083	0.033*
JFLS-20					
Mastication	18.38±13.26	17.95±12.76	.17.59±12.30	0.001*	0.001*
Mobilization	15.65± 9.82	15.18±9.17	15.04±9.02	0.003*	0.001*
Communication	19.45±19.79	18.79±18.74	18.65±18.66	0.002*	0.001*

VAS: Visual analogue scale, JFLS-20: Jaw Functional Limitation Scale-20, OHIP-14: Oral health impact profile-14.
Data were presented as mean ± SD,.
* : $p<0.05$,.
** : $p<0.01$.

Table 5
Comparison of the two groups on the basis of the posttreatment (both week 4 and week 12) percentage changes and difference scores relative to pretreatment (week 0) values.

	Week 4			Week 12		
	HILT	Placebo HILT	P value	HILT	Placebo HILT	P value
Max. Mouth open(mm)	0.17±0.14	0.02±0.04	0.000**	0.29±0.27	0.04±0.07	0.000**
Assisted max. mouth open(mm)	0.13±0.14	0.01±0.02	0.000**	0.21±0.28	0.03±0.03	0.000**
VAS-Pain (cm)	−0.47±0.32	−0.04±0.06	0.000**	−0.28±0.26	−0.06±0.12	0.002*
VAS-Function (cm)	0.16±0.43	0.08±0.13	0.003*	0.32±0.33	0.14±0.14	0.000**
OHIP-14						
Functional limitation	0.20±0.32	0.03±0.08	0.021*	0.21±0.22	0.05±0.12	0.005*
Physical pain	0.25±0.19	0.01±0.18	0.000**	0.14±0.13	0.00±0.17	0.000**
Psychological discomfort	0.15±0.17	0.02±0.07	0.001*	0.19±0.18	0.04±0.08	0.000**
Physical disability	0.32±0.26	0.02±0.07	0.000**	0.31±0.25	0.04±0.08	0.000**
Psychological disability	0.13±0.16	0.02±0.07	0.003*	0.17±0.18	0.04±0.08	0.001*
Social disability	0.10±0.15	0.03±0.09	0.038*	0.16±0.17	0.05±0.10	0.007*
Handicap	0.12±0.15	0.01±0.05	0.022*	0.16±0.18	0.03±0.09	0.023*
JFLS-20						
Mastication	0.23±0.15	0.01±0.02	0.000**	0.20±0.11	0.02±0.05	0.000**
Mobilization	0.25±0.20	0.02±0.03	0.000**	0.18±0.15	0.02±0.04	0.000**
Communication	0.18±0.14	0.02±0.03	0.000**	0.23±0.17	0.02±0.04	0.000**

VAS: Visual analogue scale, JFLS-20: Jaw Functional Limitation Scale-20, OHIP-14: Oral health impact profile-14.
HILT: High-intensity laser therapy Data were presented as mean ± SD,.
* : $p<0.05$,.
** : $p<0.01$.

knew to which group the participant was assigned (Double-blind design).

2.4. Statistical analysis

Data were evaluated using SPSS software (Statistical Package for the Social Sciences, version 20.0, Chicago, IL, USA). The normality of the data was confirmed by the Kolmogorov-Smirnov test and the homogeneity of the variances by the Levene test. Within-group comparisons were made using the dependent two-sample t-tests and the Wilcoxon test. In comparison between the two groups, The independent samples *t*-test was used when the data showed normal distribution, and the Mann Whitney U test was used when the data did not show normal distribution. The level of significance was set at $p < 0.05$.

3. Results

In the study, no side effects related to the treatment were observed in the patients. Two patients in the HILT group and one patient in the sham HILT group dropped out before completing the study. There was no statistically significant difference between the two groups in terms of demographic characteristics or pre-treatment parameters (Table 2).

The HILT group showed significant improvements in all parameters at weeks 4 and 12 (Table 3). The placebo HILT group showed significant improvements in mouth opening, assisted mouth opening, VAS pain and function parameters, and JFLS-20 scores at weeks 4 and 12 (Table 4). In the placebo HILT group, significant improvement was observed in the OHIP-14 subcomponent only in scala of psychological disturbance (4th and 12th week), functional limitation (4th week), and handicap (12th week).

However, in a comparison of the percentage changes in the parameters at weeks 4 and 12 relatives to pretreatment values, there was a significant difference in the percentage increase of all parameters at 4 and 12 weeks between the two groups. Significantly greater improvement was observed in all parameters in the HILT group compared to the Placebo-HILT group (Table 5).

4. Discussion

LLLT has been used in various studies in the treatment of TMD disorders and its effectiveness in reducing pain in TMD patients has been demonstrated. In recently, Pulsed Nd: YAG laser therapy, a type of HILT, has been used for a number of diseases such as myofascial pain syndrome [11], frozen shoulder [12], lateral epicondylitis [13], and low back pain [14]. The findings of this first study investigating the effectiveness of HILT in TMD showed that HILT is a highly effective treatment in reducing pain, improving function by reducing disability, and enhancing the quality of life in patients with myogenic TMD.

Controversial results have been reported in the literature regarding the therapeutic efficacy of low-level lasers in the treatment of temporomandibular joint disorders. Some studies have reported no beneficial effects of LLLT on temporomandibular pain. Emshoff et al. [15]. and Cunha et al. [16]. and reported that LLLT and sham LLLT significantly improved pain symptoms in TMD patients, with no difference between them. De Abreu Venancio et al. [17] reported that LLLT did not cause an improvement in TMJ pain. Carrasco et al. [18]. reported that there was a significant reduction in pain in the laser group compared to the placebo group in TMD patients, and there was no significant difference in chewing function between the two groups. Cetiner et al. [19]. found a statistically significant improvement in maximum mouth opening and pain in the laser therapy group compared to the placebo group in patients with myogenic TMD. As can be seen from the conflicting results reported in the literature, there is an ongoing scientific debate about the therapeutic value of LLLT. The biggest criticism of the use of LLLT in TMDs concerns the dose, and the lack of consensus on this issue has led to controversial results. There is no consensus on the dosage, frequency and protocol of laser application [20].

LLLT's main effect is based on the light absorption mechanism. LLLT has a low level of energy output and does not affect skin temperature. The wavelength of the low-intensity laser varies between 630 and 1300 nm. LLLT stimulates tissues through direct irradiation and has an analgesic and anti-inflammatory effect [21]. The intensity of the laser decreases by 10% at every 1 cm depth. A laser with 100 mW / cm2 on the skin surface will be 10 mW / cm2 at 1 cm below and 1 mW / cm2 below 2 cm [22].. LLLT is a non-thermal therapy that can promote cellular and tissue modifications caused by different metabolic processes, such as increased activation of mitochondria and Na + / *K* + pump, increased vascularization, and fibroblast growth [23]. HILT is a laser with a wavelength of 1064 nm and has recently been used in the treatment of musculoskeletal diseases. Its primary effect is the analgesic effect and reactive vasodilation by affecting the cutaneous nerve endings [7]. Another mechanism of action is based on tissue stimulation. This stimulation occurs at the level of cells, vascular tissue, interstitial tissue, and the immune system. It increases regeneration and beta-endorphin release by inducing protein synthesis in synovial fluid, thus exerting analgesic and anti-inflammatory effects. HILT can stimulate joints more deeply and treat a wider area than LLLT, thus, the application of HILT for TMD may improve pain and function when compared to LLLT. HILT has been known to reduce heat accumulation in tissues and to have photothermal and photochemical effects in deep tissues for limited periods [7]. In present study, it was seen that HILT treatment was highly effective in both reducing TMD pain and improving jaw functions in myogenic TMD patients, as in other musculoskeletal diseases. In this study, the VAS pain scale of TMD patients receiving HILT treatment decreased by 47% at the 4 weeks and 28% at the 12 weeks. On the other hand, VAS function scale increased by 16% at the 4th week and 32% at the 12th week. Maximum mouth opening increased by 17% in the 4th week and increased by 29% in the 12th week. As can be seen, while the effect of HILT on TMD pain is higher in the short term after treatment, its effects on jaw functions appear more strongly in the long term.

TMD, especially when it has a chronic course, restricts the functions of the patients and can impair the quality of life. While TMD has been shown to negatively affect the quality of life of patients, particularly their oral health-related quality of life (OHRQoL) [24]. In this study, improvements between 18% and 25% were observed in the JFLS-20 disability index sub-dimensions. In the OHIP-14 quality of life sub-dimensions, an improvement between 10% and 32% was observed. At 4 weeks, physical disability (32%) and physical pain (25%) were the OHIP-14 sub-dimension with the most improvement. Physical disability (31%) and functional limitation (21%) dimensions at 12 weeks were the OHIP-14 sub-dimensions that showed the most improvement. Psychological and social disability scores of the patients likewise showed a higher improvement in the 12th week compared to the 4th week. These findings show that HILT treatment is highly effective in reducing functional limitation and disability and increasing the quality of life of patients with myogenic TMD, both in the short term and in the long term after treatment.

HILT application on patients with myogenic TMD is a significantly efficient method on pain and functional scales compared to placebo HILT. HILT therapy can be an alternative and effective physical therapy modality in the treatment of myogenic TMJ disorders. More studies are needed to compare the effects of HILT with other treatment methods, especially LILT.

Financial interests

The authors declare they have no financial interests.

Consent for publication

The manuscript has been read and approved by the authors. Authors are responsible for correctness of the statements provided in the manuscript. Authors allow this study to be published in the *Journal of Stomatology, Oral and Maxillofacial Surgery*. The manuscript has not been published in any form or any language and is only submitted to the *Journal of Stomatology, Oral and Maxillofacial Surgery*

Ethics approval

This study was approved by the Human Research Ethics committee of the Faculty of Medicine, Afyonkarahisar Health Sciences University(Decision no: 2019/185). All participants were informed of the study protocol and each gave their written consent.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Competing Interest

The authors deny any conflicts of interest related to this study.

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