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EFFICACY OF LOW-LEVEL LASER THERAPY IN THE MANAGEMENT OF MYOFASCIAL PAIN DYSFUNCTION SYNDROME. COMPARATIVE CONTROLLED CLINICAL TRIAL

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ABSTRACT

Background: Myofascial Pain Dysfunction Syndrome is considered a multifactorial disorder with different treatment modalities. Recently, LLLT has been advocated as an effective way to counter and alleviate the resulting pain.

Aim of Study: The Aim of the current study was to evaluate the efficacy of different modalities of the LLLT in pain intensity, range of motion and muscles tenderness related to the MPDS.

Patients and Methods: Twenty patients suffering from MPDS were diagnosed and randomly assigned to 2 groups (n=20). All patients were treated with LLLT, InGaAsP diode laser (Biolase) with a wavelength of 1080 J with 4.0 W and 940 nm, for each affected region for 10 minutes. In **Group I** patients were treated with one session per week for 4 weeks, however, patients in **Group II** received two sessions per week for 4 weeks. Power adjusted to patients with type III based on Fitzpatrick Skin Type Scale. Muscle tenderness, maximum painless mouth opening, Pain score were evaluated using the visual analogue scale (VAS) and range of motion were assessed in the following schedule: pre-operative, 1, 2, 3 and 4 weeks post-operative.

Results: LLLT twice a week promoted reduction in pain intensity as well as improvement of range of jaw motion which is higher than those used for once per week. After third and fourth weeks, group (I) had significantly higher VAS score than group (II) ($p<0.05$). While for other intervals, the difference was not statistically significant ($p>0.05$). After the first week, group (II) had significantly higher MMO than group (I) ($p=0.001$).

Conclusion: It was concluded that LLLT twice a week promoted reduction in pain intensity as well as improvement of range of jaw motion which is higher than those used for once per week. LLLT is considered an effective and efficient treatment method for pain reduction and increase ROM in patients with MPDS.

KEYWORDS: Laser therapy, trigger points, myofascial pain dysfunction syndrome, visual analogue scale

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INTRODUCTION

About 21-30% of patients with musculoskeletal pain suffer from Myofascial Pain Dysfunction Syndrome (MPDS). It can affect patients at any age, however, mostly at 27.5-50 years. Etiology of MPDS is multifactorial, among which is the parafunctional habits, psychological, traumas, external compression, postural, emotional stresses and age related. [1, 2]

Trigger points are known as the hyperirritable spots affecting skeletal muscle(s), it might be more than single spot that could be palpable nodule which is hypersensitive with taut bands. The most common painful muscle is the Myofascial trigger point (MTP). [2]

Trigger points can affect muscles in head and neck region [3] including Trapezius muscle which count 34.7% and levator scapulae constitute 19.7% of Trigger Points, other muscles could be affected such as infraspinatus and scalenus accounts for 84.7% of Trigger Points. NSAIDs used for relieving pain of the MPDS. [4]

Classification of trigger points

- **Primary trigger points:** It develops independently and not as a result of trigger point activity elsewhere.
- **Secondary trigger point:** It may develop in antagonist muscles and neighbouring protective muscles as a result of stress and spasm. It is common for patients to experience the pain of a secondary trigger point once a primary trigger point is eliminated.
- **Satellite trigger point:** It can develop in referred pain as a result of persistent motor unit activity in the muscle.

Other classification is based on symptoms and according to this classification trigger points can be divided into 2 groups:

- **Active trigger point:** They are always tender, painful and symptomatic. Pain may be present at rest or on activity. On palpation these trigger points produce specific referred pain. Other clinical signs are local twitch responses (LTR) and jump sign.
- **Latent trigger point:** These are symptomatic and do not require treatment unless they are activated.

In 1988, Oshiro and Calderhead have been creating the term LLLT which means 'Low Level Laser Therapy'. Basic effects of the LLLT are bio-stimulative aims to increase circulation and collagen formation as well as inflammatory reduction during trigger point healing, as well as regenerative effects, anti-inflammatory and analgesic effects. Moreover, it has Bacteriostatic and Virustatic effects. [5, 6]

LLLT is a non-invasive modality that is used currently in dental field to reduce intensity of pain. Previous studies have been reported that LLLT offered many advantages to the patients and dental practitioners which included the ease of performance, convenience, effectiveness for increasing pain threshold and increasing cervical Range of Motion. [6,7]

The Aim of the current study was to evaluate the efficacy of different protocol of the LLLT in pain, range of motion and muscles tenderness related to the MPDS.

MATERIAL AND METHODS

Ethic approval

The study was approved by Research Ethics committee at Faculty of Dentistry, October 6 University, Giza, Egypt, with approval Number: **RECO6U/28-2022** obtained in its meeting held on November 12, 2022

Patients' examination

Pre-operative full examination was done for all patients included: patient's medical history, past

dental history, history of their chief complaint and any medications were taken. Clinical examination included: occlusion, MIO, range of motion (ROM), pain on biting, muscle tenderness was evaluated bilaterally. Visual Analog Scale (VAS) for assessment of pain severity preoperative. (Figure 1)

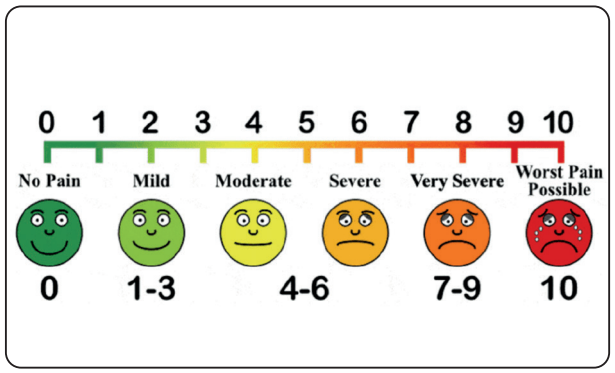

Fig. (1): diagram showing the VAS score for assessment of Pain severity

Inclusion criteria

Patients diagnosed as MPDS, with age range 18 to 65 years. Patients suffering from MPDS based on at least two of the following:

Pain during mastication related to masticatory muscles, functional and parafunctional movements. Pain referred to ear, jaw, preauricular area and temporal region. pain at maximum mouth opening.

Exclusion criteria:

Medical history, past dental history, history of trauma, pregnant females, patients on medication for treatment of MPDS in the last 2 weeks such as analgesics, steroids or muscle relaxant. Muscle incoordination including fibromyalgia as well as the orofacial dystonia and ear infections were excluded from the study as well as parafunctional habits that requires occlusal splints or night guard, bridges for compensating missing teeth were also excluded from the study.

Patients Grouping:

Twenty patients with MPDS with age range of 18 to 50 years, the mean age of the patients in the study groups was 32 years. They were diagnosed and randomly assigned to 2 groups (n=10), one of the contributing authors was responsible for making patient files and each file took number, then all numbers were divided randomly into group I/II.

LLLT InGaAsP diode laser (Biolase)©* (figure 2,3) have been used in this study with a wavelength of 1080 J with 4.0 W and 940 nm, for each affected region for 10 minutes. All patients were suffering from pain related to Masseter and Temporalis muscles. Power adjusted to patients with type III based on Fitzpatrick Skin Type Scale. The patients and the clinician used protective eyewear.

Group I included ten patients (7 females and 3 males) who received one session per week for 4 weeks, total eight sessions or each affected region for 10 minutes. However, in **Group II** ten patients (8 females and 2 males) who received two sessions per week for 4 weeks, total four sessions with a low-level laser therapy (LLLT)

Follow up

Muscle tenderness, maximum painless mouth opening and Pain score were evaluated using the visual analogue scale (VAS) and ROM were assessed preoperative, 1, 2, 3 and 4 weeks postoperative.

Fifteen females and five male patients with age 18-65 years with means 32 years were distributed randomly among both groups.

Statistical analysis:

Categorical data were presented as frequency and percentage values and were analyzed using chi-square test for intergroup comparisons and Cochran q test followed by pairwise comparisons utilizing multiple McNemar's tests with Bonferroni

* BIOLASE, *EPIC, USA*

correction for intragroup comparisons. Numerical data were presented as mean and standard deviation (SD) values. Shapiro-Wilk's test was used to test for normality. Age and maximum mouth opening data were normally distributed and were analyzed using independent t-test for intergroup comparisons and repeated measures ANOVA followed by Bonferroni post hoc test for intragroup comparisons. VAS data were non parametric and were analyzed using Mann-Whitney U test for intergroup comparisons and Freidman's test followed by Nemenyi post hoc test for intragroup comparisons. The significance level was set at $p<0.05$ within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows*.

RESULTS

The study was conducted on 20 cases that were randomly and equally allocated to each of the tested groups (i.e. 10 cases each). There were 7(70.0%) females and in group (I) and 3(30.0%) males, while in group (II) there were 8(80.0%) females and 2(20.0%) males. The mean age of the cases in group (I) was (34.10±8.63) years while in group (I) it was (37.60±6.82) years. No significant difference between both groups regarding sex (p=0.606) and age (p=0.328). Results of intergroup comparisons of demographic data are presented in table (1) and in figures (4-5).

Group (I) had significantly higher VAS score than group (II) ($p<0.05$) in the follow up of the third week as well as the fourth week postoperatively. While for other intervals, the difference was not statistically significant ($p>0.05$). For group (I) there was a significant difference between VAS values measured at different intervals with value measured after 4 weeks being significantly lower than other intervals ($p<0.001$). For group (II) there was also a significant difference but was value measured after 1 week being significantly higher than third- and fourth-week values ($p<0.001$). Results of inter and intragroup comparisons of VAS values are presented in table (2) and in figures (6-7).

TABLE (1) Intergroup comparison of demographic data

Parameter			Group (I)	Group (II)	Statistic	p-value
Sex	Female	n	7	8	0.27	0.606
		%	70.0%	80.0%		
	Male	n	3	2		
		%	30.0%	20.0%		
Age (years)	Mean± SD		34.10± 8.63	37.60± 6.82	1.01	0.328

TABLE (2) Inter and intragroup comparisons of post-operative pain

Interval	VAS (Mean±SD)		u-value	p-value
	Group (I)	Group (II)		
1st week	$6.33±1.17^{A}$	$5.75±0.89^{A}$	22.00	0.573
2nd week	$5.00±1.95^{A}$	$2.67±1.06^{AB}$	30.50	0.054
3rd week	$2.25±1.13^{A}$	$0.50±0.27^{B}$	36.00	0.005*
4th week	$0.92±0.66^{B}$	$0.04±0.10^{B}$	32.50	0.016*
q-value	17.00	17.75		
p-value	<0.001*	<0.001*		

Different superscript letters indicate a statistically significant difference within the same vertical column; *significant (p<0.05)

After the first week, group (II) had significantly higher MMO than group (I) (p=0.001). While for other intervals, the difference was not statistically significant ($p>0.05$). For both groups there was a significant difference between MMO values measured at different intervals with values measured after 3 and 4 weeks being significantly higher than other intervals ($p<0.001$) and with value measured after the second week being significantly higher than first week value ($p<0.001$). Results of inter and intragroup comparisons of MMO values are presented in table (3) and in figures (7-8).

* R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

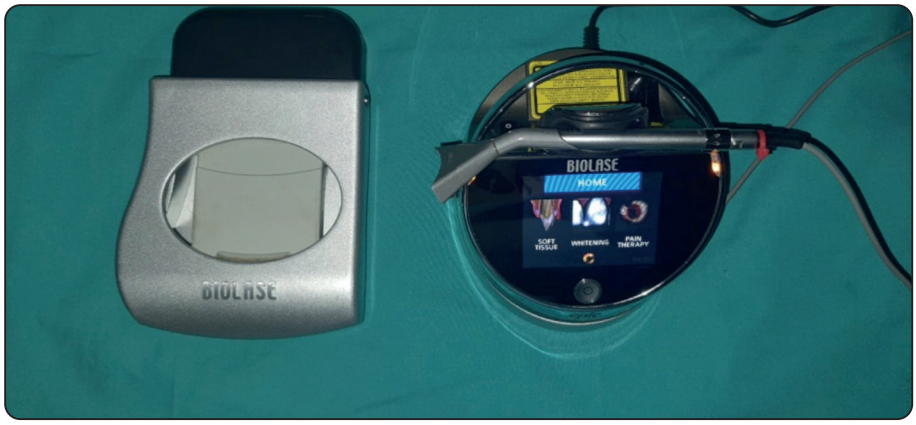

Fig. (2): photograph showing the ''BIOLASE'' equipment

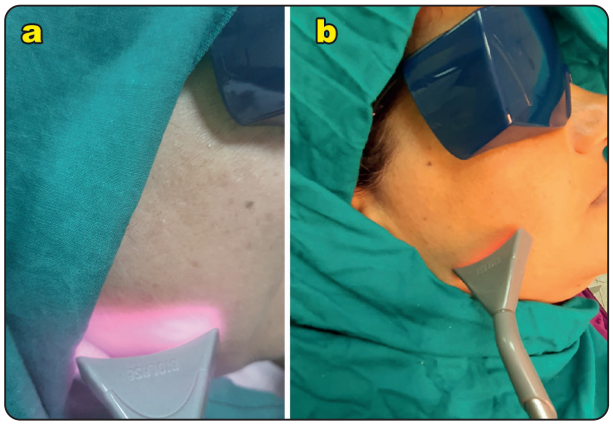

Fig. (3 a,b): photograph showing the ''BIOLASE'' probe was held onto the targeted muscle

TABLE (3) Inter and intragroup comparisons of maximum mouth opening (mm)

Interval	Maximum mouth opening (mm) (Mean±SD)		t-value	p-value
	Group (I)	Group (II)		
1st week	31.82±0.80^{C}	33.99±0.85^{C}	4.55	0.001*
2nd week	36.67±2.16^{B}	35.67±1.37^{B}	0.96	0.360
3rd week	38.50±1.52^{A}	38.33±1.63^{A}	0.18	0.858
4th week	39.00±0.89^{A}	38.33±1.63^{A}	0.88	0.401
f-value	62.47	44.72		
p-value	<0.001*	<0.001*		

Different superscript letters indicate a statistically significant difference within the same vertical column; *significant (p<0.05)

After the first week, all cases in both groups had trigger points in masseter muscle. After the second week 80% of cases in both groups had trigger points and the difference was not statistically significant (p=0.121). After the third week all the cases of group (II) and the majority of group (I) cases didn't have trigger points and the difference was not statistically significant (p=0.136). After the fourth week, all cases in both groups were free. For group (I) there was a significant difference between incidence of trigger points in different intervals with incidence after the fourth week being significantly lower than first and second weeks (p<0.001). For group (II) there was also a significant difference between incidence of trigger points in different intervals with incidence after the third and fourth weeks being significantly lower than first week (p<0.001). Results of inter and intragroup comparisons of trigger points' incidence in masseter muscle are presented in table (4) and in figures (9-10).

After the first week, 80% of cases in both groups had trigger points at temporalis muscle and the difference was not statistically significant (p=0.606). After the second week majority of cases in both groups didn't have trigger points and the difference was not statistically significant (p=0.329). After the third week all the cases of group (II) and the majority of group (I) cases didn't have trigger points and the difference was not statistically significant (p=0.136). After the fourth week, all cases in both groups were free. For group (I) there was a significant difference between incidence of trigger points in different intervals with incidence after the fourth week being significantly

lower than first week (p<0.001). For group (II) there was also a significant difference between incidence of trigger points in different intervals with incidence after the third and fourth weeks being significantly lower than first week (p<0.001). Results of inter and intragroup comparisons of trigger points' incidence in temporalis muscle are presented in table (5) and in figures (11-12).

Table (4): Inter and intragroup comparison of trigger points for masseter muscle

Interval	Trigger point		Group (I)	Group (II)	χ^2	p-value
1st week	Present	n	10^{A}	10^{A}	NA	NA
		%	100.0%	100.0%		
	Absent	n	0	0		
		%	0.0%	0.0%		
2nd week	Present	n	9^{A}	6^{AB}	2.40	0.121
		%	90.0%	60.0%		
	Absent	n	1	4		
		%	10.0%	40.0%		
3rd week	Present	n	2^{AB}	0^{B}	2.22	0.136
		%	20.0%	0.0%		
	Absent	n	8	10		
		%	80.0%	100.0%		
4th week	Present	n	0^{B}	0^{B}	NA	NA
		%	0.0%	0.0%		
	Absent	n	10	10		
		%	100.0%	100.0%		
q-value			24.20	24.00		
p-value			<0.001*	<0.001*		

Different superscript letters indicate a statistically significant difference within the same vertical column; *significant (p<0.05)

Table (5): Inter and intragroup comparison of trigger points for temporalis muscle

Interval	Trigger point		Group (I)	Group (II)	χ^2	p-value
1st week	Present	n	7^{A}	8^{A}	0.27	0.606
		%	70.0%	80.0%		
	Absent	n	3	2		
		%	30.0%	20.0%		
2nd week	Present	n	2^{AB}	4^{AB}	0.95	0.329
		%	20.0%	40.0%		
	Absent	n	8	6		
		%	80.0%	60.0%		
3rd week	Present	n	2^{AB}	0^{B}	2.22	0.136
		%	20.0%	0.0%		
	Absent	n	8	10		
		%	80.0%	100.0%		
4th week	Present	n	0^{B}	0^{B}	NA	NA
		%	0.0%	0.0%		
	Absent	n	10	10		
		%	100.0%	100.0%		
q-value			15.30	18.90		
p-value			0.002*	<0.001*		

Different superscript letters indicate a statistically significant difference within the same vertical column; *significant (p<0.05)

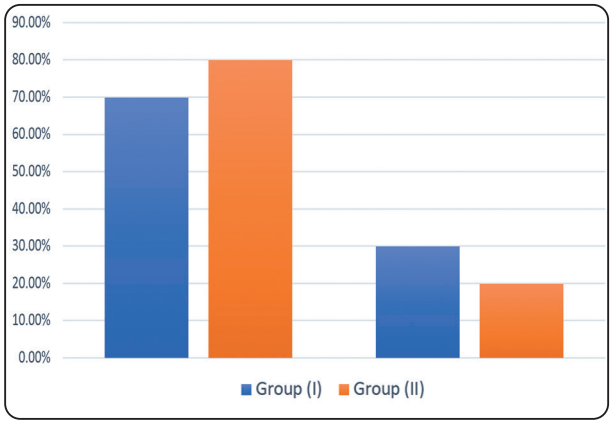

Fig (4): Bar chart showing sex distribution

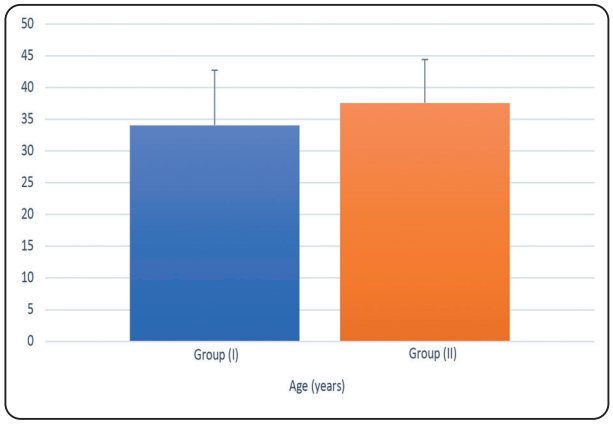

Fig. (5): Bar chart showing mean and standard deviation values of age (years)

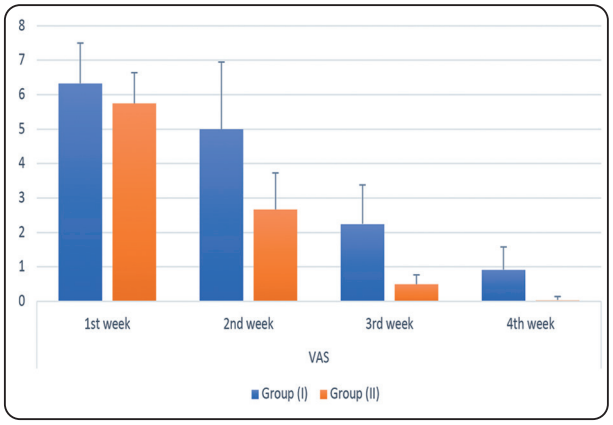

Fig. (6): Bar chart showing mean and standard deviation values of VAS

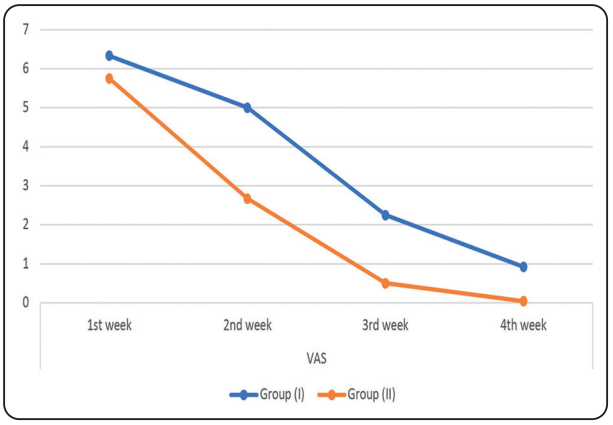

Fig. (7): Line chart showing average values of VAS

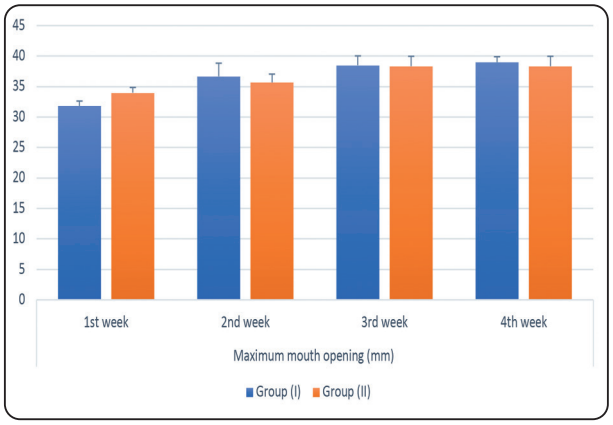

Fig. (8): Bar chart showing mean and standard deviation values of MMO (mm)

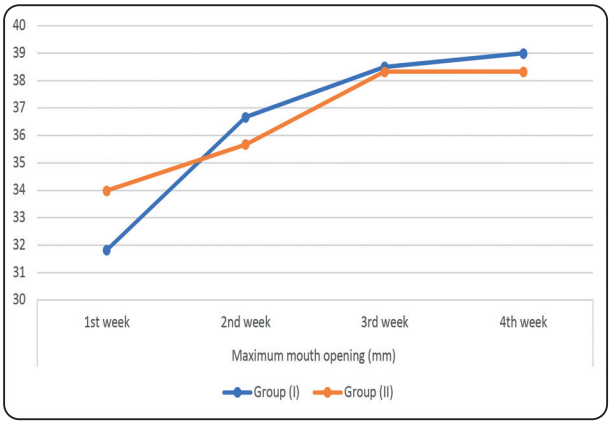

Fig. (9): Line chart showing average values of MMO (mm)

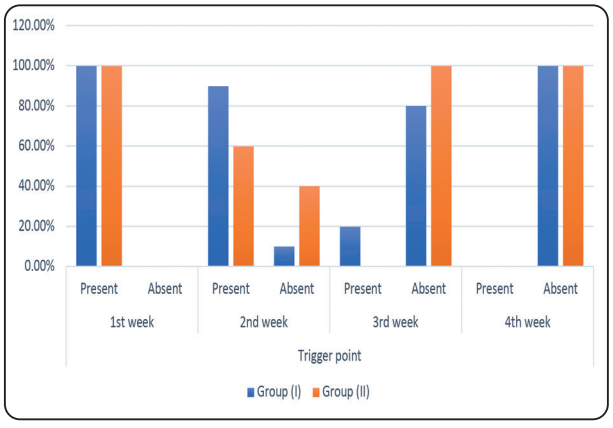

Fig. (10): Bar chart showing masseter trigger points' incidence in different groups

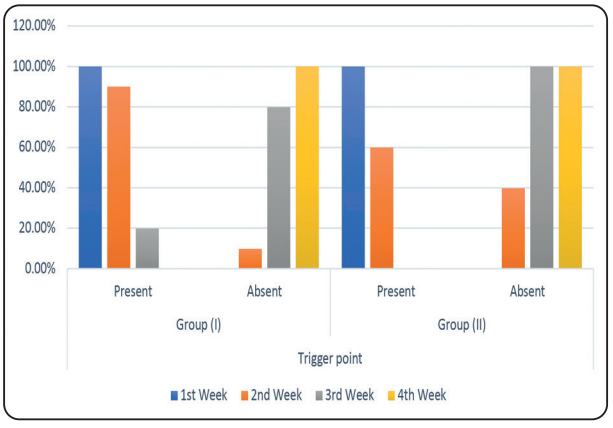

Fig. (11): Bar chart showing masseter trigger points' incidence in different intervals

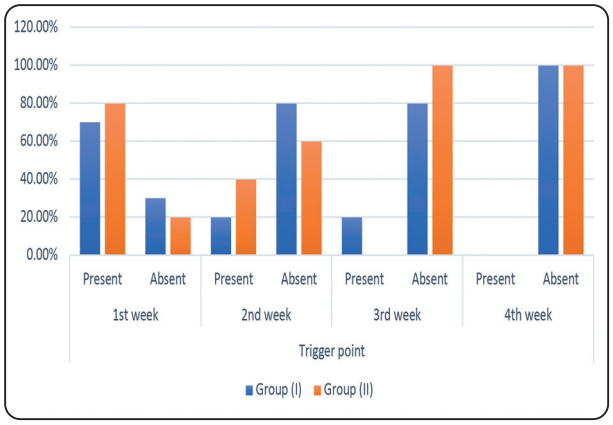

Fig. (12): Bar chart showing temporalis trigger points' incidence in different groups

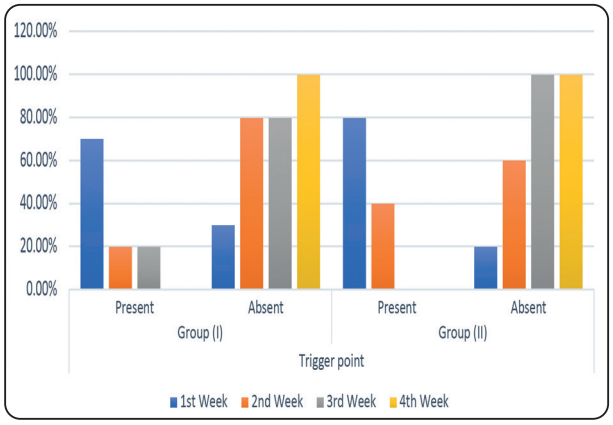

Fig. (13): Bar chart showing temporalis trigger points' incidence in different intervals

DISCUSSION

Myofascial Pain Dysfunction Syndrome leads to Mandibular dysfunction due to limitation in range of motion of the jaws along with other symptoms such as pain, mandibular deviation, clicking and popping noises that auscultated in the joints [8].

LLLT applications play an important role in reduction of pain resulted from the trigger muscle spasm through inhibiting the signals of pain which leads to transient neurons varicosities, that in turn lead to decrease impulse transmission. [9, 10].

Our study was in coincidence with other study which reported that LLLT can alleviate the inflammation affected the superficial muscles, tendons and ligaments. [11]

Several mechanisms have been reported on the analgesics effect of the LLLT, among these mechanisms; the tissue oxygenation which resulted in decreasing the muscles pain through increasing the adenosine triphosphate formation by increasing the lymphatic flow thus reducing edema, histamine and acetylcholine release, with bradykinin synthesis reduction and enhances microcirculation. Another mechanism related to its effect on endorphin levels, increase excretion of glucocorticoids which in turn lead to pain reduction. [9, 10,12, 13,14] These study supports our results in explaining the reduction of muscles pain along the follow up period.

Researches has proved the effect of LLLT on reduction of inflammation by reducing the levels of biochemical markers (PG E2, and tumour necrotizing factor-a and Cox-2, interleukine-1b), edema, neutrophil influx, oxidative stress and haemorrhage in a dose-dependent manner. [13,14]

The parameters difference in reducing pain varies along several studies, **Emshoff et al.,** [15] have proved no pain reduction in TMJ with the use of 632 nm wavelength and 1.5 J/cm 2 intensity. On the other hand, **Goulart et al.,** [16] have concluded significant pain reduction prior to orthodontic tooth movement by using 5.3 J/cm^2. Moreover, **Tunér and Hode** [17] suggested 4 to10 J/cm2 energy density for TMD's management.

Another single group study was done on twenty patients by **Nabeel Sayed et al.,** [18] their conclusion was improvement in reduction of pain intensity and increasing ROM as well as reduction of the tenderness of muscles.

On other study, the therapeutic dose was 1008 mJ for 60 s, 0.7 W for each affected region twice, to alleviate pain and reduce inflammation. [19]

Our study was in accordance with those done by several studies **Michelotti et al**., [20] **Kato et al.,** [21] and **Oz et al.,**[22] **Fouda et al.,**[23] who noticed that

the masseter and temporalis muscles were the most common involved masticatory muscles. Masseter muscle is the most common affected muscles and the temporalis was the lowest. [20] however, other studies done by **Mortazavi et al.,** [24] and **Darbandi et al.,** [25] concluded that the most commonly affected muscle was the medial pterygoid.

Our study was in coincidence to other studies which concluded the effect of LLLT has been effective in decreasing the muscle tenderness in patients suffering from MPDS because of their analgesic effect as well as its anti-inflammatory processes. [26,27,28,29]

A study was done on the effect of LLLT but with lower wavelength with (690 nm) in comparison to other studies and they reported in placebo group superior efficacy. [30]

Several protocols have been used in many studies on LLLT and their effects on the MPDS as well as TMD's. among these studies, a study done by **Mazzetto et al**., reported on a random double blinded research on patients suffering from TMD's by using the infrared laser (780 nm, 70 mW, 10 s, 89.7 J/cm^2) twice /week/4 week that was effective in reducing and controlling pain.[31]

Other study were applied LLLT with 10-15 J/ cm2 to the affected muscles in patients suffering from TMD arthralgia and MPDS for 10 sessions. The beam directed to mandibular condyle at level above, infront and behind it too [32].

Another study was done with 1.5 J/ cm2 for TMJ pain two-to-three times per week for 8 weeks [33]; 6.3 J/cm2 for capsulitis/synovitis as well as painful disc displacement with reduction at three points for each joint in five sessions [34]; 4 J/point to the most painful muscle point (three times per week) [35].

A study done by **Kogawa et al**., [36] who demonstrated that the LLLT was more effective than other physical therapies in TMDs.

CONCLUSION

LLLT is an effective non-invasive, easy and efficient treatment method for pain reduction and increase ROM in patients with MPDS. It has a significant role in musculoskeletal disorders particularly myofascial trigger points in orofacial region and around neck.

CONFLICT OF INTEREST

Nil

SOURCE OF FUNDING

Self

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