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Evaluation of Low Level Laser in Management of Myofascial Pain Dysfunction

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Abstract:
Objectives: *To evaluate the effect of using diode laser as a treatment modality in management of myofacial pain dysfunction syndrome.*
Patients and Methods*: Twenty-Four adult female patients suffering from pain related to the joint area and or limited mouth opening were included in the study. Patients were randomly divided into two equal groups; 24 patients each. Group I: Treated by using diode laser; 940 wave-length dose and a power of 1w.* Group II: *Treated by using diode laser; 940 wave-length doses and a power of 1.5 w. Duration of each session is 30 seconds. Each patient received 3 sessions per week for 4 weeks. The applications were performed on the superficial part of the masseter muscle, the anterior bundle of the temporalis muscle and the buccal vestibule opposite to the upper second and third molar in order to reach the lateral pterygoid muscle. Pre and Postoperative evaluation were performed using: Helkimo's index, VAS, Algometer, Maximum mouth opening (MMO) and EMG. Follow up were carried out at 1month, 3months and 6months***.**
Results: *There was a statistically significant difference between both groups; improvement was found in group II in mean clinical dysfunction helkimo's index, algometric pressure (masseter, temporalis, muscle), MMO, (EMG) of {masseter, temporalis, lateral pterygoid muscle}. In addition to statistically significant increase in mean amplitude of motor units during follow-up. While there was no significant differences in MMO in group I.*
Conclusion: *The use of low-level diode laser is efficient in the treatment of MPDS. The results revealed that the use of high power is better than the use of low power according to the studded circumstances***.**
Key Words: *MPD, Diode Laser, Helkim's Index, Algometer, low level laser therapy.*

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I. Introduction:

Craniomandibular dysfunction (CMD) are aggregate of symptoms which can encompass pain, tenderness and defect of the temporomandibular joint, the mouth and the occlusal contacts, the cervical backbone, and the muscles of mastication. (1) It also presents with neighborhood dentoalveolar pain; muscle pain; head, facial and neck pain; sounds at some stage in condylar movements; deviations and limitations of mandibular actions; parafunctions and negative oral conduct; and functional limitations of mastication. it's miles usually familiar that CMD has a multifactorial etiology. (1,2,3) with various associated psychological symptoms, such as depression and anxiety.(4) Moreover, in those with pre-existing TMD, symptoms may be exacerbated during times of stressful events. For example, recent studies have suggested that the during periods of lockdown and social isolation due to the ongoing COVID-19 pandemic, an impact was found on the prevalence of depressive symptoms, stress, as well as pain related to TMD (5). Myofascial pain dysfunction Syndrome (MPDS) is the most common form of CMD; and it is the most common cause of orofacial persistent pains. (6,7)

For assessing MPDs lots of modalities are available; Electromyography (EMG) is useful in diagnose suspected muscle or nerve disorders. Abnormal results indicate nerve or muscle disorder. Helkimo's index proposed by Helkimo (7) in 1974; it includes the anamnestic index and the clinical dysfunction index. The former is based mainly on the chief complaint, and the latter analyses items such as impaired range of movement, impaired temporomandibular joint (TMJ) function, muscle pain, TMJ pain and pain upon movement of the mandible. The values obtained can be used to classify the dysfunction according to its severity. (8) The utilization of Visual analogue scale (VAS) is a common and easy way to evaluate the present intensity of acute pain, degree of pain relief, or other aspects of pain.

The Algometer Testing which is a very sensitive hand-held force gauge (mechanical or digital) applies pressure over a specific area at a constant, uniform rate, thereby allowing standardization and improving the evaluation of muscle tenderness so once a trigger point has been located as mentioned by Gracely & Reid in 1995. (9)

According to Weinberg ;(10) Treatment of MPDS is divided in to four categories; Palliative therapy, Causative therapy and Adjunctive therapy and Definitive therapy. Different treatment modalities are introduced to manage MPDS Palliative therapy: includes procedures such as occlusal splint, medications, home remedies (ice, moist heat application, exercises and soft diet). Adjunctive therapy: Contain of treatment modalities that collect and assist definitive or causative type of management for TMD: Physiotherapy, Electrotherapy, Electrogalvanic Stimulation, Tens, Iontophoresis(11-17).

The use of Low-level laser Therapy (LLLT) or Photo-bio-modulation (PBM) in management of MPDS cases is not thermal; it triggers biochemical changes within cells where the photons are absorbed by cellular photoreceptors and triggers chemical changes. (17) It also induces nitric oxide synthesis, which causes the endothelial linings of capillaries to dilate, increasing circulation in the area. And also may return injured tissues to maximum energy level, improving circulation, decreasing pain and swelling. (18) Using low-level laser therapy affects four clinical targets; Trigger points to decrease tenderness and relax contracted muscle fibers, Nerves to stimulate analgesia, Lymph nodes to decrease inflammation, edema, site of injury to allow decrease inflammation, healing and remodeling (19).For LLLT to be active, the irradiation information (total energy and time, wavelength, power density, pulse parameters, power, energy density) need to be within certain ranges. Times of management per point are in range of 30 seconds to 1 minute. As little as one point may be managed for simple cases, but as many as 10 to 15 points may be managed for difficult cases such as lumbar or cervical radiculopathy. (19)

Wavelength is one of the key factors that dictate depth of penetration. The shorter wavelengths in the 600-700 range have been found to be effective in the treatment of superficial target tissues such as skin wounds. While deeper muscle, ligament and tendons are best treated with the longer wavelengths in the 700-1000 nm range.(20,21) The power of the LLLT device is measured in milliwatts (mW). The higher power levels in new generation LLLT devices decrease necessary treatment time, and enhance the depth of penetration. (22)Power Density is the average power per unit area of the beam (spot size). It is measured in W/cm2 or mW/cm2. Smaller beam areas will result in a higher power density because the light is concentrated over a smaller area. (22,23)

The aim of the current study was to evaluate the effect of using diode laser as treatment modality in the management of MPSD

II. Material and Methods

The study is conducted on twenty-four female adult patients, with age range between 20-40 years old, randomly selected from the outpatient clinic of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Suez Canal University. They were suffering from pain related to the joint area with or without limited mouth opening. The patients were diagnosed as a myofascial pain dysfunction candidate according to following criteria:

Inclusion criteria:

Pain related to one or more of the muscles of mastication.

- Type II anamnestic scale (Ai) of Helkom's index. (24)
- Scored 10 or less on clinical dysfunction (Di) of Helkom's index. (25,26)

The presence of a trigger points (TrPs) characterized by spontaneous pain.

No previous surgery in the temporomandibular region.

No other conditions that might affect the temporomandibular joint (TMJ).

Exclusion criteria:

- Patients with history of maxillofacial trauma and/or fractures.
- Tumors treated with radiotherapy related to the TMJ region.
- Pervious treatment modalities of TMD.

Preoperative Assessment

A) Clinical examination:

Diagnostic Chart: was filled for each patient included: Personal demographic data, Chief complaint. History of chief complaint, Presence of para-functional habits, Presence of other joint and/or muscle pain, past medical history and Past dental history.

The masseter and temporalis muscles were located by a flat palpation technique, using one index finger. Then they were examined by means of palpation to determine the presence of: Palpable taut band, hypersensitive area within the taut band, Trigger points (TrPs) and/or Referred pain upon stimulation of the area. Finally, the occurrence of a local twitch response (LTR) upon sharp palpation of the taut band.

B) Helkimo's index:

Clinical dysfunction (Di) Helkimo's index was applied for each patient to evaluate the muscular pain associated with TMJ motion and the muscle sensitivity in addition to the sensitivity to lateral and posterior pressure, According to the anamnestic scale as follows: 0: No symptoms ,I: Mild symptoms , II: Severe symptoms. (25, 26)

To accomplish the examination of the clinical dysfunction, a modified version of Helkimo's dysfunction index (Di) was calculated. Clinical examination included opening of mandible, deviation during opening, dysfunction of TMJ, pain in the TMJ and preauricular region, and also masticatory muscles were palpated for pain Scores assigned for the five symptoms was summed up.

Table (1): Questionnaire for anamnestic component

Name: _____			
Age: _____			
Gender: _____			
1	Do you have a sound (clicking or crepitation) in the area of TMJ?	Yes	No
2	Do you have jaw rigidity during awakening or slow movement of mandible?	Yes	No
3	Do you feel fatigue in the jaw area?	Yes	No
4	Do you have difficulty while opening mouth?	Yes	No
5	Do you have locked mandible during opening the mouth?	Yes	No
6	Do you have pain in the TMJ in the area of masticatory muscles?	Yes	No
7	Do you have pain during movement of mandible?	Yes	No
8	Do you have luxation of mandible?	Yes	No
TMJ: Temporomandibular joint			

Table (2): Clinical dysfunction component

Mandibular opening
>40 mm
30-39 mm
>30 mm
Mandibular deviation during lowering
<2 mm
2-5 mm
>5 mm
TMJ dysfunction
No impairment
Palpable clicking
Evident clicking
TMJ pain
No pain
Palpable pain
Palpebral reflex
Muscle pain
No pain
Palpable pain
Palpebral reflex
TMJ: Temporomandibular joint

Each individual had a total dysfunction score ranging from 0 to 25 points. Higher the score, the more acute/serious the disorder. Depending on the values obtained, the patients were classified as follows: Di0 - no dysfunction; DiI - mild dysfunction (1-4 points); DiII - moderate dysfunction (5-9).

Pre-operative measurements:

i. **Visual Analogue Scale (VAS):**

Assessment of pain level was performed through VAS while examining the trigger points with the algometry. The VAS is a graduated scale from 0 to 10 Fig (1) .

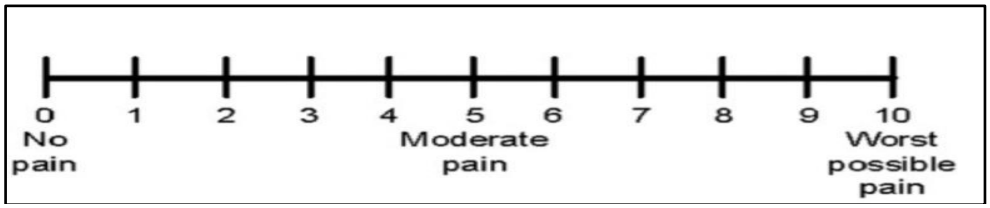

Fig (1): Diagram showing the Visual Analogue Scale (VAS).

ii. Maximum mouth opening.

Assessment of painless maximum mouth opening (MMO) was performed by measuring the distance (in mm) between the incisal edges of the upper and lower central incisors using a Vernier graduated caliper (1)Fig (2).

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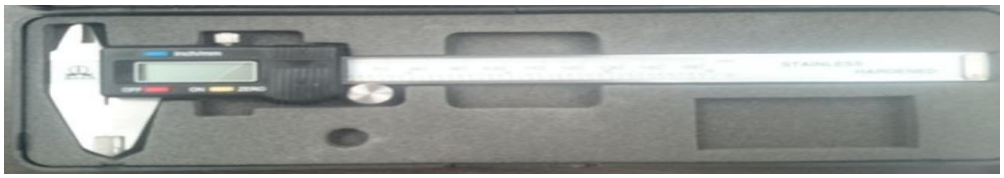

Fig (2): Vernier graduated caliper.

iii. Algometric evaluation (Reading to pressure):

Pressure algometer (**) device; was used a device used to the quantifying tissue tenderness (mechanical hyperalgesia). Before taking a measurement, was demonstrated explain to the patient by pressing the algometer into the palm of the hand. The degree of pain was recorded immediately by the patients according to the VAS while the operator records the reading of the algometer. It displayed the pressure in units of kg/cm2 Fig (3, 4, 5).

Fig (3). Clinical photograph of the Algometer device

([1]) Shan digital pinzas; 0-150 mm, changhahy, RCU.

([**]) Baseline Push Pull Force Gauge.Usa.

Fig (4): group 1 case no.1

Fig (5): group 1 case no.1

iv. Electromyographic (EMG) measurements:

This part of the study was performed in Electroneuromyography (ENMG) Unit of Physical Medicine, Rheumatology, and Rehabilitation Department, Suez University Hospital.

Electromyography (EMG) was done by Neuro-MEP-Micro (∗), and evoked potentials (EP) digital neurophysiological system software, Neurosoft Ltd, Russia. Recordings were obtained from both masseters, lateralpterygoids and temporalis (anterior fascicle) muscles. Recordings were performed twice: before and after interventions. Fig (6,7)

Fig (6): showing Electromyography device on patient.

Fig (7): group 1 case no.4 showing on masseter (superficial).

Operative procedure:

Low level laser device:

EPICTM(∗) system is used to relieve the pain and relax the muscles. It uses an Indium Gallium Aresnide Phosphorous (InGaAsP) solid state laser diode to emit infrared laser energy which is transmitted via a flexible fiber optic cable to a hand piece that emits energy to the target site. A visible light is emitted at the same time to visually identify treatment location Fig (8).

(*)version 2015, model 3.5.12.0 (32-bit), 2-channels

(*) Biolase. Epic . Version 2010 .UAS.

Fig (8): low level laser device (Biolase).

Patients grouping (chart 00):

The twenty-four patients were randomly divided into two equal groups; each group contains 12 patients Fig (9):

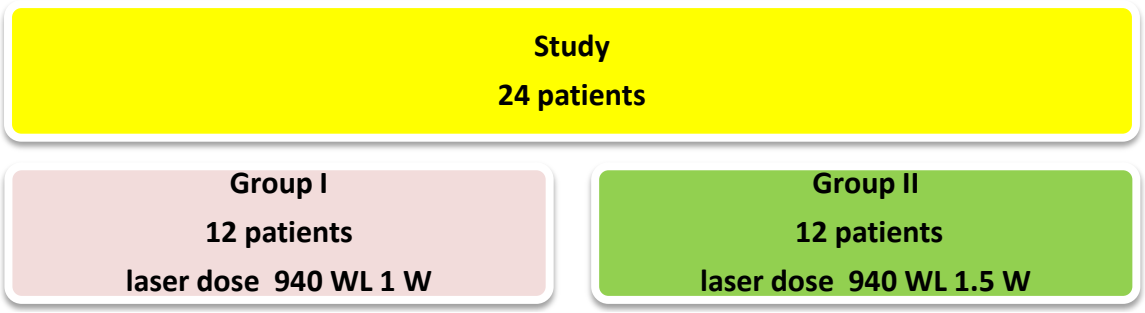

Fig (9): showing the patient grouping.

Treatment procedures:

1. The patient skin was cleaned by soap and water then dried by clean towels.
2. The area was then whipped by 70% ethyl alcohol (*).
3. The patient, the assistant and the operator put on the laser protector eye wear.
4. Low level Laser therapy was started. :Laser therapy was started by placing the tip of laser onsuperficial part of the masseter muscle, the anterior bundle of the temporalis muscle and the buccal vestibule opposite to the upper second and third molar in order to reach the lateral pterygoid muscle (Fig12-14). The dose is adjusted by selecting the power and the time of the device. For all the patients the session is repeated 3 times in week for 4 weeks. (Fig 10-11)
5. The patients were instructed to take on paracetamol (**) 500 mg whenever needed.

Group I

Group II

(*) VANO. Frist manufacture. Egypt.

(**) Paramol Misr company for pharmaceuticals

Fig (10): LLL showing control on 1Watt

Fig (11): LLL showing control on1.5Watt

Fig (12): case no.1 showing LLL on Temporlize Muscle

Fig (13): case no.1 showing LLL on Masseter Muscle

Fig (14): case no.1 showing LLL on Lateral Pterygoid Muscle

Postoperative instructions and medications:

A) Postoperative assessment:

Patients were instructed to:
Stop any other therapies.
Stop taking other pain medications.
Paracetmol 500 mg was prescribed as a pain killer only as required

B) Postoperative evaluation

he postoperative evaluation was performed using clinical assessment of pain by:
Helkimo, index:
were carried out at 1month,3month,6month.
(VAS, Algometer):
per 1week,2week,3week,1month,3month,6month
Maximum mouth opening:
Were carried out at 1month, 3month, 6month.
EMG :

All data of the electrical activity of the muscles in rest, during function prior to the low-level laser therapy, immediately after, 3 and 6 month after the therapy was recorded automatically by the computer. The EMG tests were performed on the side that the patient reported increased pain on muscles.

The same technique was described in the preoperative assessment that was utilized at the following intervals 1 month, 3months and 6 months postoperatively.

Statistical analysis

The data collected were tabulated and analyzed using SPSS statistical package2. Data were represented as mean ± Standard deviation. Paired student t-test is used to compare two variables within the same group. Independent samples t-test is used to compare variables between the two studied groups. Results were considered statistically significant if the p value is less than 0.05.

III. Results:

All the studied patients were females. There was no significant difference between groups regarding age ($p>0.05$).

A) **Helkimo's index**: The comparison between anamnestic scale (Ai) in the studied groups indicated that the groups were similar transformer from AII to A0 so showed no statistically significant difference during follow –up. Helkimo's dysfunction index (Di) at all-time intervals in the studied groups indicated that the groups were similar at baseline measurement ($p>0.05$). showed statistically significant improvement in mean dysfunction index during follow-up ($p<0.0001$).

B) **Maximum mouth opening (MMO) (mm):** no significant differences between two groups at baseline regarding MMO ($p>0.05$). there was significant increase in MMO assessment after the end of LLLT (follow-up) compared to MMO assessment before the beginning of LLLT (at baseline) in groups.

C) **Algometric pressure measurement(kg/cm2):**(Masseter muscle) at all-time intervals in two groups indicated that the groups were similar at baseline measurement ($p>0.05$). Group II showed significantly higher mean values than other groups at T1 and T3 follow-up ($p<0.05$).

(Temporalis muscle) at all-time intervals in the studied groups indicated that the groups were similar at baseline measurement ($p>0.05$). Group II showed significantly higher mean values than other groups at T1, T2 and T3 follow-up sessions ($p<0.05$) two groups showed statistically significant improvement in mean algometric pressure during follow-up ($p<0.05$).

D) **Electromyography (EMG) (µV):**(Lateral pterygoid muscle), (Temporalis muscle), (Masseter muscle) at all-time intervals in the studied groups indicated were similar at baseline measurement ($p>0.05$). Group II showed significantly higher mean amplitude of motor units than other groups at T1, T2 and T3 follow-up sessions ($p<0.05$). two groups showed statistically significant increase in mean amplitude of motor units during follow-up ($p<0.0001$).

(Masseter muscle) Group II showed significantly higher mean amplitude of motor units than other groups at T2 and T3 follow-up session ($p<0.0001$). Only group II showed statistically significant increase in mean amplitude of motor units during follow-up ($p<0.0001$).

(Temporalis muscle) Group II showed significantly higher mean amplitude of motor units than other groups at T2 follow-up session ($p<0.0001$). Only group II showed statistically significant increase in mean amplitude of motor units during all follow-up session ($p<0.0001$).

IV. Discussion:

The presented study was conducted on Twenty-four patients suffering from MPD, as it represents the most common presentation of TMJ disorders (24,27) MPDS has a lifetime prevalence of 85% in general population. According to some studies it is more common in female (28). It is most frequently seen in young females. Female to male ratio is of 3:1. It is commonly between 15-35 years of age. The age for the selected candidates ranged from 20 -40 years old as this age range represents the most stable hormonal condition. (29-31) agreement with Ahrari F, Madani AS, Ghafouri ZS, Tunér J. Cavalcanti MF, Silva UH, Leal-Junior EC, Lopes-Martins RA, Marcos LR, Pallotta RC.(32,33)

The aim of the current study was to maintain the improve mouth opening of the patient and relieve pain after each session.

Clinically, low level laser remedy (LLLT) can deal with neuropathic and nociceptive ache, at the same time as principal ache has now not yet been tested to be attentive to LLLT (34,35). LLLT is an easily tolerated, noninvasive, and nonpharmaceutical, remedy. it's far supportive therapy this is effective at treating affected person with MPD and reliving ache signs without changing the etiology of the disorder, so a hit treatment may be performed in long term. it's miles a timesaving method for each clinician and affected person and additionally has a rapid impact that can be felt by means of the patient after the application. (36)

Result of current study show decrease pain in four measurements appears in first week: The clinical results showed in Helkimo s index is a well- founded index to assess TMD especially masticatory muscles,

result of current study all groups showed statistically significant improvement in mean dysfunction index during follow-up. These results were in agreement with Sapan Rani et al. (25)

Low stage laser utility is a complementary remedy to ache as a result of TMD because of its analgesic, muscle rest and anti-inflammatory houses in agreement with Nez SC, Garcez AS, Suzuki SS, Ribeiro MS, Xu GZ, Jia J, Jin L, Li JH, Wang ZY, Cao DY . (18,37).

VAS figures that ache remedy tends to enhance after laser software on MPDS vicinity. It reflects a short-term feeling defined with the aid of the affected person; it needs to be used with warning. In present study take a look at The early enhancements for ache relief and muscle tenderness in laser irradiated group and maintain to the quilt of observation length, is available in agreement with different research (38-42), Considering the theory that because factors are caused by their inflammatory nature, it can be concluded that LEL radiation ends in lower edema, inflammation and ache via decreasing inflammatory merchandise including prostaglandin, histamine and kinines (43).

Algometry has proved to be beneficial for population research,(44) for diagnostic functions,(45) for comparing the efficacy of management techniques,(46-48)and for specific investigation of tension-kind complications.(49)

Pain and tenderness inside the masseter (50) and temporalis muscle tissues are common place findings in a TMD population. (51,10). Both muscles mass have similar underlying bone help, are easily on hand,(50) and are frequently utilized in PPT studies.(10,45-51)

Furthermore Algometer had high reliability and validity values Fischer(52) demonstrated excellent reliability and reproducibility with pressure threshold measurement. Reeves et al.(53) showed high inter- and intrarater reliability for testing marked trigger points and for locating unmarked trigger points in the temporo-mandibular region. Both examiners within the Reeves study were trained in myofascial therapy and similar results may not be feasible with untrained examiners. all groups showed statistically significant improvement in mean algometric pressure during follow-up. Therefore, using an algometer may be a useful way to quantify pain and possibly track recovery/healing.

EMG as well as scientific examinations and application of questionnaires are green strategies for comparing and diagnosing TMD (45,54). The severity of ache cannot be reflected in EMG hobby, but considering limited mandibular movement heightens muscle tonus hobby, TMD patients present a moderate growth in basal muscle tonus that is detected electromyographically. This confirms that EMG is an effective tool for assessment and diagnosis inside the remedy of those dysfunctions (55,56). In an evaluation of normal and TMD sufferers.

In our study red probe low level laser (940 nm) this technique was used in MPD region at three points, including one point for intraoral and two different points for extra oral regions. These applications were made three times a week for one month for each patient. Similar to Atef Fouda(57) report that 980 nm wavelength for LLL effective in treatment patients of TMD and reliving pain symptoms without changing etiology of disorder.

According to the Basir, Hassan(58) results of the evaluation of the test data, it can be said that low-level laser during 1 month improves the pain relief, the number of painful parts, joint sound, maximal oral opening, maximum pain opening, left lateral movement to the right and therefore the result is that LLLT is a useful method in the proper control of temporomandibular disorders within a month of the first session. Similar finding indicative of effectiveness of low level laser therapy have been reported in several other studies(59,60).

In the literature, the application points of LLLT are also varying. In general, the application sites are through the overlying skin of the masseter, temporalis muscles. Almost no intraoral application was observed. In present study utilized laser device's special probe for intraoral application to stimulate lateral pterygoid muscle via intraoral approach.

V. Conclusion:

In the present study LLLT is utilized to treat patients with MPDS with different intensity. The result revealed that the use of high power and short duration therapy is better than the use of low power and long duration according to the studded parameters.

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