LOW LEVEL LASER THERAPY VERSUS PULSED ELECTROMAGNETIC FIELD FOR INACTIVATION OF MYOFASCIAL TRIGGER POINTS

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Abstract

Most treatment methods for myofascial pain are empirical and aimed at the painful trigger points with the purpose of ablating muscle spasm and restoring normal muscle length. The current study conducted on 28 patients mainly suffering from pain and decreased mouth opening as result of TEMPD .Patients divided into two groups and treated using either Laser or PEMF therapy for two weeks. The results showed that PEMF therapy significantly decreased pain in comparison to LASER therapy. PEMF has dual effect on muscle, it produces heating and molecular resonance (vibration) with resultant muscle lengthening and reduction of ischemia. These findings suggest that PEMF has short-term beneficial clinical effects above LASER for alleviating most of myofascial pain symptoms. The treatment was found to be successful, and this could be attributed to several factors, including: patient compliance, and frequent treatment with no prolonged breaks between sessions.

Key Words: Myofascial pain, Trigger points, Magnetic Field, LASER therapy

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Review of literatures

Temporomandibular pain dysfunction (TMPD) is a disorder predominant in females, characterized by regional muscular pain with presence of hypersensitive points called myofascial trigger points (MTrP) in one or more muscles. (1) (2).

Masseter muscle is frequently involved, pain usually located on the cheek areas, and elicited on eating or mouth opening (1).

TMPD are characterized by a combination of symptoms that may include ; local dento-alveolar pain, muscular pain, head and neck pain, sounds during condylar movements, deviations and limitations of mandibular movements, altered occlusal relations, and limitations of mastication (3).

A wide varity of local and systemic factors have been implicated as etiologic factors of TMPD such as trauma, prolonged mouth opening during dental procedures, malocclusion, Neuromuscular imbalance (4) (5).

Parafunctional activities such as bruxism , clenching and grinding of the masticatory muscles can be responsible for the development of TMPD. It is possible that muscle overload may initiate or reactivate trigger points in susceptible individuals (6).

The elevated level of emotional stress can affect muscular function either by increasing muscular activity in physiologic rest position or by development of bruxism and both can occur simultaneously (7). The elevated level of emotional stress can activate the sympathetic nervous system and cause muscular pain. Activation of the sympathetic nervous system can also be related to some other psychophysical disorders (8).

TMPD can be described as the sensory, motor, and autonomic symptoms caused by myofascial trigger points (MTrP). A (MTrP) is clinically defined as a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. MTrP are classified into active and latent trigger points. An active (MTrP) can trigger locally or as referred pain. A latent MTrP does not trigger pain without being stimulated (9).

Combining all available supporting evidence of the existence of MTrPs, Simons (10) has recently proposed a new “integrated trigger point hypothesis” The hypothesis builds on the finding that excessive amounts of acetylcholine from the motor nerve terminals. The excessive acetylcholine maintains a sustained depolarization of the post-junctional membrane, which in turn results in an excessive release of calcium from the sarcoplasmic reticulum and sustained sarcomeric contractions. Also there is another mechanism of the sustained contractures that causes MTrPs when the sarcomeric contractions cause local hypoxia, reducing the available energy supply. The combined decreased energy supply and increased metabolic demand possibly may explain the common finding of abnormal mitochondria in the nerve terminals. The local energy crisis would also impair the calcium pump which avoids the returning intracellular calcium into the sarcoplasmic reticulum against a concentration gradient.

Medications may be useful for initial symptom management. The medications useful for TMPD are similar to those useful for other painful musculoskeletal conditions. Non-steroidal anti-inflammatory drugs (NSAIDs) and opiates are the mainstay of pharmacological pain treatment. Some clinicians also have found muscle relaxant medications and low-dose antidepressants of a sedating type to be useful in initial management of TMPD (11).

Occlusal appliances are often recommended as initial phase of therapy in the treatment of TMPD patients. Occlusal appliances have several uses, one of which is to temporarily provide a more orthopedically stable position. They can also be used to introduce an optimum occlusal condition that reorganizes the neuromuscular reflex activity; this in turns reduces abnormal muscle activity, while encouraging more normal muscle function. Oral appliances also protect the teeth and supportive structures from abnormal forces that may create breakdown or tooth wear (bruxism). The occlusal appliance should be individually made from hard acrylic, preferably by the use of articulator (12) (13).

Deep massage may prove effective in eliminating MTrPs when performed by experienced professionals. It is the most effective manual method in the treatment of myofascial pain. Its therapeutic principle is similar to that of the sustained pressure technique (14) (15).

Trans-cutaneous Electrical Neural Stimulation **(**TENS) is used to relax hyperactive muscles; it acts like a neuromuscular stimulator. TENS equipment produces a low amplitude, low-frequency alternating stimulus that causes muscles to contract and relax. (16) This therapy is applied to reduce the muscular activity of masticatory muscles (17).

Thermotherapy in rehabilitation is the therapeutic application of superficial mild heat to increase circulation, enhance healing, increase soft tissue extensibility, and control pain. Heat may be delivered to superficial tissues via conduction (eg, hot packs, paraffin dips, microwaves, electric heating pads), convection (eg, hydrotherapy, fluid therapy), or radiation (eg, infrared lamps) (18).

Physical therapy modalities such as ultrasound and electro galvanic stimulation (EGS) can sometimes be useful in managing trigger points. Ultrasound produces deep heat to the area of trigger point causing local muscle relaxation (19) (20).

It was reported that heating and an increase in tissue temperatures is usually associated with vasodilatation and thus an increase in blood flow to the area. Ultrasonic heating is used therapeutically to provide analgesia and assist in the resolution of pain and muscle-guarding spasm (21).

The development and history of Light amplification by stimulated emission of radiation (laser) began in the early 1900s. is one of the most recent treatment modalities in the field of physiotherapy. Laser differs from other forms of radiant energy in that the rays are coherent, monochromatic and collimated. The laser light is visible with a wavelength between 630 and 1300 nanometers (nm) (22).

Pulsed electromagnetic field (PEMF) in which electric energy generate series of magnetic pulses through injured tissues whereby each magnetic pulse induces a tiny electrical signal that stimulates cellular repair, suppressing inflammatory responses , alleviate pain and increasing range of motion (23).

Based on a clinical trial Thomas (24) concluded that PEMF may be a novel safe and effective therapy for use in subset of chronic pain. Smania (25) reported that repetitive magnetic stimulation produced significantly better results than placebo in reducing trigger points pain in trapezius muscle.

Several reports have documented the positive effects of laser in TMPD. In a study for evaluation of laser on TMPD of both myogenic and arthrogenic origins it was reported that patients responded to therapy with a significant reduction in pain, improvement in mouth opening and lateral motion, and a diminished number of trigger points (26) (27) (28) (29).

Low level laser therapy has been safely used in the treatment of TMPD with its analgesic, myo-relaxant, tissue healing, and bio-stimulation effects (30) (31) (32) (33).

Laser therapy increases metabolism of endorphins, acetylcholine, serotonin, and cortisol, it also changes nerve impulse stimulation and transmission, and reduces stimulation and perception of pain as its result. Laser radiation causes hyper-polarization of the membrane which needs greater stimulation to trigger the cellular action potential. Moreover, the analgesic effect of laser radiation has correlation with the increase of beta endorphin in cerebrospinal fluid and normalization of the tele-thermo-graphic state of the inflamed tissue (34) (35) (36).

Laser alters blood flow and induces angiogenesis. Furthermore, it increases lymph drainage and consequently inflammation decreases. (33,44).Furthermore, the biochemical effect of the laser light can stimulate the production of vascular endothelial growth factor and the conversion of adenosine-mono-phosphatase into nitric oxide, which improves vessel growth (37).

Patients and methods

The present study involved 28 female patients with TMPD with active myofascial trigger point related to the masseter muscle. Patients were selected from those referred to the outpatient clinic of Oral and Maxillofacial Surgery Department, Faculty of Oral and Dental Medicine, Cairo University. Their ages ranged from 18 to 42 years.

Group I:

Included 14 patients in whom the trigger point was exposed to low level laser therapy (IBM ,USA, diode laser of a wavelength 980 nanometers, power 0.2 watt, total energy 12 joule). In this group, laser was applied in three sessions per week for 2 weeks with exposure time 50 seconds for each session.

Group II:

Included 14 patients in whom the trigger point was exposed to PEMF stimulation using EM probe solo device (made in USA, nanosecond speed of pulse duration 200

nanoseconds and rise time 8 nanoseconds electromagnetic segment at 50 MHz and down to KHz range) In this group, PEMF was applied in three sessions per week for 2 weeks, with exposure time 15minutes for each session.

Masseter muscle was palpated by flat palpation technique using index finger of one hand to determine Palpable taut band, hypersensitive spot within the taut band, and pain that identifies an active trigger point.

After localization of the trigger point, it was exposed to LASER therapy or pulsed electromagnetic field according to the group (Fig. 1,2).

Evaluation of both groups during follow-up intervals was by means of the visual analogue scale (VAS) of pain intensity, maximum mouth opening (MMO) measured in millimeter. The numerical data was collected before each session and three months after finishing of treatment then statistically analyzed.

Fig (1) showing application of LASER to the determined trigger point.

Fig (2) showing application of PEMF to the determined trigger point.

Results

All patients of both groups showed improvement in mouth opening and pain.

Although there was great variability between patients response to treatment, there was statistically significant difference between patients exposed to PEMF applied to the superficial muscles (masseter) regarding pain and the group exposed to LASER therapy. However, the large variability in MMO across participants in both groups did not lead to a finding of statistical significance.

The results of our study have shown that the greatest reduction in the magnitude of pain was achieved when patients had started from a more unfavorable clinical situation with intense pain(values 8 to 10 in visual analog scale). We have observed that in those patients who had significant pain before starting treatment, it was common that they had

a reduction of 6 points, while those that started with mild pain (value less than 6) the expected reduction of pain was 4 points or less.

Table (1): Results of Wilcoxon signed –rank test for pain measured by(VAS) for group I

Time schedule	Mean difference	SD	P-Value
Pre-op /48 hours	-0.19	3.2	0.543
Pre-op/2 weeks	-0.3	3.4	0.574
Pre-op/3 months	-0.6	3.9	0.607

Table (2): Results of Wilcoxon signed –rank test for pain measured by(VAS) for group II

Time schedule	Mean difference	SD	P-Value
Pre-op /48 hours	-2.9	2.1	0.05*
Pre-op/2 weeks	-5.7	1.9	0.039*
Pre-op/3 months	-7.1	1.6	0.007*

*Significant at P value ≤ 0.05

Table (3): Results of paired t-test for the changes by time in (MMO) measured in mm, for group I

Time schedule	Mean difference	SD	P-Value
Pre-op /48 hours	1.1	4.2	0.329
Pre-op/2 weeks	1.3	4.6	0.413
Pre-op/3 months	-1.2	6.7	0.598

Table (4): Results of paired t-test for the changes by time in (MMO) measured in mm, for group II

Time schedule	Mean difference	SD	P-Value
Pre-op /48 hours	3.8	6	0.098
Pre-op/2 weeks	4.3	7	0.101
Pre-op/3 months	4.4	7.2	0.100

Discussion

Temporomandibular pain of myofascial origin is a condition often referred to outpatient clinic of Oral and Maxillofacial Surgery Department. The use of non invasive, with less morbidity, and costless methods for treatment is our goal.

Usual treatment of temporomandibular myofascial pain in our working environment is a combination of pharmacological and splint therapy, which produces a temporary relief. However, pharmacological treatments soon reach the limit of therapeutic efficacy and they are also associated with side effects (gastrointestinal disorders, drug interactions, and adverse reactions), so that the current trend is the search for alternative treatments.

According to a systematic review (38), active exercise, manual therapy, postural training, and relaxation techniques, may decrease pain and increase total vertical mouth opening.

The characteristics of the syndrome, however, remain highly debated as its hallmark findings of taut bands (localized areas of increased muscle tone and tenderness) and trigger points (smaller areas of increased tenderness within the bands that produce referred pain on pressure) depend on the examiner's clinical skills for identification. The identification of taut bands and trigger points was not only important for diagnosis, but also potential treatment.

In our opinion pain from TMPD is better to be expressed by the participant, so patients had to self-evaluate their pain as: nonexistent, mild, moderate, severe and very severe, by using a visual analogue scale.

Masseter muscle was selected to be a model for testing of the therapeutic effects in our study, because masseter taut bands are more superficial making them easily distinguishable and subsequently more sensitive to external effect of LASER or PEMF activity.

Considering that hypertonic shortened mandible elevators (masseter) limit TMJ range of motion. Therefore, specific work to decrease tension in these muscles would hypothetically allow for greater range of motion. Trigger points also appeared to have a positive effect on pain, releasing a trigger point through ischemic spots reduction, resulted in less pain.

Active myofascial trigger points are one of the major peripheral pain generators for regional and generalized musculoskeletal pain conditions. Recent evidence in the understanding of the pathophysiology of myofascial trigger points supports Local pain and tenderness at myofascial trigger points may be part of the process of muscle ischemia associated with sustained focal muscle contraction and/or muscle cramps. The massage techniques seemed most effective to superficial muscles as masseter muscle. (39).

In agreement with Thomas et al (40) in their study, reported that reduction of muscular pain could be achieved using portable PEMF device.

It is the author's opinion that direct application of PEMF led to masseter muscle massage(focal muscle fiber contraction) beside heating effect have had the biggest impact on maximal pain relief while LASER therapy resulted only in heating which had less pain relief.

Overall, these findings suggest that PEMF has short-term beneficial clinical effects above LASER for alleviating most of myofascial pain symptoms.The treatment was found to be successful, this could be attributed to several factors, including: patient compliance, and frequent treatment with no prolonged breaks between sessions.

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