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LOW INTENSITY PULSED ULTRASOUND THERAPY VERSUS DRY NEEDLING FOR INACTIVATION OF MYOFASCIAL TRIGGER POINTS: RANDOMIZED CLINICAL STUDY

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ABSTRACT

Objectives: This study aims to compare between the effect of low intensity pulsed ultrasound (US) therapy and dry needling in the treatment of myofascial pain syndrome.

Patients and methods: Twenty patients (5 males, 15 females; age range, 18 to 42 years with an average of 30 years) with myofascial pain syndrome were included in this prospective, comparative study. Patients were randomized into two groups as US group (n=10) and dry needle group (n=10). Low intensity pulsed ultrasound was applied 3 times per week for 5 minutes in each session for 4 weeks in the US group. Each trigger point (TrP) exposed to 12 sessions over 4 weeks. In dry needle group ,3 treatment sessions a week for 4 weeks; each session took 50 seconds. Treatment effectiveness was evaluated with Visual Analog Scale (VAS), pain pressure threshold (PPT) using algometer, and maximum interincisal opening (MIO). These parameters in both groups were evaluated at baseline, 2 weeks, and 3 months postoperative.

Results: The treatment results demonstrated insignificant difference between the means of both groups regarding VAS throughout the study (P- value>0.05). Regarding Pain Pressure Threshold (PPT), there was statistically significant difference between the means of ultrasound and dry needle groups only at base line (ultrasound 4.300±1.1091, dry needle 8.667±1.5000), and at 2 weeks (ultrasound 4.67±1.225, dry needle 8.00±2.121) (P- value<0.05). Regarding Maximum interincisal opening (MIO), there was statistically significant difference between the means of both groups at base line(ultrasound 27.00±4.183 , dry needle 35.56±5.503) (P-value=0.002), at 2 weeks (ultrasound 32.22±4.410 , dry needle 37.11±4.428) (P- value=0.032), and at 3 months postoperatively (ultrasound 42.56±2.833, dry needle 36.00±4.183) (P- value=0.001) (P-value<0.05).

Conclusion: In myofascial pain syndrome, the effect of low intensity pulsed ultrasound and dry needle are the same in reducing pain at rest (VAS). Both treatments elevate pain pressure threshold after 3 months, and ultrasound improved maximum mouth opening better than dry needle after 3 months postoperatively.

KEY WORDS: Low intensity pulsed ultrasound, dry needle, myofascial pain syndrome, trigger point

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INTRODUCTION

Myofascial pain syndrome (MPS) is described as a local syndrome represented by pain, muscle spasm, hypersensitivity, and decreased range of motion due to presence of trigger points (TrPs) on constricted fibers of muscles and fasciae.[1,2] Although the etiology of MPS is not clear, multiple factors are considered such as excessive muscle tension, trauma, structural disorders, and fatigue. [2,3] The main predisposing factors of MPS are; muscular hyperactivity, physical disorder, tissue injuries, Para functional habit, disuse, nutritional problem, psychological stress and sleep disturbance. Myofascial pain syndrome always starts as functional disorder [4], then it results in organic changes in the joints or muscles of mastication and change in occlusion.

In MPS, other symptoms may be associated with pain such as weakness and restricted range of joint movement.[5,6] The main purpose of MPS treatment is to devastate the continuous circle of "spasm-pain-spasm" and eliminate the trigger points. There are non-invasive and invasive methods for treatment of MPS. Non-invasive methods such as; hot fomentation, ultrasound therapy, spray and stretch techniques, transcutaneous electrical nerve stimulation. Invasive methods include; dry needling, local anesthetics injection, and botulinum injections. [7-9]

In the clinical and physiotherapy medical fields, ultrasound has been widely used as a non-invasive therapy. Ultrasound consists of piezoelectric crystals that utilize alternative current with high frequency to convert electrical energy to mechanical oscillation energy.[10] Ultrasound has both thermal and mechanical effects [11,12] on the tissue applied to it, which lead to increase of local tissue metabolism, blood supply, ability of connective tissue stretching and regeneration of tissue. Heat generation is the most important and well-recognized effect of ultrasound. The main results of the thermogenic effect of ultrasound are; temporary increase in the elasticity of dense collagenous tissues such as ligaments, tendons, and joint capsules, which minimize the stiffness of the joint, pain and associated muscle spasm and increases the circulation temporarily. [13]

There are also non-thermal effects for ultrasound therapy which are recognizing to submit physiological effects and segmental relief of pain. When severe muscular pain is decreased, this may lead to inhibition of nociceptive input pathway to the central nervous system and, as a sequel, central and peripheral sensitization is minimized. [14] Multiple needling treatments are used for management of myofascial pain syndrome. There are two different needling techniques can be utilized to deactivate TrP: wet needling (injections) or dry needling.[15] Wet needling technique, in which hypodermic needle with a beveled , cutting edge can be used for injection of a substance into the TrP area; whereas in dry needling ,a solid filiform needle is inserted into a TrP area without introduction of any substance. [15]

Dry needling is defined by the American Physical Therapy Association (APTA) as a: skilled interference using a thin filiform needle to pierce the skin that motivates myofascial TrPs, muscles and connective tissue for the management of neuromusculoskeletal disorders.[16] In dry needling procedure, the pain intensity is reduced by the introduction of a fine needle through the skin into TrPs or connective muscle tissue. The main goal of dry needling is to treat dysfunction of skeletal muscles, fascia and connective tissue to finally decrease the continuous peripheral nociceptive stimulation and for reestablishment of deteriorated structure and function of the body [17].

Dry needling can be applied by either superficial (Baldry model) or deep technique (Travell model). The superficial dry needling technique induce activation of Aβ fibers which results in an inhibition in the spinal cord by prevention of synaptic transmission between the Aδ and C fibers and cells of the spinal cord dorsal horn as a result of their slower passage of impulses. It also stimulates the three groups of endogenous opioids which are: β-endorphin, enkephalins, and dynorphins, their

analgesic effects are directed to inhibit the passage of afferent nociceptive information from the rear horns of the spinal cord. [16,17]

Deep technique works by extinction of the trigger point for local twitch response (LTR). Local twitch response is a spinal cord reflex, which is presented as involuntary contraction of a contracted thin band of muscles result from sudden trauma to the muscle or by introducing a thin needle. The main outcomes of deep dry needling technique are; decreasing the local intensity and referral pain, increasing the range of joint movement, reducing trigger point irritation, providing steady chemical and pH environment, and reestablishing the local blood supply. [16,18,19]

Hong is one of the authors who described the needling approach used for the management of TrPs;[20] through the "fast in, fast out" method of needling of a TrP. **Hong** suggested that to allow dry needling in trigger point areas to be effective, local twitch responses should be occurred.[20] Various investigations have been performed about the treatment of myofascial pain; however, there is still a lack of research on the most effective treatment strategies. Therefore, in this study, we aimed to compare the effectiveness of low intensity pulsed ultrasound therapy to dry needling in the treatment of MPS.[20]

PATIENTS AND METHODS

Twenty patients (15 females, 5 males; age ranges from 18-42 with an average of 30 years) with MPS, who were admitted to the outpatient clinic of Oral and Maxillofacial Surgery Department, Faculty of Oral and Dental Medicine, Cairo University, were included in this prospective comparative study. All patients signed a consent form. After obtaining approval from Cairo University research and ethical committee

The patients were selected according the inclusion criteria; that included the presence of signs and symptoms of active myofascial trigger points based on the diagnostic criteria described by **Travell and Simons** (7) **:** A palpable taut band, A tender nodule in one or more palpable taut bands, Local tenderness and Weakness of the muscle, Restricted stretch range of motion, Increased pain on active and/or passive stretch, Referred pain on manual compression as digital pressure on active TrPs, and Local twitch response (transient response of the taut band fibers).

Patients who had therapeutic intervention for myofascial pain within the past month before the study, such as using of medications for pain control or wearing of occlusal splint, clinical conditions such as pregnancy, cognitive impairment or exhibited inadequate cooperation , significant medical problem that may interfere with the procedure such as patients having a pace maker, were excluded from the study.

The program of this prospective comparative study was explained for the patients. After accepting to be enrolled in the present study, each patient was assigned into 1 of 2 equal-sized groups: group A: The trigger points in ten patients received application of low intensity pulsed ultrasound therapy, and group B: ten patients underwent dry needling of TrPs. In the first group, Low intensity pulsed ultrasound was applied 3 times per week for 5 minutes in each session for 4 weeks. In the second group, TrPs underwent 3 treatment sessions a week for 4 weeks; each session took 50 seconds.

Diagnosis of the patients included was based on case history, clinical examination and the use of algometer to evaluate the pain pressure threshold (PPT). History included; Medical and dental histories as well as history of chief complaint (pain, headache, limitation of mandibular movement, joint noises, otalgia) were recorded for each patient in his or her own questionnaire and examination chart. Clinical examination; where the masticatory muscles (masseter and temporalis) were examined by means of palpation to determine: palpable taut band, spot tenderness of a nodule in a taut band,

patient complains with pain by pressure on the tender nodule, referred pain and/or local twitch response (LTR).

Trigger point pain was assessed with the following two criteria:

1. Visual analog scale (VAS): The scale used for the evaluation of pain included a 10 cm line drawn on a horizontal plane on a plain white paper with the words 'no pain' on one end and 'unbearable pain' on the other end. According to these explanations, patients were asked to mark their pain at rest and on movement on the 10-cm line. Pain was assessed with VAS before and after the treatment.[13]
2. Algometry (digital algometer): A digital algometer (Wagner FPX™ algometer) was used to measure TrP tenderness by determining the pain pressure threshold (PPT). This device constructed from firm pistol grip handle, fiberglass reinforced plastic housing, 0.5" LCD and 4 buttons keypad and 1cm² diameters round rubber tip placed on the TrP. The units of algometer were Pound-force (lbf), Ounce-force (Ozf), Kilogram-force (kgf) and Newton (N). Application of algometer as follow: a) Identification of the maximum tender spot, b) Marking the tender spot, c) Application of the tip of the algometer exactly over the marked tender spot perpendicular to the muscle, d) Reading and recording the results (fig.1).

Assessment of mandibular active range of motion (AROM) performed through measuring the maximum painless mouth opening (MMO) by the distance in cm between the incisal edges of the upper and lower right central incisors using Vernier Caliper (fig. 2)

Ultrasound application: (group A)

The Patient was asked to sit in an upright or semi-upright position. Then the media (gel) was applied to the probe and the machine turned on for 5 minutes. The device was adjusted at intensity 1watt/cm² and frequency 3MHz. Its model is Medserve Prosound. The probe was slowly moved in circular strokes. The patient was instructed to indicate pain or overheating. Each TrP exposed to 12 sessions over 4 weeks. (fig.2)

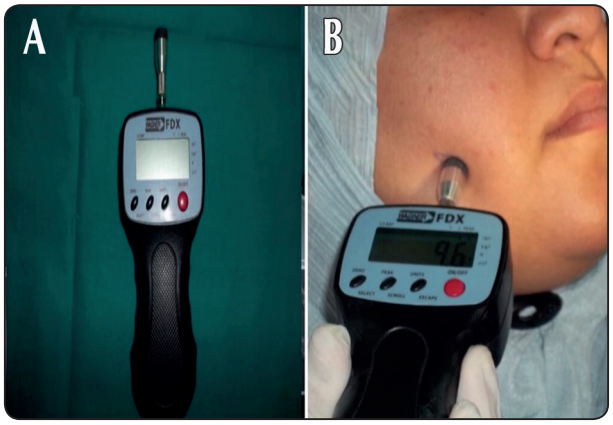

Fig. (1) Shows: A, digital algometer, B its application over tender spot

Technique of Dry needling (group B) The taut band was marked, cleansed with a Betadine swab and localized between the thumb and the index finger. It was needled forward and backward repeatedly using hypodermic needles of 23g, x1.5-inch needle with 3 ml disposable plastic syringe. The needle was inserted to a depth of 1- 2 cm at an acute angle of 30° to the skin, in various directions, with movement into the tissue. (Fig. 2) The depth of penetration varied according to the subject; however, site specificity was confirmed by the presence of local and referred pain upon insertion. The presence of a jump sign and/or local twitch response was confirmatory, but not mandatory, for the identification.

Postoperative care and instructions were given to all patients as follow: in dry needle group, bleeding was controlled by firm compression on the point punctured by the needle with gauze sponge for 10-15 seconds. All patients were advised not to use any medication during the treatment phase, the patients were advised to do physiotherapy triple a day (open

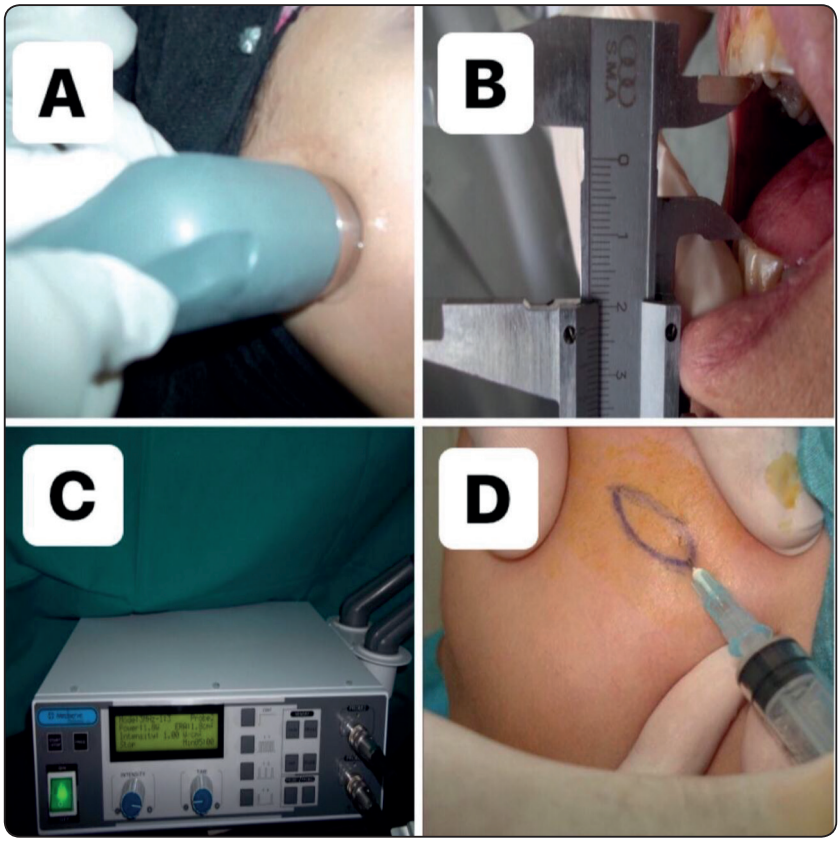

Fig. (2) Shows: A, application of ultrasound over trigger point; B, measuring MIO using Vernier caliper; C, Medserve Prosound device of ultrasound; D, dry needle insertion into TrP

and close his mouth 10 times at morning, afternoon and night) 7 days a week, warm fomentation 3 or 4 times a day was applied on the affected area, they were also advised to monitor or, as far as possible, eliminate harmful habits throughout the day, such as clenching, chewing gum and avoid biting or holding objects between the teeth (e.g., pens, pencils, clips).

Evaluation of both groups was performed in the following order: preoperative as a base line record, 2 weeks, and 3 months postoperative as means of the Pain pressure threshold (PPR) by algometer, painless maximum interincisal opening (MIO), and Visual Analogue Scale (VAS) of pain intensity. Then the data were collected and statistically analyzed.

Statistical analysis

Microsoft excel 2013was used for data entry and the statistical package for social science (SPSS version 24) was used for data analysis. Simple descriptive statistics (arithmetic mean and standard deviation) used for summary of normal quantitative data and frequencies used for qualitative data.

Independent T-test and Paired T-test was used to compare normally distributed quantitative data among both groups. Pearson correlation was used to compare normally distributed quantitative data. The level of significance was set at probability (P-value <0.05).

RESULTS

In the comparison between both groups Ultrasound and Dry needle one, there was no significant difference between the means of both groups regarding VAS (at rest) at base line (ultrasound 3.89±1.537, dry needle 3.44±2.963), at 2 weeks (ultrasound 2.56±1.944 , dry needle 2.89±2.804), and at 3 months postoperative (ultrasound 1.22±1.093, dry needle 3.00±3.536)) (P- value>0.05).

Regarding Pain Pressure Threshold (PPT), there was statistically significant difference between the means of ultrasound and dry needle groups at base line (ultrasound 4.300±1.1091, dry needle 8.667±1.5000), and at 2 weeks (ultrasound 4.67±1.225, dry needle 8.00±2.121) (p-value<0.05). While at 3 months there was insignificant difference between the means of ultrasound and dry needle groups (ultrasound 7.500±1.3010, dry needle 6.333±2.9580) (P- value>0.05).

Regarding Maximum interincisal opening (MIO), there was statistical significant difference between the means of ultrasound and dry needle groups at base line (ultrasound 27.00±4.183 , dry needle 35.56±5.503) (P-value=0.002) , at 2 weeks (ultrasound 32.22±4.410 , dry needle 37.11±4.428) (P- value=0.032) , and at 3 months postoperative (ultrasound 42.56±2.833 , dry needle 36.00±4.183) (P- value=0.001). (Table 1, fig. 3-5)

Regarding VAS in **Ultrasound** group; Paired Samples Statistics showed that there was significant difference between the means of VAS before treatment and after 2 weeks (base line 3.89±1.537, after 2 weeks 2.56 ±1.944) (P- value==0.007). There was significant difference between the means of VAS before treatment and 3 months (base line 3.89 ±1.537, after 3 months 1.22 ± 1.093) (P-value< 0.001). There was significant difference between the means of VAS after 2 weeks and 3 months of treatment (2 weeks 2.56 ±.1.94, 3 months 1.22 ±1.093) (P value=0.011). (Table 2)

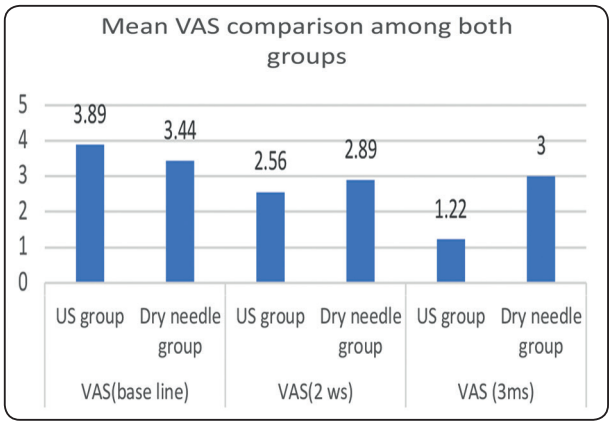

Fig. (3) Shows means of VAS comparison among both groups at base line, 2 weeks, and 3 months postoperative

TABLE (1) shows the comparison between both groups US and dry needle ones, regarding VAS, Pain Pressure Threshold, and MIO at base line, after 2 weeks, and after 3 months.

	Group	Mean	Std. Deviation	P value
VAS(base line)	US group	3.89	1.537	0.697
	Dry needle group	3.44	2.963	
Pain pressure threshold(base line)	US group	4.300	1.1091	**<0.001***
	Dry needle group	8.667	1.5000	
MIO(base line)	US group	27.00	4.183	**0.002***
	Dry needle group	35.56	5.503	
VAS(2 ws)	US group	2.56	1.944	0.774
	Dry needle group	2.89	2.804	
Pain pressure threshold(2ws)	US group	4.67	1.225	**0.001***
	Dry needle group	8.00	2.121	
MIO(2ws)	US group	32.22	4.410	**0.032***
	Dry needle group	37.11	4.428	
VAS (3ms)	US group	1.22	1.093	0.182
	Dry needle group	3.00	3.536	
Pain pressure threshold(3ms)	US group	7.500	1.3010	0.302
	Dry needle group	6.333	2.9580	
MIO (3MS)	US group	42.56	2.833	**0.001***
	Dry needle group	36.00	4.183	

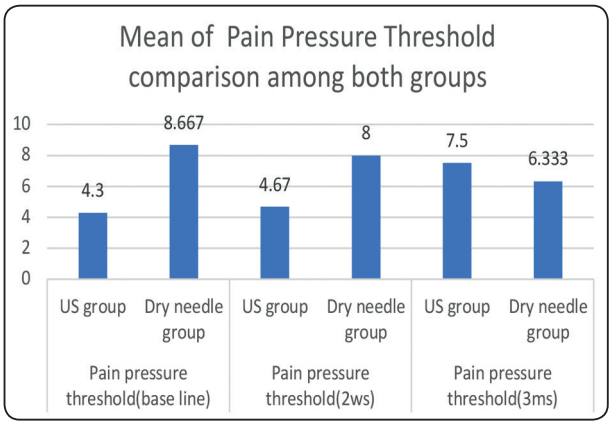

Fig. (4) Shows mean of PPT comparison among both groups at base line, 2 weeks, and 3 months postoperative

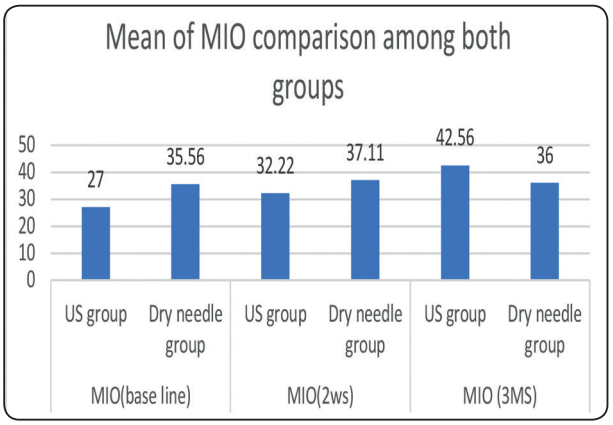

Fig. (5) Shows mean of MIO comparison among both groups at base line, 2 weeks, and 3 months postoperative

Regarding Pain Pressure Threshold (PPT) in **Ultrasound** group; Paired Samples Statistics showed that there was significant difference between the means of PPT before treatment and after 2 weeks (base line 4.300±1.1091, after 2 weeks 4.67±1.225) (P- value==0.009). There was significant difference between the means of PPT before treatment and 3 months (base line 4.300 ±1.1091, after 3 months 7.500 ± 1.3010) (P-value< 0.001). There was significant difference between the means of PPT after 2 weeks and 3 months of treatment (2 weeks 4.67 ±.1.225, 3 months 7.500 ±1.3010) (P value<0.001). (Table 2)

TABLE (2) displays the paired wise comparison of VAS, Pain Pressure Threshold, and MIO at base line, 2 weeks and 3 months among the US group.

		Mean	Std. Deviation	P value
Pair 1	VAS(base line)	3.89	1.537	**0.007***
	VAS(2 ws)	2.56	1.944	
Pair 2	VAS(base line)	3.89	1.537	**<0.001***
	VAS (3ms)	1.22	1.093	
Pair 3	VAS(2 ws)	2.56	1.944	**0.011**
	VAS (3ms)	1.22	1.093	
Pair 4	Pain pressure threshold(base line)	4.300	1.1091	**0.009***
	Pain pressure threshold(2ws)	4.67	1.225	
Pair 5	Pain pressure threshold(base line)	4.300	1.1091	**<0.001***
	Pain pressure threshold(3ms)	7.500	1.3010	
Pair 6	Pain pressure threshold(2ws)	4.67	1.225	**<0.001***
	Pain pressure threshold(3ms)	7.500	1.3010	
Pair 7	MIO(base line)	27.00	4.183	**<0.001***
	MIO(2ws)	32.22	4.410	
Pair 8	MIO(base line)	27.00	4.183	**<0.001***
	MIO (3MS)	42.56	2.833	
Pair 9	MIO(2ws)	32.22	4.410	**<0.001***
	MIO (3MS)	42.56	2.833	

Regarding MIO in **Ultrasound** group; Paired Samples Statistics showed that there was significant difference between the means of MIO before treatment and after 2 weeks (base line 27.00 ±4.183, after 2 weeks 32.22 ±4.410) (P- value<0.001). There was significant difference between the means of MIO before treatment and 3 months (base line 27.00 ±4.183, after 3 months 42.56 ± 2.833) (P-value< 0.001). There was significant difference between the means of MIO after 2 weeks and 3 months of treatment (2 weeks 32.22 ± 4.410, 3 months 42.56 ±2.833) (P value<0.001). (Table 2)

Regarding VAS in **Dry needle** group; Paired Samples Statistics showed that there were insignificant differences between the means of VAS before treatment and after 2 weeks (base line 3.44±2.963, after 2 weeks 2.89 ±2.804) (P- value=0.516), before treatment and after 3 months (base line 3.44±2.963, after 3 months 3.00±3.536)(P-value=0.777), and also insignificant difference after 2 weeks and 3 months (base line 2.89±2.804, after 3 months 3.00±3.536)(P- value=0.939) (Table 3).

Regarding Pain Pressure Threshold (PPT) in **Dry needle** group; Paired Samples Statistics showed that there was insignificant difference between the means of PPT before treatment and after 2 weeks (base line 8.667±1.5000, after 2 weeks 8.00 ±2.121) (P- value==0.360). There was significant difference between the means of PPT before treatment and 3 months (base line 8.667±1.5000, after 3 months 6.333±2.9580) (P-value=0.032). There was insignificant difference between the means of PPT after 2 weeks and 3 months of treatment (after 2 weeks 8.00 ± 2.121, after 3 months 6.333±2.9580) (P value=0.191). (Table 3)

Regarding Maximum interincisal opening (MIO) in **Dry needle** group; Paired Samples Statistics showed that there were insignificant difference between the means of MIO before treatment and after 2 weeks (base line 35.56 ±5.503 , after 2 weeks

TABLE (3) Displays the paired wise comparison of VAS, Pain Pressure Threshold, and MIO at base line, 2 weeks and 3 months among the Dry needle group.

		Paired Samples Statistics		
		Mean	Std. Deviation	P value
Pair 1	VAS(base line)	3.44	2.963	0.516
	VAS(2 ws)	2.89	2.804	
Pair 2	VAS(base line)	3.44	2.963	0.777
	VAS (3ms)	3.00	3.536	
Pair 3	VAS(2 ws)	2.89	2.804	0.939
	VAS (3ms)	3.00	3.536	
Pair 4	Pain pressure threshold(base line)	8.667	1.5000	0.360
	Pain pressure threshold(2ws)	8.00	2.121	
Pair 5	Pain pressure threshold(base line)	8.667	1.5000	**0.032***
	Pain pressure threshold(3ms)	6.333	2.9580	
Pair 6	Pain pressure threshold(2ws)	8.00	2.121	0.191
	Pain pressure threshold(3ms)	6.333	2.9580	
Pair 7	MIO(base line)	35.56	5.503	0.518
	MIO(2ws)	37.11	4.428	
Pair 8	MIO(base line)	35.56	5.503	0.857
	MIO (3MS)	36.00	4.183	
Pair 9	MIO(2ws)	37.11	4.428	0.388
	MIO (3MS)	36.00	4.183	

37.11 ±4.428) (P- value==0.518) , before treatment and after 3 months (base line 35.56 ±5.503, after 3 months 36.00 ± 4.183) (P-value=0.857), and also there was insignificant difference between the means of MIO after 2 weeks and 3 months of treatment (after 2 weeks 37.11 ± 4.428, after 3 months 36.00 ±4.183) (P value=0.388). (Table 3)

DISCUSSION

Low intensity pulsed ultrasound and dry needle are efficient therapeutic devices that are used for management of MPS. The aim of the present study was to compare the effect of ultrasound and dry needling injection on pain intensity (VAS), pain pressure threshold (PPT), and maximum interincisal opening (MIO) in the patients suffering from TrPs. Considering the VAS pain score at rest, the results of current study revealed that no significant difference between the means of both groups regarding VAS (at rest) at base, at 2 weeks, and at 3 months postoperative (P-value>0.05). This means both lines of treatment have the same effect on reduction of pain intensity in MPS.

Regarding VAS within **Ultrasound** group, the results showed that there was significant difference in VAS pain score between base line and after 2 weeks, base line and after 3 months, and after 2 weeks and 3 months. The effect of ultrasound on pain relief may be attributed to that, ultrasound changes the direction in the Sodium-potassium ATPase pump activity. When reduction in pump activity occurs in neuronal plasma membranes, it inhibits the exudation of harmful stimuli and then neural transition which lead to the pain relief. This is in accordance with the study of **Ilter et al**,[21] who compared the effects of continuous and pulsed therapeutic ultrasound therapy with the sham ultrasound in terms of the pain intensity, severity of the muscle spasm, and neck movement, the results revealed significant improvement in all the pain scores, the severity of the muscle spasm, and neck movement during assessment.

Numerous studies explained the analgesic effect of ultrasound therapy, through different mechanisms such as thermogenesis and metabolic changes. In in vivo rat study, **Hsieh** described the therapeutic effect of ultrasound on the central mechanisms of pain by proving that ultrasound therapy changes the number of dorsal horn neuronal nitric oxide synthase like neurons (nNOS-LI). Both nitric oxide (NO) and nitric oxide synthase (NOS) cause facilitation of central sensitization mechanisms and inflammatory hyperalgesia. [22]

The results of the current study revealed that, the effect of ultrasound on MPS is not conclusive due to the small number of investigated patients. Regarding VAS within **Dry needle** group; results showed that there was insignificant reduction of pain (VAS) from base line to 2 weeks, from base line to 3 months, and from 2 weeks to 3 months. (P- value>0.05). These results are in contrast to the study of **Eldad Kaljić et al,** showed that dry needling treatment is effective in reduction of pain scores in patients who suffer from musculoskeletal pain and is more effective compared to sham dry needling group.[23] The results of the current study may be attributed to small sample size in the present study, and also due to the use of dry needle without any other intervention which is in agreement with **Dunning J** who stated that in some areas, such as the knee, the application of dry needling should be used in combination with other interventions, e.g. electrical current (electrical dry needling) as mentioned in a multicenter randomized clinical study recently. [24] The current results are also in accordance to study of **Koppenhaver e**t al also revealed that no differences in pain and function records between patients with low back pain showing local twitch response during dry needling of the lumbar multifidus and those not showing local twitch responses. [25]

Considering pain pressure threshold (PPT) scores in the current study, there was statistically significant difference between the means of ultrasound and dry needle groups at base line and at 2 weeks (p- value<0.05). At 3 months there

was insignificant difference between the means of ultrasound and dry needle groups (P- value>0.05). Dry needle group showed higher PPT scores at base line and after 2 weeks than those of ultrasound group, this in agreement with **César Fernández and Jo Nijas** who studied the effects of dry needling for treatment of individuals with temporomandibular disorders deduced that dry needling was more effective than sham therapy for enhancing pressure pain thresholds. (26)

The successful effect of dry needle on PPT may be attributed to the mechanical pressure caused by the needle combined with its rotation polarizes the continuative tissue, which has an implicit piezoelectricity character. This mechanical pressure converted into electrical energy which enhances tissue reconstruction. When the needle is inserted, an axonal reflex strikes the terminal network of A delta and C fibers, that are related to the liberation of many substances with vasoactive action. (19,27,28) They cause vasodilatation and inflation of local blood flow which leads to decreasing the amount of algogenic substances and decreasing the activity of nociceptors, resulting in resolution of peripheral sensitization. (29)

In the present study, after 3 months, the effect of ultrasound therapy on PPT was increased to approached to the score of dry needling with insignificant difference. Also within ultrasound group, there was significant increase in PPT between different intervals of follow up. These results could be explained through the cumulative effect of ultrasound after end of treatment with 3 months as ultrasound transforms electrical energy to sound waves to supply the muscles with heat energy(30). Also, the thermal and non-thermal actions of ultrasound promote tissue regeneration, enhancing the stretching of collagen fibers, decreasing pain and muscle cramp, also changing the movement of ions through stable cavitation.

Regarding Maximum interincisal opening (MIO), there was statistically significant difference between the means of ultrasound and dry needle groups at base line, at 2 weeks, and at 3 months postoperative (P- value <0.05). The significant effect of dry needling which is higher than ultrasound at base line and after 2 weeks in improving MIO may be attributed to that dry needling of a myofascial trigger point evolves a local twitch response (LTR), which is an involuntary spinal cord reflex where the muscle fibers in the taut band of muscle tense. (31) When dry needling evolves LTRs, the spontaneous electrical activity (SEA) in the trigger point disappears. As the muscle contraction decreases, blood supply to the area increases, and may activate endogenous opioids. (31) When the blood and oxygen supply to the muscle increase following TrP-dry needling, this could support the decrease of sarcomere contracture. The mechanisms by which TrP-dry needling provides its therapeutic actions are not fully established and both mechanical and neurophysiological mechanisms have been suggested. (32) Both therapeutic mechanisms aim at the motor and sensitive portions of the TrP based on the incorporated assumption. The current results are in accordance with **Gonzalez-Perez et al** (33) who compared dry needling with pharmacological therapy with methocarbamol/paracetamol prescribed every 6 hours, for 3 weeks. (34)

The authors concluded that the dry needling was more effective for decreasing pain and restoring the maximum measured movements than the group were received pharmacologic therapy. The current results showed that, after 3 months, ultrasound showed significantly higher increase in MIO than dry needling; this could be attributed to the pressure and massaging actions of the ultrasound applicator. Massaging effect increase circulation reduces pain and stress, enhance relaxation, and improve the general health of patients. (35) Ultrasound effects on MIO also may be due to its both thermic and non-thermic actions, which improve tissue regeneration, increasing the flexibility and stretching of collagen fibers, minimizing pain and muscle contraction.(35)

These results are in agreement with **Peng Xia et al**,[36] and **Mustafa Aziz et al**, [37] who concluded in their studies that ultrasound is effective in treatment of myofascial pain syndrome.

CONCLUSION

The present study concluded that low intensity ultrasound and dry needle have the same effect on pain and pain pressure threshold in myofascial pain syndrom. Dry needle was more effective than ultrasound in improving MIO in early phase of treatment, while low intensity pulsed ultrasound was more effective at the late phase of treatment (3 months). Clinical improvement of patients with myofascial pain syndrome was achieved with both treatment modalities. The limitation of the present study is reduced sample size. However, further studies with larger sample size and longer follow-up periods are necessary to draw decisive conclusions.

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