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Effect of high-power pain threshold ultrasound versus extracorporeal shock wave on upper trapezius myofascial trigger points

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Abstract

The aim of the study is to investigate effect of high-power pain threshold ultrasound versus extracorporeal shock wave on myofascial trigger points. Methods: this randomized single blinded controlled trial included a sample of 60 subjects (age 20 to 26) years old with upper trapezius myofascial trigger points. Subjects randomly allocated into 3 groups; Extracorporeal shock wave (ESWT) group (n=20) which received low level energy ESWT plus neck stretching, strengthening exercise, High Power Pain threshold Ultrasound (HPPT) group (n=20) received high power-pain threshold ultrasound with intensity range from 0.5 to 2 Watt/cm² plus neck stretching, strengthening exercise and control group (n=20) received neck stretching, strengthening exercise, Arabic Neck Disability Index and Pressure algometer was used to measure neck functional disability (ANDI) and Pressure pain threshold (PPT). Results: within group study showed statistically significant improvement in ANDI and PPT in both ESWT group and HPPT group as p value was (P<0.0001), While between group analysis comparison demonstrated a statistically significant improvement in ESWT group compared to the HPPT group regarding the value of NDI and PPT (P<0.000). Conclusion: in young adult with upper trapezius myofascial trigger points, ESWT plus exercise produce better improvement in ANDI and PPT compared to HPPT Ultrasound.

Keywords: Extracorporeal shock wave; High Power Pain Thershold Ultrasound ; Myofascial trigger points.

Introduction

Myofascial pain syndrome (MPS) is considered as one of the common causes of musculoskeletal disorder, with approximately 30-50% of patients with musculoskeletal disorder reporting to have MPS (1) Which is distinguished by one or more Myofascial trigger points, (MTrP) are found in the skeletal muscle, characterized by palpable nodules in the tight band, which are tender, highly sensitive to touch and cause persistent pain muscle spasm and limited range of motion (2)Clinically About 85% of pain clinic patients, reported to have MTrP (3)MTrPs are more common in female (54%) then male (45%) (4) In the upper trapezius muscle they are more prevalent in the dominate side than non-dominate side (82.1%), (79%) respectively, with higher incidence rate then levator scapulae and finally multifidi (93.75%) (82.14%) (77.68%) (5)

Myofascial Trigger points are clinically categorized as active and latent myofascial trigger points (MTrPs), active trigger points characterized by persistent pain, hyperirritability and can be alerted through palpation while latent trigger points display only hyperirritability with no persistent pain (6)

Physical therapy approaches for the treatment of myofascial trigger points can be categorized into manual therapies which include ischemic compression, spray and stretch, strain and counter strain (7, 8)trigger points pressure release (9), muscle energy technique (10) transverse friction massage (11). Thermotherapy (12), Ultrasound therapy (13), laser therapy (14), high power pain threshold ultrasound (15) radial extracorporeal shock wave (16). Needling therapy (17)

In recent decades extracorporeal shock wave has been widely known to be effective therapeutic modality in of myofascial pain syndrome treatment a review conducted by Ramon et al. provided promising insight about the effectiveness of ESWT in Myofascial pain syndrome treatment (18)also Zhang et al ., who conducted systemic review to investigate the effect of extracorporeal shock wave on severity of

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pain and functional neck disability on subjects with upper trapezius myofascial pain syndrome, they revealed that ESWT is efficient in decreasing pain, enhancing neck function in subject with Myofascial pain syndrome (19)according to Kiraly et al. who compared laser therapy and ESWT on treatment of upper trapezius myofascial trigger points, they stated that in subjects with upper trapezius myofascial trigger points, ESWT was more beneficial than laser therapy (20)

Also, Taheri et al. who compared the effect of phonophoresis and ESWT on myofascial pain syndrome, they found that ESWT was more effective than phonophoresis treatment in reducing pain and neck functional disability (21)

High power pain threshold ultrasound is considered as an effective treatment for MTRPS
, deep heat caused by ultrasound used in the treatment of (MPS) due to its properties of increasing vasodilatation, increasing viscoelasticity and reducing muscle spasm, increasing dosage of Ultrasound applied to the trigger points breaks down the vicious cycle of pain-spasm-pain –ischemia cycle (22)

Study conducted by Koca et al. compared different intensities of ultrasound on treatment of myofascial pain syndrome, they stated that HPPT was more effective with less sessions number and less economical (23)also Unalan and Majlesi who stated that HPPT was effective in reducing pain in myofascial pain syndrome (24)

Unalan et al. (25)who compared effect of HPPT and injection therapy on myofascial pain syndrome, they proved that HPPt that the same effect with injection therapy, with HPPT being non-invasive and less side effects than injection therapy

Accordingly, there's gap in the literature about which of ESWT or HPPT has greater effect on myofascial trigger point treatment, so the aim of the current study is to compare effect of ESWT and HPPT on subjects with upper trapezius myofascial trigger points.

The hypothesis of current study was that ESWT and HPPT have the same effect on pain severity and neck function disability on subject with upper trapezius myofascial trigger points.

Materials and Methods:

The current single blinded randomized controlled trial was conducted from February to April 2021 at the outpatient clinic of Faculty of Physical Therapy, Modern University for Information and Technology. The recruitment process was ended when the appropriate sample size was reached.

Sixty subjects were diagnosed by active upper trapezius trigger points on dominant side. Subject aged (20 to 26 years old) (26)with at least one active trigger point and pain lasting from zero to 2 weeks, local twitch response and jump sign (27)were included in the study.

Subject who had recent medication for trigger points, latent trigger points, upper limb neurological disorder, cervical disorder and contraindicated to shock wave therapy or high-power pain threshold ultrasound (metal implantation) were excluded from the study.

Software G*power 3.0.10 (Heinrich Heine University Düsseldorf, Düsseldorf, Germany) the sample size was determined based on pilot study, which included 15 subjects with MTrPs, the subjects were assigned randomly, one group received extracorporeal shock wave, group received HPPT, group received stretching and strengthening. The primary dependent measurement was pain, F test-repeated measurements with between factors =0.05, and effect size =0.4 found that (15 participants per group) was the acceptable sample size. To account for potential withdrawals, the ultimate number of individuals in each group was set at 20.

The randomization process was performed using sealed envelope, each envelope contains 20 letters, 20 contain letter (A) for ESWT group, 20 contain letter (B) for HPPT group and 20 contain letter (C) for control group. In our study subject was blinded to the allocation process. As shown in figure 1

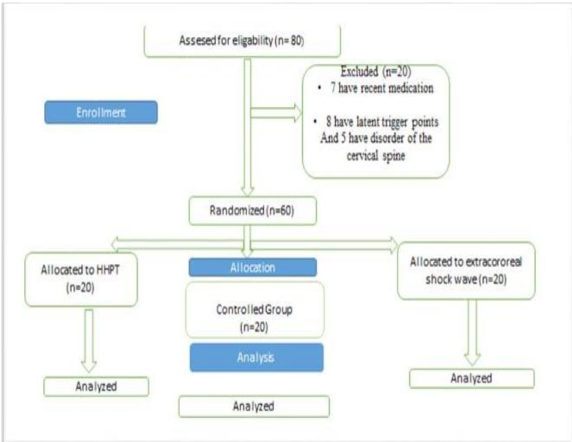

Figure (1) : flow chart of participants

Extracorporeal shock wave group received low level energy radial extracorporeal shock wave (EME S.r.l. via Degli Abeti 88/161122 Pesaro [serial number: EM12681015], Italy), each subject received 4 sessions of shock wave for 2 weeks with 700 impulse/session 400 impulse was applied to tight band and 300 impulses was applied surrounding the tight band, with frequency [10HZ], resulting in positive energy flux density [EFD] 0.056mJ/mm (28)plus neck stretching, strengthening exercise. As shown in figure (2).

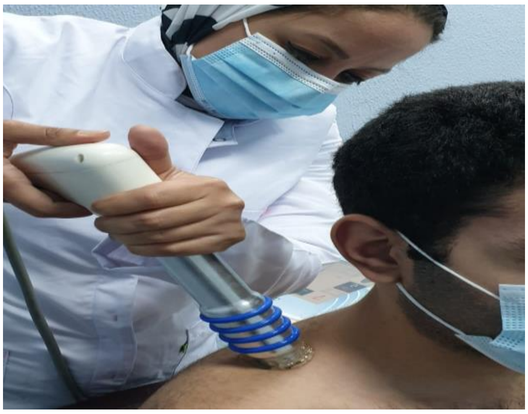

Figure (2) application of extracorporeal shock wave on upper trigger points

High power pain threshold ultrasound group received High power pain threshold Ultrasound, Med Serve system (England NN114HE, Prosound/ULS-1000, S/N: U0547) was used. Ultrasound was applied in continuous mode with intensity from 0.5 to 2 watt/cm², the patient was instructed to sit on chair back rest, to elicit pain threshold the US probe was kept motionless, and the intensity progressively increased until the maximum level of pain patient can endure was selected, it was maintained on this level for 3 to 4 seconds and then decreased to half-intensity for 15 seconds the treatment process was repeated three times. 2 sessions per week for two weeks (22)plus neck stretching and strengthening exercise as shown in figure (3).

Figure (3) application of high-power pain threshold ultrasound on upper trapezius trigger point.

Control group received neck stretching, strengthening exercise was conducted for 2 weeks for 2 times per week (29)

Stretching exercise:

Passive stretching for neck extensor muscles Patient sitting and the therapist behind his/her proximal hand on patient shoulder and distal hand slowly flex the head for 30 seconds and then relaxed for 30 seconds and repeated 3 times as shown in figure (4).

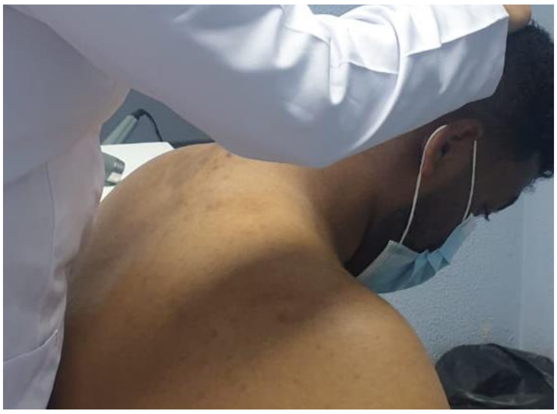

Figure (4) passive stretching neck extensor muscles

Passive stretching for neck side bending muscles Patients sitting and the therapist behind his/her stabilizes the shoulder by distal hand and the proximal one on the temporal area of the head slowly lowering the head to the opposite side and applying gentle stretch for the same side as shown in figure (5).

Figure (5) passive stretching neck side-bending

Strengthening exercise:

Isometric neck extensors exercise subjects were instructed to sit and try to extend his neck against maximum resistance of the therapist, hold for 6 seconds and then relax and repeated 5 times as shown in figure (6).

Figure (6) isometric neck extensors exercises.

Isometric side bending exercise subjects were instructed to sit and try to bend his/her head against maximum resistance of the therapist, hold for 6 second and then repeated 5 times as shown in figure (7).

Figure (7) isometric neck side bending exercise

Isometric neck flexors exercise subjects were instructed to sit and try to flex his/her neck against maximum resistance of the therapist, hold for 6 seconds and then relax and repeated 5 times as shown in figure (8).

Figure (8) isometric neck flexor exercises

Outcome measures:

The assessment of outcome measurement was two time points, before and after treatment, the assessment was conducted by author which was not included in the treatment process.

Arabic Neck Disability Index was used, which is both valid and reliable in assessing neck function It is divided into eleven categories/classes. Each category had six choices (zero-five), and the score was calculated by adding the ranking of the ten ANDI items. It is thought that patients with (zero to four) have no functional neck disability, (five to fifteen) have mild neck functional disability, (ranging from 25 to 35) have moderate neck functional disability and more than 35 scores have complete neck Functional disability (30)Each item was thoroughly explained, and the patient was instructed to choose one sentence from a list of six that described their function level, higher score indicates a greater loss of function.

Digital algometer used for the assessment of pressure pain threshold FDX® (Wagner Greenwich, USA) which is both reliable and valid for assessment of pressure sensitivity (31)subject was asked to locate the area of pain because they have active trigger point the site of pain was confirmed by pincer palpation and then mark it. The 1-cm² rubber tip was placed perpendicularly over the myofascial trigger points and the power is switched on; Appropriate pressure was applied at the site of myofascial trigger points by pressing the transducers firmly downwards. The actual pressure applied at the site appears on the digital display in kg. The applied pressure was maintained and increased gradually until the first sign of discomfort was confirmed by the patient "STOP". The digital reading at this point was the pressure pain threshold value to store this value, the hold switch was pressed, three measurements were taken and the average was calculated. Measurements were recorded in kg/cm². All measurement was taken pre and post treatment

Results

Sixty subjects who fit the inclusion and exclusion criteria joined and completed the study (dropout=zero). The characteristics of the subjects were similar at the baseline (Table 1). During the treatment, no negative effects were reported in all groups

Mixed MANOVA was conducted to assess the effect of treatment on ANDI and PPT, there was significant effects of treatment as p = 0.0001 and f = 18.40 and time as p = 0.0001 and f = 1854.12. Moreover, for interaction between time and treatment, there was a significant interaction as p = 0.0001 and f = 132. Multiple pairwise comparison within group revealed statistically significant improvement in ANDI and PPT in both groups (P< 0.0001), (Table 2)

Multple pairwise comparison between groups revealed significantly improvement in ANDI and PPT in ESWT group compared to HPPT group(P<0.000) (Table 3).

Table (1): Physical characteristics of the studied group

	Group A	Group B	Group C	comparison		sig
	Mean ±SD	Mean±SD	Mean ±SD	f- value	p- value	
Age (years)	22. 65±1. 55	23. 85±1. 7	23. 08±1. 69	1. 68	0. 19	**N. S**
Weight (kg)	63. 7±4. 49	63. 3±5. 57	64±5. 9	0. 06	0. 93	**N. S**
Height(cm)	162. 95±4. 57	163. 7±4. 7	163. 4±4. 58	0. 12	0. 88	**N. S**
BMI(kg/m²)	23. 68±1. 07	23. 1±1. 01	23. 5±1. 17	0. 06	0. 94	**N. S**
	Group A	**Group B**	**Group c**	**χ^2 value**		**p-value**
Females	10 (50%)	11(55%)	13(65%)	0. 95		0. 62*
Males	10 (50%)	9(45%)	7(35%)			

Sig; significance, N. S; Not significance, SD standard deviation: probability, value F: ANOVA, χ2: Chi squared value, p value: Probability value, *: Non significant

Table (2) within group comparison for ESWT, HPPT and Control group.

Variable	**ESWT GROUP**						**HPPT GROUP**						**CONTROL GROUP**					
	Mean ± SD		**MD**	**P**	**95% Confidence Interval**		**Mean ± SD**		**MD**	**P**	**95% Confidence Interval**		**Mean ± SD**		**MD**	**P**	**95% Confidence Interval**	
	Pre treatment	**Post treatment**			**Lower Bound**	**Upper Bound**	**Pre-treatment**	**Post-treatment**			**Lower Bound**	**Upper Bound**	**Pre-treatment**	**Post-treatment**			**Lower Bound**	**Upper Bound**
ANDI	**10.75±1.1**	**5.45±1.98**	**5.3**	**0.001**	**7.695**	**8.541**	**10.55±0.99**	**8.05±1.19**	**2.5**	**.0001**	**8.859**	**9.741**	**10.35±0.9**	**10.15±0.9**	**0.2**	**0.121**	**9.809**	**10.69**
PPT	**2.9±0.602**	**5.26±0.56**	**-2.36**	**.0001**	**3.84**	**4.325**	**2.73±0.5**	**3.78±0.61**	**-1.05**	**.0001**	**3.018**	**3.479**	**2.94±0.5**	**3.04±0.55**	**-0.01**	**0.210**	**2.74**	**3.227**

SD, standard deviation; MD, mean difference; P, level of significant; ANDI, Arabic neck disability index; PPT, pressure pain threshold

Table (3) Between group comparisons for ESWT, HHPT group and control group.

Variable	**Group**	**Mean Difference (I-J)**	**Sig.**	**95% Confidence Interval**	
				Lower Bound	**Upper Bound**
Pre-treatment ANDI	**ESWT versus HPPT**	.200	1.00	.609-	1.009
	ESWT versus control	.400	.682	.409-	1.209
	HPPT versus control	.200	1.00	.609	1.009
PPT	**ESWT versus HPPT**	.175	.925	.245	.595
	ESWT versus control	.030	1.000	.450	.390
	HPPT versus control	.205	.701	.625-	.215
RMS	**ESWT versus HPPT**	.020	1.000	.481-	.521
	ESWT versus Control	.250	.671	.251-	.751
	HPPT versus Control	.230	.788	.271-	.731
Post – treatment ANDI	**ESWT versus HHPT**	-2.600-*	.000	3.390-	-1.810-
	ESWT versus Control	-4.700-*	.000	5.490-	-3.910-
	HPPT versus Control	-2.100-*	.000	2.890-	1.310-
PPT	**ESWT versus HPPT**	1.480*	.000	1.026	1.934
	ESWT versus Control	2.225*	.000	1.771	2.679
	HPPT versus Control	.745*	.000	.291	1.199

Discussion

The current study aimed to compare the effects of extracorporeal shock wave versus high power pain threshold ultrasound on patients suffering from upper trapezius active myofascial trigger points.

According to our findings, there was a substantial improvement in neck function and pain threshold in the ESWT group over the HPPT group. There was improvement in pain and function in both groups, but the improvement in extracorporeal shock wave was greater.

Ji et al. demonstrated that ESWT was helpful in decreasing pain and muscle spasm in myofascial pain syndrome by stimulating angiogenesis, increasing perfusion, and changing pain signalling in ischemic tissue induced by calcium influx as a possible reason for this improvement(28)Gur et al. who examined the impact of ultrasound treatment vs extracorporeal shock wave on myofascial pain syndrome in sixty patients with active trigger points, determined that ESWT was more successful in reducing pain and improving neck function. They stated that ESWT, when used to treat myofascial pain syndrome, stimulates neovascularization by disrupting microcirculation surrounding the tendon, increasing production of local growth factors, and activating normal cells from stem cells, thereby ending the vicious cycle of pain. -spasm -ischemia- pain, which soothes pain and reduces muscular spasms (32)

In consistent with our study Yoo et al. who examined the influence of extracorporeal shock wave on patients with myofascial pain syndrome, found that the use of extracorporeal shock wave was more successful in the treatment of myofascial pain syndrome, with substantial improvement in pain intensity and neck function (33). Moreover Cho et al. who studied the effect of extracorporeal shock and shoulder stabilization exercise ESWT group plus exercise showed significantly improvement in visual analogue scale, functional neck disability index and pain threshold (34).

In agreement with our study park et al. (35)who studied both the effect of high- and low-level energy extracorporeal shock wave on of myofascial pain syndrome treatment, they concluded that ESWT was effective in reducing pain severity, muscle spasm, improving neck function and quality of life in subject with myofascial pain syndrome.

Similarly, Gezgİnaslan and Atalay (36) who studied the role of ESWT in patient with myofascial pain syndrome, they concluded that ESWT was effective myofascial pain syndrome treatment, with significant improvement in pain severity and neck function, ESWT was found to improve blood flow, decreasing pain level, muscle spasm and stiffens, inhibiting overstimulation of the nerves and nociceptor.

Furthermore, Yang et al. (37)concluded that ESWT can relieve tension and stiffness along the muscle and reduce pain by improving blood circulation in blood vessels after reporting improvement in pain scale and pain threshold in individuals with myofascial pain syndrome.

Additionally, Hausdorf et al. who reported that extracorporeal shock wave can reduce pain and muscle spasm in musculoskeletal disorder through selective destruction of non-myelinated nerve fiber and decreasing the level of substance p in dorsal root ganglion (38)

On the same line Jun et al. who investigated the level of pain severity and neck functional disability in the treatment of subjects with myofascial pain syndrome they found that after application of extracorporeal shock wave, pain severity and neck functional disability decreased significantly (39). Yalçın in (2021), who also compared the effect of kinesiological tape and extracorporeal shock wave and on myofascial pain syndrome, they stated that ESWT in the term of pain, pain threshold and neck function, was more effective (40)

According to, Kim et al. who investigated the effect of ESWT on subjects with myofascial pain syndrome, shock wave therapy was applied to the intramuscular taut band and referred pain, outcome measures was visual analogue scale (VAS) and American shoulder and elbow surgeons (ASES) score, VAS and ASES scale were significantly improved after application of ESWT (41).

Concerning of the improvement in HPPT group the possible explanation could be argued to that US known widely as an effective therapeutic modality in musculoskeletal disorder treatment because of its thermal and biological effect, heat generation is the most common effect, distinctive metabolic changes associated with its thermal effect, increasing blood circulation, and analgesic substance, in turn there is long lasting analgesic effect (42)

According to Koca et al. who investigated different intensities of ultrasound in subjects with myofascial pain syndrome, they concluded that HPPT was more effective, in only four sessions with improvement in number of trigger points and neck function, pain severity in HPPT group (23).Also, Elhafez et al. who studied the high-power pain threshold effect on pain and myoelectric activity of upper trapezius myofascial trigger points, they stated that HPPT was effective in decreasing pain level, improving function and reducing muscle spasm (43)

A study by Haran et al. who study the effect of HPPT with transverse friction massage and static stretching on subjects with upper trapezius myofascial trigger points, they proved that physical therapy treatment using HPPT along with TF and static stretch reduces pain and improve neck function (44)

Bahadir et al. (45)who studied the role of HPPT on local twitch response and muscle electrical activity on subjects with myofascial trigger points, they found that pain level and cervical range of motion were significantly improved. Also, the trigger points number and spontaneous electrical activity (SAE) were significantly lower after treatment.

In contrast with our findings Kim et al. who found no difference between conventional ultrasound and HPPT on elderly patient with upper trapezius latent trigger points in respect to pressure threshold and cervical range of motion(41)Also, Esenyel et al. found no statistically significant difference between HPPT and conventional US in respect to VAS. This can be attributed to several factors first the age difference, second MTrPs type(46).

In the light of the current finding extracorporeal shock wave is more effective on the treatment of upper trapezius myofascial trigger points.

Limitation

The main age of sample study was relatively young, consequently the result will apply only to this age group, the authors recommend future researchers address various age groups in their sample, the lack of blinding of the assessor and the therapist in addition to using one therapist to administer both interventions could be a source of bias however, the authors tried to eliminate this bias by preventing the therapist and assessor from extracting data regarding the achievements in outcomes and therapy respective.

Conflict of interest

No conflict of interest to be disclosed by the authors.

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None

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