Journal of Advanced Zoology

ISSN: 0253-7214

*Volume **44** Issue **S-3 Year 2023** Page **10:17***

Effect of Ultrasound and Low-Level Laser on Myofacial Trigger Points Versus Traditional Acupoints in Cervicalgia Patients

Ahmed Mahmoud Mohamed[1], Ashraf Hassan Mohamed Sliman[2], Noha Gohdan Hussein[3], Mona Ebrahim Morsy[4]

[1]*Physical Therapist at El Al-Ahram Physical Therapy Center, Giza, Egypt.*

[2]*Professor of Physiotherapy, Faculty of Physical Therapy, Cairo and Badr Universities in Cairo, Egypt.*

[3]*Lecturer at Medical Application of Laser Department, National Institute of Laser Enhanced Sciences, Cairo University, Egypt.*

[4]*Professor at Medical Application of Laser Department, National Institute of Laser Enhanced Sciences, Cairo University, Egypt.*

Article History

Received: 06 June 2023
Revised: 05 September 2023
Accepted: 21 September 2023

Abstract

Background: *Myofacial trigger point: is an area in tissue of hyper irritability that is **very** tender when palpated, refers pain and creates a twitch response when it is palpated. Trigger points must have palpable taut band exquisite tender spot in that taut band. Patient recognition of the pain as "familiar",* ***Purpose of study:*** *This study aimed to investigate the effect of phonophoresis and low-level laser therapy on both myofacial trigger points and on classical acupoints in neck pain patients.* ***Methods:*** *60 participants from both genders who had neck pain. They varied in age from 20 to 40 years old. They were divided into four equal groups at random: (A, B, C, D). The four groups will receive therapy on myofacial trigger points of the neck. The first group, Experimental (A), consisted of 15 volunteers from both genders who had neck pain and will receive LLLT myofacial trigger points of the neck for one month, they attended three sessions every week. The second group, Experimental (B), consisted of 15 volunteers from both genders who had neck pain were treated with phonophoresis of hydrocortisone 1% in conjunction with diclofenac 1%. They were engaged in three sessions per week for one month. The third group, Experimental (C), consisted of 15 volunteers from both genders, men and women, who had neck pain were treated with Phonophoresis of hydrocortisone 1% in addition to diclofenac 5%. For one month, they attended three sessions every week. The fourth group, Experimental (D), consisted of 15 volunteers from both genders, men and women, who had neck pain were treated with both LLLT and phonophoresis They attended three sessions every week, for one month.*

Keywords: *Ultrasound, Low-Level Laser, Myofacial Trigger Points.*

1. Introduction

Classical acupoints: The 360 traditional acupoints, also known as meridians, correspond to several body parts, including the heart, kidney, liver, small and large intestines, lung, bladder, pericardium, stomach, and spleen. Shousanli (Large Intestine Meridians, LI 10), Hegu (Large Intestine Meridians, LI 4), Waiguan (Sanjiao Meridians, TE 5), and Houxi (Small Intestine Meridians, SI 3), which are frequently used in the treatment of cervical myofacial pain syndrome (MPS), will be chosen as the four acupoints on the side that is affected.

Phonophoresis for trigger points:

The use of ultrasound to increase skin absorption and deep tissue penetration of topical drugs is known as phonophoresis (PH). The therapeutic effects of topically applied medications depend on a

variety of variables, including the rate, depth of the skin, degree of drug penetration, and potential harmful effects on tissues.

Low Level Laser for trigger points:
There are some very promising "trigger points" (TPs), or myofascial zones of particular sensibility and of highest projection of focal pain points, due to ischemic conditions, among the various techniques of application in Low Level Laser Therapy (LLLT) (He Ne 632.8 nm visible red or infrared 820-830 nm continuous wave and 904 nm pulsed emission). The impact of LLLT and the outcomes after treating more than 200 patients clinically (headaches and facial pain, skeletomuscular disorders, myogenic neck pain, shoulder and arm pain, epicondylitis humeri, tenosynovitis, cervical and radicular pain to whom the "trigger points" were better than we had ever expected) exceeded our expectations.

2. Materials and Methods

Data were screened, for normality assumption test and homogeneity of variance. Normality test of data using Shapiro-Wilk test was used, that reflect the data was normally distributed ($P>0.05$) after removal outliers that detected by box and whiskers plots. Additionally, Levene's test for testing the homogeneity of variance revealed that there was no significant difference ($P>0.05$). All these findings allowed the researcher to conducted parametric and non-parametric analysis. The data is normally distributed and parametric analysis is done. The statistical analysis was conducted by using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Numerical data are expressed as mean and standard deviation for patient's age, CROM and pressure algometer variables. One-way analysis of variance (ANOVA) test used to compare among 4 groups for patients age. Mixed design 4 x 2 MANOVA-test was used, the first independent variable (between subject factors) was the tested group with 4 levels (group A, group B, group C, and group D). The second independent variable (within subject factor) was measuring periods with 2 levels (pre- and post- treatment) for dependents variables CROM (right rotation, left rotation, Right side bending, left side bending) and pressure algometer (Trp1, Trp2, Trp3, and Trp4). Bonferroni correction test was used to compare between pairwise within and between groups of the tested variables which P-value was significant from MANOVA test. All statistical analyses were significant at probability ($P \leq 0.05$).

II) Equipment and tools

A-Measurement Equipment:
1-CROM Device: Cervical spine active range of motion (ACROM) is assessed using a method and procedure that is valid, reliable, and clinically applicable in both healthy and ill patients. Each patient's cervical AROM was evaluated in right/left rotation and right/left lateral flexion.

2-Pressure Algometer:
Algometer is a word for the apparatus used to measure pain threshold. The term "algometer" may connote pressure tolerance testing, which measures the highest pressure an individual can withstand. However, it does not signify the initial instance at which a pressure feeling is mistaken for pain. These gadgets are typically transportable and have a "maximum hold" function that shows the maximum pressure generated in any given application. This instrument typically has a 1-cm2 surface for applying pressure and provides force values in newtons or kilograms. According to observations, the force should be applied perpendicular to the body's surface and steadily should rise at a rate of roughly 1 kg/cm2.

B-Therapeutic Equipment:
1-ultrasound: Algometer is a word for the apparatus used to measure pain threshold. The term "algometer" may connote pressure tolerance testing, which measures the highest pressure an individual can withstand. However, it does not signify the initial instance at which a pressure feeling is mistaken for pain. These gadgets are typically transportable and have a "maximum hold" function that shows the maximum pressure generated in any given application. This instrument typically has a 1-cm^2 surface for applying pressure and provides force values in newtons or kilograms. According to observations, the force should be applied perpendicular to the body's surface and steadily should rise at a rate of roughly 1 kg/cm^2.

2- Low level laser device: It is of the Chine sport diode variety, having two separate outputs. Treatment time is automatically set based on the amount of energy supplied and the region specified.

A-Evaluative procedures: The following procedures were performed for all volunteers in all groups.
1-Cervical Range of motion measurement:
- Right and left side bending
- Right and left Rotation

2- Pressure algometer: Algometer is a word for the apparatus used to measure pain threshold. The term "algometer" may connote pressure tolerance testing, which measures the highest pressure an individual can withstand. However, it does not signify the initial instance at which a pressure feeling is mistaken for pain. These gadgets are typically transportable and have a "maximum hold" function that shows the maximum pressure generated in any given application. This instrument typically has a 1-cm2 surface for applying pressure and provides force values in newtons or kilograms. According to observations, the force should be applied perpendicular to the body's surface and steadily should rise at a rate of roughly 1 kg/cm^2.

B) Therapeutic Procedures:

1-Phonophoresis of hydrocortisone 1% + diclofenac 1%.
Ultrasound equipment (chine sport gadget). Diclofenac gel 1% and hydrocortisone 1% were first applied in a circular fashion with a thickness of 2–3 mm for 10 minutes, 3 times per week for one month, ultrasound with a 5-cm-diameter applicator at 1 MHz frequency and 1.5 Wt/ cm^2 power was administered to the trigger sites on the trapezius muscle and acupoints sites of classical acupoints. 2-phonophoresis of hydrocortisone +diclofenac 5%.

3- Chinese sport LLL gadget
The patients were seated with their backs supported and their skin exposed. The delivery parameters were as follows: wavelength 904 nm, pulse width 200 ns, pulse repetition rate 1953 Hz, peak power 90 mW, average output 30 mW, power density 22.5 mW cm^2, treatment period 600 sec, energy dosage 18 J per session, spot size 4 cm^2, and treatment frequency 3x/week for one month. In groups of myofacial trigger point patients and on acupoint locations with groups of classical acupoint patients, the laser probe (head size: 4 cm^2) was maintained in constant skin contact without applying any pressure to the trigger locations. Equal amounts of time were spent on the traditional acupoints and trigger points.

3. Results and Discussion
A total of 60 patients participated and distributed randomly into 4 groups (15 patients/group). No significant difference in age (P=0.777; P>0.05) among groups A, B, C, and D (Table 1) in myofacial trigger points.

Multiple pairwise comparison tests (time effect) for CROM variables within each group for myofacial trigger points revealed there were significantly (P>0.05) increased in right rotation, left rotation, right side bending, and left side bending (Table 1) at post-treatment compared to pre-treatment within group A (P=0.016, P=0.018, P=0.029, and P=0.004, respectively), group B (P=0.014, P=0.014, P=0.016, and P=0.005, respectively), group C (P=0.009, P=0.0001, P=0.003, and P=0.001, respectively), and group D (P=0.0001, P=0.0001, P=0.0001, and P=0.0001, respectively). These significant differences in CROM at post-treatment due to time effect are favorable of group D which received combined laser and phonophoresis treatment. Moreover, the patients in Group D who received the combined phonophoresis and laser treatment improved higher right rotation, left rotation, right side bending, and left side bending (30.92, 34.06, 48.00, and 45.39%, respectively) followed by patients in Group C (9.42, 11.51, 18.81, and 19.95%, respectively) who received the laser treatment only, patients in Group B (8.82, 7.90, 16.01, and 16.10%, respectively) who received phonophoresis hydrocortisone + 5% diclofenac treatment and then those in Group A (8.57, 6.97, 13.83, and 15.75%, respectively) who received phonophoresis hydrocortisone + 1% diclofenac treatment.

Multiple pairwise comparison tests (group effect) for CROM variables among groups A, B, C, and D for myofacial trigger points (Table 1) showed no significant differences (P>0.05) at pre-treatment in right rotation (P=0.724), left rotation (P=0.064), right side bending (P=0.826), and left side bending

(P=0.559). However, there were significant differences (P<0.05) in right rotation (P=0.0001), left rotation (P=0.0001), right side bending (P=0.0001), and left side bending (P=0.0001) at post-treatment among groups A, B, C, and D.

Table 1: Within and between group comparisons for CROM variables in myofacial trigger points

Variables	Items	Groups (Mean ±SD)				*P*-value
		Group A (n=15)	**Group B (n=15)**	**Group C (n=15)**	**Group D (n=15)**	
Age (year)		28.93 ±6.08	29.53 ±7.65	30.60 ±6.62	31.33 ±6.96	0.777
Right rotation	Pre-treatment	62.20 ±6.34	61.20 ±6.14	60.80 ±6.56	59.73 ±6.25	0.724
	Post-treatment	67.53 ±5.93	66.60 ±5.88	66.53 ±6.35	78.20 ±3.55	0.0001*
	MD (change)	5.33	5.40	5.73	18.47	
	Improvement %	8.57%	8.82%	9.42%	30.92%	
	P-value	0.016*	0.014*	0.009*	0.0001*	
Left rotation	Pre-treatment	65.00 ±6.16	59.87 ±5.09	59.07 ±5.84	59.13 ±5.05	0.054
	Post-treatment	69.53 ±5.93	64.60 ±4.92	65.87 ±4.89	79.27 ±2.68	0.0001*
	MD (change)	4.53	4.73	6.80	20.13	
	Improvement %	6.97%	7.90%	11.51%	34.06%	
	P-value	0.018*	0.014*	0.0001*	0.0001*	
Right side bending	Pre-treatment	29.93 ±6.13	28.73 ±5.04	30.47 ±4.94	29.73 ±6.45	0.826
	Post-treatment	34.07 ±5.48	33.33 ±5.21	36.20 ±4.50	44.00 ±2.00	0.0001*
	MD (change)	4.14	4.60	5.73	14.27	
	Improvement %	13.83%	16.01%	18.81%	48.00%	
	P-value	0.029*	0.016*	0.003*	0.0001*	
Left side bending	Pre-treatment	30.93 ±4.83	29.00 ±4.59	29.07 ±4.84	30.40 ±5.19	0.559
	Post-treatment	35.80 ±4.72	33.67 ±4.71	34.87 ±4.42	44.20 ±1.85	0.0001*
	MD (change)	4.87	4.67	5.80	13.80	
	Improvement %	15.75%	16.10%	19.95%	45.39%	
	P-value	0.004*	0.005*	0.001*	0.0001*	

Group A: received phonophoresis hydrocortisone + diclofenac 1% treatment; ***Group B:*** received phonophoresis hydrocortisone + diclofenac 5% treatment; ***Group C:*** received laser treatment only; ***Group D:*** received combined laser and phonophoresis treatment.

Data are expressed as mean ±standard deviation MD: Mean difference
P-value: probability value
S: significant
* Significant (P<0.05)
NS: non-significant

Multiple pairwise comparison tests (time effect) for pressure algometer variables within each group for myofacial trigger points revealed there were non-significantly (P>0.05) increased in Trp1, Trp2, Trp3, and Trp4 (Table 2) at post-treatment compared to pre-treatment within group A (P=0.047, P=0.015, P=0.026, and P=0.021, respectively), group B (P=0.046, P=0.009, P=0.017, and P=0.014, respectively), group C (P=0.005, P=0.003, P=0.005, and P=0.002, respectively), and group D (P=0.0001, P=0.0001, P=0.0001, and P=0.0001, respectively). These significant differences in

pressure algometer at post-treatment due to time effect are favorable of group D which received combined laser and phonophoresis treatment. Moreover, the patients in Group D who received the combined phonophoresis and laser treatment improved higher Trp1, Prp2, Trp3, and Trp4 (84.89, 89.08, 81.05, 90.30%, respectively) followed by patients in Group C (55.75, 47.93, 46.96, and 53.45%, respectively) who received the laser treatment only, patients in Group B (27.44, 18.18, 35.97, and 38.97%, respectively) who received phonophoresis hydrocortisone + 5% diclofenac treatment and then those in Group A (27.22, 14.12, 26.76, and 36.23%, respectively) who received phonophoresis hydrocortisone + 1% diclofenac treatment.

Multiple pairwise comparison tests (group effect) for CROM variables among groups A, B, C, and D for myofacial trigger points (Table 2) showed no significant differences (P>0.05) at pre-treatment in Trp1 (P=0.096), Trp2 (P=0.062), Trp3 (P=0.647), and Trp4 (P=0.266). However, there were significant differences (P<0.05) in Trp1 (P=0.0001), Trp2 (P=0.0001), Trp3 (P=0.0001), and Trp4 (P=0.0001) at post-treatment among groups A, B, C, and D.

Table 2: Within and between group comparisons for pressure algometer variables in myofacial trigger points

Variables	Items	Groups (Mean ±SD)				*P*-value
		Group A (n=15)	**Group B (n=15)**	**Group C (n=15)**	**Group D (n=15)**	
Trp1	Pre-treatment	1.58 ±0.45	1.64 ±0.55	1.13 ±0.44	1.39 ±0.58	0.096
	Post-treatment	2.01 ±0.44	2.09 ±0.52	1.76 ±0.37	2.57 ±0.56	0.0001*
	MD (change)	0.43	0.45	0.63	3.28	
	Improvement %	27.22%	27.44%	55.75%	84.89%	
	P-value	0.047*	0.046*	0.005*	0.0001*	
Trp2	Pre-treatment	1.70 ±0.45	1.54 ±0.57	1.21 ±0.55	1.19 ±0.50	0.062
	Post-treatment	1.94 ±0.40	1.82 ±0.48	1.79 ±0.59	2.25 ±0.59	0.0001*
	MD (change)	0.24	0.28	0.58	1.06	
	Improvement %	14.12%	18.18%	47.93%	89.08%	
	P-value	0.015*	0.009*	0.003*	0.0001*	
Trp3	Pre-treatment	1.42 ±0.54	1.39 ±0.52	1.15 ±0.42	1.53 ±0.57	0.647
	Post-treatment	1.80 ±0.44	1.89 ±0.47	1.69 ±0.44	2.77 ±0.96	0.0001*
	MD (change)	0.38	0.50	0.54	1.24	
	Improvement %	26.76%	35.97%	46.96%	81.05%	
	P-value	0.026*	0.017*	0.005*	0.0001*	
Trp4	Pre-treatment	1.36 ±0.37	1.36 ±0.50	1.16 ±0.57	1.34 ±0.46	0.266
	Post-treatment	1.88 ±0.37	1.82 ±0.46	1.78 ±0.52	2.55 ±0.56	0.0001*
	MD (change)	0.50	0.53	0.62	1.21	
	Improvement %	36.23%	38.97%	53.45%	90.30%	
	P-value	0.021*	0.014*	0.002*	0.0001*	

Group A: received phonophoresis hydrocortisone + diclofenac 1% treatment; **Group B:** received phonophoresis hydrocortisone + diclofenac 5% treatment; **Group C:** received laser treatment only; **Group D:** received combined laser and phonophoresis treatment.

Data are expressed as mean ±standard deviation
MD: Mean difference
P-value: probability value
S: significant
* Significant (P<0.05)
NS: non-significant

Bonferroni test and mean difference for CROM and pressure algometer at post-treatment between pairwise of the groups (Table 3). No significant differences (P>0.05) between group A versus group B, group A versus group C, and group B versus group C on the CROM (right rotation, left rotation, right side bending, left side bending) and pressure algometer (Trp1, Trp2, Trp3, and Trp4). However,

there were significant differences (P<0.05) in the mean differences between the others pairwise of group A versus group D, B versus group D, and C versus group D. The post-hoc test and mean differences between groups showed that the combined between phonophoresis and laser program (Group D) gave the best the CROM (right rotation, left rotation, right side bending, left side bending) and pressure algometer (Trp1, Trp2, Trp3, and Trp4) values.

Table 3: Post-hoc test (Bonferroni test) between pairwise of groups for CROM and pressure algometer at post-treatment

Variables	Items	**Post-hoc (Bonferroni test)**					
		Group A vs. Group B	Group A vs. Group C	Group A vs. Group D	Group B vs. Group C	Group B vs. Group D	Group C vs. Group D
Right rotation	MD	0.93	1.00	10.67	0.07	11.60	11.67
	P-value	1.000	1.000	0.0001*	1.000	0.0001*	0.0001*
Left rotation	MD	4.93	3.67	9.73	1.27	14.66	13.40
	P-value	0.062	0.330	0.0001*	1.000	0.0001*	0.0001*
Right side bending	MD	0.74	2.13	9.93	2.87	10.67	7.80
	P-value	1.000	1.000	0.0001*	0.774	0.0001*	0.0001*
Left side bending	MD	2.13	0.93	8.40	1.20	10.53	9.33
	P-value	1.000	1.000	0.0001*	1.000	0.0001*	0.0001*
Trp 1	MD	0.08	0.25	0.56	0.33	0.48	0.81
	P-value	1.000	0.867	0.001*	1.000	0.001*	0.0001*
Trp 2	MD	0.12	0.15	0.31	0.03	0.43	0.46
	P-value	1.000	1.000	0.001*	1.000	0.0001*	0.0001*
Trp 3	MD	0.09	0.11	0.97	0.20	0.88	1.08
	P-value	1.000	0.892	0.0001*	0.356	0.0001*	0.0001*
Trp 4	MD	0.01	0.10	0.67	0.11	0.66	0.77
	P-value	1.000	1.000	0.001*	1.000	0.001*	0.0001*

Group A: received phonophoresis hydrocortisone + diclofenac 1% treatment; **Group B:** received phonophoresis hydrocortisone + diclofenac 5% treatment; **Group C:** received laser treatment only; **Group D:** received combined laser and phonophoresis treatment.

Data are expressed as mean ±standard deviation
MD: Mean difference
P-value: probability value
S: significant
* Significant (P<0.05)
NS: non-significant.

4. Conclusion

When low level laser and phonophoresis are used together, results are improved over when either treatment is used alone. This has a big impact on patients' cervical range of motion and pain tolerance.

References:

Takla, M.K.N., & Rezk-Allah, S.S. (2018). Immediate effects of simultaneous application of transcutaneous electrical nerve stimulation and ultrasound phonophoresis on active myofascial trigger points: a randomized controlled trial. *American Journal of Physical Medicine & Rehabilitation*, 97(5), 332-338. doi:10.5812/cardiovascmed.30391.

Audette, I., Dumas, J.P., Côté, J.N., & De Serres, S.J. (2010). Validity and between-day reliability of the cervical range of motion (CROM) device. *Journal of Orthopaedic & Sports Physical Therapy*, 40(5), 318-323. doi:10.5935/1678-9741.20160022.

Gugliotti, M., Tau, J., Gallo, K., Sagliocca, N., Horan, M., Sussman, N., et al. (2021). Between-week reliability of the cervical range of motion (CROM) device for upper cervical rotation. *Journal of Manual & Manipulative Therapy*, 29(3), 176-180.

Kinser, A.M., Sands, W.A., & Stone, M.H. (2009). Reliability and validity of a pressure algometer. *Journal of Strength and Conditioning Research*, 23(1), 312-314.

Sands, W.A., McNeal, J.R., Murray, S.R., & Stone, M.H. (2015). Dynamic compression enhances pressure-to-pain threshold in elite athlete recovery: exploratory study. *Journal of Strength and Conditioning Research*, 29(5), 1263-1272.

Ribeiro, D.C., Belgrave, A., Naden, A., Fang, H., Matthews, P., & Parshottam, S. (2018). The prevalence of myofascial trigger points in neck and shoulder-related disorders: a systematic review of the literature. *BMC Musculoskeletal Disorders*, 19(1), 252.

Shahimoridi, D., Shafiei, S.A., & Yousefian, B. (2020). The Effectiveness of the Polarized Low-Level Laser in the Treatment of Patients With Myofascial Trigger Points in the Trapezius Muscles. *Journal of Lasers in Medical Sciences*, 11(1), 14-19.

Hakgüder, A., Birtane, M., Gürcan, S., Kokino, S., & Turan, F.N. (2003). Efficacy of low-level laser therapy in myofascial pain syndrome: an algometric and thermographic evaluation. *Lasers in Surgery and Medicine*, 33(5), 339-343.

Yildirim, M.A., Öneş, K., & Gökşenoğlu, G. (2018). Effectiveness of Ultrasound Therapy on Myofascial Pain Syndrome of the Upper Trapezius: Randomized, Single-Blind, Placebo-Controlled Study. *Archives of Rheumatology*, 33(4), 418-423.

Machet, L., & Boucaud, A. (2002). Phonophoresis: efficiency, mechanisms and skin tolerance. *International Journal of Pharmaceutics*, 243(1-2), 1-15.

Altan, L., Kasapoğlu Aksoy, M., & Kösegil Öztürk, E. (2019). Efficacy of diclofenac & thiocolchioside gel phonophoresis comparison with ultrasound therapy on acute low back pain; a prospective, double-blind, randomized clinical study. *Ultrasonics*, 91, 201-205.

Sarrafzadeh, J., Ahmadi, A., & Yassin, M. (2012). The effects of pressure release, phonophoresis of hydrocortisone, and ultrasound on upper trapezius latent myofascial trigger point. *Archives of Physical Medicine and Rehabilitation*, 93(1), 72-77.

Tabatabaiee, A., Ebrahimi-Takamjani, I., Ahmadi, A., Sarrafzadeh, J., & Emrani, A. (2019). Comparison of pressure release, phonophoresis and dry needling in treatment of latent myofascial trigger point of upper trapezius muscle. *Journal of Back and Musculoskeletal Rehabilitation*, 32(4), 587-594.

Ay, S., Doğan, S.K., Evcik, D., & Başer, O.C. (2011). Comparison the efficacy of phonophoresis and ultrasound therapy in myofascial pain syndrome. *Rheumatology International*, 31(9), 1203-1208.

Gurudut, P., & Bhadauria, E. (2016). Comparative effectiveness of low level laser therapy, ultrasound therapy, and combined effect of both on trigger points. *International Journal of Physiotherapy Research*, 4(5), 1701-1706.

Rayegani, S., Bahrami, M., Samadi, B., Sedighipour, L., Mokhtarirad, M., & Eliaspoor, D. (2011). Comparison of the effects of low-energy laser and ultrasound in the treatment of shoulder myofascial pain syndrome: a randomized single-blinded clinical trial. *European Journal of Physical & Rehabilitation Medicine*, 47(3), 381-389. https://doi.org/10.1007/s11556-011-0084-6

Xia, P., Wang, X., Lin, Q., Cheng, K., & Li, X. (2017). Effectiveness of ultrasound therapy for myofascial pain syndrome: a systematic review and meta-analysis. *Journal of Pain Research*, 10, 545-555. https://doi.org/10.2147/JPR.S131482

Brodsky, M., Brodsky, M., Spritzer, K., Hays, R.D., & Hui, K.K. (2017). Change in health-related quality of life at group and individual levels over time in patients treated for chronic myofascial neck pain. *Journal of Evidence-Based Complementary & Alternative Medicine*, 22(3), 365-368.

Duyur Cakit, B., Genç, H., Altuntaş, V., & Erdem, H.R. (2009). Disability and related factors in patients with chronic cervical myofascial pain. *Clinical Rheumatology*, 28(6), 647-654.

Alvarez, D.J., & Rockwell, P.G. (2002). Trigger points: diagnosis and management. *American Family Physician*, 65(4), 653-660.

Chan, Y.C., Wang, T.J., Chang, C.C., Chen, L.C., Chu, H.Y., Lin, S.P., & Chang, S.T. (2015). Short-term effects of self-massage combined with home exercise on pain, daily activity, and autonomic function in patients with myofascial pain dysfunction syndrome. *Physiotherapy Theory and Practice*, 31(1), 375-381.

Botwin, K.P., & Patel, B.C. (2007). Efficacy and safety of mixed amphetamine salts extended-release (Adderall XR) in the management of attention-deficit/hyperactivity disorder in adolescent patients: a 4-week, randomized, double-blind, placebo-controlled, parallel-group study. *Pain Physician*, 10(6), 753-756.

van der Windt, D.A.W.M., van der Heijden, G.J.M.G., van den Berg, S.G.M., Ter Riet, G., de Winter, A.F., & Bouter, L.M. (1999). Ultrasound therapy for musculoskeletal disorders: a systematic review. *Pain*, 81(3), 257-271.

Lavelle, E.D., Lavelle, W., & Smith, H.S. (2007). Myofascial trigger points. *Medical Clinics of North America*, 91(2), 229-239.

Al-Shenqiti, A.M., & Oldham, J.A. (2009). The use of low-intensity laser therapy in the treatment of myofascial trigger points. *Physiotherapy Reviews*, 4(2), 115-123.

Spencer, T.J., Wilens, T.E., Biederman, J., Weisler, R.H., Read, S.C., & Pratt, R. (2006). Efficacy and safety of mixed amphetamine salts extended-release (Adderall XR) in the management of attention-deficit/hyperactivity disorder in adolescent patients: a 4-week, randomized, double-blind, placebo-controlled, parallel-group study. *Clinical Therapeutics*, 28(2), 266-279.

Fernández-de-las-Peñas, C., Cuadrado, M.L., Arendt-Nielsen, L., Simons, D.G., & Pareja, J.A. (2007). Myofascial trigger points and sensitization: an updated pain model for tension-type headache. *Cephalalgia*, 27(5), 383-393.

Manca, A., Limonta, E., Pilurzi, G., Ginatempo, F., De Natale, E.R., Mercante, B., et al. (2014). Ultrasound and laser as stand-alone therapies for myofascial trigger points: a randomized, double-blind, placebo-controlled study. *Physiotherapy Research International*, 19(3), 166-175.

Takla, M.K.N., & Rezk-Allah, S.S. (2018). Immediate effects of simultaneous application of transcutaneous electrical nerve stimulation and ultrasound phonophoresis on active myofascial trigger points: a randomized controlled trial. *American Journal of Physical Medicine & Rehabilitation*, 97(5), 332-338.