Journal of
Modern Rehabilitation

July 2021, Volume 15, Number 3

Research Paper: Evaluate the Immediate Effect of High-power Pain Threshold Ultrasound on Treatment of Upper Trapezius Active Myofascial Trigger Points

Mehrdad Sadeghnia[1], Azadeh Shadmehr[1*], Mohammadreza Hadian Rasanani[1], Seyed Mohsen Mir[1], Shohreh Jalaei[1]

1. Department of Physiotherapy, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran.

Use your device to scan and read the article online

Citation: Sadeghnia M, Shadmehr A, Hadian Rasanani MR, Mir SM, Jalaei S. Evaluate the Immediate Effect of High-power Pain Threshold Ultrasound on Treatment of Upper Trapezius Active Myofascial Trigger Points. Journal of Modern Rehabilitation. 2021; 15(3):167-172. http://dx.doi.org/10.18502/jmr.v15i3.7737

http://dx.doi.org/10.18502/jmr.v15i3.7737

Article info:
Received: 28 Dec 2020
Accepted: 10 Jan 2021
Available Online: 01 Jul 2021

License Statement

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International license (https://creativecommons.org/licenses/by-nc/4.0/).

Non-commercial uses of the work are permitted, provided the original work is properly cited

Copyright © 2021 The Authors.

Publisher

Tehran University of Medical Sciences

ABSTRACT

Introduction: The most critical clinical presentation in myofascial pain syndrome is trigger points. Trigger points are the main problem in 30% of the patients presenting to general internal medicine practice. One of the treatments used for trigger points is ultrasound therapy. The high-power pain threshold ultrasound (HPPTUS) technique is one of the therapeutic ultrasound modifications used to treat trigger points. The present randomized clinical trial aimed to investigate the immediate effect of high-power pain threshold ultrasound on treating active trigger points of the upper trapezius muscle in men with mechanical neck pain.

Materials and Methods: Fourteen men with mechanical neck pain (Mean±SD age: 34.50±5.24 years) who met the inclusion and exclusion criteria participated in this study. The visual analog scale (VAS), pressure pain threshold (PPT), and range of motion of cervical lateral flexion (CLF) were assessed before and after the treatment. The ultrasound probe was placed on the trigger point. The frequency was set to 1 MHz, and the intensity increased from 0.5 to 2 until the patient reported an unpleasant sensation. The probe was held there for 4 seconds. Then, the intensity was reduced by 50%, and the probe was moved over and around the trigger point. This process was done several times for three minutes.

Results: Analysis of pre-treatment and post-treatment findings showed that the VAS ($P<0.001$), PPT ($P=0.001$), and CLF ($P<0.001$) improved significantly after applying the HPPTUS to trigger points.

Conclusion: Ultrasound significantly improved the muscular symptoms of the trigger points.

Keywords: High-power pain threshold ultrasound, Static ultrasound, Trigger points, Myofascial trigger point, Myofascial pain syndrome

*** Corresponding Author:**
Azadeh Shadmehr, PhD.
Address: *Department of Physiotherapy, School of Rehabilitation, Tehran University of Medical Sciences, Piche Shemiran, Enghelab Street, Tehran, Iran.*
Tel: *+98 (21) 77528468*
E-mail: *shadmehr@tums.ac.ir*

1. Introduction

The most important clinical problem in myofascial pain syndrome is trigger points [1], with two categories: active and inactive trigger points [2]. A prevalence of 10%-18% and a lifetime prevalence of 30%-50% have been reported for trigger points [3]. Trigger points are also the main problem in 30% of the patients presenting to general internal medicine practice [4].

Trigger points are caused by trauma, anxiety, muscular atrophy, and muscular ischemia [5]. According to the integrated hypothesis, they cause abnormal depolarization in the presynaptic membrane and a crisis of local energy deficiency with autonomic and sensory reflex arcs, eventually resulting in local hypercontraction in sarcomeres [6].

One of the most appropriate treatments for trigger points is ultrasound therapy [7-10]. The high-power pain threshold ultrasound (HPPTUS) technique is one of the ultrasound modifications used to treat trigger points [11]. In 2004, Majlesi et al. performed the first clinical study to compare this technique with the traditional ultrasound technique in patients with myofascial trigger points. The results showed that HPPTUS was much more effective than the traditional technique, and pain reduction and improvement of range of motion (ROM) were significant in a smaller number of sessions [12]. Due to the novelty of the HPPTUS technique [13], few studies have reported its immediate effect on the visual analog scale (VAS), pressure pain threshold (PPT), and ROM of cervical lateral flexion (CLF). In 2009, Bahadir et al. found that HPPTUS with active stretching significantly improved the VAS and ROM of CLF after one treatment session. However, there was no significant difference compared to dry needling with active stretching [14].

A literature review suggests that the effect of HPPTUS on VAS, PPT, and ROM of CLF alone should be examined. The purpose of this study was to investigate the immediate effect of high-power pain threshold ultrasound on the active trigger points of the upper trapezius muscle.

2. Materials and Methods

This double-blind clinical trial was conducted at the clinic of the Faculty of Rehabilitation between April 2017 and December 2019. The Ethics Committee of Tehran University of Medical Sciences approved the study protocol (Code: IR.TUMS.VCR.REC.1398.903). Informed consent was obtained from all participants.

Study subjects

Fourteen right-handed subjects with upper trapezius active myofascial trigger points participated in this study (Mean±SD age: 34.50±5.24 years).

The inclusion criteria were male gender, aged 18 to 45 years, right-handedness, ability to perform active movements in the full ROM of abduction, scaption, internal rotation of the shoulder, and the presence of only one trigger point in the upper trapezius muscle based on the following clinical findings:

-Touching a taut band inside the muscle,

-Presence of a hypersensitive point inside the taut band,

-A pain level of at least three according to the VAS scale in the initial evaluation, and

-A referral and familiar pain pattern when stimulating a taut band [14, 17, 18].

The exclusion criteria were history of shoulder surgery or trauma (dislocation, replacement, joint sprain) in the last 6 months; history of chronic or acute diseases such as neurological, cardiac, and metabolic diseases, skin lesions, infections, or inflammation in the trigger point area; history of traumatic neck injury (e.g., whiplash injury); history of neck surgery; any malignancy or bad posture; fibromyalgia syndrome; consumption of corticosteroids; treatment of trigger points in the past month; visual loss and color blindness; consumption of any medication or any specific illness affecting cognition; consumption of tea, alcohol, coffee, and cocoa before the test session; and unfinished high school education [14, 17, 18].

Outcome measures

Visual analog scale

Visual analog scale (VAS) was used to grade their current level of pain. The VAS for pain is a 10-cm unmarked ruler with polar descriptors of "no pain" and "worst pain possible." The subjects reported their pain by placing a vertical line through the VAS line at the point that represented their current level of neck pain (Figure 1). Then, the distance from the zero point to the marking was measured [16-18].

JMR

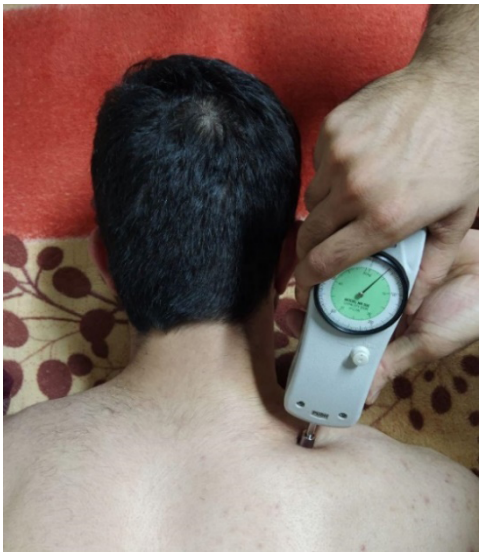
Figure 1. Visual analog scale to assess the pain severity level

Pressure pain threshold

A pressure algometer (Analog Force Gauge Model: NK-500) was used to measure the pressure pain threshold (PPT) of the trigger point. It consisted of a gauge attached to a cross-sectional area of 1 cm^2. The pressure was applied perpendicular to the desired point until the patient reported pain. The dial gauge was calibrated in kg/cm^2 ranging from 1 to 10 kg/cm^2. The pressure that caused the pain was recorded as PPT. In the present study, to measure PPT, the patient lay in the prone position with the head in the neutral position, and the hands placed next to the body (Figure 2). This test was performed in triplicate for each point with a time interval of 30 s, and the average of three measurements was recorded [16-18].

Range of motion

A range of motion goniometer (Baseline 360°) was used to measure ROM of cervical lateral flexion (CLF). The patient was placed in a flat position with a 90˚ flexion of the knee and thigh while the hands were resting on the thighs. The goniometer axis was placed on the spinous process of the seventh cervical vertebra. The fixed arm of the goniometer was perpendicular to the ground, and its movable arm was placed parallel to the hypothetical vertical line of the head. To measure the range of motion, the head was placed in the anatomical position at the beginning of the movement, and the ear approached the shoulder at the end of the movement (Figure 3). This test was performed three times for each point with a time interval of 30 s, and the average of three measurements was recorded [16-18].

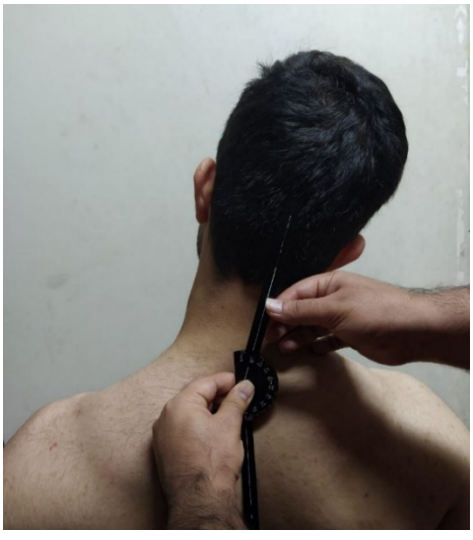


JMR

Figure 2. Algometry to assess pressure pain threshold

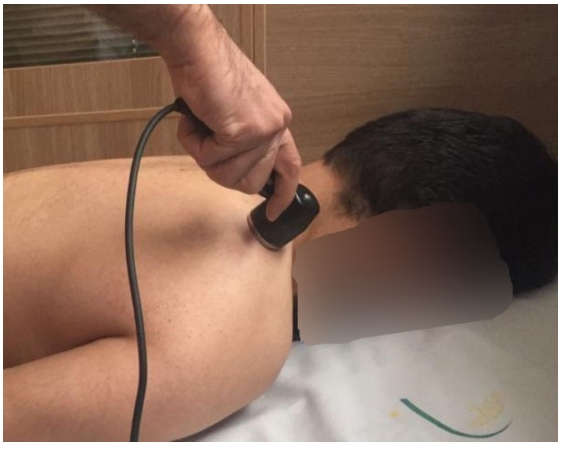
Study procedure

After explaining the procedure, the outcome measures were evaluated, and the trigger points were marked by a physical therapist that was blind to treatment. Then, the hand placed next to the prone position with the head in the neutral position, and the hands placed next to the body. The ultrasound probe was placed on the trigger point (Fig-



JMR

Figure 3. Goniometry to assess cervical lateral flexion



JMR

Figure 4. Patient position for high-power pain threshold ultrasound

Table 1. Mean±SD of neck disability index, cervical lateral flexion (degree), visual analog scale (cm), and pressure pain threshold before and after the intervention (n=14)

Variables	Pre-intervention			Post-intervention		
	Mean±SD	Min-Max	Median	Mean±SD	Min-Max	Median
Visual Analog Scale (cm)	5.47±1.42	3.7-7.9	5.3	2.75±1.42	1-6	2.3
Pressure Pain Threshold (N/cm^2)	30.82±10.55	15.00-50.00	30.62	45.28±15.49	29.68-77.50	40.00
Cervical lateral flexion (degree)	30.14±6.38	19.25-39.50	31.12	38.92±5.54	30.00-44.98	40.01

JMR

ure 4). The frequency was set to 1 MHz, and the intensity increased from 0.5 to 2 until the patient reported an unpleasant sensation. The probe was held there for 4 s; then, the intensity was reduced by 50%, and the probe was moved over and around the trigger point. This process is done several times for three minutes. All clinical tests were repeated at the end of the treatment session [17].

Statistical analysis

The data were analyzed in SPSS v. 22 after data collection. In descriptive statistics, Mean±SD were used for expressing quantitative data. The Shapiro-Wilk test was applied to determine the normal distribution of the patients' characteristics. Moreover, to evaluate the post-treatment changes, we used paired t-test for VAS and ROM because of their normal distribution and the Wilcoxon test for PPT considering its non-normal distribution.

3. Results

Table 1 presents the values (Mean±SD, median, minimum and maximum) of VAS, PPT, and CLF ROM before and after the treatment. VAS decreased significantly (P<0.001), and PPT (P=0.001) and ROM of CLF increased significantly (P<0.001) after the intervention (Table 2). To calculate the effect size, the Cohen's d formula was used for VAS and ROM of CLF, and the r formula (Wilcoxon effect size formula) was used for PPT. According to Table 2, because Cohen's d was above 0.8 [19] and r was above 0.5 [20], so the effect size of all parameters was large.

4. Discussion

The present study showed that using HPPTUS on patients with trigger points in the upper trapezius muscle significantly and promptly reduced VAS and PPT and increased ROM. These findings were consistent with a study by Majlesi et al. in 2014 that showed a significant improvement in VAS and ROM after the first treatment session. They found that the outcome measures improved completely in the first session in 7 patients, after two sessions in 7 patients, after three sessions in 10 patients, and after five sessions in 12 patients. However, after each session, the patients performed active stretching of the trapezius muscle for 30 s for five times. Moreover, the validity of the tool and the method that was used to measure the ROM was not examined. In the present study, HPPTUS was the only intervention applied, and the variables were measured immediately using valid tools and methods [21]. In 2005, Unalan et al. found that HPPTUS and local injection of lidocaine 0.5 significantly improved the VAS and ROM of CLF in the active trigger points of the trapezius muscle, but there was no significant difference between the two groups. The mean number of treatment sessions in the HPPTUS group was 1.5 sessions [22]. The exact mechanism of HPPTUS is still unknown, but experiencing an unpleasant sensation during the technique and its control can re-

Table 2. Statistical tests and results

Variables	Statistical Test	P	Effect Size
Visual analog scale	Paired t-test	<0.001	>1
Pressure pain threshold	Wilcoxon test	0.001	0.6231
Cervical lateral flexion	Paired t-test	<0.001	>1

JMR

duce pain through the pain gate theory [17]. It has been reported that HPPTHS reduces the amplitude of the action potential, which is related to the thermal effects of the ultrasound [23].

In 2016, Aridiciand et al. reported that four HPPTUS sessions every other day significantly improved VAS and CLF [24]. Moreover, Amit Dhawan found that the average pain reduction after one treatment session was 70% in the HPPTUS with the stretching group, which decreased to 64% after three weeks of follow-up. Moreover, the average increase in the ROM was 10%, which decreased to 8% after three weeks. In the present study, the mean VAS reduction was 49.72%, the mean PPT increase 46.91%, and the mean ROM increase 29.13%. Amit Dhawan conducted a study on three groups of patients, including HPPTUS with stretching, interferential current, and stretching. In this study, VAS reduced significantly in the HPPTUS with stretching and stretching groups, while ROM reduced significantly only in the HPPTUS with the stretching group. However, in the study by Amit Dhawan et al., similar to the present study, HPPTUS had more effect on pain compared to ROM [22]. Increased ROM can be secondary to reducing pain and spasm associated with heat and biophysical effects, i.e., vasodilation, increased metabolism, reduced production of inflammatory substances, and increased tissue repair [21, 24].

Few studies have investigated the effect of HPPTUS on PPT. In 2016, Yushin Kim et al. found a significant improvement in VAS after one week, in ROM of the cervical lateral flexion after three weeks, and in PPT after four weeks. Treatment was performed three times a week. ROM and PPT did not show a faster improvement, probably because the trigger points were inactive [25].

Contraindications include peripheral vascular disease, regions with diminished or lost sensitivity to heat and or pain, areas adjacent to the spinal cord or cauda equina in patients who have previously undergone laminectomy, cardiac insufficiency, cancer, and precancerous states [13].

Study limitations

This study had some limitations, including small sample size, no long-term follow-up, and a control group.

5. Conclusion

HPPTUS is an effective treatment for upper trapezius active myofascial trigger points in male subjects with mechanical neck pain.

Ethical Considerations

Compliance with ethical guidelines

The research project was ethically approved by Tehran University of Medical Sciences (Code: IR.TUMS.VCR.REC.1398.903)

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

Data collection and writing the original draft: Azadeh Shadmehr and Mehrdad Sadeghnia; Review and editing, visualization, and supervision: All authors.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

This study was extracted from the MSc. thesis of the first author in the Physical Therapy Department, School of Rehabilitation. The study was supported by Tehran University of Medical Sciences (Grant No.: 98-03-32-43655). The authors thank all the participants for their contribution to the study. The authors would also like to acknowledge the assistance of the School of Rehabilitation staff.

References

[1] Simons DG. Review of enigmatic MTrPs as a common cause of enigmatic musculoskeletal pain and dysfunction. Journal of Electromyography and Kinesiology. 2004; 14(1):95-107. [DOI:10.1016/j.jelekin.2003.09.018] [PMID]

[2] Simons DG, Travell JG. Myofascial origins of low-back-pain. 1. Principles of diagnosis and treatment. Postgraduate Medicine. 1983; 73(2):66-77. [DOI:10.1080/00325481.1983.1169775] [PMID]

[3] Dundar U, Evcik D, Samli F, Pusak H, Kavuncu V. The effect of gallium arsenide aluminum laser therapy in the management of cervical myofascial pain syndrome: A double blind, placebo-controlled study. Clinical Rheumatology. 2007; 26(6):930-4. [DOI:10.1007/s10067-006-0438-4] [PMID]

[4] Skootsky SA, Jaeger B, Oye RK. Prevalence of myofascial pain in general internal medicine practice. Western Journal of Medicine. 1989; 151(2):157-60. [PMID] [PMCID]

[5] Dommerholt J, Huijbregts P. Myofascial trigger points: pathophysiology and evidence-informed diagnosis and management. Massachusetts: Jones & Bartlett Learning; 2010. https://www.google.com/books/edition/Myofascial_Trigger_Points/PXg7LlJxXgoC?hl=en&gbpv=1&dq=

[6] McPartland JM, Simons DG. Myofascial trigger points: Translating molecular theory into manual therapy. Journal of Manual & Manipulative Therapy. 2006; 14(4):232-9. [DOI:10.1179/106698106790819982]

[7] Ilter L, Dilek B, Batmaz I, Ulu MA, Sariyildiz MA, Nas K, et al. Efficacy of pulsed and continuous therapeutic ultrasound in myofascial pain syndrome: A randomized controlled study. American Journal of Physical Medicine & Rehabilitation. 2015; 94(7):547-54. [DOI:10.1097/PHM.0000000000000210] [PMID]

[8] Kavadar G, Çağlar N, Özen Ş, Tütün Ş, Demircioğlu D. Efficacy of conventional ultrasound therapy on myofascial pain syndrome: A placebo controlled study. Agri: The Journal of the Turkish Society of Algology. 2015; 27(4):190-6. [DOI:10.5505/agri.2015.48569] [PMID]

[9] Koca I, Tutoglu A, Boyaci A, Ucar M, Yagiz E, Isik M, et al. A comparison of the effectiveness of low-, moderate-and high-dose ultrasound therapy applied in the treatment of myofascial pain syndrome. Modern Rheumatology. 2014; 24(4):662-6. [DOI:10.3109/14397595.2013.860001] [PMID]

[10] Manca A, Limonta E, Pilurzi G, Ginatempo F, De Natale ER, Mercante B, et al. Ultrasound and laser as stand-alone therapies for myofascial trigger points: A randomized, double-blind, placebo-controlled study. Physiotherapy Research International. 2014; 19(3):166-75. [DOI:10.1002/pri.1580] [PMID]

[11] Travell JG. Simons DG, Simons LS. Myofascial pain and dysfunction: the trigger point manual the lower extremities. Pennsylvania:Williams and Wilkins; 1983. https://www.google.com/books/edition/Myofascial_Pain_and_Dysfunction/8pGrvso0vnkC?hl=en&gbpv=0

[12] Majlesi J, Ünalan H. High-power pain threshold ultrasound technique in the treatment of active myofascial trigger points: A randomized, double-blind, case-control study. Archives of Physical Medicine and Rehabilitation. 2004; 85(5):833-6. [DOI:10.1016/j.apmr.2003.07.023] [PMID]

[13] Yalgin S, Ünalan H, Öztezcan S, Majlesi J, Özkan F, Akarırmak Ü. Experimental study on static ultrasound [high-power pain threshold ultrasound] application: Potential adverse effects on rats. Journal of Musculoskeletal Pain. 2010; 18(3):246-53. [DOI:10.3109/10582452.2010.502615]

[14] Bahadir C, Majlesi J, Unalan H. The effect of high-power pain threshold ultrasound therapy on the electrical activity of trigger points and local twitch response on electromyography: A preliminary study. Journal of Musculoskeletal Pain. 2009; 17(2):162-72. [DOI:10.1080/10582450902820572]

[15] Pecos-Martín D, Montañez-Aguilera FJ, Gallego-Izquierdo T, Urraca-Gesto A, Gómez-Conesa A, Romero-Franco N, et al. Effectiveness of dry needling on the lower trapezius in patients with mechanical neck pain: A randomized controlled trial. Archives of Physical Medicine and Rehabilitation. 2015; 96(5):775-81. [DOI:10.1016/j.apmr.2014.12.016] [PMID]

[16] Rezaei S, Shadmehr A, Tajali SB, Moghadam BA, Jalaei S. The effect of laser therapy and ischemic compression on active trigger points in upper trapezius muscle. Journal of Modern Rehabilitation. 2019; 13(4):221-6. [DOI:10.32598/JMR.13.4.221]

[17] Kim Y, Yang HR, Lee JW, Yoon BC. Effects of the high-power pain threshold ultrasound technique in the elderly with latent myofascial trigger points: A double-blind randomized study. Journal of Back and Musculoskeletal Rehabilitation. 2014; 27(1):17-23. [DOI:10.3233/BMR-130414] [PMID]

[18] Hesari S, Attarbashi-Moghadam B, Shadmehr A. Comparison of dry needling and physical therapy in patients with trapezius myofascial pain syndrome. Journal of Modern Rehabilitation. 2016; 1(1):43-7. https://jmr.tums.ac.ir/index.php/jmr/article/view/8

[19] Cohen J. The effect size index: d. Statistical power analysis for the behavioral sciences. Abingdon-on-Thames: Routledge Academic; 1988. http://www.utstat.toronto.edu/~brunner/oldclass/378f16/readings/CohenPower.pdf

[20] Tomczak M, Tomczak E. The need to report effect size estimates revisited. An overview of some recommended measures of effect size. Trends in Sport Sciences. 2014; 21(1):19-25. http://tss.awf.poznan.pl/files/3_Trends_Vol21_2014__no1_20.pdf

[21] Dhawan A, Bhardwaj P. The relative efficacy of high-power pain threshold static ultrasound technique versus interferential currents in the treatment of active myofascial trigger points of upper trapezius. Indian Jouanl of Physiotherapy and Occupational Therapy. 2010; 4(4):12-17. https://www.researchgate.net/profile/Suraj-Kumar-30/publication/262380147_Effect_of_core_stabilization_training_on_dynamic_balance_in_non-professional_sports_players/links/00463537961c9b28bb000000/Effect-of-core-stabilization-training-on-dynamic-balance-in-non-professional-sports-players.pdf#page=16

[22] Unalan H, Majlesi J, Aydin FY, Palamar D. Comparison of high-power pain threshold ultrasound therapy with local injection in the treatment of active myofascial trigger points of the upper trapezius muscle. Archives of Physical Medicine and Rehabilitation. 2011; 92(4):657-62. [DOI:10.1016/j.apmr.2010.11.030] [PMID]

[23] Tsui PH, Wang SH, Huang CC. In vitro effects of ultrasound with different energies on the conduction properties of neural tissue. Ultrasonics. 2005; 43(7):560-5. [DOI:10.1016/j.ultras.2004.12.003] [PMID]

[24] Guirro R, Dibai-Filho A, Dias F, Oliveira A. Efficacy static ultrasound and manual therapy in the treatment myofascial trigger points individuals with neck pain: A pilot clinical study. Physiotherapy. 2015; 101:e494-5. [DOI:10.1016/j.physio.2015.03.3291]

[25] Aridici R, Yetisgin A, Boyaci A, Tutoglu A, Bozdogan E, Dokumaci DS, et al. Comparison of the efficacy of dry needling and high-power pain threshold ultrasound therapy with clinical status and sonoelastography in myofascial pain syndrome. American Journal of Physical Medicine & Rehabilitation. 2016; 95(10):e149-58. [DOI:10.1097/PHM.0000000000000600] [PMID]