

High-Power Pain Threshold Ultrasound Technique in the Treatment of Active Myofascial Trigger Points: A Randomized, Double-Blind, Case-Control Study

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ABSTRACT. Majlesi J, Ünal H. High-power pain threshold ultrasound technique in the treatment of active myofascial trigger points: a randomized, double-blind, case-control study. *Arch Phys Med Rehabil* 2004;85:833-6.

Objective: To study what effects a high-power, pain-threshold, static ultrasound technique applied to acute myofascial trigger points of the upper trapezius has on pain and on active cervical lateral bending.

Design: Double-blind randomized trial.

Setting: Physical therapy unit of a private general hospital.

Participants: Seventy-two adults with acute pain on 1 side of the neck, admitted to the outpatient unit during 1999 and 2000.

Interventions: Not applicable.

Main Outcome Measures: Visual analog scale and goniometric measurement of active lateral bending of the neck performed daily after treatment sessions and length of treatment (number of therapy sessions).

Results: High-power ultrasound applied to the trigger points before stretching the muscle was more effective ($P < .05$) than conventional ultrasound, and it also significantly ($P < .001$) decreased the length of therapy.

Conclusions: High-power, pain-threshold, static ultrasound technique may be considered in the treatment of patients with acute myofascial pain syndrome, with the understanding that this technique demands more concentration and communication between the patient and the therapist.

Key Words: Myofascial pain syndrome; Physical therapy; Rehabilitation; Ultrasonography.

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MYOFASCIAL PAIN syndrome (MFPS) is among the most commonly encountered disorders seen by physiatrists. It is characterized by trigger points, which are defined as hyperirritable spots within taut bands of skeletal muscle fibers. The syndrome is associated with tenderness in the muscle, characteristic referred pain, spasm, and restriction of motion.¹⁻³

Many treatment approaches, such as trigger point injections, stretching exercises, and physical therapy (PT) modalities, including ultrasound therapy, have been reported in the literature.¹⁻⁴ Little is known about high-power, pain-threshold ultrasound technique, which was cited by Travell and Simons¹ in a

personal communication with Nielson in 1983. In this technique, "the power of ultrasound is first increased to the threshold pain level (to 1.5 W/cm²) and then reduced to one half of that intensity. Over the next 2 to 3 minutes, the intensity is gradually increased with frequent queries as to patient sensations, until the intensity has been increased to, but not beyond the original pain threshold level."^{1(p89-90)} To our knowledge, this ultrasound technique has not been previously studied or reported in the literature for the treatment of MFPS.

The present double-blind controlled study compared the effects of high-power, pain-threshold static ultrasound with conventional ultrasound in regard to acute upper trapezius trigger point pain and active cervical lateral bending.

METHODS

Seventy-two patients (47 women, 25 men) with pain at 1 side of the upper trapezius muscles who were seen in the outpatient section of a private province hospital were included in the study. Inclusion criteria were (1) presence of at least 1 active myofascial trigger point at 1 side of the upper trapezius muscle, (2) symptoms lasting for 0 to 2 weeks, (3) age between 18 and 60 years, (4) patients with primary MFPS (no pain at any other area than the corresponding trigger point; pain mostly on contralateral bending of the head; negative Spurling test), and (5) without application of any PT or medications to relieve pain. All the patients were informed that they would be treated in a randomized trial with 1 of 2 ultrasound techniques, both of which have potential curative effects. All the patients signed consent forms.

Active trigger points were diagnosed by a physiatrist (JM) with nearly 10 years of experience in MFPS. Diagnostic criteria² are in table 1. Patients who met the inclusion criteria were randomly assigned to 1 of 2 treatment groups. Patients in the study group (n=36) received a high-power, pain-threshold, static ultrasound technique and patients in the control group (n=36) received a conventional, stroking, ultrasound technique. All ultrasound treatments were applied by the same physiotherapist, who was experienced in both techniques. The physiotherapist was not blind to the treatment groups because both techniques required the physiotherapist's active and careful technical contribution.

Diagnosis of myofascial trigger points, measures of subjective pain, and cervical range of motion (ROM) measurements were performed by a physiatrist (JM) who was blind to the treatment groups. After the first PT sessions, the therapist informed each patient that he/she was to meet the physician (JM) for the evaluation; no communication was to take place except the necessary dialogue for the evaluation procedure. The physiotherapist accompanied all the patients during the evaluations. All assessments were performed before the first sessions and at the termination of each session. Measurement of subjective pain using a visual analog scale (VAS) and active lateral bending of the cervical spine were done before the first sessions and after each session. The anchor points of the VAS, of which all patients were informed, were 0 (no pain what-

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Table 1: Diagnostic Criteria

Primary criteria (all 5 needed)
Regional pain complaint
Pain complaint or altered sensation in the expected distribution of referred pain from a trigger point
Taut band palpable in an accessible muscle
Exquisite spot tenderness at 1 point along the length of the taut band
Some degree of restricted range of motion
Secondary criteria (1 of 3 needed)
Reproduction of clinical pain complaint, or altered sensation, by pressure on the tender spot
Local twitch response elicited by snapping palpation at the tender spot or by needle insertion into the tender spot
Pain alleviated by elongating (stretching) the muscle or by injecting the tender spot

soever) and 10 (worst pain imaginable). If the patient reported that his/her pain subsided and ROM measurements also were within the normal range, the physician ended the treatment.

The procedure for goniometric measurement was to place the fulcrum of the goniometer on the spinous process of the first thoracic spine and the center of the goniometer arm on the occipital protuberance at right angles. After the device's horizontal arm was manually stabilized, its vertical arm was moved according to the movement of the patient's head and was placed on the occipital protuberance to determine lateral bending angle.

The conventional ultrasound technique used in this study was the stroking technique, which is considered in many textbooks as the most commonly used ultrasound technique.^{5,6} In this technique, the applicator is moved in smooth overlapping sweeps or circles at rates of a few centimeters per second over areas of 25 to 100cm². In most cases, continuous-wave mode is preferred to maximize thermal effect.^{5,6} The intensity used in the present study was 1.5W/cm², and the duration of each session was 5 minutes.

High-power, pain-threshold, ultrasound therapy was applied (in W/cm²) in continuous modes, with the probe placed directly on the trigger point and held motionless. To elicit threshold pain, the ultrasound probe must be kept static on the trigger point. Intensity was gradually increased to the level of maximum pain the patient could bear. It was kept at that level for 4 to 5 seconds and then reduced to the half-intensity level for another 15 seconds. This procedure was repeated 3 times. Patients continually reported their pain level and its localization and nature.

All the patients in both groups actively stretched the upper trapezius muscle at the end of each therapy session by bending the head to the contralateral side with maximum voluntary contraction for 30 seconds. This procedure was repeated 5 times.

Because pain and ROM limitations are easily perceptible by any person, our follow-up period only consisted of telephone dialogues. Patients reported on their pain level, freedom of movements during daily living activities, and adverse effects if any. Each patient was telephoned at the end of the first and the fourth weeks after the last session to collect information about any adverse effects or unexpected complaints.

Statistical Analysis

Continuous variables were given as mean $\pm$ standard deviation (SD). To test the differences between the groups, Student

t and Mann Whitney *U* tests were used (depending on the necessity of using parametric or nonparametric tests). Dichotomous variables (eg, gender) were compared by means of the chi-square test. A significance level of .05 was used for all comparisons. All analyses were performed with Epi Info 2000 software.^a

RESULTS

Five patients from the high-power ultrasound group (group 1) were dropped because they did not complete the follow-up period. Seven patients from the conventional ultrasound group (group 2) were dropped because their attendance in the PT sessions was poor and they had incomplete follow-up. All the dropouts were kept out of statistical analysis. Of the original 72 patients, 31 from group 1 and 29 from group 2 completed the study and participated in the follow-up period (fig 1).

No statistically significant differences existed between the groups in terms of age and gender (table 2). Baseline VAS score and ROM measurements also did not show any statistical differences (table 2; figs 2, 3). An SD of ± 10.02 for the mean ROM (mean, 8.32) in group 2 resulted from the negative initial ROM of 5 patients in that group, in contrast to the negative initial ROM in only 1 patient in group 2.

The mean number of sessions in group 1 was 2.84 ± 1.4 ; in group 2 controls it was 11.8 ± 2.47 ($P < .001$) (table 2, fig 4). VAS and ROM measurements obtained at the end of the first session also showed a high statistical significance in favor of group 1 ($P < .001$) (table 2; figs 2, 3).

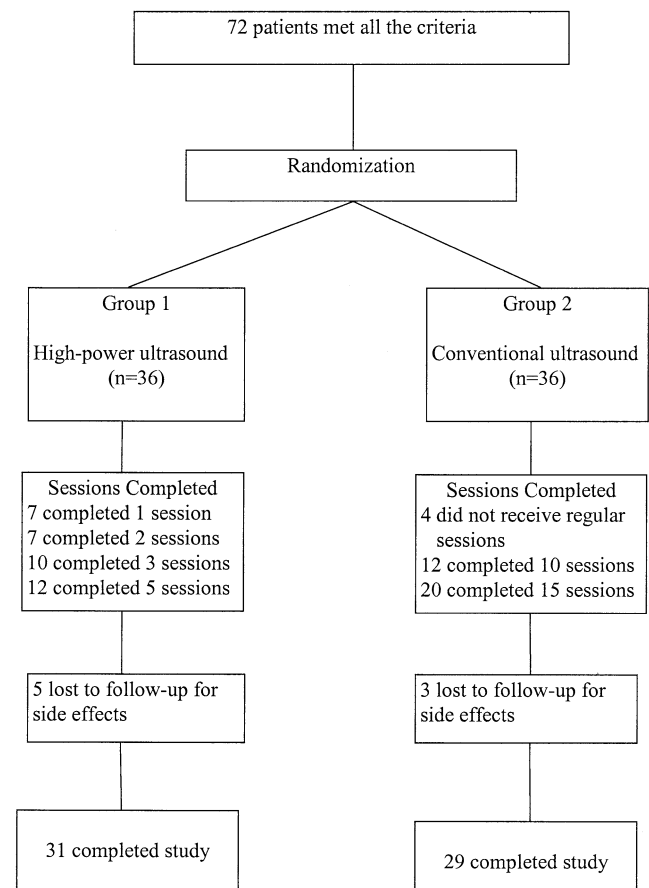


Fig 1. Group randomization and progress through the trial.

Table 2: Demographic and Clinical Characteristics of the 2 Groups

	Group 1: High-Power Ultrasound (n=31)	Group 2: Conventional Ultrasound (n=29)	P
Gender (%)			
Women	67.7	79.3	>.05
Men	32.3	20.7	
Age (y)	34.54±11.18	32.93±12.27	>.05
Initial VAS	8.32±1.07	8.48±1.05	>.05
Initial ROM	8.32±10.02	9.96±4.88	>.05
VAS after the 1st session	3.32±1.73	7.72±1.19	<.001
ROM after the 1st session	29.25±7.03	10.89±5.06	<.001
Mean no. of sessions	2.83±1.48	11.82±2.47	<.001

NOTE. Values are mean ± SD or percentage.

After completing the study, ROM measurements of all the patients showed equal values for flexion to the right and flexion to the left and showed no statistical significance between the groups ($P>.05$) (fig 3). But a statistically significant ($P<.05$) difference existed between mean VAS values of the groups after the last session (fig 2), in favor of group 1 (fig 2).

In the telephone follow-ups, no patient in either group reported any adverse effect or unexpected complaint at weeks 1 and 4 after their last sessions.

DISCUSSION

This study presents a high-power, pain-threshold static ultrasound technique that we have used for 5 years; we believe it is effective in treating active trigger points in acute MFPS. We compared the technique with the conventional stroking technique to prove, in a single study, its superiority to the more traditional method. Had we compared it with a sham ultrasound application, questions would still exist regarding its superiority to a conventional technique. Because the technique requires the therapist to make power output adjustments during the session, she inevitably was not blind to the applications. However, the study design was double-blind because the evaluating physician was blind to the treatment groups, and the patients were informed that they would be randomized to 1 of 2 ultrasound techniques; further, no patient had experience of PT.

Myofascial trigger points present on their own or accompany many acute and chronic painful musculoskeletal and other disorders. Because they contribute to the painful state and to a decline in the functional level of patients, treating them may vastly improve the patient's whole clinical state.

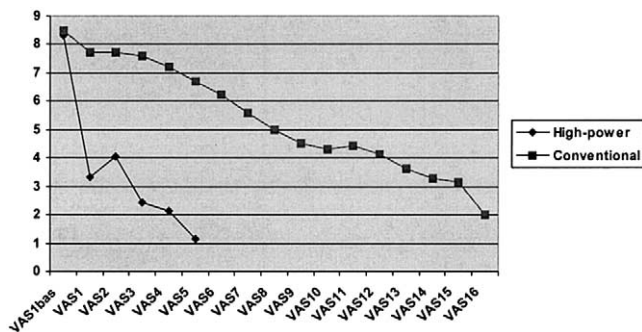


Fig 2. VAS values of the 2 groups before the first session (VAS1bas) and after each session (VAS1, VAS2, . . .).

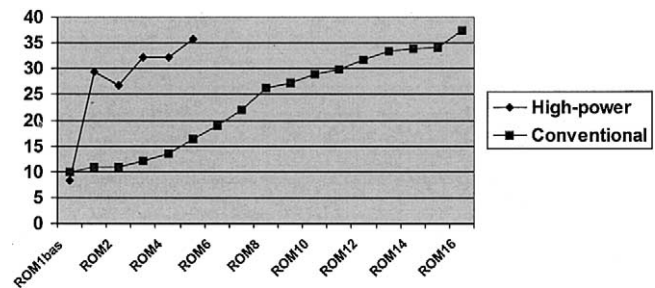


Fig 3. ROM values of the 2 groups before the first session (ROM1bas) and after each session (ROM1, ROM2, . . .).

Pain generated when ultrasound is applied on active trigger points subsides when those trigger points shift to latent or prelatent states. This pain generation can be a valuable diagnostic tool and can be an objective measure of trigger point irritability. Nevertheless, we preferred to use patient complaints and symptoms and did not use pain generation as a measure in our study. Care must be taken not to apply high-power, static ultrasound on trigger points in the vicinity of bony and neural structures. Patients will report discomfort and unbearable pain and burning when ultrasound waves meet periosteum, sympathetic chains, and peripheral nerves. We do not recommend this technique for active trigger points of facial or paraspinal muscles, or for muscles adjacent to nerve and bone structures (eg, extensor carpi radialis, tibialis anterior, peroneus longus, rectus femoris). We have observed undesirable pain during applications, but our patients did not report any short- or long-term adverse effects during the years we used this technique to treat them.

There are few published randomized clinical trials (RCTs) on the effects of conventional ultrasound technique in the treatment of MFPS. In an RCT, Esenyel et al⁷ reported that, when combined with neck stretching exercises, conventional ultrasound treatment and trigger point injections were equally effective in the treatment of myofascial trigger points of the upper trapezius muscle. However, in another RCT, Gam et al⁸ found no difference between groups given conventional ultrasound or sham ultrasound in the treatment of myofascial trigger points in the neck and shoulder.

High-power, threshold-pain technique is not invasive and seems to be free of adverse effects if applied after accurate diagnosis with knowledge of regional anatomy. It is free from serious complications such as infection, intravascular injection, nerve damage, and even pulmonary and cardiac arrest that may accompany injection of trigger points.⁹ The technique requires additional training and experience for the treating therapist. It

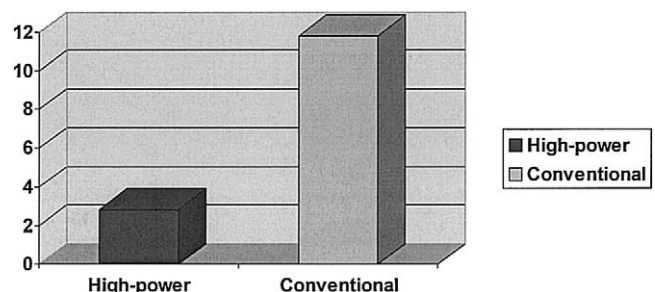


Fig 4. Mean number of therapy sessions, by group.

requires good communication and concentration for both patient and therapist. The procedure is as painful as a trigger point injection, but the intensity of pain can be immediately controlled by the therapist. In contrast to injection techniques, the procedure can be terminated or interrupted whenever necessary.

Several study limitations should be noted. We report only a comparison to traditional ultrasound. The study contained no long-term follow-up and no measures of functional improvement. The outcomes were measured by a physician who has a scientific and clinical interest in the treatment. Although every effort was made to keep the evaluator blind, we did not apply any test during the study to determine whether the evaluator was truly blinded. Finally, cervical spine ROM was assessed using a technique designed specifically for the present study. The interrater and test-retest reliability of this technique were not assessed. Despite the many published studies on cervical spine ROM measurement tools, these tools have not been fully tested for reliability, particularly in terms of adequate sample size and appropriate analysis techniques.¹⁰

CONCLUSIONS

High-power, pain-threshold, static ultrasound technique resolves acute active trigger points more rapidly than does treatment with conventional ultrasound technique. Someday it may be found more cost effective because it significantly decreases the number of PT treatment sessions.

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