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# Ultrasonically Localised Piezoelectric Focused Shockwave Intervention on Excitation Points for the Treatment of Myofascial Pain Syndrome of the Low Back and Hip in 42 Cases

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**Abstract:** ***Objective:*** ***To observe the clinical effect of piezoelectric focused shock wave in the treatment of myofascial pain syndrome (myofascial pain syndrome).*** ***Methods:*** ***From February 2024 to April 2024, 42 patients with lumbogluteal myofascial pain syndrome (18 males and 24 females) were treated with piezoelectric focused shock wave. Age ranged from 21 to 67 years, with a median of 45. 50 years. The pain point was located by ultrasound and the shock wave was treated once. VAS, JOA score, Young's modulus, strain ratio and area of pain point were compared before and after treatment.*** ***Results:*** ***42 patients were followed up. After shock wave therapy, VAS and JOA scores of patients were significantly decreased, and the difference was statistically significant (P<0. 05). The Young's modulus and area at the pain point were significantly reduced, and the difference was statistically significant (P<0. 05). The ratio of pain trigger point to normal tissue strain was significantly decreased, and the difference was not statistically significant (P>0. 05).*** ***Conclusion:*** ***Piezoelectric focused shockwave therapy after ultrasound localization of pain points can significantly improve the pain symptoms of patients, restore the ability of daily movement, and has a long-term effect, it is worthwhile to apply focused shockwave therapy to myofascial pain syndrome.***

**Keywords:** Myofascial pain syndrome, Provocative pain point, Shock wave, Ultrasound localisation**.**

## 1. Introduction

Myofascial pain syndrome (MPS) [1] is an aseptic inflammatory disease that causes pain and discomfort in the lumbar and buttock regions. Clinical complaints include localised pressure pain, limitation of movement and discomfort [2], and the duration of pain is variable, which can even affect the patient's daily work and life. Myofascial pain trigger points referred to as myofascial trigger points (MTrPs) [3] are the key to the diagnosis and treatment of MPS, and most of the Chinese and Western physiotherapy currently used is an overlay treatment for MTrPs, which is often poorly effective due to the lack of precision in the treatment method. Musculoskeletal ultrasound can clearly display the subcutaneous soft tissue texture and characteristics, and the precise location and depth of MTrPs through ultrasound can not only provide a target for clinical treatment [4], but also compare the elastic modulus of muscle fibres before and after treatment, etc. [5] so as to objectively evaluate the therapeutic effect. In this study, 42 patients with lumbar and hip MPS were treated with ultrasound-guided piezoelectric focused shockwave intervention at the excitation point, which is reported as follows.

## 2. Clinical Information

### 2.1 General Information

All 42 cases were patients with lumbar and hip MPS who attended the orthopaedic spine clinic of Xi'an Municipal Hospital of Traditional Chinese Medicine from February 2024 to April 2024. There were 18 male and 24 female cases. Excitation pain points were observed in 87 cases. Age ranged from 21 to 67 years, median 45. 50 years, mean 44. 64 years. All of the above are patients with myofascial pain syndrome of the lumbar gluteal region. This study was reviewed and approved by the Medical Ethics Committee of Xi'an Hospital of Traditional Chinese Medicine. (Approval No.: LLSCPJ2022001)

### 2.2 Diagnostic Criteria

Refer to "Diagnostic and therapeutic efficacy criteria of Chinese medicine" [6] and "Pain Medicine" [7] on the relevant diagnostic criteria of MPS.

1) Regional pain in the lumbar and hip regions.
2) Sensory abnormalities in the area involved in low back and hip pain or excitation points.
3) Tension bands palpable in the affected muscles of the lumbar gluteal region.
4) Sharp punctate tenderness at a point within the band of tension.
5) Some degree of limitation of movement within the lumbar and hip ranges of motion.

### 2.3 Inclusion Criteria

1) Meets diagnostic criteria for myofascial pain syndrome.
2) Voluntary enrolment in the study, signed informed consent, able to co-operate with understanding of the treatments.
3) No oral pain-related medication or other physiotherapy within 1 month prior to treatment.
4) No contraindications to extracorporeal shock wave therapy.
5) Lumbar disc herniation or other organic changes in the spine excluded by X-ray, CT or MRI examination.
6) Exclusion of major diseases of other organ systems.

### 2.4 Exclusion Criteria

1) Imaging to exclude conditions associated with peripheral nerve inflammation or small joint disorders.
2) People with previous mental illness or anxiety who are unable to co-operate with treatment.
3) Persons under 18 and over 80 years of age.
4) Significant dermatological or other complications on the lower back and buttocks that interfere with subsequent therapeutic manipulation, e. g. shingles, ulcers, etc.
5) Previous surgery related to the lumbosacral skeleton.

## 3. Treatment Method

The marked area was then screened by a sonographer in the Department of Functional Medicine of the hospital using colour Doppler ultrasound. Using the L14-3Ws probe, the subcutaneous muscle path was explored along the body's long-axis at the marking site, and on the way, hyperechoic areas with muscle texture disappearance were searched for, and marked on the body's surface using a straight line of long and short lengths, with a 'cross'. The area was marked on the body surface using a 'cross' of short and long lines, with a depth value at the top right of the mark, as shown in Figure 1. The use of piezoelectric focusing shock wave based on different depth data to choose the appropriate focusing head, respectively, above the pain point and the focusing head uniformly coated with coupling agent 5 to 6 ml, the focusing head centre of the projecting point aligned with the surface of the 'cross' mark. 'Set the parameters of shock wave (frequency: 6. 0-8. 0Hz, number of times: 1000-3000, impact energy density), and adjust the energy level of the shock wave according to whether the patient has a feeling of acidity, numbness and distension. After treatment, use dry paper towel to clean up the residual coupling agent.

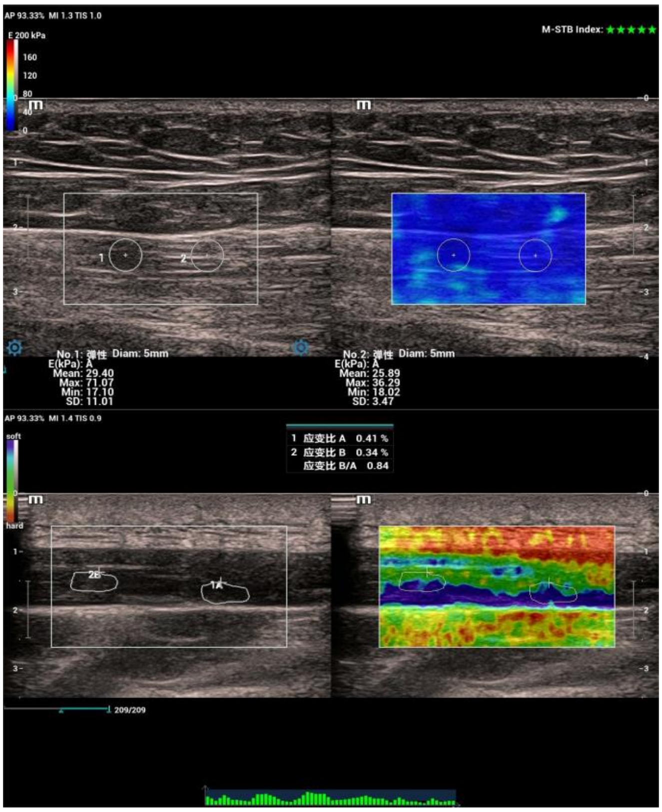


**Figure 1:** Marked areas and depth values

## 4. Observation of Therapeutic Effects

### 4.1 Observation Indicators

An irregular hypoechoic area with loss of muscle texture under the labelled area in the lumbar gluteal region was detected with ultrasound equipment and the border was manually traced along the edge of the hypoechoic area. The area of the excitation point was recorded automatically by the computer; ultrasound shear wave elastography (SWE) [8], was activated, and Diam was set to 5 mm, with the centre of the excitation point in the No. 1 circle, and the normal muscle tissue of the same muscle group close to the excitation point in the No. 2 circle, at a distance of <5 mm. In the sampling frame, when the allegation map is green and the motion stability index is 5 stars, the number of samples is taken and monitored, and the average value is taken after automatic calculation by the computer; switching to the SR [9-10] panel, when the SOFT index is green and the motion index tends to be stable, the samples are taken after 5s of observation, and the value is automatically calculated and recorded by the computer.

4.1.1 Objective observation indicators.

The excitation point, Young's modulus (E), quantifies the elasticity and stiffness of the tissue. SWE, or Young's modulus, is a higher value reflecting a lower ability of the muscle tissue to undergo deformation, and a higher stiffness of the muscle tissue. Strain ratio (SR): The strain elasticity strain ratio, i. e. the stiffness of the first region assessed by measuring the ratio of two adjacent regions of muscle tissue within the same muscle group, is used as a secondary observation.

Area(S): The area of the excitation point can reflect its morphological changes and is also a visual evidence of the mapping of the excitation point.

4.1.2 visual analogue scale, (VAS) [11] score.

The patient's immediate pain level was quantitatively assessed by scoring from 0 to 10, with 0 representing no pain and 10 representing severe pain that was intolerable.

4.1.3 Japanese Orthopaedic Association Scores, (JOA) [12].

A full score of 29 points, with a minimum of 0 points, was given to patients based on their own situation, with higher scores indicating a better functional status of the lumbar spine, and lower scores indicating a more pronounced dysfunction of the lumbar spine, with 25-29 points being excellent, 16-24 points being good, 10-15 points being moderate, and <10 points being poor.

Assessments were made based on the above indicators before and after the first treatment.

### 4.2 Statistical Processing

SPSS version 26. 0 was used for statistical processing. Measurement data conforming to normal distribution were expressed as mean ± standard deviation ($\bar{x}\pm s$), and within-group comparisons were made using repeatedmeasures analysis of variance (ANOVA) and paired-samples t-tests, those not conforming to normal distribution were expressed as median (upper and lower quartiles) [M (P25, P75)], and within-group comparisons were made using Wilcoxon's paired-ranksum test. Differences were considered statistically significant at P<0. 05.

## 5. Results

1) Comparison of Young's modulus (E), strain ratio (SR) and area (S) at the pain points before and after the first treatment.

The difference between the E value and area at the excitation point after the first treatment of the patient and before the treatment was statistically significant (P<0. 05), and the E and S values at the excitation point of the patient became smaller. Comparison of SR values before and after the first treatment was not statistically significant (P>0. 05), and SR values were reduced compared to pre-treatment. See Table 1.

**Table 1:** Comparison of Young's modulus values and areas at various time points before and after treatment in patients with MPS ($\bar{x}\pm s$)

| norm | number of examples | Before first treatment | After the first treatment |
|---|---|---|---|
| E/kPa | 87 | 34. 62±8. 43 | 31. 12±6. 54 |
| SR/kPa | 87 | 1. 01±0. 42 | 0. 96±0. 31 |
| S/cm² | 87 | 1. 01±0. 50 | 0. 71±0. 42 |

2) The patients' VAS scores were all significantly lower after the first treatment compared to before the treatment, and the difference was significant. JOA scores were significantly higher after the first treatment compared to pre-treatment, and the difference was significant. See Table 2.

**Table 2**: lower back and hips MPS Comparison of VAS and JOA scores at each time point before and after treatment M (P25, P75)

| Norm | Number of examples | pre-treatment | post-treatment |
|---|---|---|---|
| VAS | 42 | 7. 00(6. 00, 8. 00) | 3. 50(2. 25, 5. 00) |
| JOA | 42 | 21. 00(19. 00, 23. 00) | 23. 50(21. 00, 26. 00) |

## 6. Discussion

The causative factors of MPS in modern medicine are mostly focused on the analysis in the state of muscle strain [13-16], and various causes lead to increased muscle tension, and even the loss of normal flexion and extension of muscle bundle fibres, the release of various inflammatory factors and free radicals is then increased [17-19], and the pain sensation is more and more obvious, which is the basis for the generation of provocative pain points. The treatment of myofascial pain syndromes by intervening in the excitatory pain points is a concept that is currently agreed upon by most external therapies, such as knife, magnetic circular needle, silver needle, and extracorporeal shockwave [20-22], all of which aim to promote the absorption of inflammatory substances in the local area and reduce the pressure of myofascial interstitial space by destroying the excitatory pain points. However, all of these external treatments inevitably affect the normal tissue structure next to the excitation point, so how to destroy the excitation point as much as possible without affecting the normal tissue has become an important issue to improve the clinical efficacy and ensure the effectiveness of the treatment. A recent pathophysiological study of excitatory nodes pointed out that the high content and activity of free radicals, inflammatory factors, lactate dehydrogenase (LDH), malondialdehyde (MDA) in their surroundings under the effect of an energy crisis at the excitatory node, with the accompanying high water-containing nature of these extracellular matrices, is the main reason for the hypoechoic character of the echogenicity under ultrasound [23-24]. This irregularly shaped hypoechoic area on ultrasound imaging, which is usually 1 to 2 cm² in size, is the basis for the data measurements [4, 25].

Young's modulus based on Hooke's law was originally applied to measure material hardness, while Young's modulus applied to assess soft tissues of the body measures tissue hardness by measuring the difference in the speed of shear waves passing through the tissue. ($E=3\rho Cs^2$, ρ is the tissue density and Cs is the shear wave) gives an indication of the elasticity of the muscle bundles and thus an assessment of the functional state of the muscle. SR is a semi-quantitative method with high measurements and sensitivity for hard kink points. The two methods of sampling and calculating in two-dimensional sections are different, and in this observation the two methods were used together to assess the changes in elasticity and stiffness of the provocative points.

Extracorporeal shock wave therapy, (ESWT) [26-27] Osteogenesis disorders such as delayed fracture healing and necrosis of the femoral head have been used in the past [28]. However, due to the lack of precise localisation of the lesion site and the tendency for high energies to negatively affect normal tissues in lesions targeting muscle bundle tissue, dispersive shockwave therapy is often used. Previous studies have shown good results in the treatment of MPS with dispersive shockwaves [27, 29-30]. In our clinic, the focusing point of the shock wave was clarified through ultrasound guidance, when the shock wave focused on the pain point, the muscle at the pain point was loosened through its unique mechanical stress and cavitation effect, reducing the inter-tissue pressure, and the E-value and SR-value showed a tendency to decrease. At the same time, because the nutrient supply to the tissue cells increases immediately after the release, the absorption of inflammatory factors is accelerated, and the water-containing matrix that constitutes the painful spot becomes less, and the area of the painful spot is reduced. In conclusion, two biological effects, tissue lysis and tissue loosening, which are unique to shock waves, play a key role in destroying the structure of the excitation point [31-32]. The holistic therapy has achieved the combination of non-invasive, superior efficacy and visualisation. Holistic therapy achieves a combination of non-invasiveness, superior efficacy and visualisation. The results of this study showed that focused shockwave treatment of lumbar and hip MPS was effective in relieving pain, improving lumbar spine mobility, and repairing tissue elasticity by ultrasonically locating the orientation and depth of the provocative pain points. Focused shockwave therapy under ultrasound positioning is safe, and precise positioning avoids damage to normal nerves and blood vessels. The comparison of elastic shear wave measurements quantifies the changes in elasticity and stiffness of the lesion before and after treatment, and the treatment effect can be expressed visually, providing a new index for efficacy assessment.

## 7. Conclusion

In conclusion, focused shockwave therapy under ultrasound positioning can repair the muscle elasticity at the pain points, reduce tissue adhesions and promote the absorption of inflammatory mediators, accelerate the recovery of qi and blood flow through the meridians and channels, thereby reducing pain and restoring functional movement. The shortcomings of this study are that the number of muscle groups in the lumbar and gluteal region is large [33], and each muscle group is subject to different stresses in people’s daily behaviours, and there is a lack of precise classification of the changes in the provocative pain points of different muscle groups, which can be observed at a later stage by expanding the sample size and refining the classification.

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