Middle East J Rehabil Health Stud. 2023 January; 10(1):e130587. https://doi.org/10.5812/mejrh-130587.

Published online 2022 December 14. **Research Article**

The Effects of Magnet Therapy on Pain and Disability in Patients with Shoulder Impingement Syndrome

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Received 2022 August 20; **Revised** 2022 November 06; **Accepted** 2022 November 22.

Abstract

Background: Shoulder pain felt when performing daily activities is a common complaint at all ages. Shoulder impingement syndrome is one of the most common causes of shoulder pain. Since this disease is relatively prevalent, there is an urgent need to develop a treatment method with fewer complications. Magnet therapy (MT) is one of the therapies that has been recently used to treat various musculoskeletal disorders.

Objectives: This study aimed to evaluate the effects of MT on pain and disability in patients with shoulder impingement syndrome.

Methods: In this double-blind clinical trial study, 60 patients diagnosed with shoulder impingement syndrome were randomly assigned to three groups including the "MT 18 Hz" group, the "MT 100 Hz" group, and the "Sham" group. All patients received Magnet therapy three times a week for four weeks in addition to routine treatment. In the sham group, Magnet therapy was used as a placebo. All three groups received routine electrotherapy and exercise therapy. Before and after the treatment, the pain level was evaluated by the NRS scale, the disability level was assessed by the Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH), and the range of motion of the shoulder was measured using a goniometer. The values obtained in the groups and for the groups were compared before and after the treatment.

Results: The intragroup comparison of the three groups revealed a statistically significant improvement in all variables (including NRS score, DASH, and shoulder range of motion) ($P < 0.05$). The intergroup comparison, on the other hand, showed no statistically significant difference for any of the variables ($P > 0.05$).

Conclusions: It was concluded that routine physiotherapy significantly reduced pain and disability as well as improved shoulder range of motions in patients with shoulder impingement syndrome. Moreover, using magnet therapy with two frequencies of 18 and 100 Hz along with the routine electrotherapy and exercise therapy had no additional positive effect on the recovery process of patients with shoulder impingement syndrome.

Keywords: Magnet Therapy, Shoulder Impingement Syndrome, Pain

1. Background

Shoulder pain felt when performing daily activities is a common complaint in patients of all ages, affecting approximately one-third of people throughout their life (1, 2). As such, it is the third most common musculoskeletal disorder for medical consultations (2-5). Shoulder impingement syndrome (SIS) is broadly described as an encroachment on the subacromial tissues as a result of the narrowing of the subacromial space. SIS can also be classified as primary or secondary impingement. Structural narrowing of the subacromial space is seen in the primary SIS, while more functional disorders are the basis of the secondary SIS (6). Furthermore, SIS includes internal and external impingement. Internal impingement is the degenerative processes in the supraspinatus tendon itself that lead to defect. In external impingement, however, the injury is caused by the traumatic contact of the shoulder roof with the supraspinatus tendon in subacromion impingement syndrome (2).

The patients are usually over 40 years old and suffer from persistent pain without a history of trauma. They report pain when elevating the arm between 70° and 120° (the “painful arc”), on forced movement above the head, and lying on the affected side (2, 7, 8).

Conservative treatments mostly consist of prevention, rest, nonsteroidal anti-inflammatory drugs (NSAIDs), injections of steroids to the subacromial space, and various conventional methods of physiotherapy (9). Conser-

vative treatments including physiotherapy are more effective in treating SIS when combined with each other. Surgical treatment may be used when resistance to conservative treatments is developed.

Physiotherapy treatment mainly includes mobilizations, kinesiotaping, specific exercise, electrotherapy modalities including diathermy, ultrasound, interferential current, laser, radial extracorporeal shockwave, acupuncture, and pulsed electromagnetic field therapy (1, 3, 9-14).

Magnetic therapy (MT) is a conservative, non-invasive, simple, and safe modality that can penetrate the skin and reach the target tissue at the site of injury or inflammation (15, 16).

MT has several advantages including high physiological effect, low contraindications, painless and easy implementation, as well as high penetration power and cumulative effect (17). MT is achieved by applying changes to biological and physiological systems through low-energy, non-ionized electromagnetic fields (18). MT develops the potential of erythrocytes membranes, increases the oxygen content of tissues, dilates blood vessels, and relieves pain without increasing the temperature of the position. The tissue stimulated by the pulsed electromagnetic field has been reported to show an initial increase and more maturation of capillaries and fibroblasts, as well as a more prominent longitudinal orientation of the collagen fibers (10). Therefore, it has been widely used to treat patients with shoulder involvement or painful shoulder syndrome (17).

Few studies have examined the effects of this modality on SIS. For example, the studies by Aktas et al. (10) and Galace de Freitas et al. (19, 20) on the therapeutic effect of pulsed electromagnetic field in the treatment of SIS failed to show a significant difference between the studied groups. Pino et al. (17), on the other hand, showed that this modality contributed positively to pain reduction, functional capacity increase, and overall shoulder function.

Taking into account the limited number of studies on the effects of MT on musculoskeletal disorders as well as the contradictory results of these studies, there is seemingly no consensus of opinion over the effects of this method on SIS and, therefore, no appropriate parameters are available to prescribe it.

2. Objectives

The comparison of two different frequencies of MT for treatment has not been the subject of studies investigating the effect of MT on the treatment of shoulder injuries and, moreover, lower intensities have often been used. Thus, it seems that the effects of different frequencies of MT on clinical findings about SIS have remained unknown. This study, therefore, aimed to evaluate the effects of MT on pain and disability in patients with SIS, and to compare two frequencies of 18 and 100 Hz.

3. Methods

This study was a Double-blinded Randomized Clinical Trial in which the effectiveness of MT in reducing pain and disability in patients with SIS was investigated. To this end, people with the primary and external SIS diagnosed by specialists and referring to physiotherapy clinics were identified. The qualified subjects were first informed of the study purposes and the treatment methods. Then written informed consent was obtained from all subjects, and the protocol was approved by the Tabriz University of Medical Sciences Ethics Committee with an approval ID of IR.TBZMED.REC.1400.055. Personal information such as age, sex, weight, and height were recorded prior to the intervention. The patients were evaluated for inclusion criteria as follows:

(1) Having pain in the shoulder joint lasted more than 1 month (11)

(2) Diagnosis of the primary and external SIS by specialist mainly based on medical history and clinical findings such as a positive Hawkins Kennedy test and Neer test.

(3) Being subject to restriction of at least one of the active movements of flexion, abduction, external, and internal rotation of the shoulder (10)

(4) Age above 40 years (21)

(5) DASH criteria more than 40

The patients were excluded from the study based on the following criteria:

(1) Receiving any rehabilitation treatment in the past

(2) Having neurological disorder

(3) Suffering from injury to the neck, elbow, or hand

(4) Having rheumatoid arthritis

(5) Having heart disease

(6) Having undergone an upper limb surgery

(7) Being pregnant

(8) Receiving intra-articular anti-inflammatory drug in the last 60 days (22)

(9) Having other pathological shoulder disorders such as fake acromion, osteoarthritis, adhesive capsulitis, or traumatic ruptures of labrum (19)

Randomization was performed by extracting 60 codes (20 codes for each group) from the Excel program, each of which was placed inside a sealed envelope. Then an envelope was randomly selected for each patient.

The total number of 60 patients were randomly divided into three groups: The first group received routine

physiotherapy including electrotherapy and exercise therapy, and MT with a frequency of 18 Hz (MT 18 Hz group); the second group received routine physiotherapy and MT with a frequency of 100 Hz (MT 100 Hz group); and the third group received routine physiotherapy and Sham magnet therapy (MT Sham group).

All participants were informed about the devices used, the safety and harmlessness of the interventions, the way to perform the exercises correctly, as well as the proper posture of the body during the interventions and exercises, so that no error would occur due to unfamiliarity with the type of test.

in this study, PMT-Q Magnet therapy device, a product of ASA company from Italy with solenoid applicator of 36 $\times$ 21 cm^2, was applied 12 sessions, three times a week for four weeks. The frequencies of MT used for the first and second groups were 18 Hz and 100 Hz, respectively. Other parameters of MT were the same for both groups with an intensity of 100 mT and a duration of 30 minutes in each treatment session. In the Sham MT group, MT was used as a placebo using a switched-off device for 30 minutes in each treatment session. As for the simulations with the first and second groups, the device light was on.

In our study, the VAS scale was used to measure pain intensity, the DASH questionnaire was used to assess the amount of upper limb disability, and the goniometer was used to measure the active range of motion of the shoulder (including flexion, abduction, external rotation, and internal rotation).

Routine physiotherapy included the application of high TENS (80 Hz and 60 μs) and hot pack (for 30 minutes), US (Continues, 1 MHz, 1 W/cm^2, 5 Min) which was performed in all three groups three sessions per week for four weeks (13). Exercise therapy ranged from motion to stretching which were performed daily along with strengthening exercises three times a week (23).

At the end of the treatment sessions, the pain intensity was measured again by VAS scale, the amount of disability was assessed using the DASH questionnaire, and the amount of shoulder range of motion (including flexion, abduction, internal rotation, and external rotation) was evaluated by a goniometer. The changes in each group before and after the treatment, as well as the number of changes, observes in all groups were compared and analyzed.

It should be noted that the evaluator and the patients were not aware of the type of groups, as this study was a double-blind study.

3.1. Statistical Analysis

The statistical analysis was performed using SPSS 26. Concordance of the data to normal distribution was tested performing Kolmogorov-Smirnov test. The intragroup comparison (i.e., within the groups) before and after the interventions was performed by using the Paired Sample *t*-test, whereas the intergroup comparisons (i.e., among the groups) were performed by using statistical method of analysis of variance (ANOVA) and Duncan's multi-range test. Statistical significance was set at $P < 0.05$ for all tests.

4. Results

In preoperative analysis, no significant differences were observed among the groups in terms of age, initial pain score (VAS), initial disability score (DASH), initial range of motion of flexion, abduction, internal rotation, and external rotation of the shoulder ($P < 0.05$).

The results from the intragroup and intergroup comparative tests were as follows:

The data from all three groups were compared before and after treatment using Paired Sample *t*-test (Table 1), and the results showed that VAS score and DASH score significantly decreased ($P < 0.05$) while the range of motion of flexion, abduction, internal rotation, and External rotation significantly increased ($P < 0.05$).

The comparison among the groups was performed using ANOVA test, and the results revealed no statistically significant differences among the three groups in terms of VAS and DASH scores as well as in terms of changes in the range of motion Flexion, Abduction, internal rotation, and external rotation ($P > 0.05$).

5. Discussion

In this study, MT with two frequencies of 18 Hz and 100 Hz with an intensity of 100 mT was used to evaluate the effectiveness of MT in reducing pain and disability as well as in improving shoulder range of motions in people with shoulder impingement syndrome. Our study results indicated an improvement in all the variables (including VAS score, DASH, and range of motion flexion, abduction, internal rotation, and external rotation) in all three groups. However, no differences were observed among the groups regarding the given variables.

According to our results, routine physiotherapy including electrotherapy and exercise therapy significantly reduced the pain and disability and increased shoulder range of motions in patients with shoulder impingement syndrome.

Our study result was consistent with the finding from the study by Kaya et al., which found that a routine physiotherapy program for two weeks may have been significantly effective in reducing pain and disability and, therefore, in treating shoulder impingement syndrome (24). In

Table 1. Comparison of the Meansand 95% Confidence Interval (CI) of Pain, Disability, and Shoulder Range of Motions Between Before and After Treatment

	MT 18 Hz	95% CI Lower, Upper	MT 100 Hz	95% CI Lower, Upper	Sham	95% CI Lower, Upper
VAS		2.9, 4.2		2.5, 3.8		2.2, 3
Before	6.1 ± 1.2		5.90 ± 1.2		6.05 ± 1.3	
After	2.55 ± 1.7 [a]		2.75 ± 1.5 [a]		3.45 ± 1.6 [a]	
DASH		31.1, 45		29.1, 44		25.1, 31.4
Before	71.87 ± 14.6		68.58 ± 16		61.62 ± 10.6	
After	33.78 ± 9.1 [a]		32 ± 9.9 [a]		33.37 ± 11.8 [a]	
Flex		-17.6, -10.2		-24.6, -13.8		-19.1, -10.4
Before	123.95 ± 8.6		112.30 ± 12.4		116.30 ± 11.6	
After	137.90 ± 9.8 [a]		131.50 ± 10.9 [a]		131.05 ± 9.2 [a]	
Abd		-25.8, -13.5		-39, -15		-23.8, -12.3
Before	109.85 ± 14.3		97.30 ± 26.5		101.05 ± 13.5	
After	129.50 ± 11.6 [a]		123.75 ± 16.3 [a]		119.10 ± 12.6 [a]	
Int.Rot		-16.2, -10		-26.1, -15.2		-20.3, -12.4
Before	56.25 ± 10.4		49.30 ± 12.2		54.10 ± 12	
After	69.30 ± 9.9 [a]		69.95 ± 9.3 [a]		70.45 ± 10 [a]	
Ext.Rot		-23, -12.5		-19, -10.5		-21.2, -5.1
Before	57.05 ± 16.1		57.60 ± 16.8		58.10 ± 16	
After	74.95 ± 13.96 [a]		72.35 ± 16.3 [a]		71.20 ± 17.49 [a]	

Abbreviations: VAS, visual analogue scale; DASH, shoulder pain, and disability questionnaire; Flex, flexion; Abd, abduction; Int.Rot, internal rotation; Ext.Rot, external rotation; CI, confidence interval.
[a] $P < 0.05$

the study by Perez-Merino et al., it was also shown that 20 sessions of physiotherapy improved the shoulder pain and physical function of the patients with shoulder impingement syndrome without a complete rotator cuff tear (25). Our results were in line with these findings, suggesting that the improvement in pain and function was associated with the effectiveness of physiotherapy in treating the patients with SIS.

Several possible mechanisms can be involved in achieving this improvement and positive results. For example, in gate control theory, activated by TENS, the modulation process of inhibitory pain occurs at the spinal cord level. Specifically, intrinsic inhibitory neurons in the dorsal horn of the spinal cord are activated by activating Aβ fibers with innocuous tactile stimuli, which in turn leads to inhibition of pain signals transmitted through C fibers (26).

Increased circulation and, consequently, improvement in inflammation and tissue repair seems to be another mechanism which is activated by using Hot Pack and ultrasound therapy. In other words, rising tissue temperature stimulates vasodilation and increases tissue blood flow, which is believed to improve healing by increasing the supply of nutrients and oxygen to the injury site. The rate of local tissue metabolism also increases with warming, which may lead to further improvement. In addition, heat-induced changes in the viscoelastic properties of collagen tissues may be a reason for the proven effectiveness of heat therapy in improving the range of motion (27). Needless to say, the non-thermal effects of ultrasound, including cavitation and microcurrent sound, are more important than thermal effects in the treatment of soft tissue lesions (28). Furthermore, it has been argued that ultrasound is useful as an adjunct therapy when treating rotator cuff tendonopathy (28).

Apart from some possible effective mechanisms contributing to clinical findings improvement, exercise therapy is often considered as an important part of the treatment. Studies have shown that exercise therapy can help reduce pain and restore range, coordination, and/or movement control in patients. Studies have also demonstrated that ROM training improves performance, disability, and pain (29).

However, the combination of MT with a routine electrotherapy and exercise therapy regimen in our study had no significant effect on the recovery process of patients with SIS. This result was consistent with the result from

the study by Aktas et al., in which 46 patients were divided into two groups. One group was given active MT and the other group was given sham MT, 25 minutes per session, five days a week for three weeks. Then the patients' shoulder pain during their rest and daily activities as a cause of sleep disorders was examined. Significant improvement in all these variables, compared to baseline values, was observed at the end of treatment in both groups, but no significant difference was detected between the groups (10). Our results were also consistent with the findings of the study by Galace de Freitas et al. in which 66 patients were divided into two groups, the MT group (with an intensity of 20 mT and a frequency of 50 Hz for 30 minutes) and the sham group, which was administered three times. Then pain as well as muscle function and strength were measured three weeks after the treatment (20).

Galace de Freitas et al., in another study, showed the effectiveness of MT combined with exercise therapy in reducing pain and improving muscle function and strength in patients with shoulder obstruction syndrome (19). It may suggest that exercise therapy plays an important role as an adjacent to MT in terms of clinical findings improvement.

In contrast, several other studies have produced different results. For example, a study by Binder et al. found that the MT was a useful modality in the treatment of rotator cuff tendonitis (30). In another study by Pino et al., patients with shoulder involvement syndrome were first divided into three groups: Acute, subacute, and chronic. Then it was determined that adopting MT exerted positive effects on patients since it was statistically associated with reduced pain, increased functional capacity, and overall shoulder function (17). Finally, a study by Kluter et al. showed that the addition of MT to shock wave therapy enhanced the effects of the treatment targeted towards patients with rotator cuff tendonitis (31).

According to our study results, it was concluded that routine physiotherapy significantly improved pain, disability, and shoulder range of motions in patients with shoulder impingement syndrome. Moreover, it was found that using magnet therapy with two frequencies of 18 and 100 Hz along with routine electrotherapy and exercise therapy had no additional positive effects on the recovery process of patients with shoulder impingement syndrome.

5.1. Limitations of the Study

This study faced some limitations. First, the duration of MT in each treatment session was short, and the number of treatment sessions was small. Longer treatment duration and greater number of sessions may have shown the no-apparent clinical and therapeutic effects of this modality on patients with SIS. Second, the patients participating in this study were individuals with at least one month history of shoulder pain, suggesting that the lesion was in the subacute or chronic stage, and the patients with the lesion in the acute stage possibly were not included in the study. Third, the anti-inflammatory effect of MT had received the greatest emphasis in various studies; therefore, MT may not have had much effect on the complication at this stage (i.e., subacute and chronic) but may have had stronger effects on the target lesion in the acute stage. Finally, the highest rate of prevalence of SIS had been reported for individuals aged over 40 years; therefore, all patients participating in this study were over 40 years old. Thus, the patients may have had initial destructive changes in the rotator cuff or other elements of the joint, which could not be detected and interfered with their treatment process and prevented the positive effects of MT.

5.2. Suggestions

It was recommended that further studies should be conducted to investigate a longer period of time and greater number of treatment sessions in order for detecting any possible treatment effects. It was also suggested that the effects of MT on patients with acute shoulder injuries as well as the anti-inflammatory effects of MT should be explored. Finally, it was recommended that patients in age groups less than 40 years should be included in similar studies.

Footnotes

Authors' Contribution: Z.A. conceived and designed the evaluation and drafted the manuscript. A.S. re-evaluated the clinical data, revised the manuscript and performed the statistical analysis, and revised the manuscript. A.E.O. re-analyzed the clinical and statistical data and revised the manuscript. All authors read and approved the final manuscript.

Clinical Trial Registration Code: IRCT20210424051069N1.

Conflict of Interests: Funding or Research support: Tabriz University of Medical Sciences: None. Personal financial interests: None. Patents: None. Personal or professional relations with organizations and individuals (parents and children, wife and husband, family relationships, etc.): None.

Ethical Approval: The protocol was approved by the Tabriz University of Medical Sciences Ethics Committee with an approval ID of IR.TBZMED.REC.1400.055.

Funding/Support: This study was supported by Tabriz University of Medical Sciences (https://www.tbzmed.ac.ir/)

Informed Consent: Written informed consent was obtained from all participants.

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