THE EFFICACY OF MANUAL THERAPY AND ULTRASOUND IN TREATMENT OF CALCIFIC TENDINITIS OF THE SHOULDER

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Received on 10.11.2023. *Reviewed on 20.12.2023.* *Accepted on 25.01.2024.*

ABSTRACT

Introduction: Shoulder calcification, also known as calcific tendinopathy, is a common cause of shoulder pain, typically occurring between the ages of 30 and 50. It is approximately twice as common in women compared to men. The pathogenesis of the disease is not well understood, and it exhibits a cyclic nature.

Objective: To investigate and assess the impact of ultrasound and manual therapy on reducing shoulder calcifications. Materials and Methods: This study, conducted at the Rehabilitation Center "Život" in Mostar from May to July 2023, involved 30 participants. Statistical analysis, using Microsoft Excel 2010 and IBM SPSS 23.0, included descriptive and inferential statistics, revealing significant insights into participants' perspectives and forming the basis for a comprehensive discussion.

Results: The research results demonstrated a statistically significant reduction in pain intensity after therapy, both in men and women. Additionally, calcification size significantly decreased, and shoulder range of motion improved. Analysis of demographic factors revealed differences between female and male participants, emphasizing the prompt seeking of therapy after the onset of pain.

Conclusion: The combination of ultrasound and manual therapy shows promising effectiveness in treating shoulder calcifications, laying the groundwork for further study and personalized clinical practice.

Keywords: calcification in the shoulder, manual therapy, ultrasound therapy.

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INTRODUCTION

Calcification in the shoulder, also known as calcific tendinopathy, is a common cause of shoulder pain. This degenerative change in the shoulder joint is characterized by the accumulation of calcium salts within the tendons of the rotator cuff (1,2). The result of the above is the pain patients often experience, limited mobility, and reduced functionality of the shoulder. It most often occurs between the ages of 30 and 50 and is approximately twice as common in women than in men. It occurs more often in the right shoulder than in the left, and in 10% of patients, it involves both shoulders (1,3).

The disease has a cyclic nature and goes through several stages: initial, resting stage, resorptive, and post-calcifying stage (2,4). In the initial stage, the disease is mostly asymptomatic or with some mechanical symptoms, as a result of calcification deposits. In the resorptive stage, migration of calcifications to adjacent tissues can occur, which causes excruciating pain, more severe limited mobility, but also hyperesthesia, and redness of the surrounding skin, as well as increased body temperature. The causes of these migrations are not known, it is assumed that they are mechanical (5–8). Risk factors for the development of calcific tendinitis include endocrine disorders, such as thyroid disease and diabetes mellitus, alcohol consumption, and a history of traumatic injuries or surgical interventions on the shoulder (1).

The study in Taiwan included 42,915 patients diagnosed with diabetes between January 1, 2000, and December 31, 2015, and the data of 171,660 people were randomly selected as a control group. All subjects were monitored until the development of calcification tendinitis or the end of 2015. This study showed that patients with diabetes have a 27% increased risk of developing calcific tendinitis of the shoulder, 8 years after the initial diagnosis of diabetes (9).

Damage to the tendons in the shoulder and chronic inflammation, along with the formation of calcifications, can result in poorer blood supply to the tendons, muscle weakness in the shoulder joint, and junction of the tendons with other anatomical structures of the shoulder joint (area of the tendons of the supraspinatus muscle and the long head of the biceps). Shoulder pain (often at night), crepitations, reduced range of motion, and muscle weakness accompany calcifying tendinitis and "frozen shoulder."

Calcific tendinitis is classified based on the onset of symptoms into acute, subacute,

and chronic forms (3). The key instrument for the diagnosis and treatment of calcific tendinopathy is an ultrasound examination, with special emphasis on determining the location, size, and morphology of calcifications. It is important to note that ultrasound should not be exclusive, since there is a possibility of false positive and false negative findings. The diagnosis of calcifying tendinopathy can be easily made using conventional radiography (10). The use of magnetic resonance imaging is rarely recommended due to its high cost and minimal impact on the adjustment of therapy, but it is important in the assessment of potential tendon ruptures. It is important to note that the spontaneous reduction of symptoms in 9% of cases does not necessarily lead to the resorption of calcifications. The classical approach remains the basic method of treatment, achieving improvement in most patients using oral anti-inflammatory drugs, physical therapy interventions, corticosteroid injections, and endoscopic ultrasound (EUS) needles (11). Therefore, conservative treatment is recommended before surgery. Patients with acute pain should begin passive shoulder exercises to restore range of motion. In most patients with chronic pain, the range of movements (ROM) of the shoulder joint is close to the normal range. It is therefore necessary to start strengthening exercises within a range that is comfortable for the patient. Despite the variety of approaches, the combination of ultrasound and manual therapy is attracting increasing interest due to promising results (12,13).

Methods such as the Bowen and Emmett techniques, used as complementary therapies, have the potential to improve mobility and reduce symptoms. However, further studies are needed to determine the precise effects of calcification resorption in the shoulder. The Bowen technique is a manual therapeutic method that uses specific movements on soft tissue to solve biomechanical disorders. This technique has the potential to improve spinal and central nervous system function. Through gentle movements of the fingers and thumb, the physiotherapist stimulates the muscles, ligaments, tendons, and fascia, encouraging the body to return to its physiological balance. This procedure induces a piezoelectric effect, like a wave that travels through the fascia towards the brain (14). The Emmett technique, on the other hand, involves specific "moves" that the therapist applies with minimal strain. The goal of these techniques is to stimulate muscle balance, reduce tension and pain, and improve the general condition of the

body. It is used to alleviate problems such as back, neck, and shoulder pain, improve mobility, and treat sports injuries, muscle and joint problems and postural imbalances. It is important to emphasize that Bowen and Emmett's therapies are often used as complementary techniques to traditional medical care.

MATERIALS AND METHODS

This study included 30 participants, of both sexes, aged 20-60, who suffer from calcifying tendinopathy. The study was conducted in the Rehabilitation Center "Život" in Mostar in the period from May to July 2023. Ethical permission for this study was obtained from the mentioned rehabilitation institution. The criteria for the inclusion of participants were: ultrasound and radiological diagnosis of calcifying tendinopathy, age range between 20 and 60 years and willingness to participate in the study. The exclusion criteria were: the presence of other medical diagnoses in addition to calcification, mental disorders that interfere with the understanding of the study, and irregularity and non-compliance with agreed physiotherapy treatments. All participants were informed in detail about their rights and obligations, and before participating in the study they signed an informed consent. The diagnosis of calcification in the shoulder was confirmed by an orthopedist through a clinical examination and X-ray findings.

Outcome and outcome measures

The primary outcome measure was pain intensity, and secondary outcome measures included shoulder range of motion and radiological findings of shoulder calcification. All these variables were observed at two points in time - at the beginning of the study and after seven physiotherapy treatments.

The sociodemographic characteristics of the participants, including age, gender, and occupation, were collected at the beginning of the study using a self-designed questionnaire, consisting of 10 questions.

Pain intensity was assessed with a visual analog pain scale (VAS). The VAS consists of a straight line with equal intervals of 1 cm, from 0 "no pain" to 10 ("worst imaginable pain") (15). The assessment and evidence of pain were performed by the participants themselves. In the interpretation of pain intensity, the quantitative result is divided into categories: mild pain (VAS values of 1 - 3), moderate (VAS values of 4 - 7) and severe pain (VAS values of 8 - 10). The validity and reliability of this scale have

been well established and it has often been applied in scientific studies.

Shoulder range of motion was measured with a simple goniometer, assessing upper arm abduction and shoulder external rotation movements. Range of motion measurement criteria included flexion to 90°, extension to 50°, abduction to 90°, abduction to 90°, and lateral and medial rotation ranging from 0 to 90 degrees. Radiological diagnostics were used to assess the size of calcifications in the shoulder.

Intervention

The intervention consisted of paraffin wraps, ultrasound therapy (US), Emmet therapy, and Bowen therapy. Paraffin wraps were applied at the beginning of each treatment for 15 minutes. US therapy with a probe was applied to the shoulder area, with a power of 1.2 w per cm2, lasting 10 minutes during each treatment. Emmet therapy and Bowen therapy were conducted according to their principles. There were a total of 10 sessions, two sessions per week lasting 60 minutes.

Statistical analysis

Statistical data analysis included descriptive and inferential statistics. Categorized data are presented with absolute and relative frequencies, and significance was analyzed with the Chi-square test. The normality of the distribution of quantitative data (pain intensity) was tested with the Shapiro-Wilk test. Quantitative data are presented as mean value and standard deviation. The effect of the intervention on pain intensity was analyzed by Student's paired t-test. Results on ordinal scales (size of calcifications and shoulder range of motion) were evaluated by the Wilcoxon rank sum test for dependent variables. The level of significance in all tests was $p<0.05$. Statistical data processing was performed using the IBM SPSS 23 program (Armonk, NY: IBM Corp.), and Microsoft Excel 2010 was used in the interpretation of results.

RESULTS

The total sample in this study consisted of 30 participants. There were more females than males (56.7% vs 43.3%), without statistically significant difference (p=0.465). The highest number of participants was between the ages of 41 and 50 (46.7%), while the smallest number

of participants was between the ages of 20 and 30. In the age group from 20 to 40 years, there were more males, while females were more in the groups from 51 to 60 age and ≥61 age. In groups from 41 and 50 age, an equal number of participants was found, depending on sex (Table 1).

As for occupation, most of the participants were office workers (60%), 20% were health professionals, 16.7% were retired, and one was a hairdresser (3.3%). In the comparison of the representation of participants depending on their profession, a statistically significant difference was found (p>0.001).

Table 1. - *Sociodemographic characteristics in the total sample* (N=30)

Variable	N	%	χ2	df	p
Sex					
Male	13	43.3	0.533	1	0.465
Female	17	56.7			
Age group (Years)					
20-30	2	6.7	14.677	4	0.005
31-40	4	13.3			
41-50	14	46.7			
51-60	6	20			
61 i više	4	13.3			
Occupation					
Office worker	18	60	21.467	3	<0.001
Health professional	6	20			
Hairdresser	1	3.3			
Retired	5	16.7			

N – absolute frequency

% - relative frequency

χ2 – Chi-square test

df – degree of freedom

p – statistical significance (p<0.05)

The results of the analysis of pain intensity before and after the intervention are shown in Table 2. The presence of pain before the start of the study was in the range of one to three months. In a third of the participants (33%, n=10) the pain was present within

one month before the start of the study, in 43% (n=13) the pain in the shoulder was present from one to three months, and in 23% (n= 7) the participant's presence of pain lasted for six months. The presence of pain in the first month was reported only by male participants, while the presence of pain lasting three to six months was reported only by female participants.

The average rating of pain intensity at the beginning of the intervention was 8.20 (SD 1.45), while after the intervention it was 2.40 (SD 1.79). A statistically significant difference was found in the average values of pain intensity before and after the intervention ($p<0.001$). A significant reduction in pain was evident in both male and female participants ($p<0.001$).

Table 2. - *Average values and analysis of the significance of pain intensity (VAS) before and after the intervention in the total sample and depending on sex*

	Pain intensity (VAS)		Analysis of the significance*		
	Before intervention	After intervention	t	df	p
Total sample	8.20±1.45	2.40±1.79	26.15	29	<0.001
Sex					
Male	9.15±1.46	4.15±0.80	12.75	12	<0.001
Female	7.45±0.94	1.10±1	52.11	16	<0.001

* ***Student Paired t-test***

At the beginning of the intervention, 26.7% (n=8) of the participants had a calcification measuring five millimeters, 43.3% (n=13) had a calcification measuring six to ten millimeters, while 30% (N=9) had calcification of size ≥11 millimeters.

After the intervention, the size of the calcifications remained unchanged in 43.3% of the participants, while a decrease in the size of the calcifications to five millimeters was evident in 27% of the participants. Also, in 27% of the participants, a decrease in the size of the calcifications to less than 11 mm was evidenced (*Figure 1*). Analysis of the size categories of calcifications before and after the intervention revealed a statistically significant difference ($z=-4.00$; $p<0.001$).

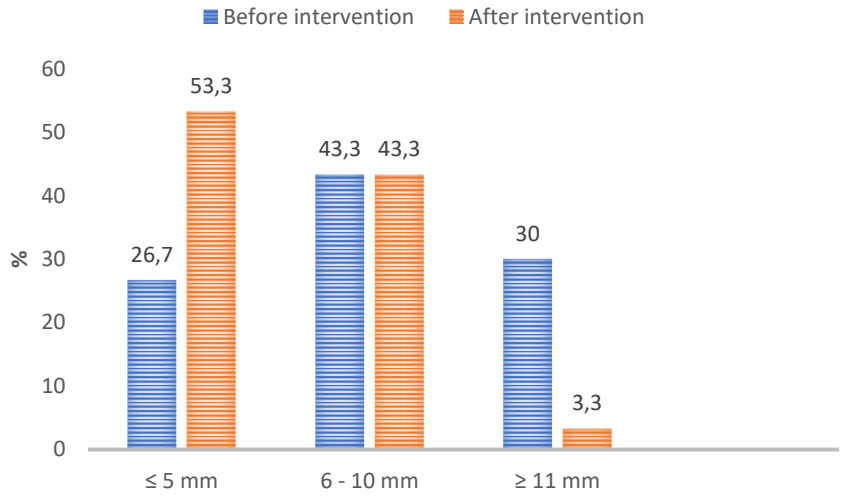

Figure 1. - *Calcification size (mm) before and after the intervention*

Before the start of the intervention, a limited range of shoulder abduction movement was evident in all participants, ranging from 30 to 60 degrees. After the intervention, a full range of motion (180 degrees) was achieved in 63.3% of participants, while in 36.7% of participants, the range of abduction ranged from 65 to 175 degrees (*Figure 2*).

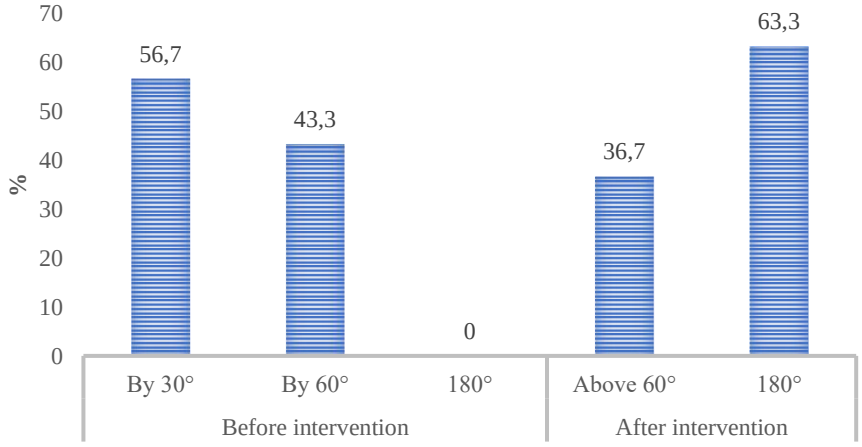

Figure 2. - *The range of abduction in the shoulder measured with a simple goniometer before and after the intervention*

The statistically significant difference in the range of motion before and after the intervention was confirmed ($z=-2.45$; $p<0.001$). Similar results were observed for the shoulder external rotation range of motion. Before the intervention, 36.7% of the subjects (n=11) could not perform the shoulder external rotation movement,

while the same number of subjects performed the movement up to 60 degrees. Also, 63.3% of the subjects (n=19) before the intervention had minimal external rotation movement up to 30 degrees, while the same number of subjects after the intervention achieved the full range of motion in the shoulder (90 degrees).

DISCUSSION

The results of this study indicate the beneficial effect of physiotherapy treatment, which consisted of the application of paraffin wraps, US and two manual therapies, Emmet and Bowen, in the treatment of calcifying tendinitis of the shoulder. The combination of these physiotherapy methods had an effect in reducing the size of the calcifications, the intensity of pain and increasing the range of abduction and extension movements in the shoulder.

Regardless of the unknown etiology of calcifications in the shoulder, it is well established that the absorption of calcifications occurs naturally (16). Moreover, a randomized controlled trial published in 2018 with a 10-year follow-up of the effect of physiotherapy interventions reports that symptomatic calcific tendinitis has a good likelihood of completely resolving naturally in the long term. However, the use of physiotherapy interventions, such as ultrasound, can accelerate the process of reducing calcific tendinitis. However, effective treatment of calcium deposits does not imply recovery from symptoms and improvement of function in calcified tendinitis (17).

The use of the US has been a well-established conservative treatment method for calcifying tendinitis of the shoulder for decades. Ultrasound has emerged as a non-invasive method that uses high-frequency sound waves to stimulate blood circulation, break down calcifications and reduce inflammation. Several authors have reported the beneficial short-term effect of the US for people with calcifin tendinitis (18, 19). On the other side, above mentioned the ten-year follow-up study reports on the short-term and long-term beneficial effects of using ultrasound in the treatment of calcifying tendinitis (17).

Systematic reviews published in 2010 and 2016, which report on the effect of the US in calcifying tendinitis of the shoulder, support these statements, with the note that all previous evidence was based on poor quality and heterogeneous studies (https://doi.org/10.2522/ptj.20080272). In conclusion, the authors state that future studies are needed with better methodology and more clearly described applied

parameters of the ultrasound (18, 20). In our study, a reduction of calcifications was found in more than half of the participants (57%), which confirms the above-mentioned records of the beneficial effect of the US in the treatment of calcifying tendinitis of the shoulder.

According to Chou et al (2007), the treatment of calcified tendinitis is possible with conservative methods, without striving for perfect decalcification, but with the necessary clinical confirmation of perfect absorption of calcareous materials during continuous treatment, regardless of the treatment method (21). Outcomes such as pain, function, and patient satisfaction provide evidence supporting conservative therapeutic interventions in the management of acute calcifying tendinopathies. For the treatment of calcified tendinopathy to be and/or be considered successful, attention should be paid to the outcomes and understanding of pathophysiology, prognostic factors, and physiotherapy interventions based on current calcium deposits and the patient's status in the healing continuum (17). Exercise therapy and manual therapy are two physiotherapy interventions that are commonly used in the treatment of calcifying tendinitis of the shoulder, not alone, but in combination with ultrasound or other non-invasive techniques (16).

In our study, two manual therapies were applied in addition to ultrasound, widely used in practice, but whose application has been poorly researched and thus confirmed in science. Recently published papers report the effectiveness of Bowen therapy in reducing pain and increasing mobility in myofascial syndromes and chronic pain (22-24). A pilot study published in 2001 also reported the beneficial effect of Bowen therapy in reducing pain, and increasing functionality and activities of daily living in individuals with frozen shoulders (25). The results of our study also established the possible benefit of Bowen therapy in the form of pain reduction and increased shoulder abduction and external rotation movements.

We have not found valid evidence about the effectiveness of Emmet therapy, so we cannot discuss it. Nevertheless, the fact that Emmet therapy was an integral part of our intervention, and its effectiveness was established, indicates that this method of manual therapy requires additional future scientific studies.

The limitation of this study is certainly that we did not have a control group, so we cannot compare the results more clearly or single out the superiority of some of the

applied interventions. So, future studies are necessary.

CONCLUSION

In the conclusion of this study, we highlight the extremely promising effectiveness of ultrasound and manual therapy in reducing calcifications in the shoulder. The application of these therapeutic methods has a positive effect on the resorption of calcifications, pain relief and functional improvement of the shoulder. Future studies will be crucial to confirm the sustainability and long-term effects of these therapeutic approaches in clinical practice.

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UČINKOVITOST MANUALNE TERAPIJE I ULTRAZVUKA KOD SMANJENJA KALCIFIKATA U RAMENU

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SAŽETAK

Uvod: Kalcifikat u ramenu, poznat i kao kalcificirajuća tendinopatija, česti je uzrok boli u ramenu i najčešće se javlja između 30. i 50. godine života te je približno dvostruko češća kod žena nego kod muškaraca. Patogeneza bolesti nije poznata i bolest ima cikličku prirodu.

Cilj: Istražiti i procijeniti utjecaj ultrazvuka i manualne terapije na smanjenje kalcifikata u ramenu.

Materijali i metode: U ovo istraživanje provedeno u Rehabilitacijskom centru "Život" u Mostaru tijekom svibnja do srpnja 2023. godine., sudjelovalo je 30 ispitanika. Statistička analiza, korištenjem Microsoft Excela 2010 i IBM SPSS-a 23.0, obuhvatila je deskriptivnu i inferencijalnu statistiku, otkrivajući značajne uvide u perspektive ispitanika i formirajući temelj za sveobuhvatnu raspravu.

Rezultati: Rezultati istraživanja su pokazali statistički značajno smanjenje intenziteta boli nakon terapije, kako kod muškaraca tako i kod žena. Također, veličina kalcifikata znatno se smanjila, a opseg pokreta u ramenu poboljšao. Analiza demografskih čimbenika otkrila je razlike između ženskih i muških sudionika te je istaknuto brzo traženje terapije nakon pojave boli.

Zaključak: Obećavajuća je učinkovitost kombinacije ultrazvuka i manualne terapije u liječenju kalcifikata u ramenu, postavljajući temelje za daljnja istraživanja i prilagođenu kliničku praksu.

Ključne riječi: kalcifikat u ramenu, manualna terapija, UZV terapija.

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