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Original article

COMPARISON OF IMMEDIATE EFFECTS OF EXTRACORPOREAL SHOCKWAVE THERAPY AND CONVENTIONAL PHYSICAL THERAPY IN PATIENTS WITH CALCIFIC TENDINITIS OF THE SHOULDER ROTATOR CUFF

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Abstract

Calcific tendinitis of the shoulder is a frequent disorder with an unknown etiology. It is usually treated with different physical therapy modalities where extracorporeal shockwave therapy comes as a new effective method.

The aim of the study was to compare extracorporeal shockwave therapy and conventional physical therapy in the treatment of calcific tendinitis of the rotator cuff of the shoulder.

The study is a prospective, monocentric clinical trial involving 40 patients with calcific tendinitis of the rotator cuff of the shoulder who were divided into two groups: group 1 (study group), 20 patients receiving extracorporeal shockwave therapy and performing shoulder exercises, and group 2 (control group), 20 patients who received conventional physical therapy with therapeutic ultrasound and diadynamic currents and performed shoulder exercises. Patients were evaluated with a Numerical Pain Scale and the range of motion in the shoulder joint was assessed. Clinical findings were evaluated before starting treatment and at the end of the treatment.

All patients after the treatment showed statistically significantly better results in the Numerical Pain Scale and the shoulder range of motion.

Extracorporeal shockwave therapy is a safe and non-invasive treatment that reduces pain and improves range of motion in the treatment of calcific tendinitis of the rotator cuff.

Keywords: calcific tendinitis, shoulder, extracorporeal shockwave therapy

Introduction

Calcific tendinitis of the rotator cuff (CTRC) of the shoulder is a common disorder of unknown etiology. It is characterized by multifocal accumulation of basic calcium phosphate crystals within the tendons of the rotator cuff and the occurrence of acute and chronic pain that leads to limitation of range of motion and function of the shoulder joint. The reported incidence of rotator cuff tendon calcifications varies from 2.7% to 20% of asymptomatic

cases of CTRC of the shoulder[1] and 51% to 90% of calcifications are located within 1-2 cm from the insertion of the tendon of *musculus supraspinatus*.

Regarding the origin of CTRC of the shoulder, there are still controversial opinions. Several hypotheses have been proposed for the pathological process in CTRC: degenerative, repetitive trauma hypothesis, tonocyte necrosis, reactive and endochondral ossification, but none of these explanations have proven to be completely satisfactory. In the etiology of calcific tendinitis of the rotator cuff, it is considered that there is circumscript hypoxia of the tissues and localized pressure, which are the most common causative factors. Two fundamentally different processes have been proposed that lead to the formation of calcium deposits in the rotator cuff: degenerative calcification and reactive calcification[2]. The pathogenetic mechanism of CTRC is still unclear. It is thought to be associated with a cell-mediated disease in which metaplastic transformation in chondrocytes causes calcification within the rotator cuff tendon[3].The pathogenesis of CTRC can be divided into three stages, as reported by Uhthoff *et al*.,[4]: a precalcifying phase, with the transformation of the tendon into a fibrocartilaginous tissue that acts as a substrate for calcium deposition; a calcifying phase, with actual calcium deposition, consisting of the formative and resorptive phases; and a postcalcifying phase, with remodeling of the tendon tissue by fibroblasts around the calcium deposit, which can last several months.

CTRC is usually presented with a finding of constant pain in the shoulder, functional disability and the presence of calcifications of the symptomatic muscles of the rotator cuff.

The diagnosis is made using several methods. Conventional radiography can detect the presence of calcifications in the soft tissues around the humerus and in the subacromial space. Diagnostic ultrasound is a well-accepted modality for assessing soft tissue structures. Magnetic resonance imaging (MRI) is a well-established technique for imaging the musculoskeletal system and allows better evaluation of all coexisting pathology.

Treatment of calcific tendinitis of the shoulder rotator cuff can be conservative and surgical. Various modalities are used to treat this disorder, and most patients do well with conservative treatment alone. Conservative treatment of CTRC usually includes initial "rest" and cryotherapy, oral administration of NSAIDs, massage to prepare shoulder muscle groups for exercise, scapular mobilization, application of exercises starting with stretching exercises, continuing with exercises to improve the range of motion in the shoulder joint, and then resistance exercises to increase muscle strength, work functional therapy, kinesitaping, electrotherapy, application of therapeutic ultrasound, laser therapy, ESWT (extracorporeal shockwave therapy), as well as application of corticosteroid injections and PRP.

The primary objective of the study was to compare the immediate outcomes of the ESWT and conventional physical therapy in the treatment of calcific tendinitis of the shoulder rotator cuff. Secondary objectives were to assess the immediate outcomes of the analgesic effect, functionality, and efficacy of treatment with ESWT and conventional physical treatment with therapeutic ultrasound and diadynamic currents in patients with CTRC.

Material and method

This was a prospective, monocentric, controlled clinical study that included 40 patients with calcific tendinitis of the shoulder rotator cuff who were rehabilitated in an outpatient settings in the University Clinic for Physical Medicine and Rehabilitation in Skopje. Patients were of both genders, different place of residence, nationality and socio-economic status. They were randomly assigned into two groups: group 1 (experimental study group - EG), 20 patients who received ESWT and performed shoulder exercises, and group 2 (control group - CG), 20 patients who received conventional physical treatment with therapeutic ultrasound (US) and diadynamic currents (DD) and performed shoulder exercises.

All patients who were included in the study were informed about the goals of the research and its course, about the method of implementing the therapy and had the opportunity to ask questions about any ambiguities. Patients who accepted to participate in the clinical study signed an informed consent form.

Patients were evaluated with a Numerical Pain Scale and the range of motion in the shoulder joint was assessed. Clinical findings were evaluated at the same time points for all patients, before treatment initiation and after treatment.

The Numerical Pain Scale (NPS) was used to assess the intensity level of shoulder pain. It consists of a straight line with endpoints defining extreme limits, such as ”no pain at all" and ”severe unbearable pain". The patient is asked to rate the intensity of shoulder pain from 0 to 10, where a score of 0 means no pain, a score of 1 to 3 means mild pain, a score of 4 to 6 means moderate pain, and a score of 7 up to 10 means severe unbearable pain. [5] Assessment of range of motion (ROM) at the shoulder joint is a very frequently used tool to assess the condition of this joint and the therapeutic effect. The measurement was carried out using a universal goniometer.

Inclusion criteria for the selection of candidates for this study were radiographically confirmed calcific tendinitis of the rotator cuff of the shoulder followed by shoulder pain that persisted for longer than 3 months and did not decrease with the application of other conservative treatment and age from 21 to 75 years. Exclusion criteria were inflammatory rheumatic disease, algodystrophic syndrome, pregnancy, infectious or malignant disease, partial or complete rupture of the musculature of the shoulder rotator cuff, skeletal osteoporosis proven by densitometry, skin ulceration, and neurological impairment.

Application of radial ESWT was performed with the Impactis M shockwave therapy unit (ASTAR Limited Liability Company, Poland). This device uses the pneumatic principle of generating shockwaves. A total of 5 (five) treatments were applied, once a week, locally in the area of the shoulder joint, according to the manufacturer's recommendations with continuous frequency, pressure 3.0 Bar, frequency 10 Hz, number of shocks - 2000, duration of treatment – 7 minutes. Patients from the control group received ultrasound therapy with an intensity of 0.5 W on an area of 1 cm^2 and diadynamic currents with therapy unit model PhysioGo 300A (ASTAR, Poland). Ultrasound therapy was applied in the area of the shoulder joint and lasted for 5 minutes. Diadynamic current therapy was applied with two electrodes in the area of the shoulder joint in a duration of 7 minutes.

During treatment, both groups of patients performed exercises to strengthen the muscles of the shoulder joint and exercises to improve the range of motion in the shoulder joint. The exercises were performed under the supervision and guidance of a physiotherapist.

Statistical analyses were performed to compare the difference between the results obtained on admission and after completion of treatment with ESWT and conventional physical treatment. The obtained data were analyzed with the statistical computer program SPSS 23.0 for Windows. Numerical features were presented with arithmetic mean, standard deviation, median, and interquartile range. Attributive features were displayed by frequency distribution. To compare the analyzed variables before and after the treatment Chi-square test, Student t-test for independent samples and Mann Whitney test were used. Values of $p<0.05$ were considered statistically significant.

Results

Patients from both groups were homogeneous in terms of sociodemographic characteristics, gender and age. They did not differ significantly in terms of gender structure and age ($p=0.52$, $p=0.3$, respectively). Female patients were more often represented in EG – 60% (12 patients), male and female patients were equally represented in both groups. The mean age of EG patients was 53.3±11.6 years, and 56.5±11.6 years of CG patients.

Patients receiving ESWT and performing shoulder exercises had a significantly higher body mass index (BMI) than patients receiving conventional physical therapy (28.85±3.6 *vs*. 25.95±2.2, p=0.004). Both techniques were more often applied to the right shoulder – 80% (16 patients) of EG and 65% (13 patients) of CG.

Table 2 and Figure 1 show the results of the comparison of the two groups in terms of pain intensity before and after completion of the treatment. Before the start of the treatment, 95% (19 patients) of EG and all 20 patients of CG had severe pain, i.e. it was quantified by grade 7, 8, 9 or 10. After the end of the treatment, EG patients more often had mild pain (grade 1, 2 and 3) - 80% (16 patients) *versus* 55% (11 patients), while CG patients more often had moderate pain - 45% (9 patients) *versus* 15% (3 patients).

Table 1. Sociodemographic characteristics, BMI and treated shoulder in EG and CG

Variable	Groups			p-level
	n	EG	CG	
Gender				
female n (%)	22	12 (60)	10 (50)	X^2=0.404
male n (%)	18	8 (40)	10 (50)	p=0.52 ns
Age				
mean ± SD	20	53.3 ± 11.6	56.5 ± 11.6	t=0.87
min - max	20	36 – 71	40 – 71	p=0.39 ns
BMI (kg/m^2)				
mean ± SD	20	28.85 ± 3.6	25.95 ± 2.2	t=3.04
min - max	20	20.6 – 35.9	21.5 – 29.4	**p=0.004 sig
Treated shoulder				
right n (%)	29	16 (80)	13 (65)	X^2=1.13
left n (%)	11	4 (20)	7 (35)	p=0.29 ns

experimental group (EG) = ESWT; X^2 (Chi-square test); t (Student t-test); control group (CG) = US+DD

The mean score for the pain scale before the start of treatment was 7.9±1.3 in EG, 8.25±0.9 in CG, and there was no statistically significant difference (p=0.34). After the end of treatment, the mean pain score was significantly higher in CG (3.5±0.8 *vs*. 2.7±1.4; p=0.029). This statistical result shows that at the end of the treatment both groups had a decrease in the mean pain score, but patients treated with ESWT showed a significant increase in the mean pain score compared to patients treated with conventional physical therapy.

Table 2. Mean score for pain before and after the end of treatment in EG and CG

NPS	n	Groups EG n (%)	CG n (%)
4 – 6	1	1 (5)	0
7 – 10	39	19 (95)	20 (100)
mean ± SD		7.90 ± 1.3	8.25 ± 0.9
p-level		t=0.97 p=0.34 ns	
1 – 3	27	16 (80)	11 (55)
4 – 6	12	3 (15)	9 (45)
7	1	1 (5)	0
mean ± SD		2.70 ± 1.4	3.50 ± 0.8
p-level		t=0.2.27 *p=0.029sig	

experimental group = ESWT; t(Student t-test); *p<0.05; control group = US+DD

Table 3 shows the results of the comparison of the two groups in relation to the results of the measurements of the range of motion in the shoulder joint, before and after the end of the treatment.

For p=0.01 and p=0.00011, respectively, before and after the end of the treatment, a statistically significant difference in the extent of elevation was confirmed between patients of the two groups. Before and after completion of treatment, patients treated with ESWT had significantly greater elevation volume values compared to patients treated with conventional physical therapy. The mean elevation values were 117.0±31.0 and 90.25±25.98, respectively, in the experimental and control groups before treatment; after the treatment the average values were 162.25±15.3 and 142.50±16.6, respectively in the EG and CG.

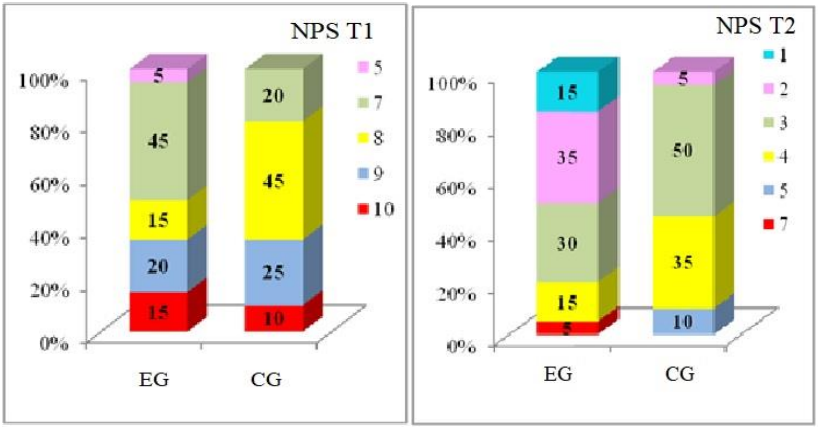

Fig. 1. Graphic representation of the distribution of the Numerical Pain Scale in both groups before and after completion of treatment experimental group = ESWT control group = US+DD

Retroflexion presented significantly higher values in EG before and after completion of treatment (p=0.036 and p=0.00032, respectively). The mean values for retroflexion were 28.25±10.04 in EG, 21.75±7.5 in CG before treatment, 42.75±7.5 in EG and 32.75±7.5 in CG, after treatment.

Table 3. Range of motion in the shoulder joint, before and after the end of the treatment

Variable	Groups		Groups	
	EG	**CG**	**EG**	**CG**
	elevation T1		**elevation T2**	
mean ± SD	117.0 ± 31.0	90.25 ± 25.98	162.25 ± 15.3	142.50 ± 16.6
min - max	70 – 160	50 – 150	110 – 180	110 – 170
median (IQR)	120 (90 – 150)	90 (70 – 105)	162 (160 – 170)	147 (130 – 152)
p-level	Z=2.57 *p=0.01 sig		Z=3.87 **p=0.00011 sig	
	retroflexion T1		**retroflexion T2**	
mean ± SD	28.25 ± 10.04	21.75 ± 7.5	42.75 ± 7.5	32.75 ± 7.5
min - max	10 – 45	10 – 35	25 – 50	20 – 45
median (IQR)	30 (22.5 – 32.5)	20 (1705 – 30)	45 (40 – 50)	32.5 (30 – 40)
p-level	Z=2.09 *p=0.036 sig		Z=3.59 **p=0.00032 sig	
	abduction T1		**abduction T2**	
mean ± SD	57.75 ± 18.4	55.75 ± 10.8	84.0 ± 6.4	76.75 ± 6.5
min - max	20 – 90	40 – 70	70 – 90	60 – 85
median (IQR)	60 (42.5 – 70)	60 (45 – 62.5)	85 (80 – 90)	80 (75 – 80)
p-level	Z=0.72 p=0.47ns		Z=3.07 **p=0.0021sig	
	adduction T1		**adduction T2**	
mean ± SD	19.50 ± 4.6	17.50 ± 3.0	28.0 ± 3.8	26.0 ± 4.2
min - max	10 – 30	10 – 20	20 – 30	20 – 30
median (IQR)	20 (20 – 20)	20 (15 – 20)	30 (27.5 – 30)	25 (22.5 – 30)
p-level	Z=1.59 p=0.11 ns		Z=1.5 p=0.0.13 ns	
	internal rotation T1		**internal rotation T2**	
mean ± SD	42.25 ± 12.4	39.50 ± 11.7	74.25 ± 9.5	65.25 ± 11.1
min - max	20 – 65	20 – 65	50 – 85	45 – 85

median (IQR)	42.5 (35 – 47.5)	40 (30 – 47.5)	77.5 (70 – 80)	67.5 (57.5 – 70)
p-level	Z=0.92 p=0.36 ns		Z=2.58 **p=0.0098 sig	
	external rotation T1		**external rotation T2**	
mean ± SD	46.25 ± 16.5	49.25 ± 13.8	81.0 ± 6.8	74.0 ± 5.8
min - max	20 – 75	30 – 75	65 – 90	65 – 85
median (IQR)	45 (32.5 – 57.5)	50 (40 – 60)	80 (80 – 87.5)	72.5 (70 – 80)
p-level	Z=0.59 p=0.55 ns		Z=2.95 **p=0.0032 sig	

experimental group = ESWT; Z(Mann-Whitney test); control group = US+DD; *p<0.05, **p<0.01

The two groups did not differ significantly in the extent of abduction before treatment (p=0.47), and significantly differed after the end of treatment, as a result of a significantly greater extent of this movement in patients treated with ESWT (p=0.0021). The average shoulder abduction after the intervention was 84.0±6.4 in EG, and 76.75±6.5 in CG.

No statistically significant difference was found in the extent of adduction between the two groups before the treatment (p=0.11) and after the end of the treatment (p=0.13).

Shoulder rotation, internal and external, did not have significantly different values between the two groups before treatment (p=0.36 and p=0.55, respectively for internal and external rotation). Both movements had significantly greater volume after the treatment in EG patients (p=0.0098 and p=0.0032, for internal and external rotation, respectively). The average values of internal rotation were 74.25±9.5 in EG, and 65.25±11.1 in CG; mean values of external rotation were 81.0±6.8 in EG, 74.0±5.8 in CG.

According to these results, the type of treatment had a significant influence on all movements in the shoulder joint, with the exception of adduction. Elevation, abduction, retroflexion, internal and external rotation had significantly greater values when using ESWT compared to conventional physical treatment with therapeutic ultrasound and diadynamic currents.

Discussion

Calcific tendonitis of the rotator cuff is a common disabling condition, often chronic and recurrent. It is a leading cause of shoulder pain with a prevalence of 5-39% in the general population[6].

There is a consensus in the literature that the primary treatment of calcific tendinitis of the shoulder rotator cuff should be conservative management. The literature recommends a minimum of 6 months of nonoperative conservative treatment before considering the option of surgical treatment[7].

ESWT is an effective treatment modality that reduces pain and increases function, especially in chronic shoulder tendon injuries[8].

In this study, the mean age of patients was 53.3±11.6 years in EG, and 56.5±11.6 years in CG. In the literature, CTRC is most common in people between the ages of 30 and 60[9]. Regarding the gender structure, in the study the patients from both groups were homogeneous (p=0.52). Female patients were more often represented in EG – 60% (12 patients), male and female patients were equally represented in both groups. According to the available literature, women are more commonly affected than men, with studies revealing that 70% of calcific tendinitis occurs in female patients, and the age distribution with the highest incidence is between 31 and 50 years of age. There are some reports of ethnic variations with increasing mean age in Asians[10].

In this study, patients receiving ESWT and performing shoulder exercises had a significantly higher body mass index than patients receiving conventional physical therapy (28.85±3.6 *vs.* 25.95±2.2, p=0.004). The findings in a study by Wendelbo *et al.,* demonstrated that increasing BMI is a risk factor for rotator cuff tendinitis and similar conditions[11]. In view of all this, it is considered that external factors such as age and BMI have been associated with shoulder pain in CTRC. The increase in pain with age is thought to be closely related to the

partial tear of the rotator cuff muscle fibers, but also, abnormal BMI has been indicated as a risk factor for the development of rotator cuff tear or the development of tendinopathy[12].

In this study, both techniques were more often applied to the right shoulder – 80% (16 patients) of EG and 65% (13 patients) of CG. There is not enough data in the literature about the incidence of this shoulder condition, but a study by Kim Min-Su *et al*., revealed that CTRC occurred more often in the right shoulder than in the left and affected both shoulders in 10% of patients[13].

Various medical treatments, injections, physical modalities and surgical methods are used in the treatment of rotator cuff[14].

In this study ESWT was applied as a newer conservative method, combined with exercises in the EG, and conventional physical treatment with therapeutic ultrasound and diadynamic currents, combined with exercises in the CG.

Conservative treatments are quite effective in improving the symptoms of CTRC in most cases, which was also reported by Cho *et al*., and presented excellent to good results in 72% of their patients[15]. In another study, Rebuzzi *et al*., compared the results of treatment with arthroscopic surgery with low energy ESWT in homogeneous supraspinatus calcification. The rate of complete disappearance of calcification associated with arthroscopic surgery was 86.35% compared to ESWT group with 58.33% at two years, but with no significant difference in clinical and functional assessment according to the UCLA scale. This leads the authors to the conclusion that they prefer the application of ESWT as the first option for therapeutic selection as a non-invasive method[16].

The primary advantage of ESWT is its noninvasive nature and minimal complications when applied to the musculoskeletal system. Experimental *in vitro* studies of tendon tissues have shown local neoangiogenesis associated with an increase in antiinflammatory cytokines and growth factors after shockwave administration, followed by cell proliferation and increased metabolism[17,18].

Conservative treatment for calcific tendinitis of the shoulder rotator cuff has been shown to provide significant improvement regardless of the location, type, size, and initial symptoms of the calcified deposits. Chu *et al*.,[19] reported that of 241 shoulders with symptomatic calcific tendinitis of the rotator cuff treated with ESWT, complete resorption and incomplete resorption of calcifications were observed in 134 and 107 shoulders, respectively. Complete relief from symptoms occurred in 81% of shoulders with complete resorption and 23.4% in those with incomplete resorption.

Therapeutic ultrasound and diadynamic currents combined with exercises were used in CG as conventional physical treatment in this study. The mechanism of action of ultrasound is complex, that is, it has mechanical, thermal, neuroreflex and physico-chemical effects. According to the Cochrane database, therapeutic ultrasound is based on low-quality evidence. In a small study of patients with noncalcified rotator cuff disease, pulsed therapeutic ultrasound was no more effective than placebo in terms of pain reduction, shoulder abduction, or overall treatment success after 4 weeks. Based on low-quality evidence from another small study in patients with calcific tendinitis, pulsed therapeutic ultrasound was more effective than placebo in terms of pain, functionality, and overall treatment success and quality of life after six weeks[20]. In a study by Calis *et al*., a comparison of the effectiveness of therapeutic ultrasound, low-energy laser therapy and kinesitherapy was made. According to this study, there was a statistically significant improvement in each of the three groups, in pain, range of motion and functional improvement of the shoulder ($p<0.05$), but the intergroup comparison did not reveal a statistically significant difference in the parameters that indicated improvement ($p>0.05$). The results of this study showed that ultrasound, laser and kinesitherapy treatment were not superior to each other[21]. DD are unidirectional low-frequency impulse currents with a semi-sinusoidal shape, and are used to achieve an analgesic effect that takes place at

the level of gate control by blocking painful signals and releasing endogenous opioids[22]. A 2019 randomized study by Demidas and Zarzycki evaluated the efficacy of DD and transcutaneous electrical nerve stimulation (TENS) in increasing tactile sensation and analgesic effect using these two electrotherapy modalities. The conclusion is that the application of TENS and DD causes similar analgesic effects. DD are applied with a shorter duration of treatment, and at the same time the analgesic effect is longer lasting in the third week of the trial, which suggests a greater contribution of DD to the analgesic effect compared to TENS. The authors conclude that DD may be a realistic alternative to TENS in clinical practice for pain management[23].

In this study, the mean shoulder pain scale score before and after completion of treatment in EG and CG was compared. The results showed that at the end of the treatment, both groups had a decrease in the mean pain score, but patients treated with ESWT had a significant decrease in the mean pain score compared to patients treated with conventional physical therapy.

There are studies showing that ESWT is effective in reducing pain in patients with CTRC of the shoulder involving pulses as high as 0.28-0.45 mJ/mm2[24]. In a study by Malliaropoulos *et al*., evaluating an individualized radial ESWT protocol for the treatment of symptomatic CTRC of the shoulder, the authors reported a 92% success rate at 12-month follow-up, a 52% reduction in mean visual analog pain scale (VAS) immediately after treatment, 62 % after one month and 75% after three months. This improvement in symptoms was sustained at one year with an 88% mean reduction in VAS from baseline at 12 months, and only a 7% relapse rate (mean pre-treatment VAS of 4.7 decreased to mean post-treatment VAS treatment of 2.4 during the six-month follow-up)[25].

In this study, the results of all analyzed movements in the shoulder were compared in both EG and CG, before and after the completed treatment. According to these results, the type of treatment had a significant influence on all movements in the shoulder joint, with the exception of adduction. Elevation, abduction, retroflexion, internal and external rotation had significantly greater values when using ESWT compared to conventional physical treatment. As shoulder pain decreased, shoulder range of motion increased in both groups of patients, so EG patients who had a lower mean pain score also had significantly greater shoulder range of motion. At the same time, both groups of patients performed the same type of exercises to improve the range of motion and trophic of the musculature of the shoulder joint. With the improvement in shoulder pain, the exercises were performed more easily and this resulted in a greater range of motion in the shoulder joint in both groups.

In a study by Avancini-Dobrović *et al.*, after treatment with ESWT in a group of 30 patients outcome assessment included measurement of range of motion, measurement of active isometric contraction of the shoulder muscles with a manual muscle test, and subjective assessment of pain intensity with a VAS. The results showed that the radial ESWT applied to patients with CTRC of the shoulder resulted in a significant reduction in pain and an increase in the range of motion, and at the same time an increase in muscle strength[26]. In another study, Chen *et al*., came to the conclusion that even in adhesive capsulitis of the shoulder after the application of radial ESWT, the range of motion in the shoulder joint in 40 patients had a statistically significant improvement[27].

In this study, low energy was applied with radial ESWT, although in terms of energy level, the tendency is to consider that higher energy is more effective in the treatment of calcification.

Verstraelen *et al.,* in 2014 published a meta-analysis in Clinical Orthopedics and Related Research and concluded that the use of high energy determined a higher rate of calcification resorption and a better functional response, but the treatment was painful, more expensive and sometimes required hospital treatment.

However, the rapid growth of radial ESWT in recent years positions it as an alternative to focal ESWT for treatment. Cacchio *et al*., reported a high rate of calcification resorption using radial ESWT in a randomized controlled trial. Time will tell if radial shockwaves meet the same standards of efficiency compared to focal shockwaves[28].

In addition, no side effects were observed in patients related to the application of physical modalities in both groups.

This study has several limitations. Patients were evaluated twice, at the beginning of treatment and at the end of treatment. Moreover, treatment success was not evaluated by diagnostic techniques in terms of calcification localization and size, but was evaluated in terms of shoulder pain and range of motion, which affects shoulder joint functionality.

In conclusion, radial ESWT in combination with exercises is a non-invasive, safe and effective method of treatment of CTRM of the shoulder, which allows early reduction of pain and improvement of range of motion in the shoulder.

Conflict of interest statement. None declared.

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