

Pilot Study In Calcified Tendinopathy Of The Shoulder: The Importance Of Targeted Ultrasound-Guided Shock Wave Treatment

Iosif Ilia^{1,2}, Gyongyi Osser¹, Caius Calin Miuta^{1*}, Andrei Bitang¹, Gabriel Roberto Marconi¹

Corina Ramona Dulceanu¹, Viorel Petru Ardelean¹, Brigitte Osser^{1,3}.

¹ “Aurel Vlaicu” University, FPES, Kinesitherapy and Special Motricity department, Arad,

Romania

² Ilimed Kinetica Clinical Center, Rehabilitation department, Timisoara, Romania

³ University of Oradea, Doctoral School of Biomedical Sciences, 410087, Oradea, Romania,

Universității no.1.

Correspondence: caius.miuta@uav.ro

Abstract

Calcific tendinopathy of the shoulder is a degenerative disorder marked by calcium accumulation within the rotator cuff tendons, most commonly involving the supraspinatus tendon. This condition is a frequent source of persistent shoulder pain and reduced function, with reported prevalence among symptomatic individuals ranging from 2.5% to 54% (Uhthoff, Sarkar, & Maynard, 1976). A variety of non-surgical treatments are available, including nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, corticosteroid injections, and, in resistant cases, surgery. Recently, extracorporeal shock wave therapy (ESWT) has gained attention as a promising non-invasive treatment option (Brindisino, Marruganti, Lorusso, Cavaggion, & Ristori, 2024). This randomized, controlled, prospective study aimed to be a pilot study in assessing the therapeutic effectiveness of r-ESWT in managing calcific tendinopathy of the shoulder. Two ESWT techniques were compared: one guided by ultrasound to target calcific deposits directly, and the other based on anatomical landmarks focusing on the supraspinatus tendon origin.

Materials and Methods: The study included twenty-one patients diagnosed with calcific tendinopathy, randomly divided into two treatment groups. Each participant received three ESWT sessions, with 2000 pulses delivered at 2.2 bars pressure, using an energy level of 5 and frequency of 8Hz. Clinical progress was evaluated using the Constant-Murley Shoulder Outcome Score (CMS) at 12 weeks and six months following treatment. Additionally, ultrasound imaging was used to monitor changes in the calcium deposits.

Results: Patients treated with ultrasound-guided ESWT showed better clinical and imaging results than those who received the landmark-based treatment. The ultrasound-guided group experienced greater pain reduction and functional improvement, along with a significantly higher rate of complete resolution of calcific deposits.

Conclusions: These results highlight the critical role of accurate targeting in maximizing the effectiveness of r-ESWT for shoulder calcific tendinopathy (Haake, Deike, Thon, & Schmitt, 2002).

Keywords: calcific tendinopathy, supraspinatus tendon, shockwave therapy, ultrasound guidance, Constant-Murley Score

Introduction

Calcific tendinopathy of the rotator cuff is a prevalent cause of persistent shoulder pain, functional limitation impacting daily activities and overall quality of life. The condition is defined by the deposition of hydroxyapatite crystals within the rotator cuff tendons, with the supraspinatus tendon being the most frequently affected (Loew, Daecke, Kusnierczak, Rahmanzadeh, & Ewerbeck, 1999), frequently linked to chronic degenerative processes and metabolic influences (Uthoff, Sarkar, & Maynard, 1976).

Initial treatment typically involves conservative approaches such as NSAIDs, physical therapy, and subacromial corticosteroid injections, which mainly offer symptom relief without addressing the calcium buildup itself (Mouzopoulos, Stamatakis, Mouzopoulos, & Tzurbakis, 2007). For patients unresponsive to these measures, surgical interventions like arthroscopic calcium removal or needle aspiration may be considered (Loew & Jurgowski, 1993). Nonetheless, extracorporeal shock wave therapy (ESWT) has recently gained recognition as a promising, non-invasive therapeutic option. ESWT is thought to work by stimulating local metabolic activity, encouraging the formation of new blood vessels, and promoting calcium resorption through mechanical fragmentation (Wang, Yang, & Wang, 2003).

Reported radiologic resolution rates of calcium deposits following ESWT range from 47% to 77% (Uthoff, Sarkar, & Maynard, 1976; Rompe, Rumler, Hopf, Nafe, & Heine, 1995). This pilot study was designed to evaluate and compare the outcomes of two ESWT application methods: one utilizing ultrasound to directly target the calcific lesions, and the other employing anatomical landmarks as a guide. The central hypothesis was that ultrasound-guided ESWT would yield superior results in terms of pain reduction, functional recovery, and calcium deposit dissolution.

Materials and Methods

Study Design

A prospective, randomized controlled study was conducted to evaluate the impact of radial extracorporeal shock wave therapy (r-ESWT) on patients diagnosed with calcific tendinopathy of the shoulder.

The study enrolled twenty-one patients with ultrasound-confirmed calcific tendinopathy of the shoulder, with imaging performed no more than two weeks prior to inclusion. Participants were recruited from the Outpatient Physical Rehabilitation Center in Arad, Romania, between June 2023 and March 2024.

The research followed the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use – Good Clinical Practice (ICH-GCP) guidelines and received approval from the Local Ethics Committee. All participants provided written informed consent and were screened for eligibility before randomization.

Inclusion and Exclusion criteria are shown in Table 1:

Table 1.

List of Inclusion and Exclusion criteria

Inclusion criteria:
Adults aged 18 years or older
Confirmed diagnosis of calcific tendinopathy through ultrasound imaging
Preserved shoulder mobility, defined as either full range of motion or a minimum of 90° abduction with unrestricted rotational movement
Ongoing symptoms for a minimum of six months, unresponsive to conservative therapies such as NSAIDs, physiotherapy, or subacromial corticosteroid injections
Exclusion criteria:
Rotator cuff tears.
Glenohumeral arthritis or instability.
Neurological disorders affecting the shoulder.
Pregnancy or contraindications to shock wave therapy.
Previous ESWT or surgical intervention.

Clinical Evaluation

Demographic data, including age and gender, were collected for each participant.

The Constant-Murley Score (CMS) was used to assess shoulder function by evaluating pain, range of motion, strength, and the ability to perform daily activities. Assessments were carried out at the start of the study, at 12 weeks, and again at six months after treatment.

The CMS consists of four components: pain (up to 15 points), activities of daily living (up to 20 points), strength (up to 25 points), and range of motion, which includes forward elevation, external rotation, abduction, and internal rotation of the shoulder (up to 40 points) (Ziegler et al., 2019). Higher scores reflect better shoulder functionality. The CMS is interpreted as follows: (Hirschmann, Wind, et al., 2010).

0-55 points=poor

- 56-70 points=fair
- 71-85 points=good
- 86-100 points= excellent

Ultrasound imaging was used at baseline to determine the size and location of the calcium deposits (Gschwend, Scherer, & Lohr, 1989). Follow-up evaluations were conducted at 12 weeks and six months post-treatment, including both a shoulder ultrasound to reassess the size of the calcific deposits and a functional assessment using the 100-point Constant-Murley Score (CMS), performed by the same evaluator throughout the study.

Randomization and Intervention

The enrolled patients were randomly divided into two study groups using random permuted blocks by an independent observer, not involved in the treatment delivery:

- Group 1: Received ESWT targeted on the calcific deposit under ultrasound guidance.
- Group 2: Received ESWT applied at the supraspinatus tendon origin using simply anatomical landmarks.

Each participant received three r-ESWT treatment sessions spaced one week apart (Uhthoff, Sarkar, & Maynard, 1976), with each session delivering 2000 shock wave impulses at an intensity of 2.2 bars, energy level 5, and a frequency of 8 Hz. Treatments were administered using the Storz (Chattanooga) Intelect RPW Lite shock wave device.

Statistical Analysis

Data analysis was performed using SPSS version 10.0 (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL). An independent samples t-test was used to compare outcomes between the two groups, with statistical significance defined as $p < 0.05$. Before applying for the t-test, the Kolmogorov-Smirnov test was conducted to verify the normality of

the data distribution and confirm variance homogeneity. All experimental results are reported as mean values \pm standard deviations (SD).

Results

From June 2023 to March 2024, a total of 21 patients were enrolled in the study. The gender distribution was balanced across both groups, with a mean age of 54 years (ranging from 41 to 68 years). Of the participants, thirteen were female and eight were male.

All patients had a confirmed diagnosis of calcific tendinopathy of the shoulder and were treated using the Storz (Chattanooga) Intelect RPW Lite shock wave device.

The first group (n = 11) underwent three treatment sessions, each delivering 2000 impulses at 2.2 bars (energy intensity level 5, frequency 8 Hz), with the shock waves precisely targeted to the calcific deposits under ultrasound guidance. The second group (n = 10) received an identical treatment protocol, but the shock waves were applied to the anatomical origin of the supraspinatus tendon.

Patient progression through the study is illustrated in the flow diagram in Figure 1.

Figure 1.

Patient progression through the study

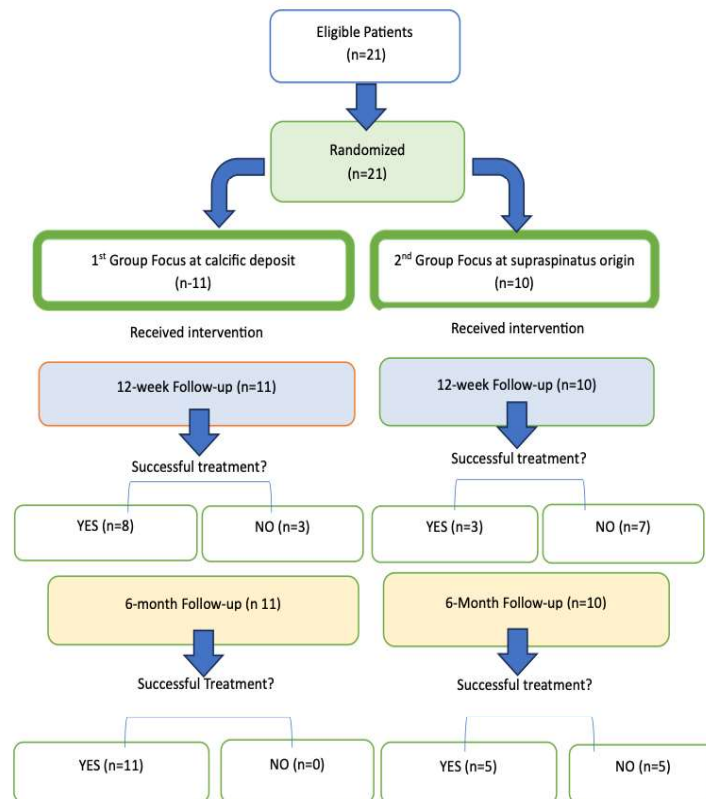


Table 2.

Displays the numerical results of the study as a comparison between the two-study groups.

Group/ Parameter	Focus on Deposits (Calcific Deposit Group)	Focus on Supraspinatus tendon (Landmark- Based Group)	95% Confidence Interval (group difference)	Student's test significant
Constant and Murley score (age corrected)				
Before intervention	46,6±10,5(n=11)	41,7±11,2(n=10)	-3,1 to 7,8	No
12 weeks	92,4±18,7(n=11)	72,6±21,3n=10)	9,6 to 30,3	Yes
6month	95,1±16,3 (n=11)	80,5±20,1 n=10)	10,8 to 27,2	Yes
Number of successful treatments				
12 weeks	8 (n=11)	3(n=10)	n/a	n/a
6month	11(n=11)	5(n=10)	n/a	n/a
Subjective improvement (%)				
12 weeks	72,72±27,1 (n=11)	30±29,4 (n=10)	10,6 to 45,31	Yes
6month	90,9±16,3 (n=11)	50±20,1 (n=10)	12,8 to 29,9	Yes

An increase of function and a reduction of pain occurred in both groups. Statistical analyses showed a significant superiority of extracorporeal shock wave application at the calcified area using ultrasound guidance, based on the Constant-Murley score both at 12 weeks and 6 months compared to Baseline.

Pain and functional improvement were observed in both groups, but the ultrasound-guided ESWT group demonstrated significantly superior results:

Table 3.

Overall CMS at 6-month post Extracorporeal Shockwave Therapy (ESWT)

Group 1 (Focus on Calcific deposit – Targeted Ultrasound-Guided ESWT):
63.6% Excellent (7/11)
27.27% Good (3/11)
8.9% Fair (1/11)
Group 2 (Focus on Supraspinatus tendon origin - Anatomical Landmark-Based ESWT):
50% Good (5/10)
30% Fair (3/10)
20% Poor (2/10)

The overall results based on CMS at 6-month post-treatment in the first group were 63,6% excellent (7/11), 27,27% good (3/11), 8,9% fair (1/11) and those of the second group were 50% good (5/10), 30% fair (3/10) and 20% poor (2/10).

The symptom recurrence rate in the first group was 8,9% (1/11) at 12 weeks and remained unchanged at 6month follow-up.

No significant side effects were seen during the treatment in either of the study groups.

Table 4.

Two-by-Two cross table for complete resorption of the calcific deposit 6 month after Extracorporeal Shock Wave Therapy

Group	Complete Resorption	Partial Resorption	No Resorption	Number
CD group*	4	4	3	11
TM group**	0	4	6	10
Number	4	8	9	21

Note: *CD group - focus of shock waves at calcific deposit; **TM group - focus of shock waves at tuberculum majus

Calcium deposit resorption was significantly greater in Group 1 (13). In this group, complete resorption occurred in 36.4% of patients (4 out of 11), partial resorption in another

36.4% (4 out of 11), and no change was observed in 27.3% (3 out of 11). In contrast, Group 2 showed partial resorption or fragmentation in 40% of cases (4 out of 10), while the remaining 60% (6 out of 10) exhibited no change in deposit size.

Discussions

These findings highlight the value of accurate targeting in the application of extracorporeal shock wave therapy for calcific tendinopathy. Utilizing ultrasound guidance allows for more precise localization of the calcific deposits, which contributes to improved treatment effectiveness and faster relief of symptoms (Xue et al., 2024). Previous studies have similarly shown that focused ESWT not only enhances short-term outcomes but also lowers recurrence rates and supports sustained functional improvement.

Clinical Implications:

- ESWT is safe and effective for calcific tendinopathy treatment.
- Ultrasound guidance ensures optimal results by precisely targeting the calcific deposits.
- The risk of symptom recurrence is lower when ESWT is guided accurately.

This study has several limitations, particularly the lack of a control group and the relatively small sample size. Psychological factors, including both general and pain-related distress such as fear-avoidance beliefs, catastrophizing, low self-efficacy, work-related stress, depression, and anxiety, can significantly influence disability, quality of life, and treatment outcomes in individuals with musculoskeletal conditions. These effects are often more pronounced in female patients.

It is important to identify and consider these psychological aspects, often referred to as "yellow flags," to interpret Patient-Reported Outcome Measures (PROMs) more accurately, prevent the development of chronic pain, and create more effective and individualized treatment plans.

Therefore, the results of this analysis should be considered preliminary. Further studies with larger sample sizes are needed to confirm the statistical patterns and relationships observed in this research.

Conclusions

Extracorporeal shock wave therapy represents an effective, non-invasive option for treating calcific tendinopathy of the shoulder. The findings of this study indicate that targeting the calcific deposits with ESWT under ultrasound guidance leads to greater improvements in pain relief, shoulder function, and calcium deposit resorption compared to treatments guided solely by anatomical landmarks. These results support the routine use of ultrasound guidance to enhance treatment precision and effectiveness.

Clinical Recommendation: When administering ESWT for calcific tendinopathy, targeted ultrasound-guided application should be considered a valuable method to optimize therapeutic outcomes.

Limitations

As this is a pilot study, one of its main limitations is the small number of participants. Future research will aim to include a larger patient cohort to strengthen the findings and validate the statistical trends observed.

References

- Bannuru, R. R., Flavin, N. E., Vaysbrot, E., Harvey, W., & McAlindon, T. (2024). High-energy extracorporeal shock-wave therapy for treating chronic calcific tendinitis of the shoulder: A systematic review. *Annals of Internal Medicine*, 160(8). <https://doi.org/10.7326/M13-1982>
- Brindisino, F., Marruganti, S., Lorusso, D., Cavaggion, C., & Ristori, D. (2024). The effectiveness of extracorporeal shock wave therapy for rotator cuff calcific tendinopathy: A systematic review with meta-analysis. *Physiotherapy Research International*, 29(3), e2106. <https://doi.org/10.1002/pri.2106>
- Gschwend, N., Scherer, M., & Lohr, J. (1989). Tendinopathy calcarean of shoulder joint. *Orthopäde*, 10, 196–205.
- Haake, M., Deike, B., Thon, A., & Schmitt, J. (2002). Exact focusing of extracorporeal shock wave therapy for calcifying tendinopathy. *Clinical Orthopaedics and Related Research*, 397, 323–331. <https://doi.org/10.1097/00003086-200204000-00037>
- Hirschmann, M. T., Wind, B., et al. (2010). Reliability of shoulder abduction strength measure for the Constant-Murley Score. *Clinical Orthopaedics and Related Research*, 468, 1565–1571.
- Loew, M., Daেকে, W., Kusnierczak, D., Rahmānzadeh, M., & Ewerbeck, V. (1999). Shock-wave therapy is effective for chronic calcifying tendinopathy of the shoulder. *Journal of Bone and Joint Surgery. British Volume*, 81(6), 863–867.
- Loew, M., & Jurgowski, W. (1993). Erste Erfahrungen mit der extrakorporalen Stosswellen-Lithotripsie (ESWL) in der Behandlung der Tendinosis calcarea der Schulter. *Zeitschrift für Orthopädie und ihre Grenzgebiete*, 131, 470–473.
- Mouzopoulos, G., Stamatakis, M., Mouzopoulos, D., & Tzurbakis, M. (2007). Extracorporeal shock wave treatment for shoulder calcific tendonitis: A systematic review. *Skeletal Radiology*, 36(9), 803–811. <https://doi.org/10.1007/s00256-007-0297-3>
- Rompe, J. D., Rumler, F., Hopf, C., Nafe, B., & Heine, J. (1995). Extracorporeal shock wave therapy for the calcifying tendinopathy of the shoulder. *Clinical Orthopaedics and Related Research*, 321, 196–201.
- Tenforde, A. S., Borgstrom, H. E., DeLuca, S., McCormack, M., Singh, M., Soo Hoo, J., & Yun, P. H. (2022). Best practices for extracorporeal shockwave therapy in musculoskeletal medicine: Clinical application and training consideration. *PM&R*, 14(5), 611–619. <https://doi.org/10.1002/pmrj.12790>

- Uhthoff, H. K., Sarkar, K., & Maynard, J. A. (1976). Calcifying tendinitis: A new concept of its pathogenesis. *Clinical Orthopaedics and Related Research*, 118, 164–168.
- Wang, C.-J., Yang, K. D., & Wang, J.-W. (2003). Shock wave therapy for calcific tendinitis of the shoulder: A prospective clinical study with two-year follow-up. *The American Journal of Sports Medicine*, 31(3), 425–430.
<https://doi.org/10.1177/03635465030310031701>
- Xue, X., Song, Q., Yang, X., Kuati, A., Fu, H., Liu, Y., & Cui, G. (2024). Effect of extracorporeal shockwave therapy for rotator cuff tendinopathy: A systematic review and meta-analysis. *BMC Musculoskeletal Disorders*, 25(1), 357.
<https://doi.org/10.1186/s12891-024-07445-7>
- Ziegler, P., Kühle, L., Stöckle, U., Wintermeyer, E., Stollhof, L. E., Ihle, C., & Bahr, C. (2019). Evaluation of the Constant score: Which is the method to assess the objective strength? *BMC Musculoskeletal Disorders*, 20(1), 1–6.