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Shockwave Therapy After Lavage in Gartner Type II Calcific Rotator Cuff Tendinopathy

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Summary. Background. *Ultrasound-guided percutaneous irrigation of calcific deposits (lavage) is widely used for calcific rotator cuff tendinopathy, but the added value of focused extracorporeal shockwave therapy (ESWT) after lavage in Gartner type II deposits remains insufficiently studied. Objective. To compare lavage followed by focused ESWT with lavage alone in patients with Gartner type II calcific rotator cuff tendinopathy.* ***Materials and Methods.*** *A prospective comparative cohort study. Group A received lavage, three focused ESWT sessions, a subacromial corticosteroid injection, and physiotherapy; group B received the same without focused ESWT. The primary outcome was total SPADI at 6 months.* ***Results.*** *Sixty-six patients (32 in group A and 34 in group B) with comparable baseline characteristics were analyzed. At 6 months, group A showed superior outcomes for total SPADI (9.57 vs 28.81%; difference – 19.24), SPADI pain and disability subscales, and numeric-scale pain at night, at rest, and during activity (all $p < 0.01$). Residual deposit was smaller in group A (1.43 vs 3.93 mm; $p < 0.001$). Complete resorption of the calcific deposit was achieved in 62.5% vs 26.5% of patients (OR 4.63), near-complete resorption (≤ 2 mm residual calcification) in 75.0% vs 32.4% (OR 6.27), and significant subjective improvement in 62.5% vs 11.8% (OR 12.50). In both groups, the calcific deposit size decreased significantly, while the difference in absolute reduction was non-significant ($p = 0.215$).* ***Conclusions.*** *The addition of focused ESWT after lavage was associated with better pain relief, functional recovery, and ultrasound-assessed calcification resorption at 6 months. Because of the non-randomized study design, these findings should be interpreted as associative.*

Key words: *calcific rotator cuff tendinopathy; Gartner type II; lavage; ultrasound-guided percutaneous lavage; extracorporeal shockwave therapy; SPADI.*

Introduction

Calcific rotator cuff tendinopathy is a common cause of shoulder pain and functional impairment resulting from the deposition of calcium hydroxyapatite crystals within the rotator cuff tendons, most commonly the supraspinatus tendon. When symptomatic, the condition is characterized by nocturnal pain, pain during activity, sleep disturbance, and restricted shoulder motion, and most frequently affects women between 30 and 60 years of age [1–3].

Management remains challenging: in some patients, symptoms resolve over time and with conservative treatment, whereas in others pain and functional limitations persist despite nonsteroidal anti-inflammatory drugs, physical rehabilitation, and activity modification. The most commonly used non-surgical treatment options include focused extracorporeal shockwave therapy (hereafter referred to as ESWT), ultrasound-guided percutaneous lavage of the calcific deposit (hereafter referred to as lavage), and subacromial corticosteroid injection [4–6].

Current evidence suggests that lavage provides faster reduction of calcific deposits and a more pronounced short-term structural response than ESWT alone. However, in the longer term, these differences are less consistent and study findings remain heterogeneous [7–10]. One important source of this heterogeneity is the morphology of the calcific deposit. According to the Gartner classification, type II calcifications represent an intermediate phenotype, characterized by a dense deposit with partial radiolucency, and biologically occupy a transitional position between the well-defined dense type I calcifications and the more resorptive type III lesions.

The sequential combination of lavage followed by ESWT has been investigated less extensively than direct comparisons between these two treatments. Some retrospective and cohort studies have suggested that adding ESWT after needle lavage may improve

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both ultrasound and clinical outcomes compared with lavage alone; however, prospective data for specific calcification phenotypes remain limited [11, 12]. In particular, the additional benefit of focused ESWT following standardized lavage in patients with Gartner type II calcifications has not yet been established.

Objective. To compare the outcomes of ultrasound-guided lavage followed by focused ESWT with those of lavage alone (with identical concomitant treatment) in patients with Gartner type II calcific rotator cuff tendinopathy. We hypothesized that the addition of ESWT after lavage would be associated with greater pain relief, better shoulder function, smaller residual calcific deposits, and higher rates of ultrasound-confirmed calcification resorption and patient-reported recovery.

MATERIALS AND METHODS

Study Design and Setting

This prospective comparative cohort study was conducted at the SI «Institute of Traumatology and Orthopedics of NAMS of Ukraine» between February 2023 and September 2025 (patient enrollment, treatment, and follow-up). Group allocation was non-randomized and based on patient preference after detailed explanation of the additional time commitment, costs, and discomfort associated with ESWT. Patient enrollment, group allocation, losses to follow-up, and the final analysis are summarized in Figure 1. The study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the Local Bioethics Committee of the SI «Institute of Traumatology and Orthopedics of NAMS of Ukraine» (Protocol No. 09, February 11, 2023). Written informed consent was obtained from all participants.

Participants

The study included adult patients with symptomatic calcific tendinopathy of the rotator cuff that was resistant to conservative treatment, including nonsteroidal anti-inflammatory drugs and physical therapy. Inclusion criteria comprised persistent shoulder pain for more than 3 months, Gartner type II calcification confirmed on radiographs, ultrasonographic confirmation of the calcific deposit, and a baseline calcification size of at least 5 mm. Calcific deposits could be located in the supraspinatus, infraspinatus, or subscapularis tendon, or involve both the supraspinatus and infraspinatus tendons.

Exclusion criteria included partial- or full-thickness rotator cuff tears, adhesive capsulitis, glenohumeral osteoarthritis, shoulder instability, migration of the calcific deposit into the subacromial-subdeltoid bursa, previous surgery on the affected shoulder, lavage or ESWT performed on the affected shoulder within the preceding 3 months, subacromial corticosteroid injection within the preceding 3 months, coagulation disorders, pregnancy, allergy to lidocaine, rheumatoid arthritis, and poorly controlled diabetes mellitus.

Interventions

All procedures were performed by experienced musculoskeletal ultrasonography specialists using a high-resolution ultrasound system. In both groups, ultrasound-guided lavage was performed first under sterile conditions and local anesthesia. Following skin preparation, 10 mL of 1% lidocaine was infiltrated into the skin, the subacromial-subdeltoid bursa, and the peritendinous tissues surrounding the calcific deposit. A two-needle technique (16–18-gauge needles) was used. Warmed normal saline (38–42°C) was repeatedly injected and aspirated until the returning fluid became macroscopically clear. Gentle rotation and back-and-forth movements of the needles facilitated fragmentation of the calcific deposit.

Patients in group A subsequently received focused ESWT beginning one week after lavage. The treatment protocol was identical to that used in our previous cohort with dense calcific deposits and consisted of three weekly sessions delivered with a focused electromagnetic shockwave device (DUOLITH SD1, Storz Medical, Switzerland). Each session consisted of 2,000 impulses administered at a frequency of 3–8 Hz and an energy flux density of 0.15–0.30 mJ/mm². Before each treatment session, the calcific deposit was localized by ultrasound, and, as in the previous protocol, local anesthesia was administered to improve patient tolerance.

Patients in group B did not receive ESWT. To standardize anti-inflammatory treatment, both groups underwent ultrasound-guided subacromial-subdeltoid injection of 6.43 mg betamethasone mixed with 2 mL of 1% lidocaine after completion of the intervention protocol. In group A, the injection was administered after the final ESWT session, whereas in group B it was performed immediately after lavage.

Following completion of the interventions, both groups received the same short course of analgesic and anti-inflammatory medication and participated in an identical standardized home-based physical rehabilitation program consisting of sequential phases: pain control, restoration of range of motion, scapular control, muscle strengthening, and gradual return to activity. Rehabilitation was initiated one week after completion of treatment and was performed twice daily for 15–30 minutes over a period of 4–8 weeks.

Adherence to the rehabilitation program was not formally monitored.

Time Points and Outcome Measures

Assessments were performed before treatment (at baseline) and at 1, 3, and 6 months. Follow-up time points were scheduled from completion of the assigned intervention course: in group A, from the day of the final (third) shockwave therapy session and subacromial corticosteroid injection; in group B, from the day of lavage and subacromial corticosteroid injection. Completion of the treatment course was selected as the common reference point because both groups subsequently followed the same rehabilitation program. However, due to the additional ESWT sessions, the treatment course in group A lasted approximately 3–4 weeks longer, which should be taken into account when interpreting the early follow-up assessments.

The primary outcome was the total Shoulder Pain and Disability Index (SPADI) score at six months. SPADI was assessed before treatment and at 1, 3, and 6 months. The pain and disability subscales were also analyzed separately. Secondary clinical outcomes included pain intensity measured using the 11-point Numeric Rating Scale (NRS) for night pain, pain at rest, and pain during activity at the same time points.

Sonographic outcomes were based on ultrasound measurement of the largest visible diameter of the calcific deposit before treatment and at six months. In addition to residual calcification size and absolute reduction in calcification size, complete disappearance of the calcification (0 mm) and near-complete sonographic resorption, defined a priori as a residual size of ≤ 2 mm, were analyzed. At 6 months, subjective recovery was assessed using the Patient Global Impression of Improvement (PGI-I) scale; a responder was predefined as a patient who rated their condition as «much better.»

Statistical Analysis

Statistical analysis was performed using JASP (version 0.19.6 for Mac). Quantitative data are presented as mean ± standard deviation for approximately normally distributed variables, or as median with interquartile range [Q1–Q3] for non-normally distributed or ordinal variables. Categorical data are presented as counts and percentages. Baseline differences between groups were assessed using Welch's t-test, the Mann–Whitney U test, and Fisher's exact test, or the chi-square test.

The primary longitudinal analysis was performed using linear mixed-effects models with fixed effects for time, treatment group, and their interaction, and a random effect for patient identifier. Comparisons between groups at six months were performed using Welch's t-test or the Mann–Whitney U test. Within-group changes in calcific deposit size were assessed using the Wilcoxon signed-rank test. For binary outcomes, odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. All statistical tests were two-sided, and $p < 0.05$ was considered statistically significant. The final analysis was conducted according to the protocol and included only patients with complete data across all predefined time points.

Results

Study Population and Baseline Characteristics

Of the 85 patients assessed for eligibility, 80 met the inclusion criteria and 76 agreed to participate. Initially, 40 patients were assigned to group A (lavage + ESWT + corticosteroid) and 36 to group B (lavage + corticosteroid). At the 1-month follow-up, 37 patients remained in group A and 34 in group B; at the 3- and 6-month follow-ups, 32 and 34 patients, respectively, remained. Thus, the final per-protocol analysis included 66 patients with complete data (Fig. 1).

Reasons for participant withdrawal were unrelated to treatment dissatisfaction or adverse events. In group A, three patients did not attend the first follow-up visit (two because of relocation and one because contact with the study center was lost), while another five withdrew before the 3-month assessment for personal reasons unrelated to treatment. In group B, two patients withdrew because of relocation. Because the drop-out rate was moderate (8 of 40 patients [20%] in group A and 2 of 36 patients [6%] in group B) and no withdrawals resulted from

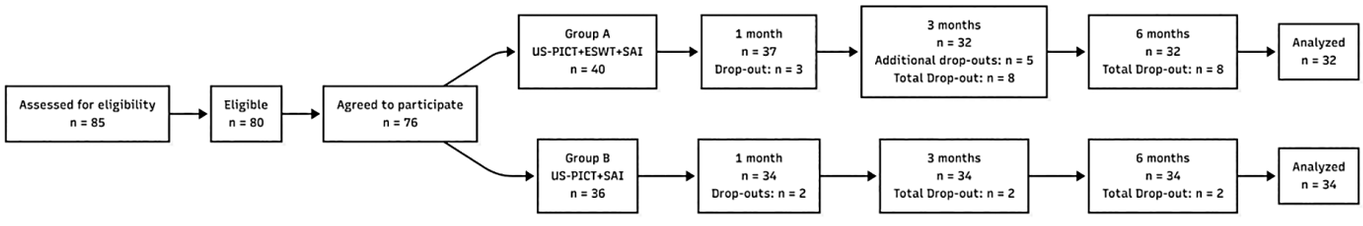

Fig. 1. Flow diagram of study participants.

treatment failure or complications, these losses were unlikely to have substantially affected the study results.

All analyzed patients had radiographic Gartner type II calcific deposits. Baseline demographic, clinical, metabolic, and imaging characteristics were comparable between the groups (Table 1). The supraspinatus tendon was the most frequently affected site (65.6% in group A and 64.7% in group B). No significant between-group differences were observed regarding age, body mass index, symptom duration, dominant-side involvement, diabetes mellitus, hypothyroidism, smoking status, baseline calcific deposit size, SPADI scores, or NRS pain scores.

Longitudinal Clinical Outcomes

Linear mixed-effects models demonstrated significant effects of time and treatment group for all longitudinal clinical outcomes. A significant time × group interaction, favoring group A, was observed for total SPADI ($F = 10.94$, $p < 0.001$), SPADI pain ($F = 9.88$, $p < 0.001$), SPADI disability ($F = 11.50$, $p < 0.001$), NRS pain at night ($F = 9.63$, $p < 0.001$), and NRS pain during activity ($F = 9.87$, $p < 0.001$). For NRS pain at rest, the effects of time ($F = 207.02$, $p < 0.001$) and group ($F = 16.24$, $p < 0.001$) were significant, whereas the interaction was not ($F = 1.01$, $p = 0.388$), indicating parallel improvement over time, with consistently lower pain scores in group A (Fig. 2).

Mean outcome trajectories are presented in Table 2. From baseline to 6 months, the total SPADI score decreased from 61.70 ± 14.58 to 9.57 ± 7.53 in group A and from 65.14 ± 13.01 to 28.81 ± 9.99 in group B. Similar patterns were observed for the SPADI pain and disability subscales. In group B, a noticeable plateau was evident for total SPADI and pain during activity between 1 and 3 months, whereas group A demonstrated a more continuous decline.

Comparison at 6 Months

At the 6-month follow-up, all clinical outcomes were significantly better in group A (Table 3). The total SPADI score was significantly lower in group A than in group B (9.57 ± 7.53 vs. 28.81 ± 9.99), with a mean difference of −19.24 points (95% CI, −23.58 to −14.90; $p < 0.001$). SPADI pain and disability scores were also lower in group A, with mean differences of −9.95 (95% CI, −12.24 to −7.67; $p < 0.001$) and −15.05 points (95% CI, −18.44 to −11.67; $p < 0.001$), respectively. Pain intensity at 6 months was likewise lower in group A, including pain at night (0.62 ± 0.55 vs. 1.18 ± 0.76; $p = 0.001$), pain at rest (0.09 ± 0.30 vs. 0.71 ± 0.58; $p < 0.001$), and pain during activity (1.91 ± 0.78 vs. 2.59 ± 0.96; $p = 0.002$).

Table 1.

Baseline Characteristics of the Study Participants

Parameters	Group A (n=32)	Group B (n=34)	Test	p
Age, years	49.53 ± 7.90	52.56 ± 8.77	Welch t-test	0.145
Female sex, n (%)	19 (59.4)	24 (70.6)	Fisher exact test	0.44
Body mass index, kg/m	26.45 ± 2.11	27.02 ± 1.98	Welch t-test	0.263
Affected dominant side, n (%)	26 (81.2)	23 (67.7)	Fisher exact test	0.265
Symptom duration, months	21.00 [15.00–30.50]	24.50 [16.25–35.75]	Mann–Whitney U test	0.376
Diabetes mellitus, n (%)	6 (18.75)	4 (12.5)	Fisher exact test	0.505
Hypothyroidism, n (%)	5 (15.63)	7 (20.6)	Fisher exact test	0.752
Smoking, n (%)	9 (28.1)	7 (20.6)	Fisher exact test	0.57
Baseline calcification size, mm	14.58 ± 4.45	15.74 ± 4.29	Welch t-test	0.284
Affected tendon, n (%)			χ^2	0.943
Supraspinatus	21 (65.6)	22 (64.7)		
Infraspinatus	4 (12.5)	5 (14.7)		
Subscapularis	3 (9.4)	2 (5.9)		
Supraspinatus + Infraspinatus	4 (12.5)	5 (14.7)		
Total SPADI, %	61.70 ± 14.58	65.14 ± 13.01	Welch t-test	0.318
SPADI pain, points	32.03 ± 7.79	33.74 ± 7.11	Welch t-test	0.358
SPADI disability, points	48.19 ± 11.21	50.94 ± 9.84	Welch t-test	0.294
NRS night pain	4.94 ± 1.48	5.44 ± 1.26	Mann–Whitney U test	0.192
NRS pain at rest	2.72 ± 1.14	3.09 ± 1.03	Mann–Whitney U test	0.193
NRS pain during activity	7.00 ± 1.55	7.35 ± 1.50	Mann–Whitney U test	0.327

Note. Quantitative data are presented as mean ± standard deviation or median [Q1–Q3]. All patients had Gartner type II calcific deposits. Group A = lavage + ESWT + corticosteroid; Group B = lavage + corticosteroid.

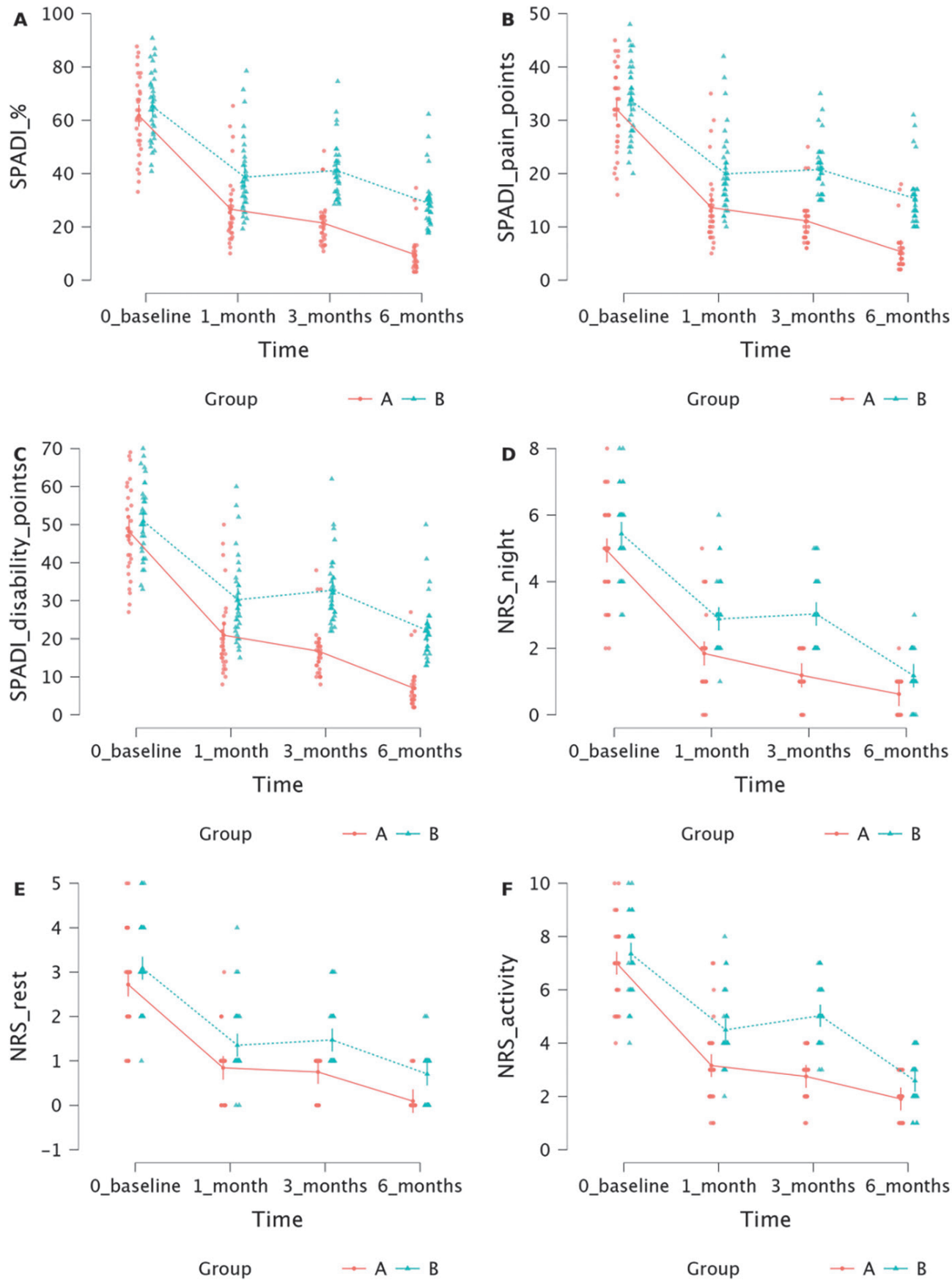

Figure 2. Changes in clinical outcomes over time in the two treatment groups. Panels: (A) total SPADI; (B) SPADI pain; (C) SPADI disability; (D) NRS pain at night; (E) NRS pain at rest; (F) NRS pain during activity.

Table 2.

Changes in Clinical Outcomes over Time

Parameters	Group	Baseline	1 month	3 months	6 months
Total SPADI, %	A	61.70 ± 14.58	26.56 ± 13.16	21.44 ± 8.64	9.57 ± 7.53
	B	65.14 ± 13.01	38.62 ± 14.18	41.13 ± 10.68	28.81 ± 9.99
SPADI pain, points	A	32.03 ± 7.79	13.59 ± 6.97	11.12 ± 4.35	5.34 ± 3.96
	B	33.74 ± 7.11	19.94 ± 7.59	20.74 ± 5.12	15.29 ± 5.27
SPADI disability, points	A	48.19 ± 11.21	20.94 ± 10.15	16.75 ± 6.92	7.09 ± 5.86
	B	50.94 ± 9.84	30.26 ± 10.84	32.74 ± 8.91	22.15 ± 7.81
NRS night pain	A	4.94 ± 1.48	1.84 ± 1.17	1.19 ± 0.69	0.62 ± 0.55
	B	5.44 ± 1.26	2.88 ± 1.07	3.03 ± 1.00	1.18 ± 0.76
NRS pain at rest	A	2.72 ± 1.14	0.84 ± 0.72	0.75 ± 0.44	0.09 ± 0.30
	B	3.09 ± 1.03	1.35 ± 0.81	1.47 ± 0.71	0.71 ± 0.58
NRS pain during activity	A	7.00 ± 1.55	3.16 ± 1.51	2.75 ± 0.88	1.91 ± 0.78
	B	7.35 ± 1.50	4.50 ± 1.31	5.03 ± 1.09	2.59 ± 0.96

Note. Values are presented as mean ± standard deviation. Group A = lavage + ESWT + corticosteroid; Group B = lavage + corticosteroid.

Table 3.

Clinical, Sonographic, and Patient-Reported Outcomes at 6 Months

Parameters	Group A (n=32)	Group B (n=34)	Test	p	Effect Estimate (95% CI)
Total SPADI, %	9.57 ± 7.53	28.81 ± 9.99	Welch t-test	<0.001	MD −19.24 (−23.58...−14.90)
SPADI pain, points	5.34 ± 3.96	15.29 ± 5.27	Welch t-test	<0.001	MD −9.95 (−12.24...−7.67)
SPADI disability, points	7.09 ± 5.86	22.15 ± 7.81	Welch t-test	<0.001	MD −15.05 (−18.44...−11.67)
NRS night pain	0.62 ± 0.55	1.18 ± 0.76	Welch t-test	0.001	MD −0.55 (−0.88...−0.23)
NRS pain at rest	0.09 ± 0.30	0.71 ± 0.58	Welch t-test	<0.001	MD −0.61 (−0.84...−0.39)
NRS pain during activity	1.91 ± 0.78	2.59 ± 0.96	Welch t-test	0.002	MD −0.68 (−1.11...−0.25)
Residual calcification, mm	1.43 ± 2.85	3.93 ± 4.54	Mann–Whitney U test	<0.001	HL −2.3 (−2.8...−0.2)
Reduction in calcification size, mm	13.15 ± 4.69	11.82 ± 3.87	Welch t-test	0.215	MD 1.33 (−0.79...3.46)
Complete disappearance, n (%)	20 (62.5)	9 (26.5)	Fisher exact test	0.006	OR 4.63 (1.63...13.17)
Resorption ≤2 mm, n (%)	24 (75.0)	11 (32.4)	Fisher exact test	<0.001	OR 6.27 (2.14...18.39)
PGI-I, median [Q1–Q3]	1.00 [1.00–2.00]	2.00 [2.00–3.00]	Mann–Whitney U test	<0.001	HL −1 (−1...−1)
PGI-I responders, n (%)	20 (62.5)	4 (11.8)	Fisher exact test	<0.001	OR 12.50 (3.53...44.30)

Note. MD = mean difference (group A − group B); HL = Hodges–Lehmann estimate (group A − group B); OR = odds ratio for group A vs group B. Lower values indicate better outcomes for SPADI, NRS, PGI-I, and residual calcific deposit size.

Calcific Deposit Size and Ultrasound-Assessed Resorption

The size of the calcific deposit decreased significantly from baseline to 6 months in both groups (Fig. 3). In group A, it decreased from 14.58 ± 4.45 to 1.43 ± 2.85 mm (W = 528.0, z = 4.94, p < 0.001), whereas in group B it decreased from 15.74 ± 4.29 to 3.93 ± 4.54 mm (W = 595.0, z = 5.09, p < 0.001). At 6 months, the residual calcific deposit was significantly smaller in group A than in group B (1.43 ± 2.85 vs 3.93 ± 4.54 mm; p < 0.001; Hodges–Lehmann estimate: −2.3 mm; 95% CI, −2.8 to −0.2). The mean absolute reduction was 13.15 ± 4.69 mm in group A and 11.82 ± 3.87 mm in group B; this difference was not statistically significant (p = 0.215).

However, clinically more meaningful sonographic outcomes favored group A. Complete disappearance of the calcific deposit was observed in 20 of 32 patients (62.5%) in group A compared with 9 of 34 patients (26.5%) in group B; OR, 4.63 (95% CI, 1.63–13.17; p = 0.006). Near-complete resolution (residual deposit ≤ 2 mm) was achieved in 24 of 32 patients (75.0%) in group A versus 11 of 34 patients (32.4%) in group B; OR, 6.27 (95% CI, 2.14–18.39; p < 0.001).

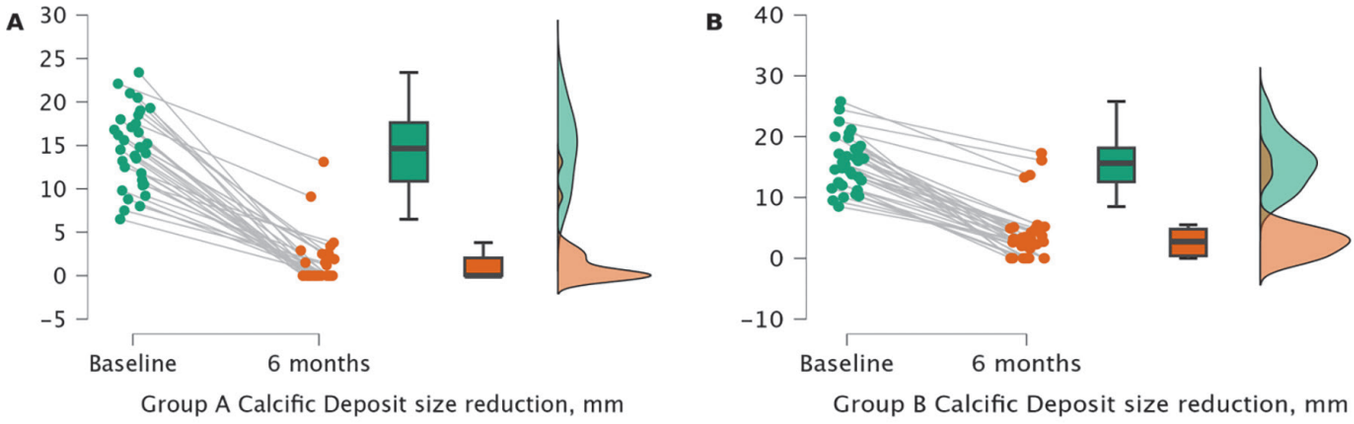

Figure 3. Within-group changes in calcific deposit size from baseline to 6 months.
Panel A, group A (lavage + ESWT + corticosteroid); Panel B, group B (lavage + corticosteroid).

Patient Global Impression of Improvement

Patient-reported improvement at 6 months also favored group A. The PGI-I score was lower in group A than in group B (median [Q1–Q3], 1.00 [1.00–2.00] vs. 2.00 [2.00–3.00]; $p < 0.001$). According to the predefined responder criterion, 20 of 32 patients (62.5%) in group A were classified as responders compared with 4 of 34 patients (11.8%) in group B; OR, 12.50 (95% CI, 3.53–44.30; $p < 0.001$).

Safety

Both treatment strategies were well tolerated. Consistent with our previous cohort, minor adverse events were infrequent, resolved spontaneously, and required no specific treatment. Occasional vasovagal reactions occurred during or immediately after the lavage procedure in both groups. In group A, transient pain exacerbation following ESWT and small superficial hematomas were observed occasionally. No serious complications, including infection, neurovascular injury, tendon rupture, or hospitalization, were recorded. Because adverse events were recorded descriptively rather than as formal incidence endpoints, they are reported qualitatively.

Discussion

The principal finding of this study is that the addition of focused ESWT after lavage was associated with better clinical and sonographic outcomes at 6 months compared with the same lavage-based treatment protocol without ESWT in patients with Gartner type II calcific tendinopathy. The superiority of group A was consistently demonstrated across total SPADI, SPADI pain and disability scores, pain at night and during activity, patient-reported improvement, residual calcific deposit size, and the rates of complete and near-complete sonographic resorption.

These findings are clinically relevant because the existing literature has focused primarily on direct comparisons between lavage and ESWT rather than on additive treatment strategies. Randomized studies and meta-analyses have shown that lavage often provides greater short-term reductions in pain and calcific deposit size than ESWT alone, although long-term differences appear less consistent [5–9]. Our study addressed a different clinical question: does a patient who has already undergone lavage derive additional benefit from a standardized course of subsequent ESWT? In this cohort of patients with type II calcific deposits, the answer appears to be affirmative, at least over a 6-month follow-up period.

The pattern of recovery is also noteworthy. In group A, pain and functional limitations gradually decreased, whereas in group B several outcomes improved early and then reached a plateau between 1 and 3 months, particularly total SPADI and pain during activity. These findings suggest that lavage combined with subacromial corticosteroid injection provides substantial early symptom relief in patients with type II calcific tendinopathy, whereas the addition of ESWT may help sustain or further enhance recovery during the subacute phase.

The sonographic findings require careful interpretation. Calcific deposit size decreased significantly in both groups, as expected, since all patients underwent lavage. However, the difference in the absolute reduction between the groups was not significant, in contrast to the clear differences in the residual calcification size and categorical measures of resorption. In other words, the addition of ESWT increased the likelihood of complete or near-complete clearance of the calcific deposit by 6 months. This is likely to represent a more clinically meaningful structural signal than the average reduction in deposit size.

Overall, our findings are consistent with recent reports on combined treatment strategies. Zhang

et al. reported better clinical and sonographic outcomes when ESWT was added to ultrasound-guided needling lavage compared with lavage alone, whereas Hiraoka et al. demonstrated high resorption rates and favorable clinical outcomes with repeated focused ESWT combined with lavage in a large observational cohort [11, 12]. Our study adds prospective evidence and, importantly, focuses on a morphologically homogeneous population with Gartner type II calcific deposits.

Specifically restricting the study population to type II calcific deposits is a major advantage of this study. Many previous investigations combined different radiographic types of calcific deposits despite the fact that the biological and mechanical behavior of dense type I deposits, transitional type II deposits, and the more resorptive type III deposits may differ. By focusing exclusively on type II lesions, we reduced phenotypic heterogeneity and matched the intervention to a subgroup in which both lavage and subsequent fragmentation- and resorption-promoting stimulation are mechanistically justified. A second advantage is protocol standardization: the lavage technique, corticosteroid regimen, analgesia, and rehabilitation program were identical in both groups, minimizing the risk that differences resulted from unequal co-interventions.

Limitations

Several limitations should be acknowledged. The allocation was non-randomized and based on patient preference, making it impossible to exclude expectation effects, residual confounding, and selection bias, despite the well-balanced baseline characteristics. In particular, patients who chose to undergo additional ESWT (group A) may have been more motivated and had a higher socioeconomic status and, consequently, may have adhered more closely to the rehabilitation program, although adherence was not formally monitored. These unmeasured factors may therefore have contributed, at least in part, to the observed advantage of group A. Imaging assessments were not blinded and were performed by the treating physician. Analyses were conducted on a per-protocol rather than according to the intention-to-treat principle. Adverse events were recorded descriptively rather than as formal endpoints. Finally, this was a single-center study with only 6 months of follow-up; therefore, the durability of treatment benefits and the risk of recurrence remain uncertain.

Despite these limitations, the study has important clinical implications. In patients with Gartner type II calcific tendinopathy, a lavage-based treatment strategy may be enhanced by the addition of standardized focused ESWT. The greatest benefits were observed in shoulder function, night pain, pain during activity, patient-perceived recovery, and the likelihood of complete or near-complete resorption. Randomized trials with blinded imaging assessment, formal recording of adverse events, and longer follow-up are needed to confirm these findings.

Conclusions

In this prospective cohort study of patients with radiographic Gartner type II calcific rotator cuff tendinopathy, the addition of focused ESWT following ultrasound-guided percutaneous lavage was associated with better pain relief, improved shoulder function, greater patient-reported improvement, and better sonographic resorption at 6 months than an otherwise identical lavage-based treatment protocol without ESWT. Because the study was non-randomized and imaging assessments were not blinded, these findings should be interpreted as associative rather than definitively causal.

ADDITIONAL INFORMATION

Conflict of interest. The author declares no conflict of interest.

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Ударно-хвильова терапія після лаважу при кальцифікуючій тендинопатії плеча II типу за Gartner

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Резюме. Актуальність. *Лаваж (черезшкірне промивання кальцинату під ультразвуковим контролем) широко застосовують при кальцифікуючій тендинопатії ротаторної манжети, проте додаткова користь фокусованої ударно-хвильової терапії після лаважу при кальцинатах II типу за Gartner вивчена недостатньо.* ***Мета дослідження.*** *Порівняти результати лаважу з наступною фокусованою ударно-хвильовою терапією та ізольованого лаважу при тендинопатії II типу за Gartner.* ***Матеріали і методи.*** *Проспективне порівняльне когортне дослідження: група А отримала лаваж, три сеанси ударно-хвильової терапії, субакроміальний кортикостероїд і реабілітацію; група В — те саме без ударно-хвильової терапії. Первинним показником був сумарний бал SPADI через 6 місяців.* ***Результати.*** *Проаналізовано 66 пацієнтів (32 у групі А, 34 у групі В) із зіставними вихідними характеристиками. Через 6 місяців група А переважала за сумарним SPADI (9,57 проти 28,81 %; різниця −19,24), болем і функціональною недостатністю за SPADI та болем за числовою шкалою вночі, у спокої й під час навантаження (усі $p<0,01$). Залишковий кальцинат був меншим у групі А (1,43 проти 3,93 мм; $p<0,001$). Повне зникнення кальцинату досягнуто в 62,5 проти 26,5 % (ВШ 4,63), майже повне розсмоктування ≤2 мм — у 75,0 проти 32,4 % (ВШ 6,27), виразне суб'єктивне поліпшення — у 62,5 проти 11,8 % (ВШ 12,50). В обох групах розмір кальцинату суттєво зменшився, а різниця в абсолютному зменшенні була незначущою ($p=0,215$).* ***Заключення.*** *Додавання фокусованої ударно-хвильової терапії до лаважу асоціювалося з кращими через 6 місяців болем, функцією та сонографічним розсмоктуванням; через нерандомізований дизайн результати слід трактувати як асоціативні.*

Ключові слова: *кальцифікуюча тендинопатія ротаторної манжети; II тип за Gartner; лаваж; черезшкірне промивання під ультразвуковим контролем; ударно-хвильова терапія; SPADI.*