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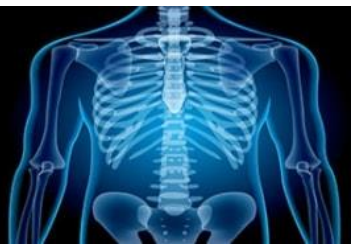

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Effectiveness of ultrasound-guided barbotage in reducing shoulder pain and improving function in supraspinatus calcific tendinitis

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Abstract
Background: Supraspinatus calcific tendinitis is a common and often painful condition characterized by the deposition of calcium within the supraspinatus tendons. This study aimed to determine whether supraspinatus calcific tendonitis might be successfully treated using ultrasound (US)-guided barbotage.
Methods: This single-arm interventional study included 40 patients aged ≥ 18, both sexes, diagnosed with supraspinatus calcific tendinitis through clinical and radiological evaluation. A diagnostic US was delivered to each patient, and they were also asked to self-evaluate their level of pain and disability in the affected area. At the first, third-, and sixth months post-treatment, they reevaluated the changes in pain and disability scores.
Results: The pain score and disability score were significantly lower (1, 3, and 6 months) after treatment than before treatment (p<0.001). Range of motion of shoulder abduction was significantly higher at (1, 3, and 6 months) after treatment than before treatment (p<0.001). US examination showed that 25 (62.5%) patients had total disappearance of tendinopathy without calcification, 8 (20%) patients had partial regain of a fibrillar pattern of the normal tendon with few calcifications, and 7 (17.5%) did not have changes in tendinopathy with scattered calcification. Regarding clinical success rate, symptoms disappeared in 33 (82.5%) patients and 7 (17.5%) patients with marked improvement in symptoms. Technical success occurred in 26 (65%) patients.
Conclusion: Barbotage is a less invasive and very effective way to treat calcific tendinosis, particularly in cases when other conservative techniques have failed to alleviate the pain.

Keywords: Ultrasound, barbotage, pain, supraspinatus calcific tendinitis

Introduction

Supraspinatus calcific tendinitis is a common shoulder condition that often affects individuals in their 40s to 60s and has a prevalence rate of 6.8% to 54% among patients [1]. Despite claims that the sickness is self-limiting and causes mild pain, the symptoms can be severe and endure for a long time [2].

The calcific deposits in one or more rotator cuff tendons are the hallmark of supraspinatus calcific tendinitis. Although its origin is unknown, researchers have identified three distinct phases: (1) the pre-calcific stage, (2) the calcific resting period, and (3) the post-calcific resorptive phase. The deltoid region is the most common site of discomfort in the latter stages of the condition, and it tends to get worse at night or after physical exertion, and the degree to which it impairs function can vary [3, 4].

Traditional management strategies for supraspinatus calcific tendinitis range from conservative approaches such as physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), and corticosteroid injections to more invasive interventions, including surgical removal of calcific deposits [5]. However, in cases where conservative management fails, the need for an effective, minimally invasive treatment option is critical [6].

Among these minimally invasive options, barbotage has emerged as an effective and promising technique for treating supraspinatus calcific tendinitis [7]. The barbotage process involves removing calcium deposits from the shoulder by aspirating them with a needle after liquified with saline under ultrasound (US)-guidance [8]. Patients suffering from supraspinatus calcific tendinitis report immediate relief from discomfort and improved shoulder function after barbotage. An injection of corticosteroids is usually administered at the same time as the barbotage process [9].

The optimal method of treating supraspinatus calcific tendinitis remains debatable, even if barbotage has been effective [10]. Alternative techniques have demonstrated similar effectiveness in alleviating the symptoms of supraspinatus calcific tendinitis for up to five years after the original therapy. One such procedure is subacromial corticosteroid injections, which do not involve barbotage. Even though barbotage can temporarily relieve supraspinatus calcific tendinitis symptoms, it is not uncommon for patients to have a return of symptoms and need additional therapy. Further investigation into the effects of barbotage on patients is warranted in light of these findings [11].

This work aimed to evaluate the effectiveness of US-guided barbotage in the treatment of supraspinatus calcific tendinitis.

Patients and Methods

This single-arm interventional study was carried out on 40 patients aged ≥ 18 years, both sexes, with supraspinatus calcific tendinitis diagnosed based on clinical and radiological evaluation. The study was done from August 2021 to September 2024. The patient's signed informed consent was acquired.

Patients who responded well to conservative treatment or had a radiological diagnosis of a tendon tear, or had symptoms that were resolved within six months were not included in the study.

The patients' history was documented, along with their clinical examinations. Clinical and radiological evaluations were performed to diagnose supraspinatus calcific tendinitis. The Pain and Disability Scale (PADS) was used for a prospective evaluation [12]. The purpose of this self-administered score is to track the progress of treatment over time. There are 11 questions broken down into two groups that measure tendinopathy-related pain and disability. On the one hand, we have the pain subcategory, which contains six items (0 = no pain, 1 = pain with forced active movement, 2 = pain with simple active movement, 3 = pain with passive movement, 4 = pain at rest, 5 = pain at rest and disability). On the other hand, we have the disability subcategory, which contains five items (0 = intact full movement range, 1 = near full movement range, 2 = partial movement, 3 = slight movement, 4 = no movement). The patient was asked to complete this survey before the procedure and during the scheduled follow-up appointments 1, 3, and 6 months after the therapy.

It is possible to gauge the extent to which a patient's impairment has improved by measuring the range of motion in the shoulder joint before and after therapy by the x-ray post-procedure.

Every patient underwent a diagnostic first US. There was a pre- and post-activity examination of the tendon in a neutral posture. A power Doppler test was performed on each tendon to check for tendon tears, tendon-related calcifications, enhanced vascularity, and focal tendinosis.

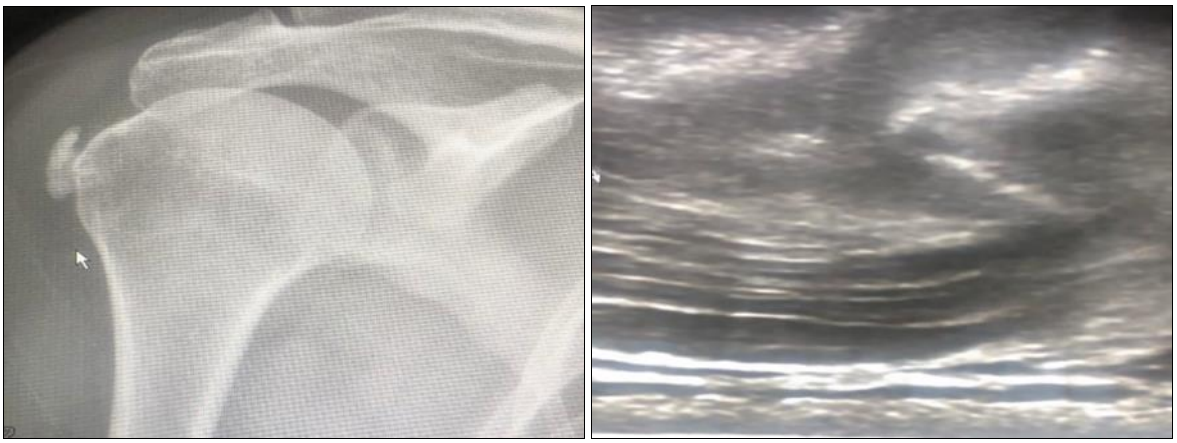
Treatment Procedure

In most circumstances, the patient would sit on a rotating stool with their affected tendon in the best visible position during the procedure. For patients who have experienced vagal reactions during injections in the past, it was recommended that they lie down. The intervention was performed under complete aseptic technique.

Using the US to locate the calcified deposit, a local anesthetic (2% Lidocaine hydrochloride) was then delivered. Under continuous US guidance, a 18-gauge needle was used to puncture the calcification. The needle was attached to a 20 ml syringe that contained a mixture of normal saline and Lidocaine 2%. For simpler US localization of the needle and calcification, a horizontal course and anteroposterior axis of the needle were preferred. After positioning the needlepoint gently in the center of the calcification, an attempt was made to aspirate the broken calcified material. The amount and uniformity of calcifications during the procedure determined the aspiration success rate and the number of sessions needed.

It was easy to identify the extracted calcium in the syringe by its white, chalky-like consistency, which was mixed with the Lidocaine that had been deposited in the dependent region of the syringe. The syringe and needle were kept parallel to the floor during the lavage procedure to minimize the amount of calcium that could enter the needle. 40ml of long-acting corticosteroid was injected under US-guidance within the subacromial space.

The procedure was completed after 10–15 minutes, or when no more calcified material can be extracted.



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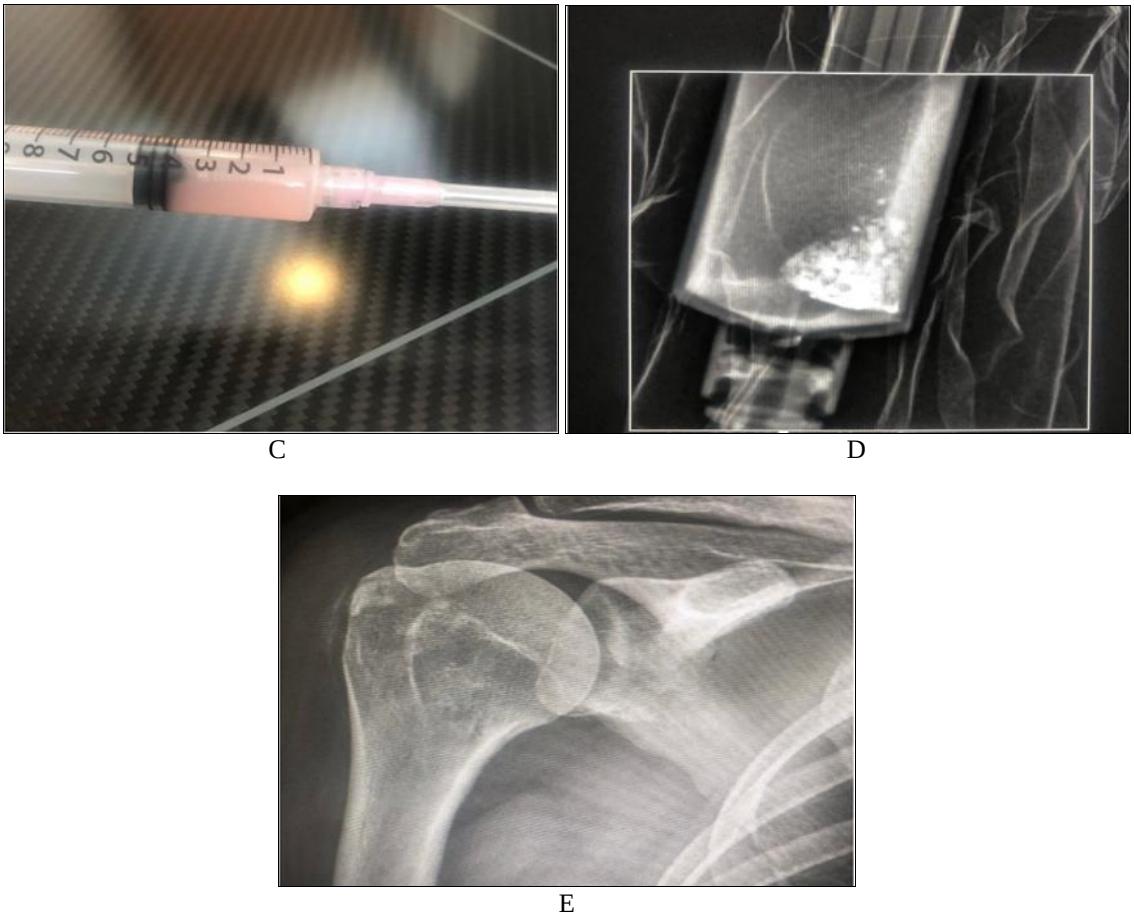

C D E

Fig 1: Ultrasound (US)-guided barbotage case of supraspinatus calcified tendinitis (A) Supraspinatus calcified tendinitis, (B) US-guided barbotage, (C) Aspirated calcium using two 18 gauge needles, saline after local anesthesia, (D) X ray of the aspirated calcium, (E) Post-barbotage with disappearance of the calcium.

Post-procedure

Ice pack/pain killer is advised after the procedure.

Regular follow-up visits were conducted to reevaluate patients at 1-, 3-, and 6-month post-procedure. They were asked to complete the pain and disability score questionnaire again on each visit. I also had a routine US, which showed any changes in tendon thickness, echogenicity, or calcification.

The ability to access the tendon and completely remove the calcium deposit was deemed a technical success. We defined clinical success as a full or significant improvement in symptoms within the first six months following the treatment, independent of the use of orthoscopy or physical therapy.

The primary outcome was the improvement in pain score. The secondary outcomes were disability score, clinical success rate, and technical success rate.

Sample size calculation

Using G*Power 3.1.9.2 (Universitat Kiel, Germany), we were able to estimate the sample size. Based on our pilot investigation, which included five cases, we found that the mean (± SD) of pain score was 3.20 ± 1.48 pre-treatment and 1.80 ± 0.84 at 6 months post-treatment. Forty patients were joined in each group based on a 95% confidence limit, 90% power, and an effect size of 1.163, and six cases to overcome dropout.

Statistical analysis

SPSS v26 (IBM Inc., Chicago, IL, USA) was employed to conduct statistical analysis. We used repeated-measures ANOVA to compare quantitative parametric data, which were expressed as mean and standard deviation (SD). The median and interquartile range (IQR) were used to express quantitative non-parametric data with Friedman test and Wilcoxon tests used for comparison. The qualitative variables were compared using the Chi-square test and were expressed as percentages and frequencies. Statistical significance was defined as a two-tailed P value ≤ 0.05.

Results

The mean value (±SD) of age was 45.7 (±11.84) years. There were 15 (37.5%) male and 25 (62.5%) female. The mean value (±SD) of weight was 81.65 (±11.74) kg. The mean value (±SD) of height was 171.8 (±6.48) cm. The mean value (±SD) of BMI was 27.72 (±4.11) kg/m^2. Table 1

Table 1: Demographic data of the studied patients

		(n=40)
Age (years)		45.7 ± 11.84
Sex	Male	15 (37.5%)
	Female	25 (62.5%)
Weight (kg)		81.65 ± 11.74
Height (cm)		171.8 ± 6.48
BMI (kg/m^2)		27.72 ± 4.11

Data are presented as mean ± SD or frequency (%). BMI: Body mass index.

The pain score was significantly lower 1 month after treatment (2(2 - 3)), 3 months after treatment (1(1 - 2)), and 6 months after treatment (0(0 - 1)) than before treatment (4(3 - 4)) (p<0.001). Table 2

Table 2: Pain score of the studied patients

	Before treatment	**1 month after treatment**	**3 months after treatment**	**6 months after treatment**
Pain score	4 (3 - 4)	2 (2 - 3)	1 (1 - 2)	0 (0 - 1)
P value		<0.001*	<0.001*	<0.001*

Data are presented as median (IQR). *: Significant as P value ≤0.05.

The disability score was significantly lower at (1, 3, and 6 months) after treatment than before treatment (p<0.001). Range of motion (ROM) of shoulder abduction was significantly higher at (1, 3, and 6 months) after treatment than before treatment (p<0.001). Table 3

Table 3: Disability score and ROM of shoulder abduction of the studied patients

	Before treatment	**1 month after treatment**	**3 months after treatment**	**6 months after treatment**
Disability score	2 (2 - 3)	1 (0 - 2)	1 (0 - 1)	0 (0 - 1)
P value		<0.001*	<0.001*	<0.001*
ROM of shoulder abduction	132.3 ± 9.22	146.7 ± 10.57	156.9 ± 10.57	171.2 ± 11.17
P value		<0.001*	<0.001*	<0.001*

Data are presented as mean (±SD) or median (IQR). *: Significant as P value ≤0.05, ROM: Range of motion.

US examination showed that 25 (62.5%) patients had total disappearance of tendinopathy without calcification, 8 (20%) patients had partial regain of a fibrillar pattern of the normal tendon with few calcifications, and 7 (17.5%) did not have changes in tendinopathy with scattered calcification. Table 4

Table 4: US examination of the studied patients

	(n=40)
Total disappearance of tendinopathy without calcification	25 (62.5%)
Partial regain of fibrillar pattern of normal tendon with few calcifications	8 (20%)
No changes in tendinopathy with scattered calcification	7 (17.5%)

Data are presented as frequency (%). US: ultrasound.

Regarding clinical success rate, symptoms disappeared in 33 (82.5%) patients and 7 (17.5%) patients had marked improvement of symptoms. Technical success occurred in 26 (65%) patients. Table 5

Table 5: Clinical and technical success rate of the studied patients

		(n=40)
Clinical success rate	Disappearance of symptoms	33 (82.5%)
	Marked improvement of symptoms	7 (17.5%)
Technical success rate		26 (65%)

Data are presented as frequency (%).

Discussion

Barbotage seems to alleviate shoulder calcified tendinitis pain significantly in the 2-month following the procedure, but its effectiveness starts to wane in subsequent longer-term assessments, especially after 6 months. Furthermore, many barbotage procedures necessitate other procedures, such as additional barbotage, surgical intervention, or injections of corticosteroids [13].

In our trial, both the pain and disability scores at 1,3-, and 6 months post-treatment were considerably lower than pre-treatment levels. At 1,3- and 6-months post-treatment, the ROM of the shoulder abducted was noticeably greater than pre-treatment levels.

Werry et al. [9] demonstrated that the utilization of barbotage as a treatment for calcific tendonitis of the shoulder appears to produce notable pain reduction at 2 months but begins to lose some efficacy over long-term evaluation. De Witte et al. [14] found that barbotage significantly alleviated symptoms of calcific tendinitis after 12 months. This improvement was evaluated using the shoulder pain and disability index.

Similarly, Niazi and Hetta [15] demonstrated that, over the

first six months following the procedure, the average pain score for these patients decreased from 3.5 before treatment to 2 in the first month, 1.5 in the third month, and 1 in the sixth month, for a mean reduction of 2.5 points. Patients' mean disability scores decreased over the first six months after the procedure, going from 2.5 before treatment to 1.5 in the first month, 1 in the third month, and 1 in the sixth month, for a total disability reduction of 1.5 points.

Furthermore, at the one-year follow-up, 91% of the 67 patients surveyed by Del Cura et al. [16] had observed substantial or full improvements in pain, disability, and range of motion.

According to our findings, ultrasound examination revealed that 22 patients (62.5%) experienced a complete resolution of tendinopathy free of calcification, 8 patients (20%) showed some improvement toward a normal tendon fibrillar pattern with few calcifications, and 7 patients (17.5%) showed no improvement and scattered calcification. In terms of the clinical success rate, 33 patients (82.5%) reported that their problems went away, while 7 patients (17.5%) said that their symptoms significantly improved. Due to the small sample size, 26 patients (or 65%) were able to achieve technical success in our study.

Consistent with this, Niazi and Hetta [15] discovered an 80% rate of clinical success. Six months after injection, sonographic results showed that 60% of calcification deposits had completely disappeared, while 20% showed scattered calcification smaller than 3 mm but no clinical signs.

According to Zhu et al. [17], a total of 74% of patients were successful, with 13% seeing the complete elimination of calcification and 61% seeing a reduction in calcification. Additionally, Lin et al. [18] demonstrated that during follow-up durations ranging from 8 months to 3 years, 75% of patients showed significant clinical progress.

The study contained several limitations, including a small sample size, the absence of a control group for comparison, a single-center design, the operator-dependent nature of ultrasound guidance, the steep learning curve, in addition to the fact that a patient's high body mass index raises attenuation and reduces needle vision, which could make US-guidance even more challenging. Additional research is required to assess the long-term results, compare them to other treatments, and identify predictors of success.

Conclusions

US-guided barbotage is a promising treatment modality for supraspinatus calcific tendinitis, offering significant improvements in both clinical and radiological outcomes as it can effectively reduce pain, disability, and improve shoulder range of motion in patients with supraspinatus calcific tendinitis.

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Conflict of Interest: Nil

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