RESEARCH PAPER

A Prospective Study of Functional and Radiological Outcome of Ultrasound Guided Barbotage and Sub-Acromial Steroid Injection

Dr. Thamiz arasu[1], Dr. Sundararajan T[2], Dr. W. Vikramaditya Singh [3], Dr Naga Sai Akhil[4]*, Dr. F Abdul Khader[5] and Dr. Sathyanarayna L.Y[6]

[1]Senior Resident, Professor, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry, India
[2]Professor, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry, India
[3]Senior Resident, Department of Orthopaedics, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry, India
*[4]*3rd Year Postgraduate, Department of Orthopaedics,Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry , India*
[5]Professor, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry, India
[6]Professor, Department of Orthopaedics, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry, India
Corresponding Author: Email: nagasai700@gmail.com

Received: 1st Mar, 2026; Revised: 7th Mar 2026; Accepted: 28th March, 2026; Available Online: 30th March, 2026

ABSTRACT

Background: Calcific tendinitis of the shoulder is a common cause of chronic shoulder pain and functional limitation, characterized by deposition of calcium hydroxyapatite crystals within the rotator cuff tendons. Although conservative management is often effective, a subset of patients continues to experience persistent symptoms requiring interventional treatment. Ultrasound-guided barbotage combined with subacromial steroid injection has emerged as a minimally invasive technique aimed at reducing calcific deposits and relieving inflammation.

Methods: A prospective study was conducted in the Department of Orthopaedics at Shri Sathya Sai Medical College and Research Institute over a period of 18 months. Thirty-seven patients diagnosed with calcific tendinitis of the shoulder and persistent symptoms despite conservative management were included. All patients underwent ultrasound-guided percutaneous barbotage using an 18-gauge needle followed by subacromial steroid injection. Functional and radiological outcomes were evaluated using the Visual Analog Scale (VAS), American Shoulder and Elbow Surgeons (ASES) score, range of motion measurements, and radiographic assessment of calcific deposit size at baseline, 1 week, 3 weeks, 6 weeks, and 3 months.

Results: The study population consisted predominantly of patients aged 40–59 years, with supraspinatus tendon involvement observed in the majority of cases. Significant improvement in pain and function was noted during follow-up. Mean VAS scores improved from 7.9 ± 1.0 at baseline to 1.3 ± 0.7 at 3 months ($p < 0.001$). ASES scores increased from 42.6 ± 7.5 pre-procedure to 84.2 ± 6.3 at 3 months ($p < 0.001$). Range of motion also improved substantially, with shoulder abduction increasing from 92.5° to 156.3° and flexion from 104.6° to 165.2° at 3 months. Radiological evaluation demonstrated significant reduction in calcific deposit size from 12.8 ± 3.2 mm at baseline to 3.1 ± 2.4 mm at final follow-up, with complete radiological resolution in 59.5% of patients.

Conclusion: Ultrasound-guided barbotage combined with subacromial steroid injection is an effective and safe minimally invasive procedure for the management of calcific tendinitis of the shoulder. The technique provides significant pain relief, improved functional outcomes, and substantial radiological reduction of calcific deposits in the short term. This approach may serve as a valuable alternative to surgical intervention in patients with persistent symptomatic calcific tendinitis.

How to cite this article: Arasu T, Sundararajan T, Singh WV, Akhil NS, Khader FA and Sathyanarayna LY, A Prospective Study of Functional and Radiological Outcome of Ultrasound Guided Barbotage and Sub-Acromial Steroid Injection. Int J Drug Deliv Technol. 2026;16(26s):461-472. Doi: 10.25258/ijddt.16.26s.51

Source of support: Nil.

Conflict of interest: None

**Author for Correspondence: nagasai700@gmail.com*

INTRODUCTION

The shoulder is a complex synovial joint that enables a wide range of motion while relying on the integrity of periarticular soft tissues, particularly the rotator cuff tendons, for stability and function. Deposition of calcium hydroxyapatite crystals within tendons and periarticular structures forms the pathological basis of hydroxyapatite crystal deposition disease, a condition that commonly involves the shoulder region and has significant clinical implications [1]. When these deposits occur within the rotator cuff tendons and become symptomatic, the condition is recognized as calcific tendinitis, a frequent cause of shoulder pain and functional limitation in adults [2].

Calcific tendinitis is characterized by localized inflammation, tendon degeneration, and mechanical impingement, which together contribute to pain, restricted range of motion, and impaired daily activities. The disease process is dynamic, with varying consistency and biological activity of calcific deposits influencing symptom severity and treatment response [1,2]. Advances in musculoskeletal imaging, particularly ultrasonography, have enhanced understanding of tendon pathology by allowing real-time visualization of calcific deposits and surrounding soft tissues [3]. This imaging capability has facilitated the development of minimally invasive, image-guided therapeutic interventions aimed at targeted deposit removal while preserving tendon integrity. Among these, ultrasound-guided percutaneous barbotage has emerged as a technique that combines diagnostic precision with therapeutic efficacy, forming a foundation for contemporary management strategies in calcific tendinitis of the shoulder [4].

BRIEF OVERVIEW

Calcific tendinopathy of the shoulder is a disorder characterized by deposition of calcium hydroxyapatite crystals within the rotator cuff tendons, most frequently involving the supraspinatus tendon. The condition represents a distinct clinical entity with variable presentation, ranging from incidental radiographic findings to severe pain and functional disability [5]. The pathogenesis is considered multifactorial and dynamic, involving cellular metaplasia, crystal deposition, and subsequent inflammatory response, rather than a purely degenerative process [6].

Clinically, calcific tendinitis progresses through well-recognized stages, including precalcific, formative, resorptive, and post-calcific phases, each associated with differing symptom intensity and imaging characteristics [7]. The resorptive phase is typically associated with acute pain due to increased intratendinous pressure and inflammatory reaction, whereas chronic symptoms are often linked to persistent deposits and mechanical impingement.

Management strategies vary depending on symptom severity and disease stage. Conservative treatment remains the initial approach; however, persistent or severe cases often require targeted interventions. Recent evidence highlights the role of image-guided minimally invasive techniques, such as ultrasound-guided percutaneous lavage, which aim to reduce calcific burden and alleviate pain while avoiding surgical morbidity [8].

Clinical Relevance

Calcific tendinitis of the shoulder is clinically significant due to its direct impact on pain, shoulder function, and quality of life. Patients commonly present with persistent shoulder pain, nocturnal discomfort, and marked restriction of active and passive movements, which interfere with occupational tasks and daily activities [9]. Acute exacerbations, particularly during the resorptive phase, can result in severe pain requiring medical attention and may mimic other causes of acute shoulder pathology, complicating clinical decision-making [10].

The functional impairment associated with calcific deposits often leads to reduced work productivity and prolonged disability if not managed appropriately. Chronic cases may develop secondary complications such as subacromial impingement, bursitis, and rotator cuff dysfunction, further increasing morbidity [10]. From a therapeutic perspective, timely and effective intervention is essential to achieve pain relief while preserving tendon integrity and shoulder biomechanics.

While surgical options such as arthroscopic removal have demonstrated favorable outcomes in selected cases, surgery is associated with higher costs, longer recovery periods, and potential perioperative risks [11]. Consequently, there is growing clinical emphasis on minimally invasive treatments that can provide comparable symptomatic relief and functional improvement with reduced morbidity. Image-guided barbotage has gained relevance in this context, offering targeted treatment aimed at rapid pain reduction and functional recovery [9,11].

Burden (Global, National, Regional)

Shoulder disorders constitute a substantial proportion of musculoskeletal complaints worldwide, with subacromial pathologies representing one of the most frequent causes of shoulder pain encountered in clinical practice [12]. Among these conditions, rotator cuff–related disorders, including calcific tendinopathy, contribute significantly to outpatient visits, work absenteeism, and long-term functional disability. Epidemiological studies indicate that shoulder pain affects a considerable segment of the adult population, with prevalence increasing with age and occupational shoulder use [13].

Globally, tendinopathies of the shoulder are recognized as a major source of chronic musculoskeletal morbidity, often requiring repeated medical consultations and prolonged treatment courses. In many healthcare systems, these conditions impose a notable economic burden due to direct treatment costs and indirect losses related to reduced productivity and sick leave [12]. From a regional

perspective, shoulder pain is a common presentation in orthopaedic and rehabilitation clinics, frequently associated with rotator cuff pathology detected on imaging [14].

The widespread availability of diagnostic ultrasonography has led to increased detection of calcific deposits, highlighting the clinical relevance of calcific tendinopathy as an underrecognized contributor to shoulder pain burden. This rising diagnostic recognition underscores the need for effective, accessible management strategies tailored to routine clinical settings [13,14].

Current Gaps in Diagnosis / Knowledge

Despite advances in musculoskeletal imaging and interventional techniques, several gaps persist in the diagnosis and management of calcific tendinopathy of the shoulder. Clinical assessment alone often fails to accurately localize the pain generator, as symptoms may overlap with other causes of shoulder dysfunction such as subacromial bursitis, rotator cuff tears, or biceps tendon pathology [15]. This diagnostic overlap can delay definitive treatment and contribute to prolonged patient discomfort.

Conventional imaging modalities, including plain radiography, provide information regarding the presence of calcific deposits but offer limited insight into the biological activity of the deposit or its relationship to surrounding soft tissues. While ultrasonography improves structural assessment, standardized criteria for correlating imaging findings with symptom severity and treatment response remain insufficiently defined [16]. Additionally, variability in calcific deposit morphology and stage further complicates clinical decision-making.

From a therapeutic standpoint, uncertainty persists regarding the optimal timing and selection of interventional procedures. Although injection and needling techniques are widely practiced, there is heterogeneity in technique, injectate composition, and post-procedural rehabilitation protocols, leading to inconsistent outcomes [15]. Furthermore, involvement of adjacent structures such as the long head of the biceps tendon may influence pain patterns and recovery, yet remains underexplored in routine diagnostic algorithms [17].

Need for the Study

Shoulder pain remains a frequent cause of functional limitation and healthcare utilization, with calcific tendinopathy representing a challenging subset due to its variable clinical course and response to treatment. Persistent pain arising from calcific deposits can lead to chronic disability, sleep disturbance, and reduced participation in daily and occupational activities, emphasizing the need for effective and timely interventions [18]. Conventional management strategies often rely on prolonged conservative therapy, which may not adequately address symptoms in patients with persistent or biologically active deposits.

Contemporary understanding of shoulder disorders highlights the importance of targeted, pathology-specific treatment rather than generalized pain management approaches [19]. Minimally invasive image-guided interventions have emerged as promising options that aim to directly address the underlying pathology while minimizing tissue trauma and recovery time. However, variability in reported outcomes and lack of standardized follow-up data necessitate further evaluation of these techniques in routine clinical practice.

Ultrasound-guided barbotage, combined with subacromial steroid injection, offers a mechanism to reduce calcific load, control inflammation, and restore shoulder function. Systematic assessment of both functional and radiological outcomes is essential to establish its effectiveness and guide clinical decision-making [20]. Therefore, the present study is required to generate objective evidence on treatment outcomes, supporting rational selection of minimally invasive management strategies for calcific tendinopathy of the shoulder.

Diagnostic / Management Tools

Accurate diagnosis and appropriate selection of management strategies are central to effective treatment of calcific tendinopathy of the shoulder. Clinical evaluation is supported by imaging, with plain radiographs serving as an initial tool to identify calcific deposits, while ultrasonography provides superior assessment of deposit size, location, and consistency, as well as associated soft-tissue changes [21]. These imaging findings form the basis of structured treatment algorithms that guide clinicians in selecting conservative, interventional, or surgical options based on symptom severity and disease stage.

Ultrasound-guided percutaneous lavage, commonly referred to as barbotage, has emerged as a key interventional modality by enabling direct mechanical disruption and aspiration of calcific material under real-time visualization. This technique allows precise targeting of the deposit while minimizing injury to surrounding structures, thereby enhancing procedural safety and therapeutic effectiveness [22]. Adjunctive measures such as subacromial corticosteroid injection are frequently employed to control post-procedural inflammation and pain.

Pharmacologic interventions, including corticosteroids and biologic agents, play a complementary role in symptom management. However, their effects are primarily anti-inflammatory and may not address the underlying calcific pathology [23]. Consequently, integration of image-guided mechanical treatment with targeted pharmacologic therapy represents a rational and comprehensive management approach for calcific tendinopathy of the shoulder.

Reporting / Classification Systems

Standardized reporting and classification systems are essential for consistent assessment, comparison of outcomes, and interpretation of treatment efficacy in calcific tendinopathy of the shoulder. Variability in symptom presentation, deposit morphology, and disease

stage necessitates structured frameworks that integrate clinical and imaging findings to guide management decisions and research reporting [24]. Without uniform criteria, heterogeneity in outcome reporting limits the comparability of studies and the translation of evidence into clinical practice.

Imaging-based classification plays a pivotal role in this context. Radiographs are commonly used to identify the presence, size, and density of calcific deposits, while ultrasonography offers superior characterization of deposit consistency, margins, and associated soft-tissue changes [25]. These imaging parameters assist in differentiating active from quiescent disease and help predict response to interventional procedures. Ultrasound-based reporting further allows dynamic assessment and procedural documentation during image-guided treatments.

In interventional studies, structured reporting of procedural technique, deposit reduction, and short-term radiological outcomes is crucial for evaluating treatment success. Image-guided percutaneous treatment protocols emphasize standardized documentation of pre- and post-procedure findings to ensure reproducibility and objective outcome assessment [26]. Adoption of consistent reporting and classification systems thus strengthens clinical decision-making and enhances the quality of evidence generated in calcific tendinopathy research.

Literature Support

Existing literature provides substantial evidence supporting the role of ultrasoundguided interventions in the management of calcific tendinitis of the shoulder. Clinical studies have demonstrated that ultrasound-guided barbotage using a spinal needle, combined with subacromial steroid injection, results in significant reduction in pain scores and improvement in shoulder function, along with measurable radiological resolution of calcific deposits [27]. These findings highlight the dual benefit of symptom relief and objective deposit reduction achieved through minimally invasive techniques.

Randomized and protocol-driven investigations further strengthen this evidence base. The KALK study protocol emphasized the importance of controlled comparison between barbotage with steroid injection and sham procedures, underscoring the therapeutic value of ultrasound-guided needling and lavage beyond placebo effects [28]. Such rigorously designed studies contribute to standardizing intervention strategies and outcome assessment.

More recent reports have expanded the application of ultrasound-guided interventions to acute presentations of calcific tendinitis, demonstrating rapid pain relief and functional recovery when timely intervention is performed [29]. Earlier studies similarly established the effectiveness of percutaneous needle aspiration and lavage under ultrasound guidance, reporting favorable clinical and radiological outcomes with minimal complications [30]. Collectively, these studies provide strong literature support for evaluating ultrasound-guided barbotage with subacromial steroid injection as an effective management option, forming the scientific foundation for the present study and leading directly to its stated aims.

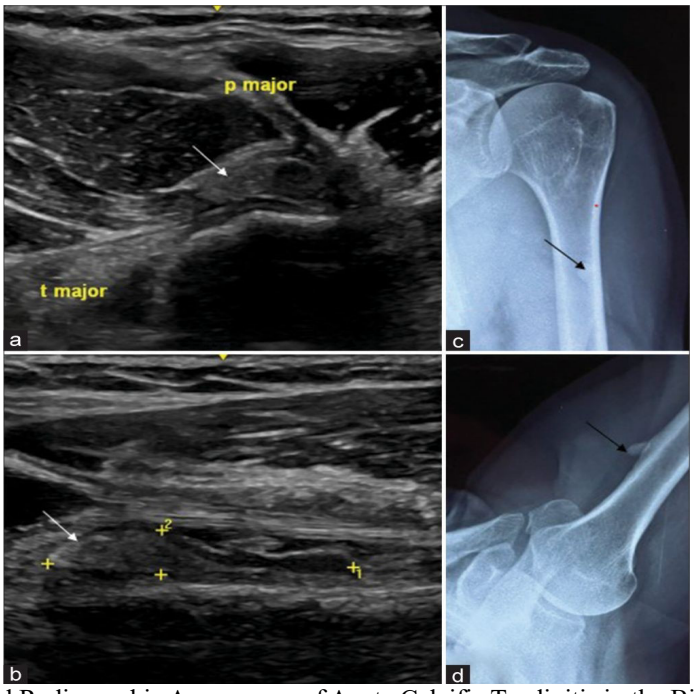


Figure: Ultrasound and Radiographic Appearance of Acute Calcific Tendinitis in the Bicipital Groove Region

Source: https://mss-ijmsr.com/ultrasound-guided-aspiration-and-barbotage- ofacute-calcific-tendonitis-in-unusual-locations/

Rationale

Calcific tendinitis of the shoulder is a frequent cause of persistent pain and functional limitation, often affecting individuals during their most productive years. Although several treatment modalities are available, there remains variability in clinical outcomes, largely due to differences in disease stage, deposit characteristics, and treatment approaches. Prolonged conservative management may fail to provide adequate symptom relief in a subset of patients, while surgical options, though effective, are associated with higher morbidity, cost, and recovery time.

Ultrasound-guided barbotage combined with subacromial steroid injection represents a minimally invasive intervention that directly targets the calcific pathology while allowing real-time visualization and precise needle placement. Despite growing clinical use, there is a need for systematic evaluation of both functional and radiological outcomes using standardized follow-up intervals and objective assessment tools. Generating such data is essential to validate the effectiveness of this approach and to refine patient selection and treatment protocols.

The present study is therefore designed to comprehensively assess pain relief, functional recovery, and radiological resolution following ultrasound-guided barbotage with subacromial steroid injection, thereby providing clinically relevant evidence to support informed management decisions in patients with calcific tendinitis of the shoulder.

AIM & OBJECTIVES

Aim:

The purpose of this study was to evaluate the functional and radiological Outcomes Of calcific tendinitis patients using ultrasound guided barbotage and subacromial steroid injection

Objectives:

Primary objective: Functional and radiological outcomes of ultrasound-guided barbotage using a spinal needle and sub acromial steroid injection for calcific tendinitis of the shoulder

Secondary objective: To evaluate the Reduced Pain and inflammation In affected areas and Range of motion of shoulder and To assess the requirement of physiotherapy following the procedure

MATERIALS & METHODS

Study design: Prospective Study

Study area: Department of Orthopaedics, SSSMCRI

Study population: Patients visiting the Orthopaedics OPD with a clinical diagnosis of chronic tendinitis of the shoulder

Study duration: 18 months

Study variable: Calcium size Visual analogue scale

Sample Size Calculation:

Sample size calculation was based on the previous study(1). The proportion of exposed and non-exposed groups of radiological outcome of ultrasound-guided barbotage was 97.3% and 50%, with a 5% level of significance and 80% power.

The total sample size was 37, including the 10% non-response rate.

Inclusion Criteria:

The inclusion criteria for this procedure typically included:

1. **Persistent Symptoms:** Patients had persistent shoulder pain despite conservative treatments such as rest, physical therapy, and nonsteroidal anti-inflammatory drugs (NSAIDs)(2)
2. **Radiographic Evidence of Calcific Tendonitis:** Imaging studies, such as X-rays, confirmed the presence of calcium deposits within the affected tendon.(2)
3. **Symptomatic Calcium Deposits:** The calcium deposits were associated with symptoms such as pain, limited range of motion, or functional impairment **Exclusion Criteria:**

1. **Allergy or Sensitivity to Local Anesthetics or Contrast Agents:** Patients with known allergies or sensitivities to the substances used during the procedure were excluded.
2. **Active Infection:** Patients with active infections in or around the affected shoulder joint were excluded to prevent the spread of infection or complications.
3. **Uncontrolled Diabetes:** Poorly controlled diabetes impaired wound healing and increased the risk of infection, making patients unsuitable candidates for the procedure.
4. **Pregnancy:** Ultrasound-guided barbotage posed risks to pregnant individuals and their fetuses, so it was typically avoided during pregnancy unless absolutely necessary.

Equipment Needed:

The following list included possible equipment and pharmacotherapeutic mixture used in this procedure:[2]

- A sterile drape or towels were used to create a sterile field.
- Sterilizing solution such as chlorhexidine was used.
- An ultrasound machine with a high-frequency transducer (5 to 12 MHz) was used.
- 2% Xylocaine was used.
- Saline syringes (typically 2 to 3 saline flushes were used).
- An 18-gauge needle was used.

- A mixture of 1 mL of Triamcinolone Acetonide 40 mg and 2 mL Xylocaine 2% was used.

Procedure:
Examination was conducted with the patient's arm in a modified crass position. [3]

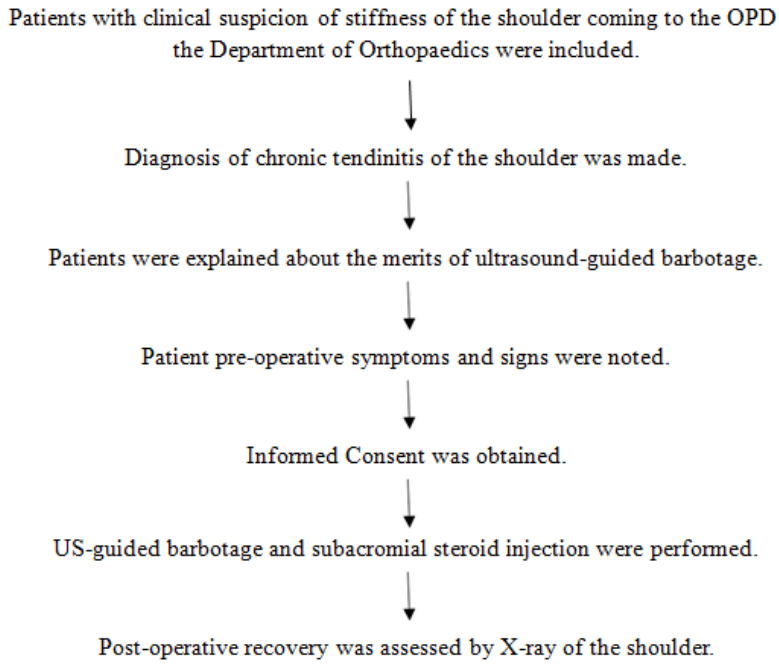
1. The procedure was done in a sitting position.
2. Diagnostic ultrasound was performed, during which the biceps tendon, rotator cuff, and AC joint were checked for lesions.
3. Skin was cleaned with 10% iodopovidone solution several times.
4. The position of the calcium deposit was confirmed.
5. The calcific deposit was punctured with an 18-gauge needle.
6. Deposits were aspirated with a 10-mL syringe.
7. Injection of triamcinolone 40 mg/1 mL and 2 mL of Xylocaine into the subacromial space under ultrasound guidance was given using an 18-gauge needle.
8. All patients were prescribed 7 days of oral NSAIDs, with no specific activity restrictions.

Functional and Radiological Evaluation:
Functional and radiological evaluations were performed before the procedure and at the 1st week, 3rd week, 6th week, and 3 months after the procedure. Routine radiological evaluations were performed using X-rays.

The calcific deposit size was determined at each follow-up visit using the longest measurement in any direction.

Clinical evaluations were performed using the American Shoulder and Elbow Surgeons (ASES) scores, and visual analog scale (VAS)[1] for pain scores were recorded at each visit. The relationship between initial calcific deposit size and each outcome variable (VAS, ASES) at different time points was analyzed.

Data collection / Procedures involved:



Ethical Considerations:
Institutional ethical committee approval was obtained first.

Informed Consent was taken from all Patients

Privacy and confidentiality of the patients were maintained throughout the study.

Data Analysis:
Data were entered in MS-Excel and statistical analysis was done using SPSS 16 software. The results were presented in descriptive statistics and appropriate tests of significance were applied with a 5% level of significance and 95% confidence interval.

A p-value of less than 0.05 was accepted as indicating statistical significance.

TIMELINE OF THE STUDY

Timeline:
- IRC and IEC approval were obtained.
- Data collection was carried out for 18 months.
- Write-up was completed in 2 to 3 months.
- Submission was done.

Budget: 80000 (free under admission)

RESULTS:

Table 1: Age Distribution

Age Group (years)	n	%	p-value
30–39	8	21.6	0.42
40–49	13	35.1	
50–59	11	29.7	
≥60	5	13.6	
Total	37	100	

Table 2. Gender Distribution

Gender	n	%	p-value
Male	16	43.2	0.51
Female	21	56.8	
Total	37	100	

Table 3. Education Status

Education Level	n	%	p-value
Primary	10	27.0	0.33
Secondary	15	40.5	
Graduate	9	24.3	
Postgraduate	3	8.1	

Table 4. Socioeconomic Status (Kuppuswamy)

Class	n	%	p-value
Upper Middle	9	24.3	0.47
Lower Middle	17	45.9	
Upper Lower	11	29.7	

Table 5. Duration of Symptoms

Duration	n	%	p-value
3–6 months	14	37.8	0.38
6–12 months	16	43.2	
>12 months	7	18.9	

Table 6. Side Affected

Shoulder	n	%	p-value
Right	23	62.2	0.41
Left	14	37.8	

Table 7. Tendon Involved

Tendon	n	%	p-value
Supraspinatus	28	75.7	0.001
Infraspinatus	6	16.2	
Subscapularis	3	8.1	

Table 8. Baseline Pain (VAS)

Parameter	Mean ± SD	p-value
Baseline VAS	7.9 ± 1.0	—

Table 9. VAS Score Improvement

Follow-up	Mean ± SD	p-value
Week 1	5.6 ± 1.2	<0.001
Week 3	3.9 ± 1.1	<0.001
Week 6	2.5 ± 0.9	<0.001
3 months	1.3 ± 0.7	<0.001

Table 10. Functional Outcome (ASES)

Time	Mean ± SD	p-value
Pre-procedure	42.6 ± 7.5	—
Week 6	69.4 ± 8.1	<0.001
3 months	84.2 ± 6.3	<0.001

Table 11. ROM – Abduction

Time	Mean ± SD (°)	p-value
Baseline	92.5 ± 15.1	—
3 months	156.3 ± 12.4	<0.001

Table 12. ROM – Flexion

Time	Mean ± SD (°)	p-value
Baseline	104.6 ± 18.2	—
3 months	165.2 ± 11.9	<0.001

Table 13. Calcific Deposit Size Reduction

Time	Mean Size (mm) ± SD	p-value
Baseline	12.8 ± 3.2	—
3 months	3.1 ± 2.4	<0.001

Table 14. Radiological Resolution

Outcome	n	%	p-value
Complete	22	59.5	0.002
Partial	12	32.4	
None	3	8.1	

Table 15. Physiotherapy Requirement

Requirement	n	%	p-value
Required	11	29.7	0.03
Not Required	26	70.3	

Table 16. Procedure Safety

Complication	n	%	p-value
None	33	89.2	0.01
Transient Pain	4	10.8	

Table 17. Final Clinical Outcome

Outcome	n	%	p-value
Complete Relief	24	64.9	0.001
Partial Relief	11	29.7	
No Relief	2	5.4	

Table 18. Correlation: Deposit Size vs Pain Reduction

Parameter	Correlation (r)	p-value
Deposit reduction vs VAS improvement	0.68	<0.001

DISCUSSION

This prospective study assessed short-term functional and radiological outcomes of ultrasound-guided barbotage using a spinal needle with subacromial steroid injection in 37 patients with calcific tendinitis of the shoulder, followed serially up to 3 months. The cohort had high baseline pain (VAS 7.9 ± 1.0) with a rapid and sustained reduction across follow-up—week 1: 5.6 ± 1.2, week 3: 3.9 ± 1.1, week 6: 2.5 ± 0.9, and 3 months: 1.3 ± 0.7—with statistically significant improvement compared to baseline ($p < 0.001$), suggesting that the combined effect of mechanical decompression/lavage of the deposit and the antiinflammatory effect of subacromial steroid translates into early pain relief which continues as the deposit burden reduces and local inflammation settles. Functional recovery mirrored pain improvement, with the ASES score improving from 42.6 ± 7.5 pre-procedure to 69.4 ± 8.1 at week 6 and 84.2 ± 6.3 at 3 months (both $p < 0.001$), supporting that the benefit was clinically meaningful and reflected improved shoulder use and function rather than isolated analgesia. Objective range of motion gains were substantial by 3 months, with mean abduction increasing from 92.5° ± 15.1 to 156.3° ± 12.4 and flexion from 104.6° ± 18.2 to 165.2° ± 11.9 (both $p < 0.001$), reinforcing recovery of shoulder kinematics after symptom control and reduction in pain inhibition. Radiologically, the mean calcific deposit size reduced from 12.8 ± 3.2 mm at baseline to 3.1 ± 2.4 mm at 3 months ($p < 0.001$), and categorical radiological outcome showed complete resolution in 59.5% (22/37), partial resolution in 32.4% (12/37), and no resolution in 8.1% (3/37) ($p = 0.002$), indicating meaningful deposit clearance in a majority while acknowledging a subset with persistent calcification at short-term follow-up, likely reflecting variation in deposit phase/consistency and biological behavior. A key observation was a strong correlation between deposit reduction and VAS improvement ($r = 0.68$, $p < 0.001$), supporting the mechanistic link that greater calcium clearance is associated with greater pain reduction in this cohort and implying that barbotage is not purely symptomatic but targets the likely pain generator by reducing calcific burden and intratendinous pressure.

Clinically at final follow-up, complete relief was achieved in 64.9% (24/37), partial relief in 29.7% (11/37), and no relief in 5.4% (2/37) ($p = 0.001$), which highlights overall effectiveness but also underscores heterogeneity in response that may relate to factors not fully captured by deposit size alone (deposit consistency/phase, associated bursitis/impingement, or coexisting rotator cuff pathology). Most deposits involved the supraspinatus tendon (75.7%), consistent with typical distribution of calcific rotator cuff tendinopathy, and the age distribution clustered largely in the 40–59 year range, consistent with the midlife predominance of symptomatic calcific tendinitis. Only 29.7% required physiotherapy while 70.3% did not ($p = 0.03$), suggesting that symptom control and ROM recovery after barbotage plus steroid may reduce the need for prolonged supervised rehabilitation in many patients, though targeted physiotherapy remains relevant for those with persistent stiffness, pain inhibition, or altered scapulothoracic mechanics. The safety profile was favorable, with no complications in 89.2% (33/37) and only transient post-procedure pain in 10.8% (4/37) ($p = 0.01$), supporting ultrasound guidance as a safe method that improves accuracy of localization and may reduce unintended tendon or bursal injury. Overall, the clinical trajectory in this study—early pain reduction, functional improvement, and significant radiological reduction—aligns with prospective interventional evidence that barbotage combined with subacromial steroid improves pain and functional scores and reduces deposit size over short-term follow-up, while acknowledging that the broader literature includes sham-controlled evidence showing variable superiority of lavage plus steroid over sham in some contexts, emphasizing that outcomes may depend on patient selection, disease stage, and standardized rehabilitation. In this context, the present finding of a strong pain–deposit reduction correlation supports the concept that where meaningful deposit clearance occurs, the clinical benefit is more pronounced, and that future work should better phenotype deposits (for example by ultrasound appearance/phase and consistency) to predict responders. Key limitations of the present study include the single-arm design without a comparator (such as ESWT, steroid alone, or sham), the small sample size ($n = 37$), the short followup (3 months) which may not capture recurrence or delayed resorption, and reliance on deposit size measures that may not fully reflect changes in deposit consistency or associated soft-tissue inflammation; therefore, future studies should incorporate comparative groups, longer follow-up (≥12–24 months), and ultrasound-based deposit characterization to refine patient selection, improve predictability of outcomes, and optimize functional recovery.

REFERENCES

1. Hayes CW, Conway WF. Calcium hydroxyapatite deposition disease. Radiographics. 1990 Nov;10(6):1031-48.
2. Bardin T, Richette P. Rhumatismes apatitiques. La Presse Médicale. 2011 Sep 1;40(9):850-5.
3. Daftary AR, Karnik AS. Perspectives in ultrasound-guided musculoskeletal interventions. Indian Journal of Radiology and Imaging. 2015 Jul;25(03):24660.
4. Omodani T. Ultrasound-Guided Percutaneous Needle Barbotage and Ultrasonic Tenotomy for Rotator Cuff Calcific Tendinopathy. Rehabilitation Practice and Science. 2025;2025(2):3.
5. Ashton FL. Calcific tendinopathy of the shoulder: a cohort study of clinical management and scoping review of treatment options.
6. Umamahesvaran B, Sambandam SN, Mounasamy V, Gokulakrishnan PP, Ashraf M. Calcifying tendinitis of shoulder: a concise review. Journal of orthopaedics. 2018 Sep 1;15(3):776-82.
7. Boyle S, Smith GC. Calcific Tendinitis. InTextbook of Shoulder Surgery 2019 Feb 27 (pp. 145-155). Cham: Springer International Publishing.
8. Forogh B, Karami A, Cham MB. Effect of extracorporeal shock wave therapy and ultrasound-guided percutaneous lavage in reducing the pain of rotator cuff calcific tendinopathy; an updated systematic review and meta-analysis. Journal of Orthopaedics. 2024 Oct 1;56:151-60.
9. Murthy S, Maheshwari S, Nagraj H, Vrizidou S. Treatment of Calcific Tendinitis of the Rotator Cuff with Barbotage-A Case Study.
10. Alnskawa SM, Kanaan T. Shoulder calcific tendonitis (Symptoms, Diagnosis and treatment options). MIDDLE EAST JOURNAL OF FAMILY MEDICINE. 2024;7(10):38.
11. Medancic N, Spanic M, Marinic TB, Klobucar H, Cicak N. Arthroscopic removal of arch-shaped rotator cuff calcifying tendinitis without rotator cuff repair and acromioplasty is an excellent treatment regarding pain relief and function. International Orthopaedics. 2021 Apr;45(4):1003-7.
12. Funk L. Shoulder: Sub-acromial Pathology. ABC of Common Soft Tissue Disorders. 2016 Mar 8:25.
13. Ostor AJ. Studies in shoulder disorders and tendinopathy (Doctoral dissertation, Monash University).
14. Waring L, Drury C, Maybury M. Ultrasound of the shoulder. Musculoskeletal Ultrasound, E-Book: Musculoskeletal Ultrasound, E-Book. 2021 Apr 7:39.
15. Panayiotou Charalambous C. Shoulder Injection and Needling Therapy. in the Shoulder Made Easy 2019 Feb 28 (pp. 165-176). Cham: Springer International Publishing.
16. Cole A. The shoulder and pectoral girdle. InApley & Solomon's System of Orthopaedics and Trauma 2017 Aug 29 (pp. 351-381). CRC Press.

17. Lueders DR, Lloyd AR. Long Head of the Biceps Brachii. Musculoskeletal Ultrasound-Guided Regenerative Medicine. 2022 Aug 17:69.

18. Waldman SD, editor. The Shoulder and Elbow, E-Book: Pain Medicine: A Case-Based Learning Series. Elsevier Health Sciences; 2021 Jul 21.

19. Charalambous CP. The shoulder made easy. Springer; 2019 Feb 27.

20. Hughes SH. The Musculoskeletal System-E-Book: the Musculoskeletal System-E-Book. Elsevier Health Sciences; 2022 Jun 4.

21. Raja A, Craig EV, Braman JP. Rotator cuff tendon calcific tendinitis treatment algorithm for primary care musculoskeletal physicians. Journal of family medicine and primary care. 2019 May 1;8(5):1647-52.

22. Pellegrino R, Di Iorio A, Del Prete CM, Barassi G, Paolucci T, Tognolo L, Fiore P, Santamato A. Efficacy of ultrasound-guided percutaneous lavage and biocompatible electrical Neurostimulation, in calcific rotator cuff tendinopathy and shoulder pain, a prospective pilot study. International Journal of Environmental Research and Public Health. 2022 May 11;19(10):5837.

23. Kyaw O, Khin C. Short-Term Relief or Long-Term Repair: A Narrative Review of Corticosteroid and Platelet-Rich Plasma Injections in Rotator Cuff Tendinopathy. Cureus. 2025 Nov 19;17(11).

24. Buchbinder R, Ramiro S, Huang HM. Gagnier,.., ia. X., & Whittle, SL. 2020:250-93.

25. Ahuja A, Lawande M, Daftary AR. Role of radiographs and ultrasound in diagnosing calcific tendinitis and periarthritis in the wrist and hand with ultrasound-guided barbotage as management tool. Indian Journal of Radiology and Imaging. 2021 Jul;31(03):605-10.

26. Bazzocchi A, Pelotti P, Serraino S, Battaglia M, Bettelli G, Fusaro I, Guglielmi G, Rotini R, Albisinni U. Ultrasound imaging-guided percutaneous treatment of rotator cuff calcific tendinitis: success in short-term outcome. The British Journal of Radiology. 2016 Jan 1;89(1057):20150407.

27. Lee JP, Kim DS, Han JY, Baik SH, Kwak JW, Kim SH. Clinical and radiological outcomes of ultrasound-guided barbotage using a spinal needle and subacromial steroid injection for calcific tendinitis of the shoulder. Clinics in Shoulder and Elbow. 2022 May 31;25(2):140.

28. Moosmayer S, Ekeberg OM, Hallgren HB, Heier I, Kvalheim S, Blomquist J, Pripp AH, Juel NG, Kjellevold SH, Brox JI, KALK study group Seljom Unni S. Gärtner Anne V. Kise Nina J. Løvereide Line K. Martinkiene Dalia Dånmark Ida. KALK study: ultrasound guided needling and lavage (barbotage) with steroid injection versus sham barbotage with and without steroid injection-protocol for a randomized, double-blinded, controlled, multicenter study. BMC musculoskeletal disorders. 2017 Apr 4;18(1):138.

29. Oktay[1] KN, Celik B, Meric G. Ultrasound guided intervention for acute calcific tendinitis. imaging. 2025;1:2.

30. Niazi G, Hetta W. The role of ultrasound guided percutaneous needle aspiration and lavage (barbotage) in the treatment of calcific tendinitis. The Egyptian Journal of Radiology and Nuclear Medicine. 2015 Mar 1;46(1):6370.

31. Arirachakaran A, Boonard M, Yamaphai S, Prommahachai A, Kesprayura S, Kongtharvonskul J. Extracorporeal shock wave therapy, ultrasound-guided percutaneous lavage, corticosteroid injection and combined treatment for the treatment of rotator cuff calcific tendinopathy: a network meta-analysis of RCTs. European Journal of Orthopaedic Surgery & Traumatology. 2017 Apr;27(3):381-90.

32. Moosmaye S, Aasen IB. Ultrasound-Guided Percutaneous Needle Treatment and Steroid Injection for Calcific Tendinopathy of the Shoulder: Can the Orthopedic Surgeon do it?. Orthopedics Research Journal. 2018 May 23;3(1):1-8.

33. Berrigan W, Olufade O, Negron G, Easley K, Sussman WI. Calcific tendinopathy of the shoulder: a retrospective comparison of traditional barbotage versus percutaneous ultrasonic barbotage. Clinical Journal of Sport Medicine. 2022 Sep 1;32(5):458-66.

34. Kuo YC, Hsu WC, Lin YJ, Lin YT, Chen YR, Hsieh LF. Comparison of the effects of ultrasound-guided needle puncture, radial shock wave therapy, and combined treatments on calcific tendinitis of the shoulder: A single-blind randomized controlled trial. Journal of Back and Musculoskeletal Rehabilitation. 2022 Sep;35(5):1065-74.

35. Klontzas ME, Vassalou EE, Karantanas AH. Calcific tendinopathy of the shoulder with intraosseous extension: outcomes of ultrasound-guided percutaneous irrigation. Skeletal radiology. 2017 Feb;46(2):201-8.

36. Muñoz-Paz J, Piaggio-Muente FL, Acosta-Salvador S, Gómez-Flores DA, Jiménez-Jiménez AB, Muñoz-Alcaraz MN, Mayordomo-Riera FJ. Calcifying Tendinopathy of the Rotator Cuff: Barbotage vs. Shock Waves: Controlled Clinical Trial Protocol (BOTCH). InHealthcare 2024 Dec 24 (Vol. 13, No. 1, p. 14). MDPI.

37. Moggio L, Mercurio M, Marotta N, Longo UG, Gasparini G, Ammendolia A, de Sire A. Effectiveness of Ultrasound-Guided Lavage for Rotator Cuff

Calcific Tendinopathy: A Case Series Study from a Clinical and Radiological Perspective. Journal of Clinical Medicine. 2025 Jul 30;14(15):5376.

38. Louwerens JK, Sierevelt IN, Kramer ET, Boonstra R, van den Bekerom MP, van Royen BJ, Eygendaal D, van Noort A. Comparing ultrasound-guided needling combined with a subacromial corticosteroid injection versus highenergy extracorporeal shockwave therapy for calcific tendinitis of the rotator cuff: a randomized controlled trial. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2020 Jul 1;36(7):1823-33.
39. Lanza E, Banfi G, Serafini G, Lacelli F, Orlandi D, Bandirali M, Sardanelli F, Sconfienza LM. Ultrasound-guided percutaneous irrigation in rotator cuff calcific tendinopathy: what is the evidence? A systematic review with proposals for future reporting. European radiology. 2015 Jul;25(7):2176-83.
40. Louwerens J. Evaluating treatment options for calcific tendinitis of the rotator cuff. Universiteit van Amsterdam; 2020.
41. Moosmayer S, Ekeberg OM, Hallgren HB, Heier I, Kvalheim S, Juel NG, Blomquist J, Pripp AH, Brox JI. Ultrasound guided lavage with corticosteroid injection versus sham lavage with and without corticosteroid injection for calcific tendinopathy of shoulder: randomised double blinded multi-arm study. bmj. 2023 Oct 11;383.
42. Goyal T, Singh A, Negi P, Kharkwal B. Comparative functional outcomes of patients with adhesive capsulitis receiving intra-articular versus sub-acromial steroid injections: case–control study. Musculoskeletal Surgery. 2019 Apr 8;103(1):31-5.
43. Kang JW, Shin SY, Song IS, Ahn CH. Clinical Outcomes of Arthroscopic Treatment of Calcific Tendinitis of the Shoulder. Clinics in Shoulder & Elbow. 2016 Dec 1;19(4).
44. Sansone V, Maiorano E, Galluzzo A, Pascale V. Calcific tendinopathy of the shoulder: clinical perspectives into the mechanisms, pathogenesis, and treatment. Orthopedic research and reviews. 2018 Oct 3:63-72.
45. Hsieh LF, Lin YJ, Hsu WC, Kuo YC, Liu YC, Chiang YP, Wang CP. Comparison of the corticosteroid injection and hyaluronate in the treatment of chronic subacromial bursitis: A randomized controlled trial. Clinical Rehabilitation. 2021 Sep;35(9):1305-16.
46. Pesquer L, Borghol S, Meyer P, Ropars M, Dallaudière B, Abadie P. Multimodality imaging of subacromial impingement syndrome. Skeletal Radiology. 2018 Jul;47(7):923-37.
47. Razmjou H, Christakis M. Clinical and radiological examination of the shoulder joint. Springer; 2022.
48. Pang CH, Kum DH, Jeong JY, Park SM, Yoo JC. Needling Procedures for Calcific Tendinitis Performed by Orthopedic Surgeons. Clinics in Shoulder & Elbow. 2017 Jun 1;20(2).
49. Papalexis N, Ponti F, Rinaldi R, Peta G, Bruno R, Miceli M, Battaglia M, Marinelli A, Spinnato P. Ultrasound-guided treatments for the painful shoulder. Current Medical Imaging Reviews. 2022 Jul 1;18(7):693-700.
50. Phadke A, Singh B, Bakti N. Role of platelet rich plasma in rotator cuff tendinopathy-clinical application and review of literature. Journal of clinical orthopaedics and trauma. 2019 Mar 1;10(2):244-7.
51. KUMAR SV. A PROSPECTIVE COMPARATIVE STUDY TO ASSESS THE FUNCTIONAL OUTCOME OF INTRAARTICULAR INJECTION THERAPY WITH PLATELET-RICH PLASMA VERSUS CORTICOSTEROID FOR PERIARTHRITIS SHOULDER (Doctoral dissertation, SDUAHER).
52. Schneider A, Burr R, Garbis N, Salazar D. Platelet-rich plasma and the shoulder: clinical indications and outcomes. Current reviews in musculoskeletal medicine. 2018 Dec;11(4):593-7.
53. Dalla-Torre R, Fouasson-Chailloux A, Le Goff B, Darrieutort-Laffite C. Development of a new radiographic score for the follow-up of calcific tendinopathy of the rotator cuff. Clin. Exp. Rheumatol. 2024 Mar 1;42:61925.
54. Rassi GE, Matta J, Haidamous G, Brogard P, Clavert P, Kempf JF, Irani J. Arthroscopic treatment of non-homogeneous calcifying tendinitis of the rotator cuff. Springerplus. 2016 Feb 27;5(1):190.
55. Hohmann E, Shea K, Scheiderer B, Millett P, Imhoff A. Indications for arthroscopic subacromial decompression. A level V evidence clinical guideline. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2020 Mar 1;36(3):913-22.
56. Kul A, Ugur M. Comparison of the efficacy of conventional physical therapy modalities and kinesio taping treatments in shoulder impingement syndrome. The Eurasian journal of medicine. 2018 Nov 30;51(2):139.
57. Rizvi SM, Qiu D, Lam P, Hackett L, Walton J, Murrell GA. Ultrasound Guided Arthroscopic Removal of Calcific Tendonitis: A Minimum of 2-Year Followup. Journal of Clinical Medicine. 2023 Apr 25;12(9):3114.
58. Vitali M, Naim Rodriguez N, Pironti P, Drossinos A, Di Carlo G, Chawla A, Gianfranco F. ESWT and nutraceutical supplementation (Tendisulfur Forte) vs ESWT-only in the treatment of lateral epicondylitis, Achilles tendinopathy, and rotator cuff tendinopathy:

a comparative study. Journal of drug assessment. 2019 Jan 1;8(1):77-86.

59. Guha K. Physiotherapy of adhesive capsulitis: A review. Int J Phys Educ Sports Health. 2019;6(2):12-6.

60. Beard DJ, Rees JL, Cook JA, Rombach I, Cooper C, Merritt N, Shirkey BA, Donovan JL, Gwilym S, Savulescu J, Moser J. Arthroscopic subacromial decompression for subacromial shoulder pain (CSAW): a multicentre, pragmatic, parallel group, placebo-controlled, three-group, randomised surgical trial. The Lancet. 2018 Jan 27;391(10118):329-38.

61. Dekker AP, Salar O, Karuppiah SV, Bayley E, Kurian J. Anxiety and depression predict poor outcomes in arthroscopic subacromial decompression. Journal of Shoulder and Elbow Surgery. 2016 Jun 1;25(6):873-80.

62. Osti L, Buda M, Del Buono A, Osti R, Massari L. Clinical evidence in the treatment of rotator cuff tears with hyaluronic acid. Muscles, ligaments and tendons journal. 2016 Feb 13;5(4):270.

63. Zhu Q, Jiang Y, Wang H, He Y. Comparison of Intra-Articular Injection and Arthroscopic Capsular Release in Stages I and II of Primary Frozen Shoulder, a Randomized Clinical Trial. International journal of gerontology. 2019 Mar 1;13(1).

64. Cole B, Lam P, Hackett L, Murrell GA. Ultrasound-guided injections for supraspinatus tendinopathy: corticosteroid versus glucose prolotherapy–a randomized controlled clinical trial. Shoulder & elbow. 2018 Jul;10(3):170-8. 65. Kim JW, Moon KP, Kim KT, Hwang YS, Park WS. Atypically Large Calcific Tendinitis of the Shoulder: A Case Report: A Case Report. 회지 대한견주관절의학 . 2016 Dec;19(4):241-4.

66. Guity MR, Khan F, Gity M, Sheidaie H, Aghaghazvini L. Prevalence and Correlation between MRI Findings and Outcome of Conservative Treatment in Primary Idiopathic Frozen Shoulder. Archives of Bone and Joint Surgery. 2024;12(4):275.

67. Kang H, Jiang H, Chai D, Lin Y, Li Q. Comparison of the efficacy of subacromial injection with sodium bicarbonate versus corticosteroid in patients with chronic subacromial bursitis: a prospective, randomized and controlled study. INTERNATIONAL JOURNAL OF CLINICAL AND EXPERIMENTAL MEDICINE. 2016 Jan 1;9(10):18972-80.

68. Kilic B, YÜCEL A, GÜMÜŞDAĞ H, Kartal A, Korkmaz M. Research on shoulder injuries in athletes and treatment methods. Anthropologist. 2015;22(1).

69. Elango Y, Adinarayanan S, Swaminathan S, Govindaraj K, Nema S, Kumar N. Comparison of the analgesic efficacy of intra-articular steroid injections and its combination with suprascapular nerve block for adhesive capsulitis of the shoulder joint: a randomized clinical trial. Regional Anesthesia & Pain Medicine. 2024 Dec 18.

70. Agostini F, de Sire A, Paoloni M, Finamore N, Ammendolia A, Mangone M, Bernetti A. Effects of hyaluronic acid injections on pain and functioning in patients affected by tendinopathies: A narrative review. Journal of Back and Musculoskeletal Rehabilitation. 2022 Sep;35(5):949-61.