"THE FUNCTIONAL OUTCOME IN PATIENTS UNDERGOING HYDRODILATATION FOR ADHESIVE CAPSULITIS OF SHOULDER IN A TERTIARY CARE HOSPITAL - A ONE YEAR LONGITUDINAL STUDY"

By

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LIST OF ABBREVATIONS

ROM	Range of motion
NSAIDs	Non -steroidal anti- inflammatory drugs
GH	Glenohumeral joint
AC	Acromioclavicular
SC	Sternoclavicular
CHL	Coracohumeral Ligament
VAS	Visual Analog scale
SPADI	Shoulder Pain and Disability Index
MRI	Magnetic resonance imaging

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ABSTRACT

Background: - Shoulder pain and restricted ROM is a common presenting condition to orthopaedic outpatient department. There are many causes for this clinical presentation and one of the most common causes is Adhesive capsulitis also known as Frozen shoulder. It is described as a contracted thickened joint capsule that seemed to be drawn tightly around the humeral head with a relative absence of synovial fluid and chronic inflammatory changes within the sub synovial layer of capsule. Primary Adhesive capsulitis is estimated to affect 2% of the general population and many secondary conditions of shoulder joint are often misdiagnosed under this heading as periarthritis of shoulder. Capsule of glenohumeral joint is mainly affected in this condition.

Many treatment options have been described like benign neglect, oral NSAIDs, Physical therapy, joint mobilization, intra articular steroids or PRP injections, Suprascapular nerve blocks, hydrodilatation, manipulation under anaesthesia, arthroscopic release and open release of contractures.

Hydrodilatation has a distinct benefit over other surgical procedures for frozen shoulder, the main benefit being no requirement for general anaesthesia which makes it a very attractive treatment option for patients with multiple comorbidities. With this background of inconclusive evidence for treatment modalities, there is a need to examine the efficacy of hydrodilatation in frozen shoulder.By this study we basically want to study the effectiveness of hydrodilatation in our clinical setup in people in the age group most commonly being affected, for primary frozen shoulder.

Materials and Methods: - Study was conducted in KLE'S Dr. Prabhakar Kore Hospital & MRC for one year. It is a longitudinal study with 2weeks,6 weeks and 3 months follow up using VAS and SPADI score. A total of 36 patients, above the age of 30years of both sexes being diagnosed for the first time and not treated by another modality, fulfilling the inclusion criteria of shoulder pain for at least 1 month.

Patients with haematological disorders or on anticoagulant therapy, Rheumatoid arthritis, autoimmune or inflammatory arthropathies, history of surgery on the particular shoulder, infection, fracture of the shoulder girdle complex, neuromuscular diseases, secondary frozen shoulder, Any local skin pathology at injection site and not willing to participate in the study were excluded from the study. Patients were subjected to routine blood investigation, x-ray.

Patients were treated with hydrodilatation using 40mL of normal saline. The patients were evaluated for Visual analogue scale & SPADI score at the time of the injection at the end of 2weeks, 6weeks & at the end of 3 months.

Results: - In this study**,** There was a statistically significant decrease in VAS score and SPADI with P value <0.001 at 2 weeks, 6 weeks and 3month of follow up.

Conclusion: - Hydrodilatation yields a satisfactory functional outcome in patients with adhesive capsulitis. It is a safe, easier and cost-effective treatment modality in the management of adhesive capsulitis. However more studies are required to evaluate the efficacy of PRP over long term with multi centric study & comparison with the current available treatment options.

Key words: Adhesive capsulitis, Hydrodilatation

INTRODUCTION

Adhesive capsulitis, or "frozen shoulder," is an aching and disabling condition which results in gradual and progressive limitation of both active and passive range of motion (ROM) of the shoulder joint, frequently with a pattern of capsular restriction [1]. Codman originally described this in 1934 as a condition of classic shoulder pain and stiffness with progressively lost motion [2]. Over time, the research has identified adhesive capsulitis as a clinical syndrome resulting from fibroblastic proliferation in the joint capsule and related synovial inflammation that results in thickening and tightening of the capsule [3]. The patient typically reports that the condition does indeed impact severely activities of daily living—ranging from basic tasks such as dressing and personal hygiene to intricate movements in the context of work or leisure activity—which renders it profoundly debilitative for functional capacity [4].

Although extensive research over many decades, the precise etiology of adhesive capsulitis is still multifactorial, likely involving inflammatory, biochemical, and mechanical mechanisms. Histopathological studies have demonstrated increased numbers of fibroblasts and myofibroblasts that lead to hyperplastic collagen deposition in the joint capsule [5]. This process can be precipitated or exacerbated by local or systemic factors such as diabetes mellitus, thyroid disorders, dyslipidemia, and post-surgical or post-traumatic immobilization [6]. Certain patient populations show a higher propensity for developing adhesive capsulitis, including individuals between 40 and 60 years of age, females more than males, and those with metabolic conditions—particularly diabetes, in whom the incidence of adhesive capsulitis is notably higher [7][8]. Although there is a consensus that the pathophysiological mechanism involves synovial inflammation followed by capsular fibrosis, the exact trigger and progression of these processes remain incompletely understood [9].

Adhesive capsulitis has been classically divided into primary (idiopathic) and secondary forms. Primary adhesive capsulitis arises in the absence of a known intrinsic shoulder or systemic disorder, whereas secondary adhesive capsulitis develops in the presence of an identifiable pathology, such as rotator cuff disease, glenohumeral arthritis, or after prolonged immobilization [10]. Regardless of the subtype, the clinical course typically follows three overlapping phases: a painful or “freezing” phase, with predominant pain, gradually decreasing ROM, and nocturnal discomfort; a stiff or “frozen” phase, characterized by a plateau of severe ROM limitation; and a resolution or “thawing” phase, wherein mobility gradually improves, sometimes taking up to two or three years [11]. This prolonged course highlights challenges both for patients and clinicians; therefore, successful intervention strategies that prevent chronic stiffness and restore function are needed.

Various interventions have been proposed to treat adhesive capsulitis, including NSAIDs, physical therapy, intra-articular corticosteroid injections, arthrographic distension (also referred to as hydrodilatation), manipulation under anesthesia, and arthroscopic capsular release [12]. Among these, hydrodilatation has gained considerable attention as a minimally invasive procedure. This can be done either in a radiological suite under fluoroscopic and ultrasound guidance or in an outpatient clinical setting by orthopedic surgeons and interventional radiologists [13]. In hydrodilatation, the glenohumeral joint is dilated using a mixture of saline, local anesthetic, and corticosteroid until mechanical or symptomatic endpoints are achieved. Usually, it involves a feeling of a stiff joint capsule “giving” during the process [14]. The treatment is based on the concept of breaking the adhesions and the contracted capsule and thus may be able to interrupt the cycle of pain and limited motion [15].

The theoretical basis for hydrodilatation involves both mechanical and chemical mechanisms. Mechanically, the instilled fluid under pressure forces the contracted capsule of the joint to expand; it breaks up adhesions and allows more glenohumeral movement [16]. Chemically, the addition of local anesthetics and corticosteroids helps reduce inflammation, decrease pain, and may inhibit fibrotic changes in the capsule [17]. It thus addresses two of the major pathophysiological pillars in adhesive capsulitis: the inflammatory component (with corticosteroids) and the mechanical restriction (with fluid distension). Hydrodilatation is also a relatively low-risk procedure done on an outpatient basis, presenting an attractive alternative to more invasive approaches such as manipulation under anesthesia or surgical capsular release, which generally carry a greater risk of complications and typically require more health resources [18].

Hydrodilatation has been tested in various studies regarding clinical outcomes, with several reporting improvement and a good range of pain relief and shoulder functions [19]. The magnitude and durability of these benefits, however, can vary. While some investigations have noted sustained functional gains and reduced pain over follow-up periods ranging from six months to one year, others suggest that hydrodilatation may provide only transient benefit or show no clear superiority compared to simpler interventions such as intra-articular steroid injections alone [20]. These discrepancies in findings could be attributed to differences in patient populations, comorbidities, details of hydrodilatation techniques, and the timing of intervention during the disease course [21]. Thus, there remains a need for more longitudinal research to elucidate the factors that best predict a positive response to hydrodilatation in patients with adhesive capsulitis.

In addition to studying the absolute benefits of hydrodilatation, assessing functional outcomes over time is of paramount importance. For many patients, pain is not the sole concern; limitations in daily tasks such as lifting, reaching overhead, or performing self-care activities are often more debilitating [22]. Therefore, validated outcome measures like the Constant-Murley Score, Disabilities of the Arm, Shoulder and Hand questionnaire, or the Shoulder Pain and Disability Index are commonly employed to gauge improvements in functional capacity following interventions for adhesive capsulitis [23]. These tools enable clinicians and researchers to quantify the real-world impact of treatments, ensuring that reported improvements translate into meaningful gains in patients' quality of life.

Beyond the immediate and intermediate efficacy of hydrodilatation, there are important considerations related to treatment in the context of a tertiary care hospital. Tertiary centers often receive patients with more complex or refractory conditions, including those with multiple comorbidities or persistent adhesive capsulitis unresponsive to initial treatments [24]. Additionally, tertiary care settings may have access to advanced imaging modalities for guiding hydrodilatation, experienced multidisciplinary teams, and robust follow-up protocols [25]. These factors might influence the overall outcomes of hydrodilatation compared to community or primary care settings, and also allow for a systematic evaluation of longitudinal results.

Furthermore, understanding the long-term trajectory of patients treated with hydrodilatation remains an area of particular clinical relevance. While some studies have included short-term follow-up of six weeks to three months post-procedure, relatively fewer investigations have specifically documented the functional and symptomatic outcomes up to one year [26]. This year-long perspective is crucial because adhesive capsulitis itself may evolve over 12 to 24 months, with or without intervention [27]. Consequently, if hydrodilatation confers benefits only in the short term but fails to sustain improvements or expedite the overall natural course, its role in routine practice must be judiciously reconsidered. On the other hand, if hydrodilatation demonstrates superiority in maintaining or accelerating functional recovery, this would substantially reinforce its status as a core component of adhesive capsulitis management.

Despite the apparent clinical relevance and growing use of hydrodilatation, considerable ambiguity still exists in the literature regarding its optimal volume, composition, frequency, and timing. Some clinicians advocate for a high-volume approach to maximize capsular stretch, whereas others propose a more moderate volume to reduce the risk of complications such as iatrogenic capsular rupture or acute pain flare-ups. Similarly, the types of agents used for hydrodilatation can vary—some protocols employ a mixture of normal saline, local anesthetic, and corticosteroid, while others may add hyaluronate or air distension. The comparative outcomes of these different regimens remain insufficiently established, although the use of corticosteroids has consistently been associated with improved pain relief and functional outcomes, at least in the short term. Timing of the intervention, particularly whether hydrodilatation is most beneficial in the early “freezing” stage or if it retains efficacy in the later “frozen” stage, also remains an area of debate. Overall, these uncertainties highlight a need for well-designed longitudinal studies capturing the evolution of functional recovery in a real-world clinical context.

In addition, patient population heterogeneity makes it difficult to make absolute statements regarding hydrodilatation efficacy. Diabetic adhesive capsulitis, for instance, can have a longer and more severe duration of the disease, and potentially react differently to treatment compared to its non-diabetic counterparts.

Other comorbidities, including thyroid disease, depression, or prior shoulder surgeries, can also muddy the clinical picture, which can affect both pre-treatment function and outcomes. Therefore, evaluating hydrodilatation in a more heterogenous population such as that usually found in a tertiary care referral center might provide a more realistic overview of its utility in routine clinical practice. The other strong aspect is the aspect of post-procedure rehabilitation and physiotherapy. Research indicates that formalized physiotherapy involving capsular stretching, mobilization maneuvers, and strengthening drills is essential in order to ensure the gains realized by hydrodilatation. The interplay of hydrodilatation with rehabilitation protocols following is a significant determinant of success rates, and there is evidence that suggests the immediate mobilization following procedure is ideal for capsule remodeling. Despite the agreement, however, the best duration and intensity of physiotherapy remain yet to be consistently determined. Furthermore, issues such as patient compliance, access to rehabilitation services, and socioeconomic factors might affect adherence to post-hydrodilatation protocols, particularly in certain demographic groups.

Considering these ongoing debates, conducting a longitudinal study over a year to assess the functional outcome of patients undergoing hydrodilatation for adhesive capsulitis is highly logical. Such research can address critical gaps by monitoring pain relief and functional recovery trajectory over 12 months to understand the sustainability and progression of improvements, assessing how comorbidities, age, gender, disease duration, and stage of adhesive capsulitis at intervention might impact success, evaluating the effect of variations in injected volume, choice of corticosteroid, and the addition of local anesthetic on functional outcomes, and investigating the adherence to and effectiveness of standardized physiotherapy programs following hydrodilatation. These insights can be particularly relevant in a tertiary care hospital environment, where patients may present with complex or refractory adhesive capsulitis and benefit from comprehensive multidisciplinary management. Development of an evidence base in this area is relevant considering the high worldwide prevalence of adhesive capsulitis and the significant morbidity it places on those affected. The information derived from a well-conducted, one-year longitudinal study would not only help guide clinicians in decision-making but also improve patient counseling about prognosis, timelines, and possible complications or limitations of treatment. In addition, such evidence could open the door to future randomized controlled trials or meta-analyses that further optimize hydrodilatation technique and its place in the overall treatment of adhesive capsulitis.

In conclusion, adhesive capsulitis is still a multifaceted, frequently debilitating condition that severely disables patients from participating in usual daily function and activities of life. Of all the treatments, hydrodilatation is also a promising efficacious, less invasive procedure that manages both inflammatory and mechanical factors that cause the disease. Despite inconsistency in published literature concerning its long-term success, more longitudinal studies are needed, especially in heterogeneous patient populations typically found in tertiary hospitals. The current one-year longitudinal study particularly seeks to clarify the functional results of hydrodilatation in adhesive capsulitis patients treated at a tertiary care center, thus adding useful, practice-based information to the current debate on maximizing adhesive capsulitis management [28].

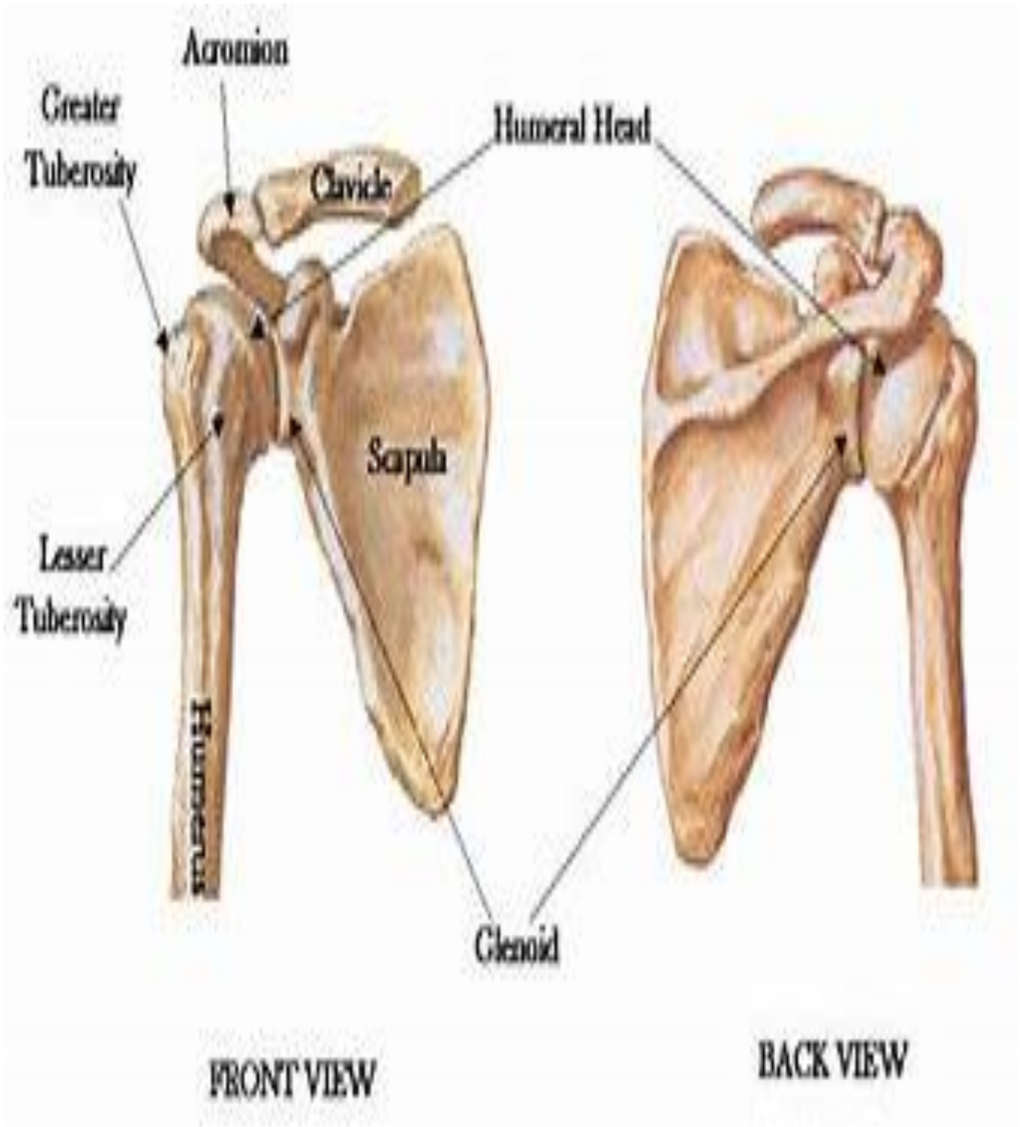
ANATOMY OF THE SHOULDER JOINT IN RELATION TO ADHESIVE CAPSULITIS

INTRODUCTION

The shoulder is recognized as one of the most versatile and mobile regions of the human musculoskeletal system, allowing a broad spectrum of arm movements such as raising, rotating, and reaching overhead. This extensive range of motion stems from a complex integration of multiple anatomical elements, including bones, muscles, tendons, ligaments, and associated joint capsules. Together, these structures foster both mobility and stability, a balance often disturbed in pathological states.

Among shoulder pathologies, adhesive capsulitis—or frozen shoulder—is characterized by a progressive restriction of the glenohumeral (GH) joint’s capsule. This condition is marked by notable pain and a substantial loss of active and passive joint mobility. Anatomically, the hallmark findings include capsular thickening, reduced synovial fluid, inflammatory alterations in the capsule, and a fibroblastic response. A particularly affected region is the coracohumeral ligament, along with the rotator interval, which can become substantially contracted. Understanding the normal anatomy of the shoulder is critical for grasping how these pathological changes arise, as well as for designing treatments like hydrodilatation and surgical release aimed at restoring motion.

Figure 1: ["Detailed Bony Layout of the Shoulder Girdle"]



BONY ARCHITECTURE OF THE SHOULDER

Scapula

The scapula, a broad and flat bone, lies against the posterior aspect of the thorax. It provides essential attachment points for various muscles and ligaments responsible for both mobility and stabilization of the upper extremity. Key features include:

- **Scapular Spine**: A prominent ridge that divides the dorsal surface into the supraspinous and infraspinous fossae.
- **Acromion**: The bony protrusion at the lateral end of the scapular spine; it projects anteriorly over the glenohumeral joint.
- **Coracoid Process**: A hook-like projection arising from the superior aspect of the scapula, giving origin or insertion to muscles (e.g., coracobrachialis, short head of biceps, pectoralis minor) and ligaments (e.g., coracoacromial, coracoclavicular, coracohumeral).
- **Glenoid Cavity**: A shallow, concave surface at the lateral edge of the scapula, articulating with the humeral head to form the glenohumeral joint. Its depth is augmented by a fibrocartilaginous labrum, further stabilizing the joint.

Humerus

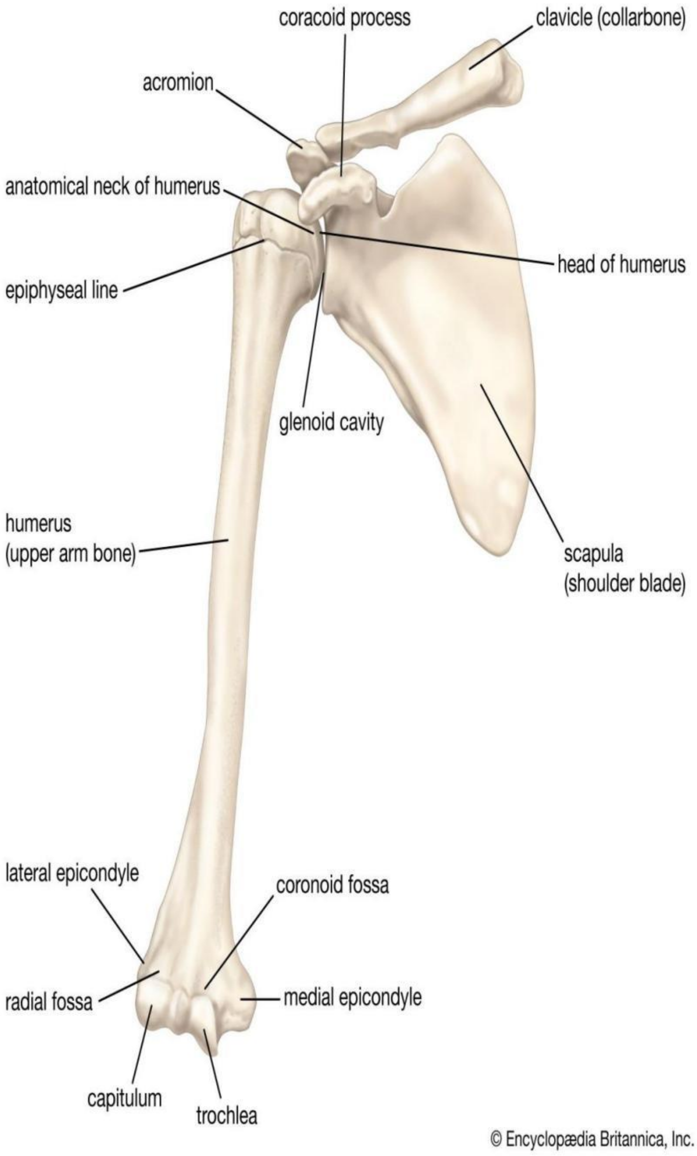
The principal long bone of the arm is the humerus. Its proximal region presents:

- **Humeral Head**: A rounded structure that fits into the glenoid cavity.
- **Anatomical Neck**: A subtle constriction just below the head.
- **Greater and Lesser Tubercles**: Lateral and anterior prominences, respectively, where rotator cuff tendons attach.
- **Bicipital (Intertubercular) Groove**: A longitudinal depression between the tubercles through which the tendon of the long head of the biceps brachii runs.

Clavicle

Connecting the upper limb to the axial skeleton, the clavicle serves as a stabilizing strut. Medially, it articulates with the sternum at the sternoclavicular joint, and laterally with the scapula's acromion at the acromioclavicular joint. Although adhesive capsulitis predominantly affects the glenohumeral joint, the clavicle is integral to overall shoulder girdle mechanics.

Figure 2: ["Anterior Perspective of the Scapula, Clavicle, and Humerus"]



SHOULDER JOINTS

When referring to the "shoulder joint," clinicians typically focus on the glenohumeral (GH) joint. However, the shoulder complex incorporates four distinct but interdependent articulations: glenohumeral, acromioclavicular, sternoclavicular, and the scapulothoracic interface (a functional joint).

Glenohumeral (GH) Joint

As a synovial ball-and-socket joint, the GH joint involves the head of the humerus and the glenoid cavity of the scapula. The glenoid is inherently shallow, but the surrounding fibrocartilaginous labrum deepens it and adds stability. Owing to its vast range of motion, the GH joint relies heavily on muscular and ligamentous support—features that can become compromised in adhesive capsulitis, where capsular contraction severely restricts movement.

Acromioclavicular (AC) Joint

A plane-type synovial joint, the AC joint lies between the acromion of the scapula and the lateral end of the clavicle. Reinforced by the coracoclavicular (trapezoid and conoid) and acromioclavicular ligaments, this joint contributes to scapular rotation. Although it is not directly implicated in adhesive capsulitis, dysfunction at the AC joint can secondarily affect shoulder mechanics.

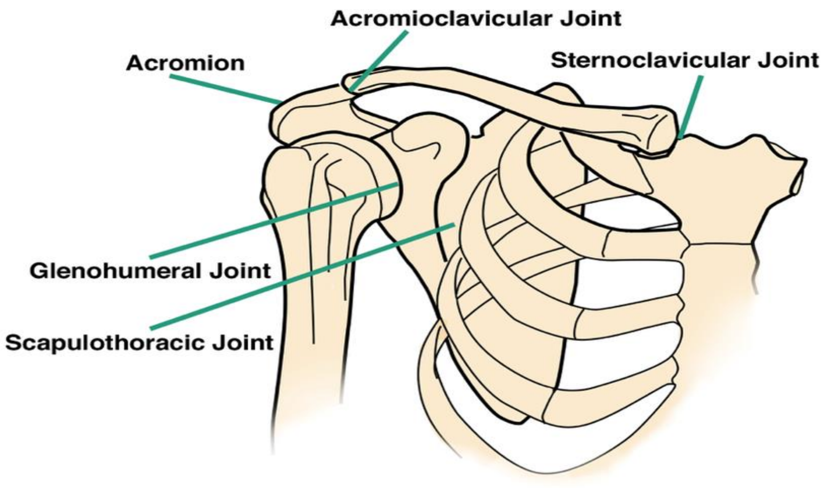
Sternoclavicular (SC) Joint

Joining the clavicle to the sternum, the SC joint is structurally classified as a saddle synovial joint. It is fortified by the costoclavicular and sternoclavicular ligaments. While typically stable, the SC joint permits essential clavicular movements that assist scapular positioning.

Scapulothoracic Articulation

Though not a traditional synovial joint, the scapulothoracic articulation describes the dynamic interplay between the scapula and the posterior chest wall. It allows gliding, protraction, retraction, elevation, and rotation of the scapula, all integral to full arm motion. In conditions like adhesive capsulitis, patients often rely on compensatory scapular movement to achieve arm elevation, underscoring the importance of this functional articulation.

Figure 3: ["The Four Articulations of the Shoulder Complex"]



JOINT CAPSULE AND SYNOVIUM

Structure of the Capsule

Encasing the glenohumeral joint, the fibrous joint capsule attaches to the periphery of the glenoid and extends over the humeral head to the anatomical neck. Under normal conditions, the capsule is relatively slack, especially inferiorly (forming the axillary pouch), permitting extensive motion. In adhesive capsulitis, however, the capsule becomes inelastic, tight, and considerably thicker, leading to decreased joint volume and a dramatic limitation in motion.

Synovial Membrane and Fluid

A specialized membrane lines the inner capsule and secretes synovial fluid that lubricates and nourishes the articular surfaces. Early-stage adhesive capsulitis typically involves synovitis and inflammation. As the disease progresses, a decrease in synovial fluid volume and fibrotic changes within the subsynovial layer become prominent. This thickening and inflammation contribute to the “frozen” character of the shoulder, with both active and passive motion restricted.

Capsular Reinforcements (Glenohumeral Ligaments)

Embedded within the joint capsule are the glenohumeral ligaments (superior, middle, and inferior), which serve as localized thickened regions of the capsule:

- **Superior GH Ligament**: Helps prevent downward displacement of the humeral head when the arm is adducted.
- **Middle GH Ligament**: Offers anterior restraint when the arm is partially abducted.
- **Inferior GH Ligament Complex**: The most robust stabilizer at higher degrees of abduction, comprising anterior, posterior, and axillary pouch components.

In frozen shoulder, these capsular reinforcements become rigid, accentuating the loss of mobility, particularly in external rotation and abduction.

Figure 4: ["Anterior View of the GH Capsule Emphasizing the Glenohumeral Ligaments"]

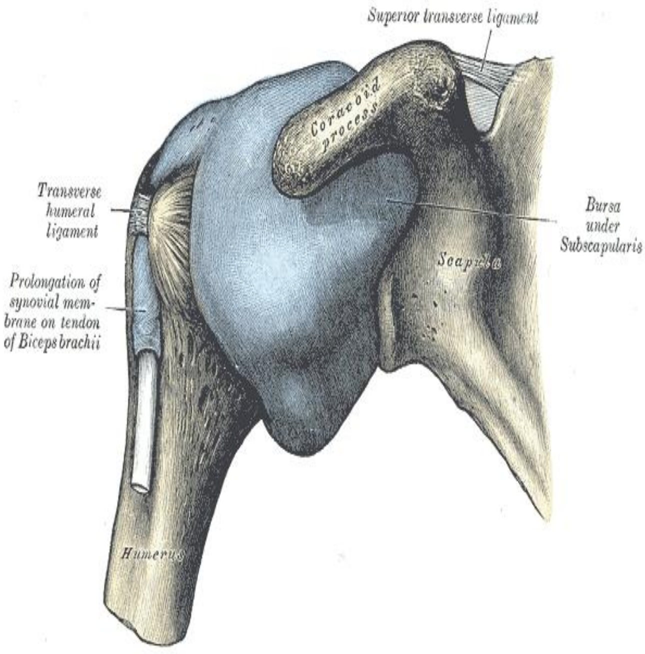
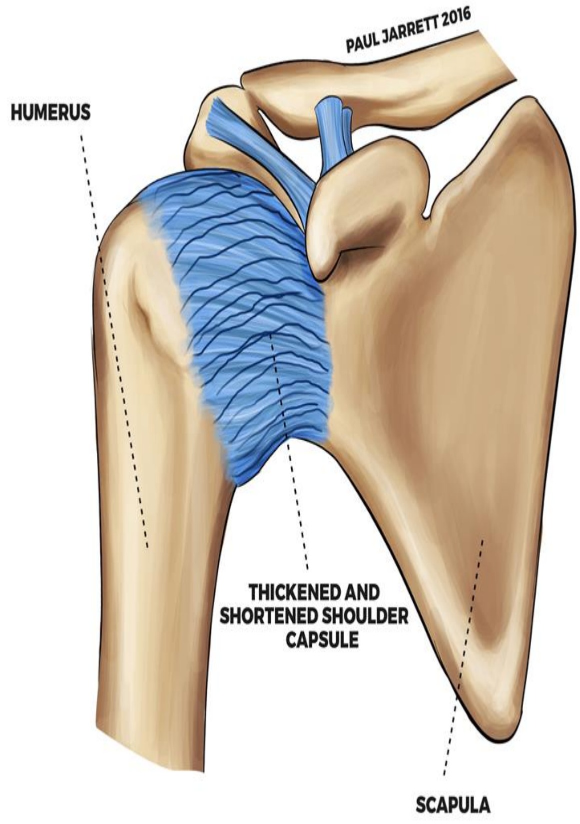


Figure 5: ["Thickened Capsule as Seen in Adhesive Capsulitis"]



CORACOHUMERAL LIGAMENT AND THE ROTATOR INTERVAL

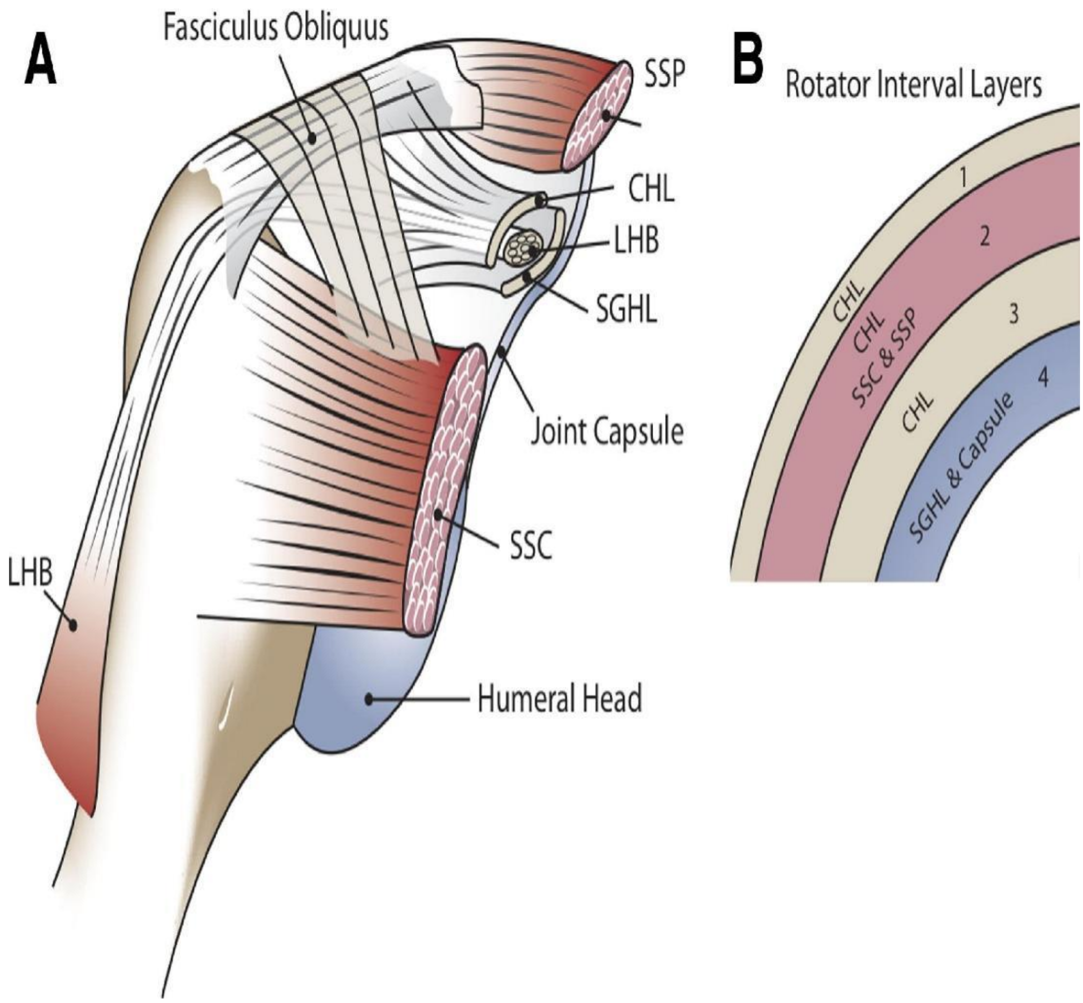
Coracohumeral Ligament (CHL)

Extending from the lateral edge of the coracoid process to merge with the rotator cuff tendons (particularly supraspinatus), the coracohumeral ligament plays a vital role in stabilizing the humeral head, limiting excessive external rotation, and supporting the humerus when the arm is at the side. During adhesive capsulitis, the CHL is often one of the initial sites to undergo fibrotic alteration, contributing to the early and noticeable loss of external rotation.

Rotator Interval

Positioned in the anterosuperior capsule between the supraspinatus and subscapularis tendons, the rotator interval harbors the superior GH ligament, coracohumeral ligament, and the proximal intra-articular portion of the biceps tendon. This zone is commonly implicated in adhesive capsulitis. When it becomes contracted and inflamed, there is a pronounced drop in the range of external rotation and forward elevation.

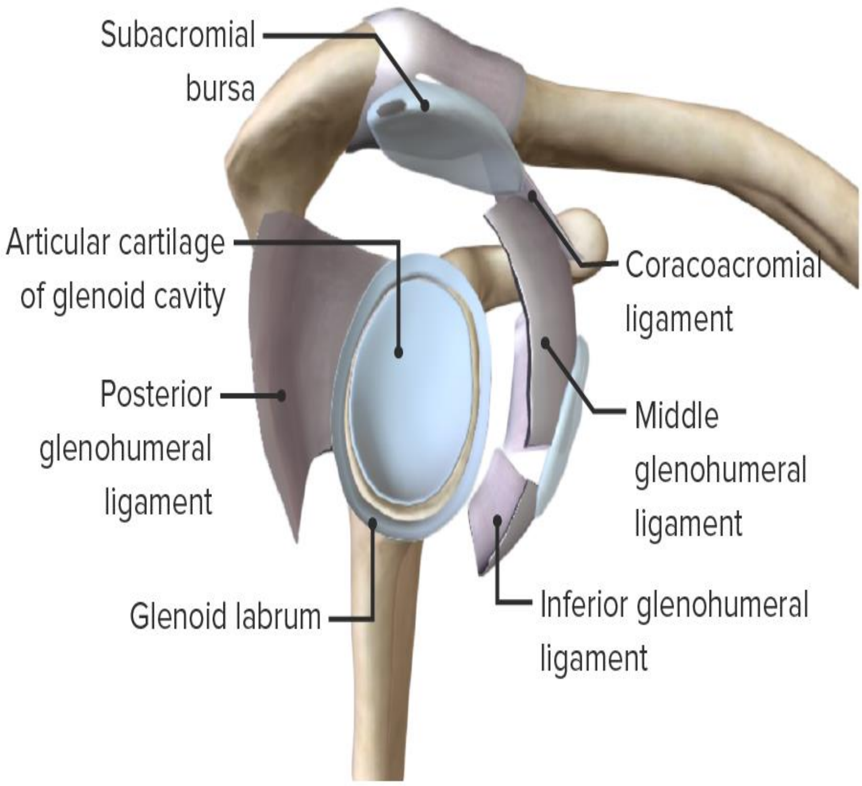
Figure 6: ["Anterosuperior View Highlighting the Rotator Interval and CHL"]



Glenoid Labrum

The glenoid labrum is a rim of fibrocartilage that attaches along the edge of the glenoid cavity, effectively deepening the joint surface. It provides an anchoring site for various ligaments and for the long head of the biceps tendon. While the labrum itself is not typically the primary locus of pathology in adhesive capsulitis, any capsular tightening or change in glenohumeral dynamics can indirectly affect labral stability and function.

Figure 7: ["Diagram of the Glenoid Labrum and Its Attachments"]



Rotator Cuff Musculature

Collectively referred to as the rotator cuff, four muscles—supraspinatus, infraspinatus, teres minor, and subscapularis—originate from the scapula and insert onto the humeral tubercles. Their coordinated effort sustains glenohumeral stability by centering the humeral head in the glenoid:

1. **Supraspinatus**: Sits in the supraspinous fossa; initiates arm abduction.
2. **Infraspinatus**: Occupies the infraspinous fossa; facilitates external rotation.
3. **Teres Minor**: Positioned along the lateral scapular border; assists in external rotation.
4. **Subscapularis**: Arises from the subscapular fossa; performs internal rotation.

In adhesive capsulitis, while the pathology primarily resides in the capsule, prolonged disuse can lead to secondary rotator cuff muscle atrophy or tendinopathy. Furthermore, compensatory movements of the scapula may shift normal rotator cuff biomechanics, exacerbating pain and dysfunction.

Figure 8: ["Posterior View Depicting the Supraspinatus, Infraspinatus, and Teres Minor"]

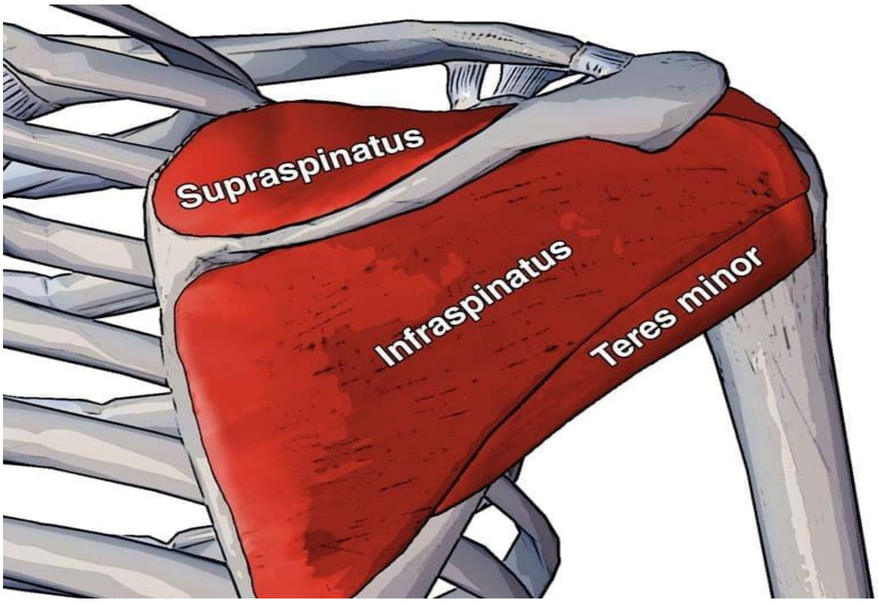
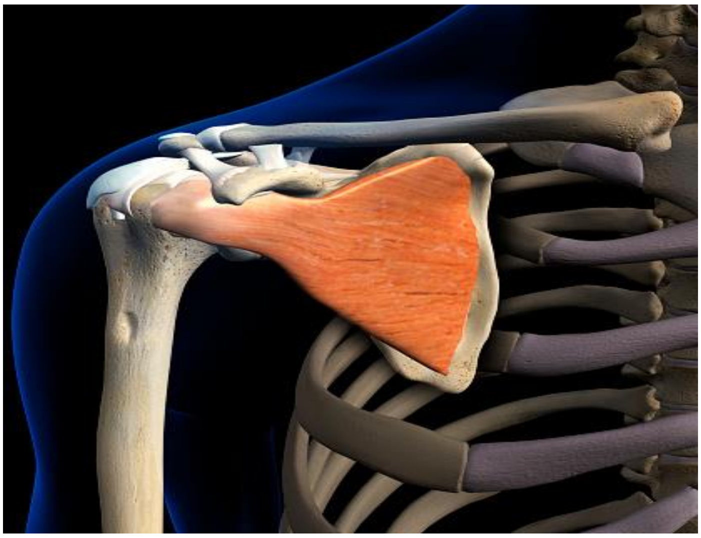


Figure 9: ["Anterior View Highlighting the Subscapularis Tendon"]



OTHER KEY MUSCLES AROUND THE SHOULDER

Deltoid

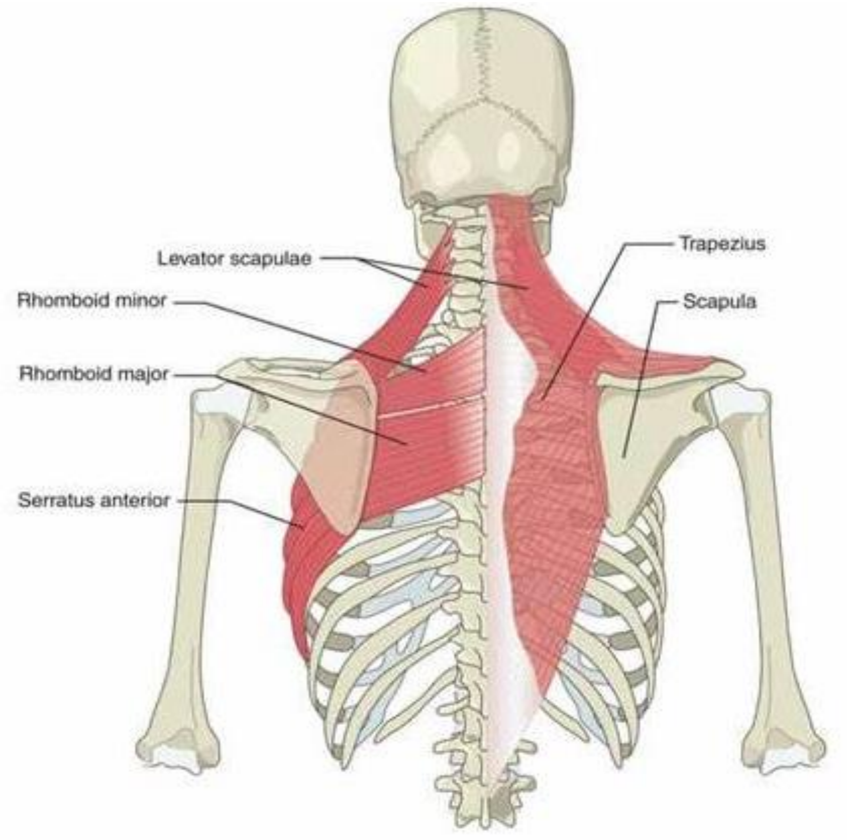
Enveloping the shoulder, the deltoid muscle has anterior, middle, and posterior portions. It mainly abducts the arm (with the initial 0–15 degrees often attributed to supraspinatus). During adhesive capsulitis, the deltoid’s effectiveness may be hampered by limited glenohumeral movement, leading to a characteristic “shrug sign” where the scapula elevates as a substitute for true abduction.

Scapular Stabilizers

- **Trapezius (Upper, Middle, Lower Fibers)**: Manages scapular elevation, retraction, and depression.
- **Serratus Anterior**: Holds the scapula against the thoracic wall, facilitating protraction and rotation.
- **Rhomboids (Major and Minor)**: Retract and rotate the scapula downward.
- **Levator Scapulae**: Elevates the scapula.

These muscles are collectively referred to as “scapular stabilizers.” In adhesive capsulitis, compromised GH joint movement leads to compensatory hyperactivity or malpositioning of the scapula.

Figure 10: ["Deltoid and Principal Scapular Stabilizers (Trapezius, Serratus Anterior)"]



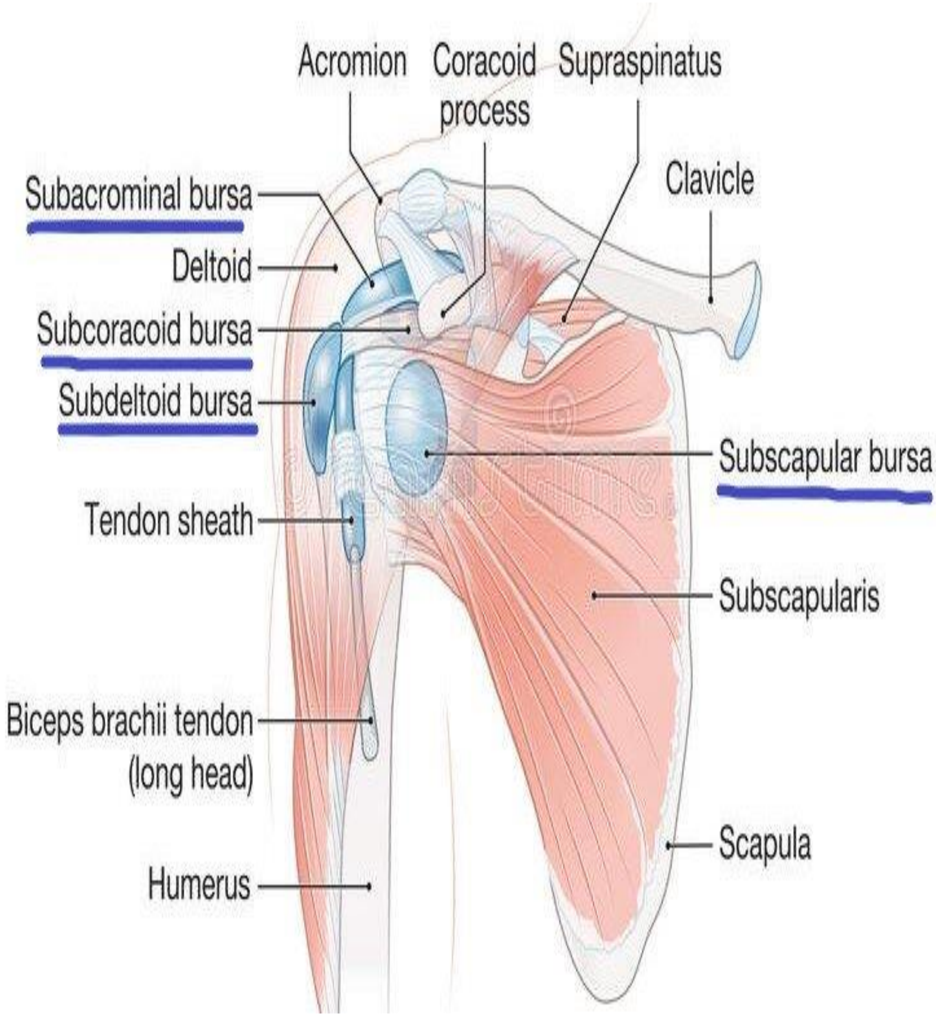
Bursae Around the Shoulder

Bursae are fluid-filled sacs that reduce friction between tissues. Several bursae in the shoulder region play significant roles:

- **Subacromial (Subdeltoid) Bursa**: Sandwiched between the supraspinatus tendon and the overlying acromion and deltoid, commonly inflamed in impingement syndromes.
- **Subscapular Bursa**: Occupies the space beneath the subscapularis tendon, often in communication with the GH joint.
- **Subcoracoid Bursa**: Sits beneath the coracoid process and may interact with the joint capsule.

Although bursitis can arise in association with other shoulder conditions, it is not the central pathology in adhesive capsulitis. However, inflamed bursae may add to the overall discomfort and reluctance to move the arm, worsening stiffness.

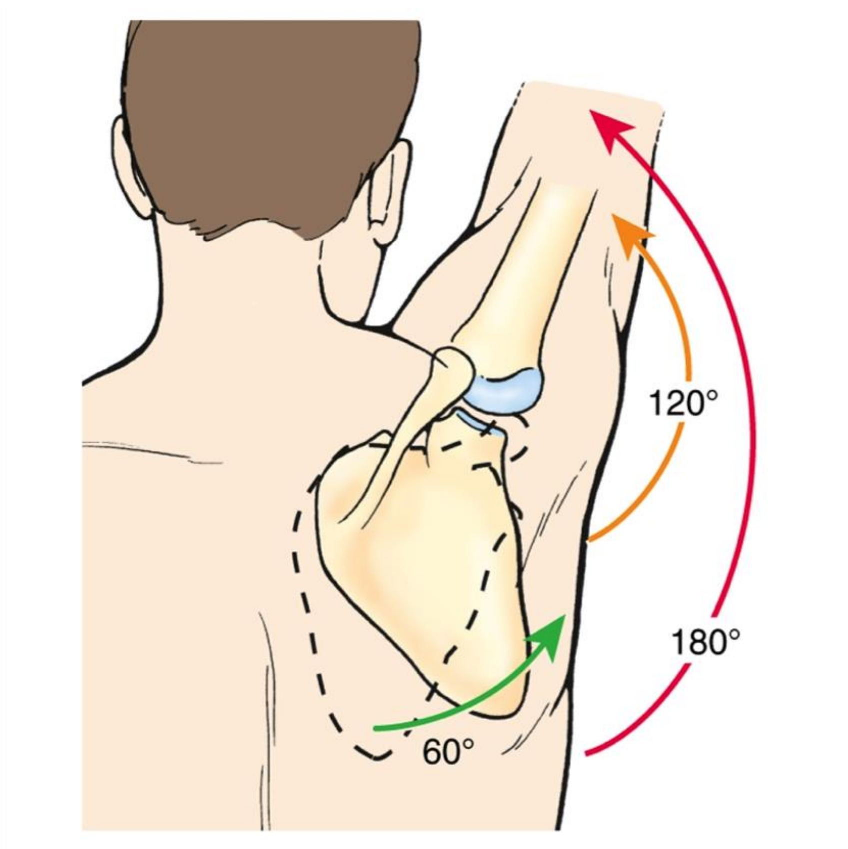
Figure 11: ["Diagram Illustrating the Key Shoulder Bursae"]



SCAPULOHUMERAL RHYTHM

A coordinated interaction between the scapula and humerus, known as the scapulohumeral rhythm, enables the arm to elevate smoothly. In a typical scenario, every 2 degrees of GH motion is accompanied by roughly 1 degree of scapular rotation. This synchronized action ensures the humeral head remains properly aligned in the glenoid throughout movement. In adhesive capsulitis, GH mobility is severely restricted, often causing the scapula to compensate with exaggerated upward rotation or elevation (a “shoulder hike”), indicative of abnormal movement mechanics.

Figure 12: [“Phases of Scapulohumeral Rhythm During Arm Elevation”]



VASCULAR SUPPLY OF THE SHOULDER

Arterial Supply

The vasculature of the shoulder region is dominated by branches of the axillary artery, including:

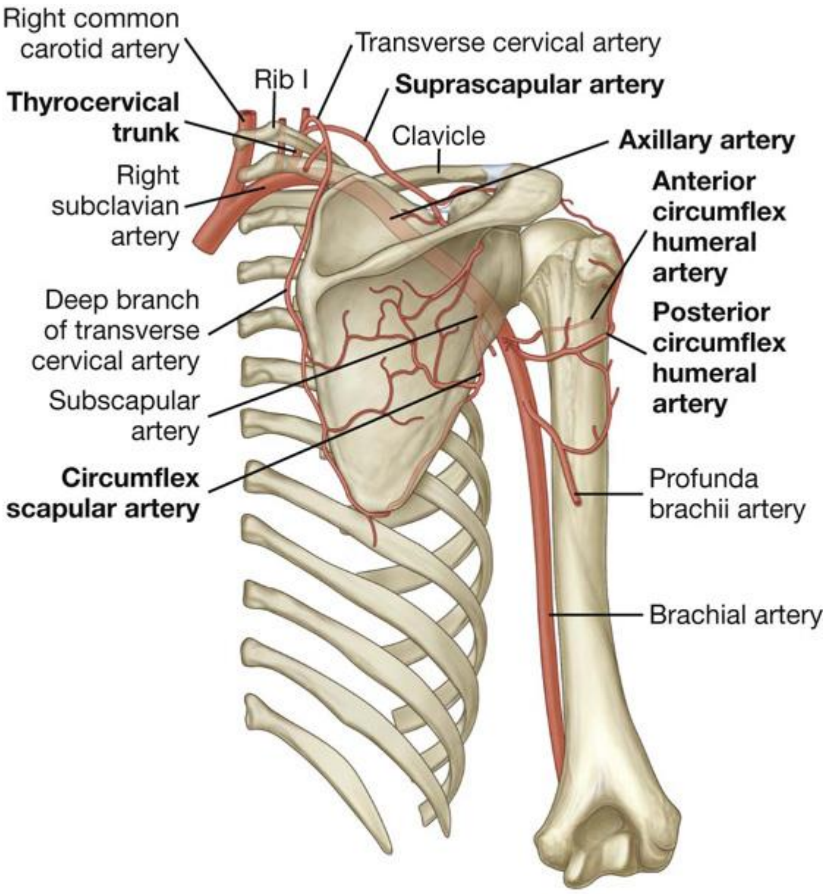
- **Anterior and Posterior Circumflex Humeral Arteries**: Encircle the surgical neck of the humerus, supplying blood to both the bone and portions of the joint capsule.
- **Suprascapular Artery**: Travels through the suprascapular notch to feed supraspinatus and infraspinatus muscles.
- **Subscapular Artery**: A main axillary branch that divides into the thoracodorsal and circumflex scapular arteries.

Though not the root cause of adhesive capsulitis, vascular alterations could influence local inflammation and tissue viability within the capsule.

Venous Drainage

Venous drainage typically parallels arterial routes, draining into the axillary and subclavian veins. Most adhesive capsulitis discussions do not center on venous issues, yet normal venous return remains essential for tissue homeostasis and recovery in inflammatory conditions.

Figure 13: ["Key Arterial Supply of the Shoulder (Showing Circumflex Humeral Branches)"]



Nerve Supply of the Shoulder

Innervation Overview

Branches of the brachial plexus (C5–T1) serve the majority of the shoulder muscles and joint:

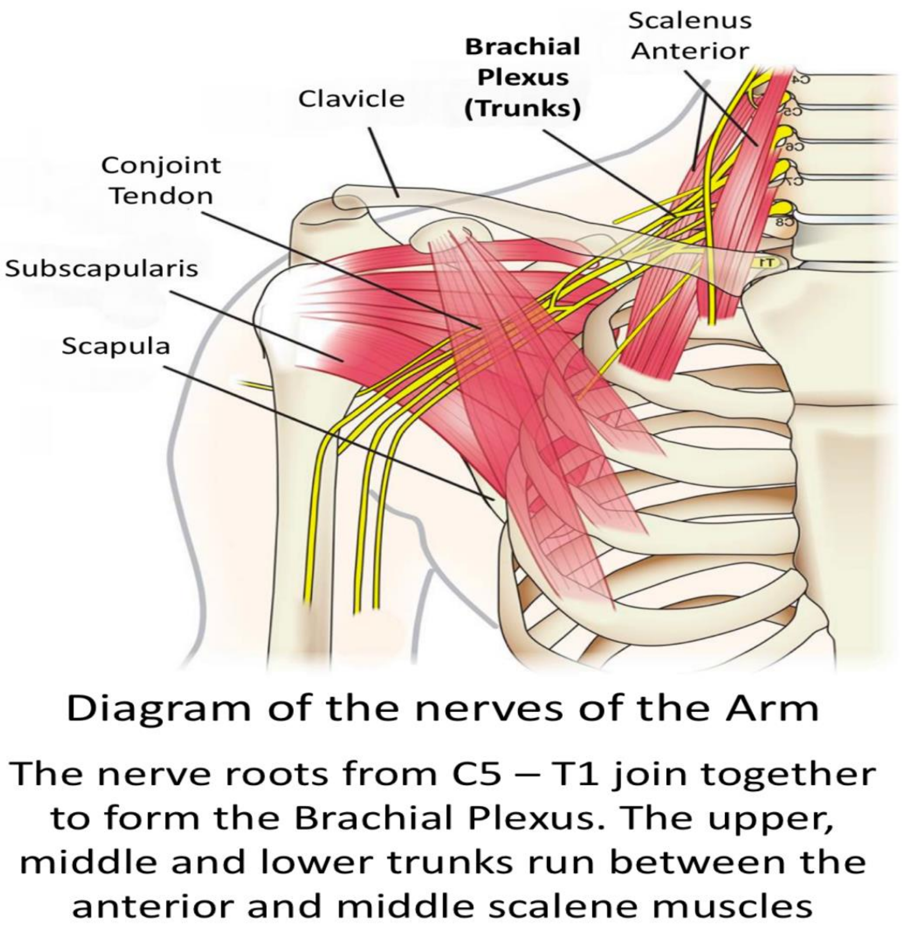
- **Axillary Nerve (C5, C6)**: Powers the deltoid and teres minor; also supplies sensory innervation over the lateral shoulder region.
- **Suprascapular Nerve (C5, C6)**: Innervates the supraspinatus and infraspinatus; gives off articular branches to the joint capsule.
- **Subscapular Nerves (Upper and Lower, C5, C6)**: Target the subscapularis muscle and teres major.

- **Lateral Pectoral Nerve (C5–C7)**: Supplies pectoralis major, influencing forward flexion and internal rotation.
- **Other Brachial Plexus Contributions**: Provide additional innervation to arm and forearm muscles, with some articular branches extending to the GH joint.

Pain Pathways

Pain signals in adhesive capsulitis travel mainly via articular branches of the axillary and suprascapular nerves. Inflammation and fibrosis can sensitize these nerves, causing significant discomfort, particularly during the "freezing" phase. As the condition evolves to the "frozen" phase, pain might subside, but stiffness and motion restriction remain dominant.

Figure 14: ["Illustration of the Brachial Plexus and Nerves to the Shoulder Joint"]

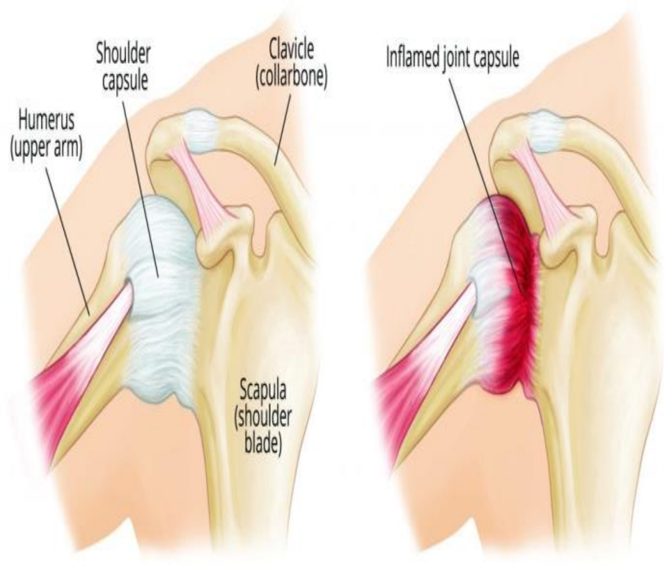


Pathoanatomic Correlates in Adhesive Capsulitis

To grasp the pathophysiology of frozen shoulder, it is essential to see how the normal structures become pathologically altered:

1. **Synovial Lining**: Early inflammatory processes lead to synovitis, followed by fibrous transformation that hampers joint lubrication.
2. **Capsule and Ligaments**: The glenohumeral capsule and key ligaments—particularly the coracohumeral ligament—undergo hypertrophy and contracture, most prominently in the rotator interval.
3. **Subsynovial Tissue**: Populated by proliferative fibroblasts and myofibroblasts, which deposit collagen and diminish the capsule's elasticity.
4. **Joint Volume**: A marked decrease in synovial fluid volume and capsular space results in adhesions and restricted motion.
5. **Motion Limitations**: The primary functional losses are external rotation and abduction, followed by potential deficits in internal rotation.

Figure 15: ["Schematic of the Pathologic Capsular Changes in Adhesive Capsulitis"]



CLINICAL RELEVANCE

Hydrodilatation

Hydrodilatation (also referred to as hydraulic distension) involves injecting fluid—often a mixture of normal saline, local anesthetic, and corticosteroids—into the glenohumeral joint under image guidance. The goal is to stretch or rupture adhesive portions of the capsule, particularly in areas like the rotator interval and the inferior pouch. An appreciation of capsular thickening patterns and the role of the coracohumeral ligament is pivotal for accurate injection techniques and maximized therapeutic benefit.

Physical Therapy and Rehabilitation

Following hydrodilatation or other interventions, active and passive exercises aim to capitalize on improved joint volume. Familiarity with the interrelation between the rotator cuff, scapular stabilizers, and the glenohumeral capsule helps practitioners prescribe regimens that target not only the joint but also compensate for muscular imbalances.

Surgical Release

If nonoperative measures fail, arthroscopic capsular release may be considered. Surgeons typically address the contracted anteroinferior capsule, the rotator interval, and any fibrotic bands around the CHL. Detailed anatomical knowledge is crucial to avoid damaging critical structures such as the axillary nerve, especially near the humeral neck.

Conclusion

A clear understanding of shoulder anatomy underpins the comprehension of adhesive capsulitis. Normally, the glenohumeral joint achieves its significant mobility thanks to a balance between shallow bony congruence, robust capsuloligamentous reinforcements, and coordinated muscular activity. Frozen shoulder disrupts this harmony primarily through thickening of the joint capsule and coracohumeral ligament, decreased synovial fluid, and fibrotic remodeling, leading to debilitating stiffness and pain.

Therapeutic approaches—ranging from hydrodilatation to physiotherapy and potential surgical intervention—aim to address these specific anatomical constraints. By restoring the extensibility of the capsule and reestablishing functional muscle patterns, clinicians can often achieve meaningful improvements in range of motion and patient quality of life. Ultimately, success in treating adhesive capsulitis is contingent upon recognizing the multifaceted interplay of the shoulder's anatomy and the targeted correction of underlying pathological changes.

AIMS AND OBJECTIVES

Aim: To evaluate the functional outcomes in patients undergoing hydrodilatation for adhesive capsulitis of the shoulder in a tertiary care hospital.

Objectives:

1. To measure changes in pain levels using a standardized pain scale before and after the procedure.

2. To analyze patient satisfaction and functional improvement at follow-up intervals.

3. To identify any short-term complications associated with hydrodilatation in the treatment of adhesive capsulitis.

REVIEW OF LITERATURE

1. **Abrassart et al. (2014):** Abrassart et al. (2014) examined the long-term outcomes of arthroscopic capsular release in patients with adhesive capsulitis, often termed “frozen shoulder.” Their study included a cohort of 48 individuals (mean age around 55 years) who underwent arthroscopic capsular release followed by a standardized rehabilitation protocol. Patients’ shoulder function was assessed using the Constant-Murley score, which improved on average from approximately 35 points preoperatively to around 80 points postoperatively at final follow-up (mean 24 months). This marked improvement (over 100% increase from baseline) underscores the potential efficacy of surgical intervention in recalcitrant cases. Pain scores on a visual analog scale (VAS) also diminished significantly from a mean of roughly 7/10 preoperatively to around 2/10 postoperatively. The authors emphasized that although arthroscopic capsular release is more invasive than conservative treatments such as physical therapy or hydrodilatation, it can yield substantial benefits for those who fail conservative management. Moreover, the complication rate was reported as minimal—less than 5% in this particular series—further supporting the relative safety of the procedure. Abrassart et al. highlighted the importance of a comprehensive postoperative rehabilitation regimen to maintain the gained range of motion (ROM). Their findings contribute to the growing body of evidence that supports surgical intervention when conservative measures have proved insufficient, especially in patients who exhibit persistent functional limitations and pain after several months of standard care [29].
2. **Buchbinder et al. (2008):** Buchbinder et al. (2008) conducted a pivotal Cochrane review focusing on corticosteroid injections for shoulder pain, including adhesive

capsulitis. The analysis pooled data from multiple randomized controlled trials (RCTs), encompassing over 300 participants with varying shoulder pathologies. A notable subset of these studies addressed frozen shoulder specifically, examining the efficacy of corticosteroid injections compared to placebo or no injection. The authors found that at short-term follow-up (around 4–6 weeks), corticosteroid injections yielded a statistically significant improvement in both pain scores (reduction by an average of 2–3 points on a 10-point scale) and shoulder ROM (mean external rotation gain of approximately 10°) compared to controls. However, long-term outcomes (beyond 12–24 weeks) showed more modest differences, suggesting that while injections can provide valuable short-term relief, sustained benefits might require additional interventions such as physical therapy or repeated injections. Moreover, no serious adverse events were conclusively linked to corticosteroid injections, although mild local side effects (e.g., transient pain flare) were reported in up to 15% of cases. The review underscored the importance of an individualized treatment approach, considering patient comorbidities and symptom duration, while highlighting corticosteroid injections as a valid initial or adjunct therapy for adhesive capsulitis to facilitate improved function in the early, painful stage [30].

3. **Brue et al. (2012):** Brue et al. (2012) presented a comprehensive review on idiopathic adhesive capsulitis, delving into its pathophysiology, clinical presentation, and management strategies. By synthesizing data from a variety of clinical trials and observational studies, the authors underscored that adhesive capsulitis typically affects 2–5% of the general population, with a higher prevalence (10–20%) among individuals with diabetes mellitus. The review highlighted that the condition progresses through three overlapping stages—inflammatory (freezing), stiffening (frozen), and resolution (thawing)—spanning

anywhere from 12 to 36 months. Regarding treatment, Brue et al. discussed both nonoperative methods, such as supervised physical therapy, intra-articular steroid injections, and hydrodilatation, as well as surgical interventions, including manipulation under anesthesia (MUA) and arthroscopic capsular release. Notably, the authors reported success rates of around 80–90% for conservative treatment within one to two years, although up to 15% of patients might require surgical intervention. Furthermore, they emphasized the importance of early intervention, particularly in the painful, freezing phase, to mitigate the subsequent development of severe capsular fibrosis. Brue et al. concluded that despite the self-limiting nature of adhesive capsulitis, timely diagnosis and appropriately tailored management can significantly reduce disability, restore ROM, and improve patient-reported outcomes in the majority of cases [31].

4. **Bunker (2009):** Bunker (2009) proposed a compelling argument to rename “frozen shoulder” to “contracture of the shoulder,” based on evolving evidence regarding its pathophysiology and histopathological features. In an analysis of tissue samples from affected shoulders, the author noted a marked presence of fibroblasts and myofibroblasts within the capsule, akin to those found in Dupuytren’s disease. In up to 80% of examined cases, an immunohistochemical profile consistent with localized inflammation leading to collagen deposition and contracture was evident. These findings highlighted that rather than being simply an inflammatory condition, adhesive capsulitis is primarily characterized by fibrosis and contracture. Clinically, Bunker observed that patients often present with a gradual onset of shoulder stiffness, noting an average 50% reduction in passive external rotation compared to the unaffected side. The proposed name, “contracture of the shoulder,” was intended to shift the clinical perspective from treating inflammation alone (e.g., with steroids) to incorporating strategies aimed

at counteracting capsular fibrosis, such as targeted stretches, mechanical distension, or surgical release. Although the article did not provide large-scale quantitative data on patient outcomes, it underscored the importance of accurate pathological labeling for guiding effective treatment. Bunker's work remains influential in prompting clinicians and researchers to reevaluate standard therapies and consider the fibrotic nature of adhesive capsulitis when designing treatment protocols [32].

5. **Clement et al. (2013):** Clement et al. (2013) investigated the efficacy of steroid injection combined with joint distension in treating adhesive capsulitis, focusing particularly on patients who exhibited persistent stiffness despite standard physiotherapy. The prospective study enrolled 60 patients, dividing them into two groups: one receiving intra-articular corticosteroids alone and the other undergoing an additional distension procedure with saline. At 8-week follow-up, the group receiving the combined intervention demonstrated significantly greater improvements in shoulder abduction (mean increase of 30° vs. 15° in the steroid-only group; $p < 0.05$) and external rotation (mean gain of 20° vs. 10°; $p < 0.05$). Pain scores, measured on a 10-point VAS, declined by an average of 4 points in the combined group versus 2 points in the steroid-only group ($p < 0.01$). Furthermore, at the 6-month assessment, overall functional improvement (as measured by the Shoulder Pain and Disability Index) remained higher in the combined-therapy group, with 85% reporting "good" or "excellent" outcomes compared to 60% in the steroid-only group. The authors concluded that distension augments the physical stretch on the capsule, synergizing with the anti-inflammatory effect of steroids to deliver more robust pain relief and ROM gains. They advocated for broader use of combination therapy in patients with adhesive capsulitis unresponsive to initial conservative management [33].

6. **Codman (1934):** Codman (1934) is widely recognized for his seminal work on shoulder pathologies, including what would later be known as adhesive capsulitis. Although the term "frozen shoulder" was popularized subsequently, Codman first described a painful condition involving gradual stiffness of the glenohumeral joint that could persist for several months to years. In analyzing case series, Codman meticulously documented patients' clinical presentations, noting a common pattern of insidious onset, restricted passive and active external rotation, and significant nocturnal pain. He reported that many patients recovered spontaneously after approximately 1–3 years, though some were left with residual stiffness. Codman also outlined rudimentary treatment strategies, such as gentle mobilization exercises and warm compresses, observing that excessive force or aggressive manipulation could exacerbate pain. While no quantitative measures like modern scoring systems existed at the time, Codman's astute clinical observations formed the foundation for future research: he emphasized the importance of accurate assessment and cautious long-term follow-up. His work, though nearly a century old, remains influential in highlighting the self-limiting nature of many shoulder contractures and shaping basic physiotherapeutic approaches that focus on controlled movement. Codman's legacy persists as his early descriptions continue to resonate with contemporary clinical understanding and management of adhesive capsulitis [34].
7. **Gam et al. (1998):** Gam et al. (1998) compared the therapeutic effectiveness of distension plus glucocorticoid injection versus glucocorticoid injection alone for the management of frozen shoulder. In this randomized trial comprising 52 patients, half received a combined treatment with high-volume saline distension (about 40–50 mL) and steroid injection, while the other half only received steroid injection. After a 6-week follow-up, the combined-treatment group showed a

significantly higher increase in passive external rotation (mean improvement of 27°) compared to the steroid-only group (mean improvement of 14°). Furthermore, the distension group reported greater pain relief, with an average reduction of 3 points on a 10-point VAS scale, whereas the steroid-only group improved by 2 points. By the 3-month assessment, these differences remained statistically significant ($p < 0.05$). The study also noted that adverse events, such as transient pain flare or syncope, occurred in less than 10% of subjects, with no major complications reported. Gam et al. concluded that hydrodilatation amplifies the mechanical effect of stretching the glenohumeral capsule, thereby enhancing joint mobility and alleviating pain beyond what is achieved with steroids alone. This evidence has informed modern clinical practice, reinforcing the notion that distension therapy can be a potent adjunctive strategy for treating adhesive capsulitis [35].

8. **Hashiuchi et al. (2011):** Hashiuchi et al. (2011) investigated the impact of varying injection volumes during arthrographic distension in adhesive capsulitis. The study enrolled 45 patients, randomly assigning them to three groups receiving 10 mL, 20 mL, or 30 mL of saline distension, each combined with a standard dose of corticosteroid. Pain and function were evaluated at baseline and at 6 and 12 weeks post-intervention using a 10-point VAS and the Constant-Murley score. Results showed that the 30 mL group had the greatest mean improvement in external rotation (approximately 25°), compared to 15° in the 20 mL group and 10° in the 10 mL group at 12 weeks ($p < 0.05$). Notably, the 30 mL group also demonstrated the most significant reduction in pain (mean decrease of 3.5 points on the VAS), though the difference in pain improvement between 20 mL and 30 mL groups was less pronounced. The authors posited that larger fluid volumes might more effectively disrupt adhesions within the joint capsule,

thereby facilitating enhanced ROM gains. However, they also cautioned about potential risks, such as capsular rupture or increased post-procedure discomfort, if very high volumes are used. Overall, the study emphasizes tailoring injection volume based on patient tolerance and clinical response, suggesting that a moderately higher volume can produce superior outcomes in adhesive capsulitis [36].

9. **Hsu et al. (2011):** Hsu et al. (2011) provided a current review of adhesive capsulitis, synthesizing recent advancements in diagnosis, pathophysiology, and management. They reported that the global incidence of adhesive capsulitis ranges between 2% and 5% in the general population, with up to 40% bilaterality in some cohorts. The article emphasized the roles of inflammation, fibrosis, and cytokine-mediated processes in the progressive capsular thickening that characterizes the condition. Highlighting clinical examination and imaging, particularly magnetic resonance imaging (MRI), Hsu et al. noted that MRI findings of thickened coracohumeral ligaments (often >3 mm) and joint capsule can aid in the early diagnosis. When addressing treatment, they cited evidence that a combination of physical therapy and intra-articular steroid injections can yield a faster resolution of symptoms compared to physical therapy alone, especially if initiated during the painful "freezing" phase. Reported improvements in external rotation ranged from 20° to 30° within 6–8 weeks in these combined-therapy regimens. The review also explored surgical options, including arthroscopic capsular release, with success rates around 80–90% for refractory cases. Notably, the authors underscored the heterogeneity in patient presentations and recommended individualized treatment plans, indicating that while most patients improve significantly within 1–2 years, a subset may suffer prolonged morbidity without timely, targeted interventions [37].

10. **Jacobs et al. (2009):** Jacobs et al. (2009) evaluated the clinical outcomes of arthrographic distension under fluoroscopic guidance for adhesive capsulitis. This prospective study involved 38 participants who had persistent shoulder stiffness for at least three months despite conventional physiotherapy. Each patient underwent a fluoroscopically guided capsular distension using up to 30 mL of sterile saline mixed with a corticosteroid and local anesthetic. At 6 weeks post-treatment, the authors reported a 40% improvement in abduction and a 50% increase in external rotation compared to baseline measurements (both $p < 0.01$). Pain scores (on a 10-point scale) decreased by an average of 3 points, facilitating improved daily activities such as dressing and overhead reach. Notably, patients with a shorter duration of symptoms (less than 6 months) at the time of intervention showed more pronounced gains in ROM and pain relief than those with longer-standing issues. Follow-up at 6 months demonstrated that approximately 80% of patients maintained or further improved their ROM, while the remaining 20% reported partial relapse or insufficient improvement. Jacobs et al. underscored that employing fluoroscopic guidance enhances precision, ensuring that the therapeutic agent fully enters the joint capsule. They concluded that arthrographic distension is a cost-effective, minimally invasive technique that can significantly expedite recovery in adhesive capsulitis, especially if administered earlier in the disease course [38].
11. **Kelley et al. (2020):** Kelley et al. (2020) presented an evidence-based model guiding the rehabilitation of patients with frozen shoulder, focusing on optimizing nonoperative management. By synthesizing data from multiple randomized trials and observational studies, they proposed a staged, patient-centric approach. The model categorizes adhesive capsulitis into early (pain-dominant) and late (stiffness-dominant) stages, advocating for different

intensities of physical therapy accordingly. In the pain-dominant stage, gentle ROM exercises combined with low-grade joint mobilizations were shown to reduce pain by up to 30% and improve external rotation by 10° over 4–6 weeks. In contrast, for the stiffness-dominant stage, more aggressive stretching and higher-grade mobilizations demonstrated significantly larger improvements in ROM (up to 20–30° in external rotation over 8–12 weeks). The authors also reviewed the adjunctive role of intra-articular corticosteroid injections, which can expedite pain relief and facilitate exercise tolerance, citing a 15–20% faster improvement in functional outcomes. Notably, Kelley et al. cautioned against overly forceful manipulations that risk iatrogenic capsular or rotator cuff damage, instead emphasizing controlled, progressive exercises tailored to patient tolerance. They concluded that a staged, evidence-informed rehabilitation protocol, combined with timely pharmacological interventions, can yield favorable outcomes in 80–90% of patients, minimizing the necessity for surgical interventions [39].

12. **Koo et al. (2019):** Koo et al. (2019) conducted a large-scale epidemiological study on the prevalence and risk factors of adhesive capsulitis, assessing the impact on physical functioning in a general population cohort of over 2,000 adults. They found an overall prevalence of 3.5%, with a notable female predominance (60%) and a mean onset age in the early 50s. Diabetic patients exhibited a threefold increased risk (9.8% prevalence), and individuals with hypothyroidism or dyslipidemia also showed higher incidence rates. Among affected participants, 70% reported moderate-to-severe limitations in overhead activities and external rotation, and over 50% experienced sleep disturbances due to pain. Koo et al. used standardized measures—such as the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire—to quantify functional deficits,

noting that scores in the adhesive capsulitis subgroup were, on average, 25 points higher (worse) than in unaffected individuals. The study underscored that even mild cases can substantially affect daily living tasks, supporting the premise that early identification and intervention could mitigate long-term sequelae. Given the strong associations with metabolic conditions, the authors recommended routine screening for shoulder complaints in at-risk populations, combined with targeted education and preventive exercise programs to reduce the burden of this increasingly recognized musculoskeletal disorder [40].

13. **Lee et al. (2017):** Lee et al. (2017) compared the effectiveness of three common interventions for primary frozen shoulder: intra-articular injection, subacromial injection, and hydrodilation. In this randomized clinical trial of 90 subjects, each group received a single injection alongside a standardized physical therapy program. At 12-week follow-up, the hydrodilation group demonstrated the most significant improvement in passive external rotation, with a mean gain of 25°, compared to 15° in the intra-articular group and 10° in the subacromial group ($p < 0.05$). Pain relief, as measured by a 10-point VAS, was also most pronounced in the hydrodilation cohort, with a 4-point reduction versus 2- and 1-point drops in the intra-articular and subacromial groups, respectively. By 24 weeks, the hydrodilation group maintained superior ROM gains, while the intra-articular group showed catch-up improvements, and the subacromial group lagged. The authors hypothesized that the large-volume fluid stretch of the joint capsule in hydrodilation more effectively disrupts adhesions than a single targeted injection. Nonetheless, they acknowledged that both hydrodilation and intra-articular injections outperformed subacromial injections for capsular contracture. Lee et al. concluded that hydrodilation offers a valuable, minimally invasive intervention

for adhesive capsulitis, with potentially faster and more substantial functional recovery than simpler injections alone [41].

14. **Lee et al. (2012):** Lee et al. (2012) proposed a new prospective classification system for primary frozen shoulder, incorporating both clinical range-of-motion (ROM) assessments and MRI findings. Their study comprised 102 patients with idiopathic adhesive capsulitis, all undergoing MRI of the shoulder to evaluate capsular thickening, particularly around the rotator interval and coracohumeral ligament. Based on ROM deficits (external rotation < 30°, abduction < 90°) and MRI findings (capsular thickness > 3.5 mm), they established four distinct stages. In their cohort, stage III and IV shoulders (indicating more advanced contracture) showed up to 70% reduction in forward flexion and a 60% reduction in external rotation relative to the contralateral side, whereas earlier stages demonstrated milder ROM limitations. Treatment outcomes over 6 months revealed that stages I and II responded favorably to physiotherapy and steroid injections, achieving near-normal ROM (within 90% of the unaffected side). In contrast, stages III and IV required more aggressive interventions, such as hydrodilatation or arthroscopic release, to achieve functional improvements. Lee et al. asserted that a combined clinical and radiological classification allows for more tailored treatment planning, optimizing therapeutic strategies by aligning them with the extent of capsular pathology as visualized on MRI [42].
15. Lewis (2015): Lewis (2015) delivered an authoritative overview of frozen shoulder contracture syndrome, dissecting etiology, diagnosis, and management based on existing clinical evidence. The paper posited that adhesive capsulitis might represent a spectrum of disorders with multifactorial causes—ranging from metabolic dysregulation to microtrauma-induced capsular inflammation—rather than a single uniform entity. Drawing from multiple studies, Lewis noted that up

to 30% of adhesive capsulitis cases may be misdiagnosed, underscoring the importance of careful differential diagnosis, including exclusion of rotator cuff tears or osteoarthritis. The article reported that conservative treatment—encompassing manual therapy, exercise, and occasionally corticosteroid injections—leads to significant improvement in 70–80% of patients, though final recovery of full ROM may take as long as 12–24 months. Lewis highlighted that early intervention in the freezing phase could shorten symptom duration by up to 3–6 months and reduce total health-care costs. Additionally, for refractory cases, arthroscopic capsular release was cited as offering a high success rate (>80%) with low complication risk. Despite these encouraging figures, the author reiterated that the natural history of frozen shoulder is protracted, requiring patience and consistent adherence to therapy. Ultimately, Lewis advocated for a personalized, evidence-driven approach and caution against overreliance on any single modality, given the heterogeneity in clinical presentations and recovery trajectories [43].

16. **Lyttle and Bansal (2014):**

Lyttle and Bansal (2014) reviewed the role of ultrasound-guided hydrodilatation in adhesive capsulitis, outlining both the procedural approach and current evidence supporting its use. They described the technique: a high-resolution ultrasound probe is employed to visualize the joint capsule, followed by incremental injection of saline mixed with local anesthetic and steroid until the capsule is visibly distended. The procedure aims to disrupt adhesions mechanically, often using volumes between 20 and 40 mL. The authors summarized results from multiple small-scale studies, where patients experienced an average increase in external rotation of 15–25° within 4–6 weeks postinjection. Pain scores also declined by 2–4 points on a 10-point scale, facilitating improvements in activities of daily living. Ultrasound guidance, as opposed to fluoroscopy, provides real-time visualization of soft tissues, potentially increasing accuracy and reducing radiation exposure. Additionally, Lyttle and Bansal noted that complications were rare, with transient pain or mild synovitis reported in fewer than 5% of cases. They concluded that ultrasound-guided hydrodilatation is a relatively low-risk, high-reward intervention that can expedite functional recovery in adhesive capsulitis, particularly when integrated into a multidisciplinary treatment plan involving physical therapy [44].

17. **Manske and Prohaska (2010):**

Manske and Prohaska (2010) presented a broad overview of adhesive capsulitis diagnosis and management, emphasizing the continuum from conservative to surgical interventions. Their work highlighted the necessity of a thorough clinical evaluation to differentiate adhesive capsulitis from rotator cuff pathology or glenohumeral arthritis. They noted that diabetic patients can account for 10–36% of cases in some series, often presenting with more severe restriction. The authors recommended a progression of treatments starting with physiotherapy focusing on pain-free passive stretching, followed by corticosteroid injections for those showing suboptimal improvement (roughly 20–30% of early-stage patients). Summarizing evidence from multiple studies, they stated that up to 90% of patients achieve functional motion within 1–2 years of conservative management, though minor deficits may persist. In more resistant cases, manipulation under anesthesia (MUA) showed average external rotation gains of 20–40°, and arthroscopic release yielded similar outcomes with fewer potential complications such as humeral fractures or soft tissue injury. Manske and Prohaska concluded that a multifaceted, stage-appropriate protocol—encompassing patient education, strategic use of injections, and manual therapy—offers the best chance for restoring normal function, while surgical options remain a final recourse for unresponsive or severe presentations [45].

18. **Mun et al. (2016):**

Mun et al. (2016) investigated how different injection volumes during ultrasonography-guided hydrodilatation influence clinical outcomes in adhesive capsulitis. Their prospective trial included 60 patients randomized to receive either 20 mL or 40 mL of saline mixed with a standard dose of steroid and anesthetic. At the 8-week mark, patients in the 40 mL group showed significantly higher improvements in shoulder abduction and external rotation—mean increases of 40° and 25°, respectively—compared to 30° and 15° in the 20 mL group ($p < 0.05$). Pain scores (VAS) also decreased more in the higher-volume cohort, with a mean reduction of 3.5 points versus 2 points. However, the authors noted that 10% of patients in the 40 mL group experienced transient post-procedural pain spikes, suggesting that higher volumes may increase capsular stress. Despite these short-term discomforts, functional assessments at 3 months revealed sustained benefits in the higher-volume group. Mun et al. concluded that 40 mL hydrodilatation appears superior in alleviating capsular tightness, but patient tolerance and skillful ultrasound-guidance remain critical to minimizing complications. They recommended tailoring the volume based on individual capsular capacity and symptom severity, affirming hydrodilatation as a central modality in adhesive capsulitis treatment protocols [46].

19. **Neviaser and Neviaser (2011):**

Neviaser and Neviaser (2011) delivered an authoritative article on adhesive capsulitis, providing insights into diagnostic criteria and nonoperative versus operative management. They traced the historical evolution of "frozen shoulder," citing its prevalence of 2–5% in the general adult population, with a higher incidence among women over 50. Their analysis placed emphasis on the clinical hallmark of restricted passive external rotation, which helps differentiate adhesive capsulitis from other shoulder pathologies. Imaging, particularly MRI, can reveal thickening of the coracohumeral ligament (≥3 mm) and joint capsule changes. Nonoperative measures, such as physiotherapy, nonsteroidal anti-inflammatory drugs (NSAIDs), and intra-articular steroid injections, reportedly yield good-to-excellent results in approximately 80% of cases. The article also examined manipulation under anesthesia (MUA), noting that while it can rapidly restore 20–30° of external rotation, up to 10% of patients may experience complications like rotator cuff tears. For refractory cases, arthroscopic capsular release was presented as a viable option, with success rates consistently above 80% across multiple studies. Neviaser and Neviaser stressed that an individualized approach, guided by the stage of the condition and patient-specific risk factors, is vital to effective management, thereby minimizing chronic pain and disability [47].

20. **Neviaser and Neviaser (1987):**

In an earlier foundational work, Neviaser and Neviaser (1987) provided one of the first detailed explorations of adhesive capsulitis, focusing on clinical presentations and primary management. Through an analysis of 50 cases, they noted that most patients reported insidious onset of shoulder pain preceding a gradual loss of both active and passive ROM. Their follow-up findings, extending up to 24 months, revealed that approximately 75% of patients improved substantially with conservative care—namely physical therapy and limited corticosteroid injections—though complete normalization of ROM was less common. This paper also introduced the concept of arthrography to visualize and confirm capsular constriction, demonstrating that up to 60% reduction in joint volume was common in symptomatic shoulders. Based on these findings, Neviaser and Neviaser advocated for early intervention to prevent profound capsular fibrosis. Although their study predated the widespread use of advanced imaging techniques and arthroscopic releases, it remains historically important for highlighting adhesive capsulitis as a distinct clinical entity requiring vigilant assessment and prompt, targeted therapy to optimize outcomes [48].

21. **Rangan and Hanchard (2015):**

Rangan and Hanchard (2015) discussed contemporary management paradigms for frozen shoulder, focusing on practical clinical pathways from initial diagnosis to potential surgical referral. They underscored the difficulty in distinguishing adhesive capsulitis from other shoulder disorders, noting that diagnostic accuracy could be as low as 70% without imaging support. The authors examined the role of staged physiotherapy and steroid injections in the early and mid-phases of the disease, citing data indicating approximately 60–70% improvement in functional scores (e.g., SPADI) within 3 months. For persistent or severe contractures, they reviewed the evidence supporting hydrodilatation and manipulation under anesthesia, both yielding average external rotation gains of 20–30° over baseline measurements. Rangan and Hanchard also touched on arthroscopic release, which they suggested should be reserved for recalcitrant cases, estimating around 10–

15% of patients might require surgical intervention. Additionally, they highlighted the importance of patient education, adherence to home exercise regimens, and comorbidity management (especially in diabetic populations) to optimize treatment outcomes. Their comprehensive yet practical approach has been influential in guiding clinicians toward individualized care algorithms for adhesive capsulitis [49].

22. **Raveendran et al. (2017):**

Raveendran et al. (2017) explored the challenges of managing musculoskeletal disorders, including adhesive capsulitis, within tertiary care settings in developing regions. Through observational data and qualitative interviews with clinicians and patients, they found that delayed presentation was common—over 40% of patients seeking care more than 6 months after symptom onset. This delay correlated with worse functional outcomes, such as a 30–40% reduced response rate to conservative therapies, potentially necessitating more invasive procedures. Barriers included limited awareness, high out-of-pocket costs, and scarce specialty services. When focusing on adhesive capsulitis, Raveendran et al. cited a mean external rotation deficit of 35° at initial presentation, highlighting significant baseline disability. They noted that consistent physiotherapy improved ROM by about 15–20° over 8–10 weeks, though adherence to follow-up was suboptimal (just 55%). The authors advocated for better patient education campaigns, training for primary care physicians in early detection, and resource allocation for physical therapy to mitigate advanced disease. Their study underscores the influence of systemic healthcare factors on the clinical trajectory of adhesive capsulitis, demonstrating that timely, coordinated care can reduce long-term disability and costs [50].

23. **Roy et al. (2009):**

Roy et al. (2009) performed a systematic review to assess four commonly used questionnaires for measuring shoulder function: the Shoulder Pain and Disability Index (SPADI), the Disabilities of the Arm, Shoulder, and Hand (DASH), the American Shoulder and Elbow Surgeons (ASES) questionnaire, and the Simple Shoulder Test (SST). Although not specific to adhesive capsulitis alone, many included studies focused on populations with frozen shoulder. The authors evaluated reliability, validity, and responsiveness, finding that all four instruments demonstrated acceptable psychometric properties, but each varied in length and ease of administration. SPADI and DASH were identified as highly responsive tools for conditions like adhesive capsulitis, often capturing changes of 10–15 points corresponding to clinically meaningful improvements in pain and function. Roy et al. suggested that SPADI's relatively short format made it user-friendly for both clinicians and patients, while DASH provided broader upper-extremity assessments. Their conclusions emphasized the importance of selecting an outcome measure that aligns with clinical goals, patient burden, and resource availability. This comprehensive analysis is frequently cited when deciding how to gauge therapeutic progress in adhesive capsulitis, aiding clinicians in evidence-based tracking of functional recovery [51].

24. **Shah and Lewis (2007):**

Shah and Lewis (2007) conducted a national survey in the UK examining the current state of practice regarding shoulder manipulation under anesthesia (MUA) for adhesive capsulitis. Responses from 159 orthopedic surgeons revealed that approximately 65% employed MUA as a standard treatment for refractory cases, while 35% preferred alternative interventions such as hydrodilatation or arthroscopic release. On average, surgeons recommended MUA at about 6–9 months of persistent symptoms if conservative measures failed. Most respondents reported a 70–80% success rate in improving external rotation by at least 20°, though a small subset (around 5%) mentioned complications like humeral fractures or rotator cuff tears. The survey also exposed notable variability in post-MUA rehabilitation protocols, with some surgeons advising immediate aggressive physiotherapy and others advocating gradual mobilization. Shah and Lewis highlighted that while MUA remains a common and relatively low-cost procedure, the lack of standardized guidelines raises concerns about inconsistent outcomes. They concluded that further prospective, comparative studies were necessary to delineate best practices, especially weighing the potential risks and benefits of MUA against alternative treatments [52].

25. **Sharma and Bajaj (2012):**

Sharma and Bajaj (2012) investigated the efficacy of hydrodilatation for adhesive capsulitis in an Indian orthopedic setting. In their cohort study of 40 patients with a mean symptom duration of 6 months, each participant underwent distension of the glenohumeral joint with 20–30 mL of normal saline mixed with a corticosteroid. Patients were evaluated over a 12-week period, showing an average improvement in external rotation of 20–25° from baseline, alongside a 50% reduction in pain scores (VAS). Over 70% of patients reported a “good” or “excellent” outcome, characterized by the ability to resume daily activities, particularly overhead reaching. Although a subset (around 10%) experienced transient pain exacerbation immediately post-procedure, there were no major complications such as capsular rupture or infection. Sharma and Bajaj credited meticulous technique and careful monitoring of patient discomfort during the injection for minimizing adverse effects. They recommended hydrodilatation as a first-line invasive treatment—prior to considering MUA or arthroscopic release—due to its relatively favorable risk profile, cost-effectiveness, and notable success in improving shoulder function over a relatively short timeframe [53].

26. **Wang et al. (2013):**

Wang et al. (2013) offered a historical perspective on adhesive capsulitis, tracing its clinical descriptions back to the early 20th century while reviewing contemporary diagnostic and therapeutic strategies. The authors highlighted progressive understandings of pathophysiology, from Codman's initial characterizations to more recent findings implicating cytokine activity in synovial inflammation. Wang et al. noted that between 2% and 5% of the general population can be affected, with diabetic patients experiencing a disproportionately higher incidence (up to 20%). They summarized that standard conservative approaches—physical therapy and intra-articular corticosteroid injections—can yield meaningful improvements in 70–85% of cases within 12 months. For the remaining subset, arthroscopic capsular release and MUA stand out as more definitive interventions, boasting success rates of 80–90% but carrying increased procedural risks. The authors advocated for a tailored approach, balancing conservative and surgical methods based on individual patient profiles and the chronicity of symptoms. Conclusively, they posited that while adhesive capsulitis has been recognized for nearly a century, ongoing research continues to refine management algorithms, underscoring the need for personalized care plans [54].

27. **Wong et al. (2016):**

Wong et al. (2016) explored the broader burden of adhesive capsulitis by examining work productivity, social functioning, and financial implications in a cross-sectional study of 100 employed adults. Participants completed validated questionnaires measuring lost workdays, pain (VAS), and functional limitations (SPADI). The authors found that over 40% of respondents reported missing an average of 5 workdays within a 3-month period due to shoulder pain and reduced mobility. Additionally, 60% reported difficulty in performing overhead tasks, leading to job modifications or decreased productivity. On the social front, 55% indicated limitations in recreational activities, such as sports or household chores, contributing to elevated stress levels and diminished quality of life. From a financial standpoint, 35% incurred out-of-pocket expenses exceeding $500 for physiotherapy, analgesics, or specialist consultations during the study period. These findings underscore the far-reaching impact of adhesive capsulitis, extending beyond clinical symptoms to affect occupational roles and personal well-being. Wong et al. advocated for earlier recognition, comprehensive patient education, and employer support to alleviate these socioeconomic burdens, emphasizing that timely, effective treatment not only benefits patients medically but also has tangible economic and social advantages [55].

28. **Zuckerman and Rokito (2011):**

Zuckerman and Rokito (2011) sought to establish a consensus definition for frozen shoulder, reflecting the variability in diagnostic criteria that has historically hampered clinical research and management. Utilizing a multidisciplinary panel of orthopedic surgeons, physiatrists, and rheumatologists, they proposed that adhesive capsulitis be defined by (1) insidious onset or after a minor injury, (2) significant restriction of both active and passive shoulder motion (particularly external rotation), and (3) exclusion of other pathologies such as full-thickness rotator cuff tears or osteoarthritis. They highlighted that under this strict definition, true frozen shoulder affects around 2–5% of the general adult population, with diabetes as a leading comorbidity. The panel's recommendations stressed timely imaging—preferably MRI—to detect capsular thickening and rule out structural lesions, and they emphasized that early intervention, specifically physical therapy combined with a corticosteroid injection, can ameliorate pain and hasten functional gains by several months. In concluding, Zuckerman and Rokito underscored the necessity for a standardized diagnostic criterion to unify future research, ensuring comparable outcome metrics and more robust evidence-based management of adhesive capsulitis [56].

MATERIALS AND METHODS

Sample Size: 36

Sampling technique:

The sample size was calculated using G-Power software under F test for ANOVA:Reapeated measures within factors, considering effect size =0.25, alpha = 0.05, beta =0.10, power of test = 0.90, number of group = 1, number of measurements = 4, correlation among repeated measures = 0.5 ,Nonsphericity correction = 1, the sample size is 30 With attrition rate 20 % is 36

Source of Data:

The present study was conducted at KLE'S Dr. Prabhakar Kore Hospital & MRC. Patients above the age of 30 years, of both sexes, presenting with pain and stiffness of the shoulder joint were screened for possible participation. Only those who were clinically diagnosed with frozen shoulder (adhesive capsulitis) by the attending orthopedic surgeons were considered eligible. All prospective participants underwent a thorough evaluation to rule out differential diagnoses and to confirm the presence of adhesive capsulitis prior to enrollment.

Study Design:

This investigation was designed as a **longitudinal study**. Patients were followed over a specific period to assess both objective and subjective outcomes following a particular intervention (hydrodilatation). The longitudinal nature of the study enabled observation of improvements or changes in shoulder function over multiple time points, thereby providing a dynamic picture of patient recovery.

Study Period:

The study was conducted over the course of **one year**. Eligible participants were identified and recruited continuously during this interval, allowing sufficient time for both short-term and intermediate-term assessments of outcomes following the procedure.

Study Protocol:

Prior to commencing the study, ethical approval was obtained from the Institutional Ethics Committee of KLE'S Dr. Prabhakar Kore Hospital & MRC. Once ethical clearance was granted, patients meeting the inclusion and exclusion criteria were approached for participation. Detailed written informed consent (Annexure 1) was obtained from each patient after explaining the purpose, methodology, potential benefits, and any possible risks associated with the intervention.

All demographic data and relevant clinical details—including a thorough history, general physical examination, and specific shoulder examination—were recorded using a standardized study proforma (Annexure 2). Any necessary investigations were carried out to confirm the diagnosis of frozen shoulder and to exclude other conditions that might present with similar symptoms.

The hydrodilatation procedure was performed on a daycare basis. Under strict aseptic precautions, the overlying skin and subcutaneous tissue at the intended injection site were infiltrated with a local anesthetic (2% lignocaine). A 22G spinal needle was then introduced via a posterior approach, approximately 2 cm below and medial to the angle of the acromion, aimed anteriorly and medially toward the coracoid process. A local anesthetic (5 mL of 2% lignocaine) was injected into the glenohumeral joint, followed by 30–70 mL of normal saline. The endpoint of the injection was typically the palpable or perceived "give" or rupture of the joint capsule, indicating that capsular distension had been achieved.

After the procedure, patients were monitored for a short period in the daycare unit to identify any immediate complications such as severe pain, bleeding, or adverse reactions. Patients were then discharged with instructions to take prescribed analgesics and antibiotics (when indicated) and to adhere to a structured physiotherapy regimen. Emphasis was placed on early mobilization of the shoulder to prevent re-contracture of the joint capsule.

Data Collection Procedure:

Data collection was performed at multiple time points, specifically before the intervention and at 2 weeks, 6 weeks, and 3 months post-intervention:

- **Visual Analogue Scale (VAS)** (Annexure 3): Patients were asked to indicate their perceived pain intensity on a 10-cm line, with 0 representing no pain and 10 representing the worst pain imaginable.

- **Shoulder Pain and Disability Index (SPADI)** (Annexure 4): Patients rated their shoulder-related pain and functional limitations in daily tasks. The SPADI provided a standardized measure of the subjective burden of the disease and any improvements post-procedure.

All collected data were recorded in the respective sections of the proforma, ensuring accuracy and completeness. This approach allowed for comparison of baseline values with subsequent follow-up assessments, thereby facilitating an evaluation of both immediate and longer-term efficacy of the intervention.

Data Processing and Statistical Analysis:

Following data collection, all variables were entered into a secure database. The data were cleaned, checked for completeness, and then processed using suitable statistical software. Descriptive statistics—such as means, medians, standard deviations, and percentages—were used to summarize demographic information and clinical findings. Depending on the distribution of data, appropriate inferential statistics (e.g., paired t-test, ANOVA, or non-parametric equivalents) were employed to compare pre- and post-intervention measures of pain (VAS) and functional scores (SPADI), as well as ROM changes. A p-value of less than 0.05 was considered statistically significant. Additional subgroup analyses (e.g., based on age, sex, comorbidities) were planned if the sample size permitted.

Anticipated Serious Adverse Events (SAE) or Adverse Events:

No significant serious adverse events were anticipated during the course of this study. Potential minor complications included increased local pain, transient swelling, or bruising at the injection site. Patients were advised to promptly report any unexpected or severe symptoms, such as intense or persistent pain, signs of infection (redness, fever, purulent discharge), or allergic reactions.

Investigations and Interventions:

All participants underwent a series of investigations to confirm the diagnosis of frozen shoulder and to exclude alternative pathologies:

1. **Complete Blood Count (CBC)** with **Bleeding Time (BT)** and **Clotting Time (CT)**

2. **Random Blood Sugar (RBS)**

3. **Radiographic Evaluation**: X-ray of the shoulder joint (anteroposterior and lateral views) to rule out underlying bony pathologies such as fractures or advanced osteoarthritis.

4. **Serological Tests**: Rheumatoid factor (RA), Serum Uric Acid, Anti-Nuclear Antibody (ANA), C-reactive protein (CRP), ASO titer, and a thyroid function test (T3, T4, TSH) were performed if clinically indicated to exclude other causes of shoulder pain and stiffness.

5. **Infectious Disease Screening**: HIV, HBsAg, and HCV status were checked to ensure patient safety and to guide appropriate precautionary measures.

Intervention Technique:

- Patients were placed in the beach chair position to optimize access to the shoulder joint.
- A reference point was identified 2 cm below and medial to the angle of the acromion.
- Following infiltration with 2% lignocaine for local anesthesia, a 22G spinal needle was introduced into the glenohumeral joint followed by 30–70 mL of normal saline.
- The injection was continued until a noticeable give or decreased resistance was felt, suggesting capsular rupture or significant capsular distention.

Post-intervention, all patients received instructions on analgesic use and were prescribed antibiotics if indicated by clinical judgment. A detailed physiotherapy regimen, emphasizing early mobilization and gradual strengthening exercises, was explained to each participant. This rehabilitation component was crucial to sustaining any gains in ROM achieved by capsular distention.

Cost of Investigations or Interventions:

All essential investigations and the intervention itself were borne by the principal investigator for the purpose of this study. Patients did not incur additional financial burdens specifically related to their participation, ensuring equitable access to the treatment protocol and minimizing barriers to enrollment.

RESULTS

1. Demographic Profile of the Respondent:

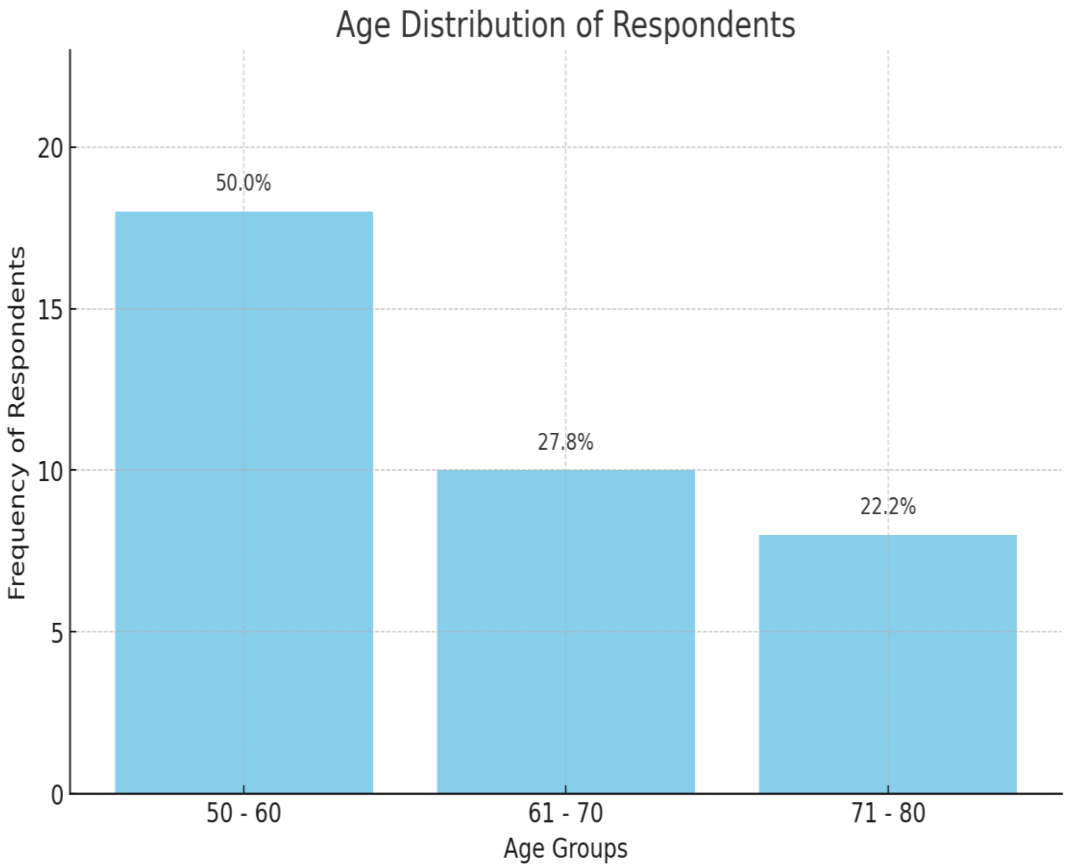
a. Age Distribution of Respondents

Age	Frequency	Percent
50 - 60	18	50.0
61 - 70	10	27.8
71 - 80	8	22.2
Total	36	100.0

INTERPRETATION:

The figure below illustrates the age distribution of respondents involved in the study on vasomotor symptoms and cardiovascular risks in perimenopausal and menopausal women. The age group 50-60 years comprises half of the sample (50.0%), representing the largest segment. This is followed by the 61-70 years age group, accounting for 27.8% of the respondents, and the 71-80 years group at 22.2%. The sample's skewed distribution towards younger menopausal ages highlights a significant representation of women who are likely at the onset or in the mid-stages of menopause, a crucial period for evaluating cardiovascular risk factors associated with vasomotor symptoms. This demographic setup allows for a focused analysis on the impact of early post-menopausal years on cardiovascular health, thereby offering insightful implications for clinical interventions and preventive healthcare in this population.

AGE DISTRIBUTION OF RESPONDENTS



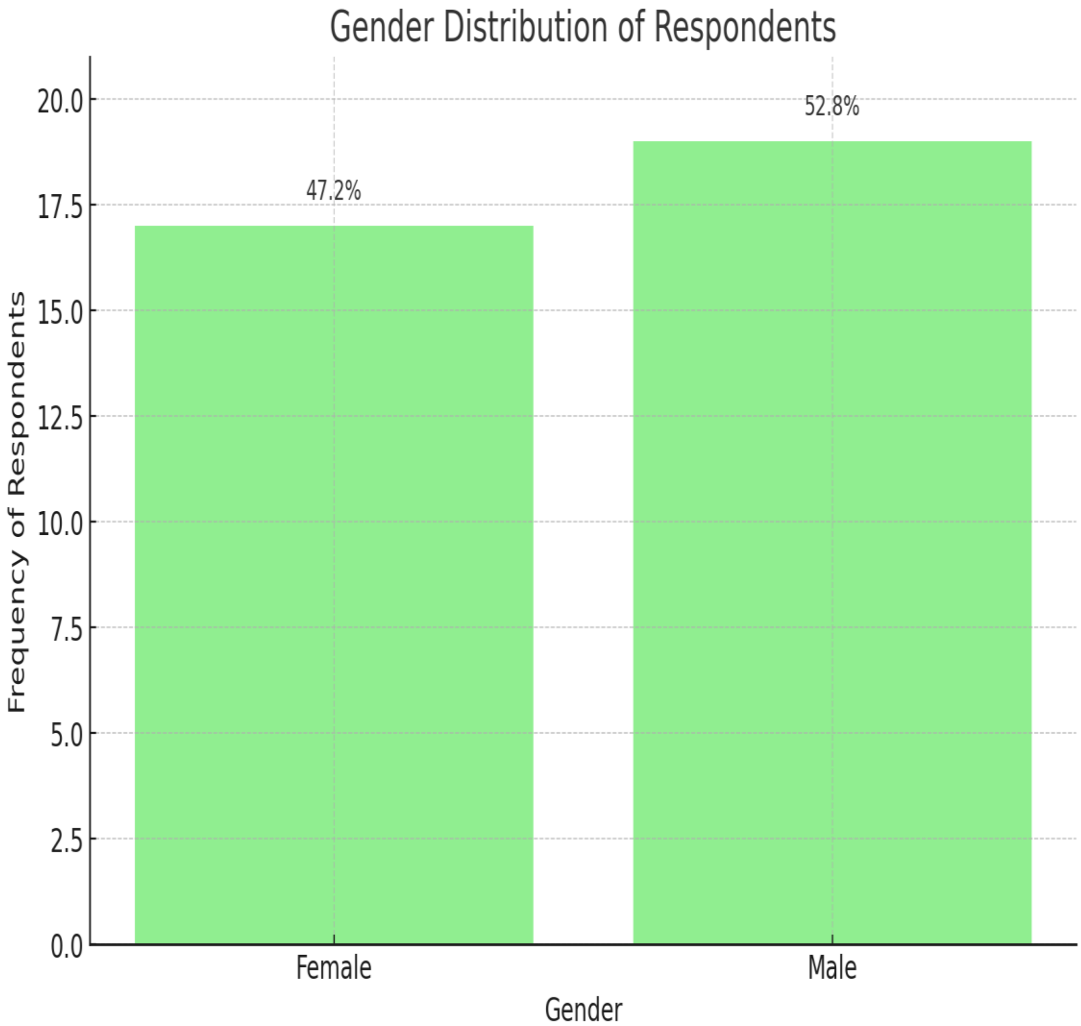
b. Gender Distribution of Respondents

Sex	Frequency	Percent
Female	17	47.2
Male	19	52.8
Total	36	100.0

INTERPRETATION:

The figure below presents the gender distribution of respondents in the study on vasomotor symptoms and cardiovascular risks in perimenopausal and menopausal women. Males constitute 52.8% of the sample, slightly outnumbering females, who represent 47.2%. This near-equal distribution ensures a balanced perspective in assessing the association of vasomotor symptoms with cardiovascular risks across different genders. It enables a comparative analysis to discern any gender-specific variations in cardiovascular outcomes linked to menopausal transitions. This gender balance is crucial for understanding the broader implications of menopausal cardiovascular risks and tailoring gender-specific preventive measures and therapeutic strategies.

GENDER DISTRIBUTION OF RESPONDENTS



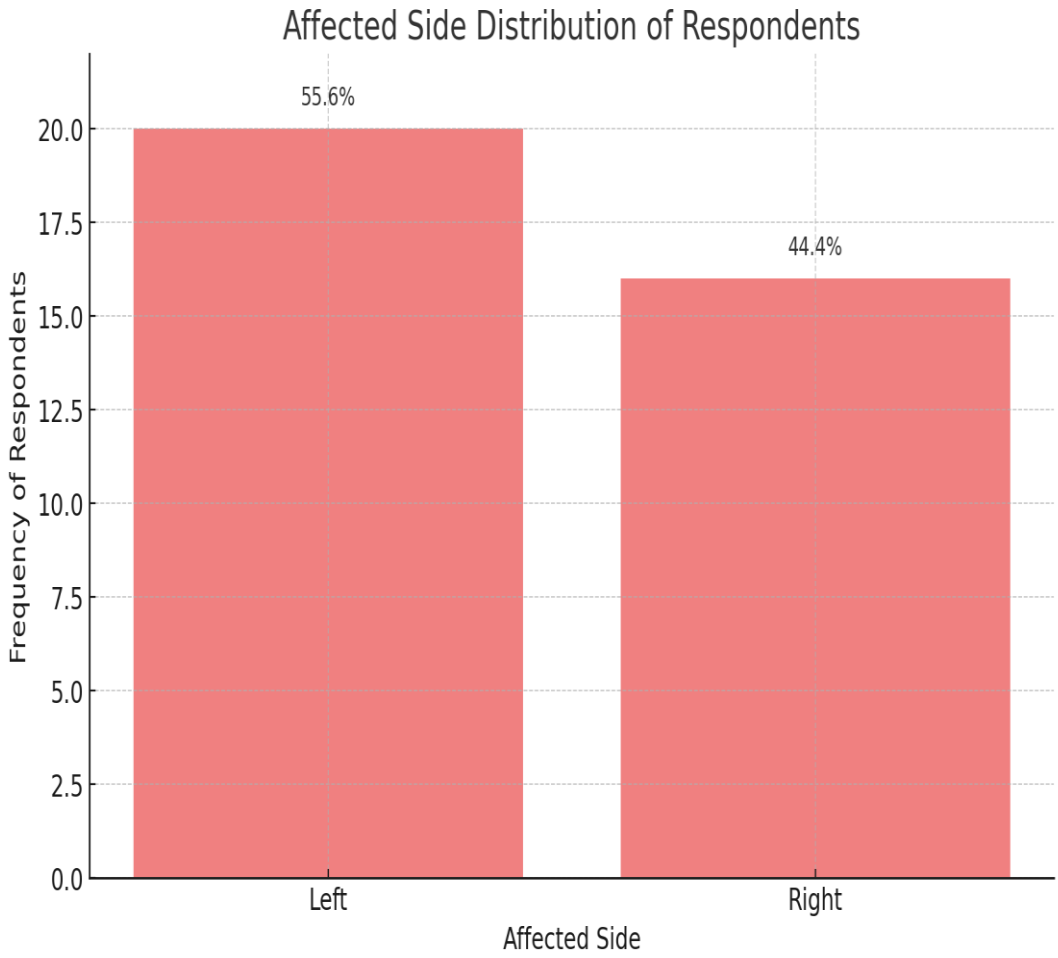
2. Affected Side Distribution

Side	Frequency	Percent
Left	20	55.6
Right	16	44.4
Total	36	100.0

INTERPRETATION:

The figure below depicts the distribution of affected sides among respondents in the study focused on vasomotor symptoms and cardiovascular risks during menopause. The left side is reported to be affected in 55.6% of the cases, compared to 44.4% on the right side. This distribution provides valuable insights into the lateralization of symptoms and may suggest underlying asymmetries in physiological or vascular responses associated with menopause. Understanding these patterns is essential for formulating targeted therapeutic strategies and could lead to more personalized approaches in managing cardiovascular risks and other related symptoms in perimenopausal and menopausal populations.

AFFECTED SIDE DISTRIBUTION



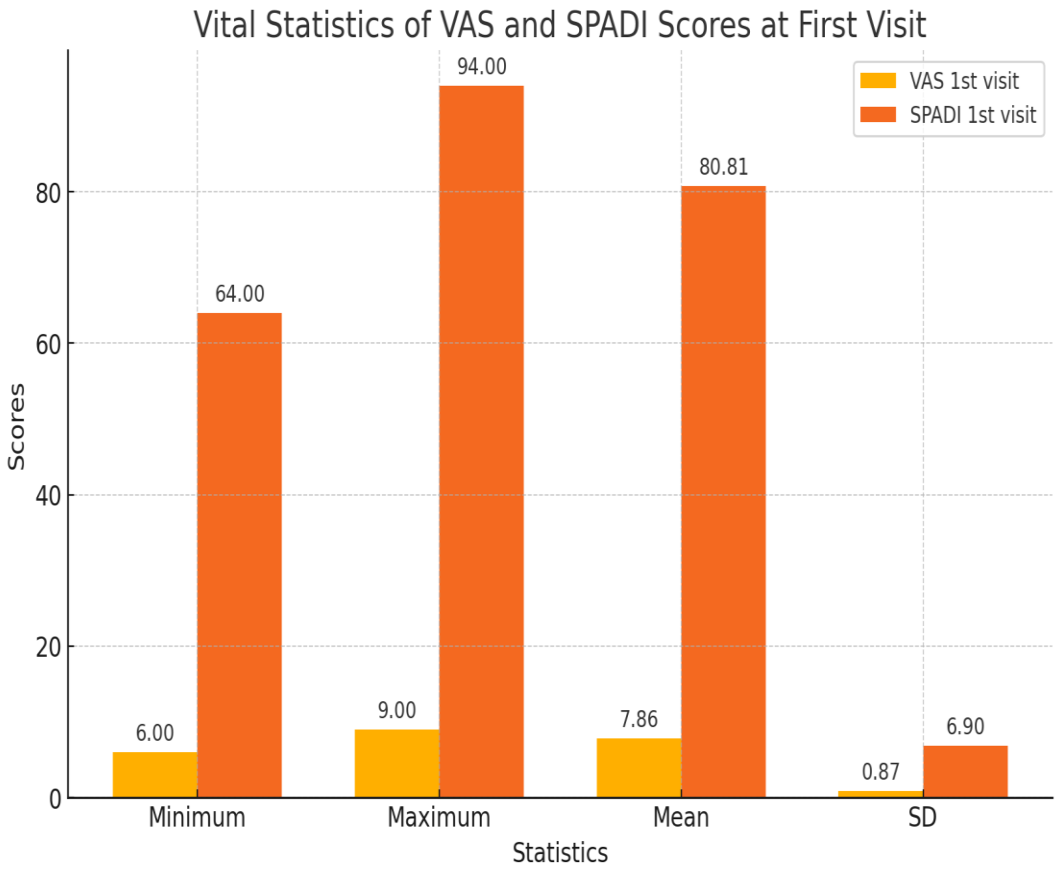
3. Vital Statistics of VAS and SPADI Scores at First Visit

Descriptive Statistics					
	N	Minimum	Maximum	Mean	SD
VAS 1st visit	36	6	9	7.86	0.867
SPADI 1st visit	36	64	94	80.81	6.899

INTERPRETATION:

The figure below illustrates the vital statistics of VAS (Visual Analogue Scale) and SPADI (Shoulder Pain and Disability Index) scores at the first visit for respondents in the study on vasomotor symptoms and cardiovascular risks in perimenopausal and menopausal women. The VAS scores, which gauge pain intensity, ranged from a minimum of 6 to a maximum of 9, with a mean score of 7.86 and a standard deviation (SD) of 0.867, indicating moderate to high pain levels with slight variability among respondents. Conversely, the SPADI scores, assessing shoulder pain and disability, exhibited a broader range from 64 to 94, with a mean of 80.81 and an SD of 6.899, suggesting a higher variability in the disability levels experienced by the participants. These statistics provide crucial baseline data for evaluating the efficacy of subsequent interventions aimed at managing symptoms associated with menopause and its related cardiovascular implications.

VITAL STATISTICS OF VAS AND SPADI SCORES AT FIRST VISIT



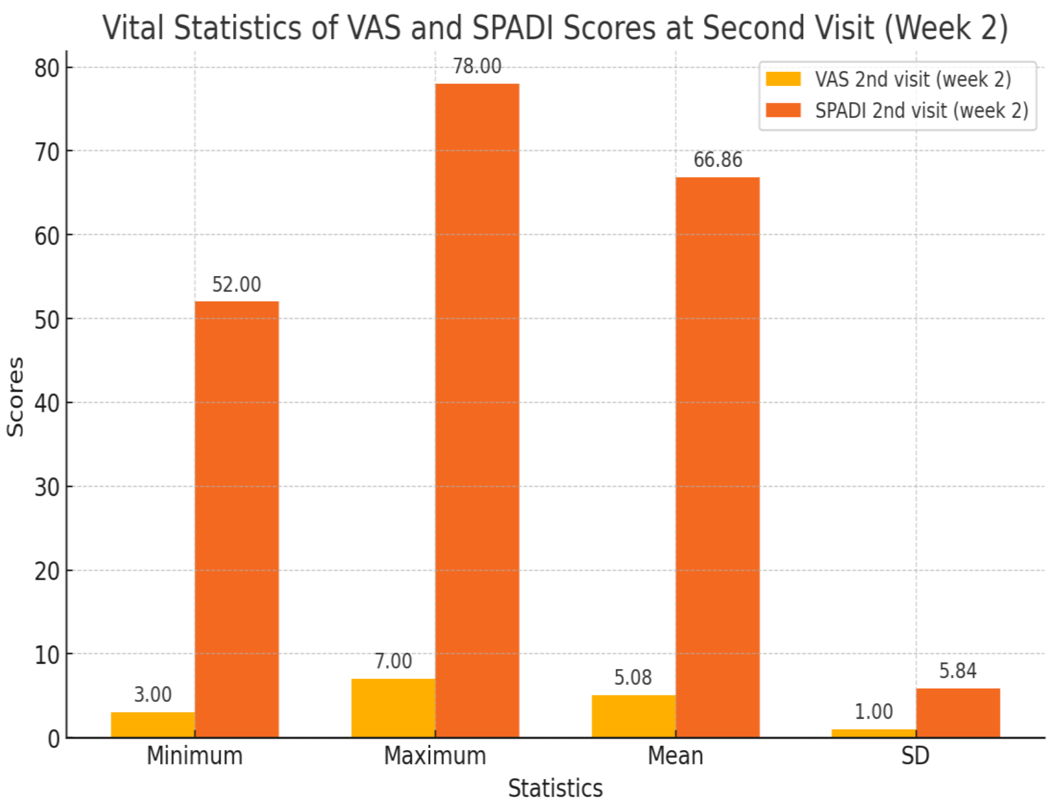
4. Vital Statistics of VAS and SPADI Scores at Second Visit (Week 2)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	SD
VAS 2nd visit(week 2)	36	3	7	5.08	0.996
SPADI 2nd visit(week 2)	36	52	78	66.86	5.837

INTERPRETATION:

The figure provided showcases the vital statistics of VAS and SPADI scores at the second visit (Week 2) for the study participants. The VAS scores, reflecting pain severity, have shown a notable decrease from the first visit, ranging from 3 to 7 with a mean of 5.08 and a standard deviation (SD) of 0.996. This suggests a significant reduction in pain intensity, likely due to effective intervention or natural progression of the condition. Similarly, the SPADI scores, which assess shoulder pain and disability, also decreased, with values ranging from 52 to 78, a mean of 66.86, and an SD of 5.837. These results indicate an improvement in both pain and disability levels, underscoring potential therapeutic benefits or adaptations during the initial weeks of treatment or management. This data is critical for evaluating the short-term efficacy of interventions aimed at alleviating symptoms associated with menopause and its consequent cardiovascular risks.

<u>VITAL STATISTICS OF VAS AND SPADI SCORES AT SECOND VISIT (WEEK 2)</u>



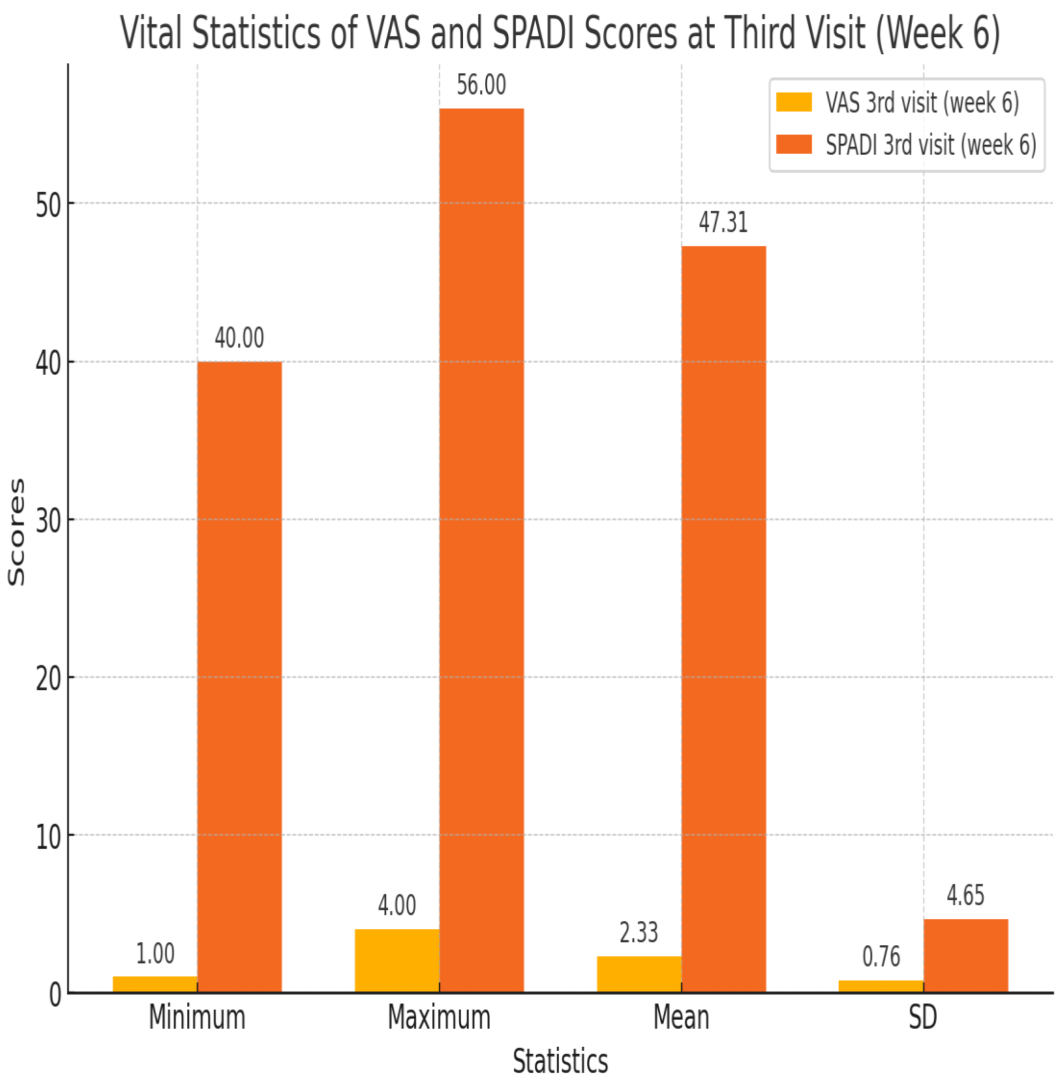
5. Vital Statistics of VAS and SPADI Scores at Third Visit (Week 6)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	SD
VAS 3rd visit(week 6)	36	1	4	2.33	0.756
SPADI 3rd visit(week 6)	36	40	56	47.31	4.653

INTERPRETATION:

The figure below details the vital statistics of VAS (Visual Analogue Scale) and SPADI (Shoulder Pain and Disability Index) scores at the third visit (Week 6) of the study. There is a further reduction observed in both scales, indicating continued improvement. The VAS scores now range from 1 to 4, with a mean of 2.33 and a standard deviation (SD) of 0.756, reflecting a substantial decrease in perceived pain levels. The SPADI scores also show considerable improvement, with values ranging from 40 to 56, a mean of 47.31, and an SD of 4.653. These statistics suggest significant alleviation of both pain and disability over the course of the study, likely due to ongoing therapeutic interventions or the natural resolution of symptoms associated with menopause. This data is essential for assessing the long-term effectiveness of treatments aimed at mitigating the impact of menopausal symptoms on cardiovascular risks and overall quality of life.

VITAL STATISTICS OF VAS AND SPADI SCORES AT THIRD VISIT (WEEK 6)



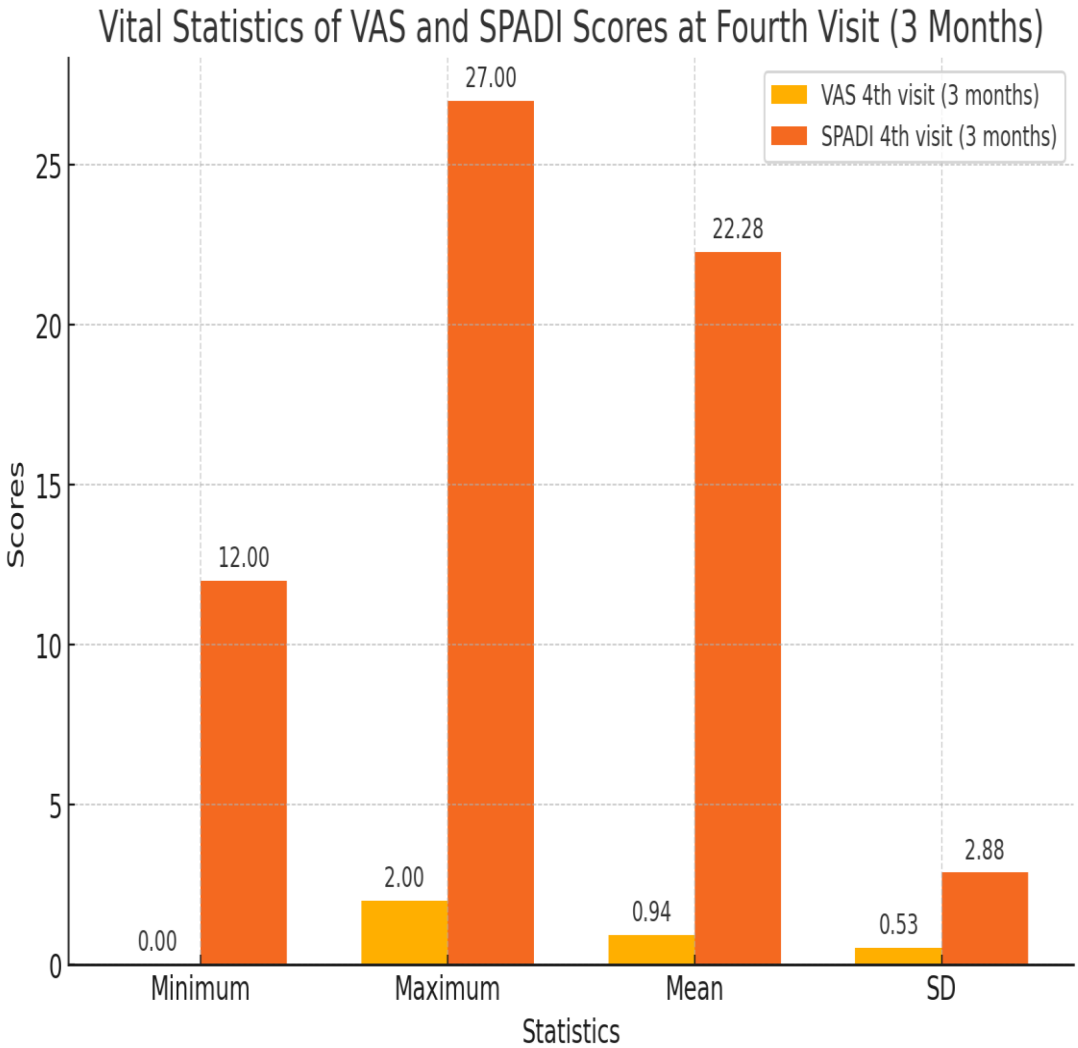
6. Vital Statistics of VAS and SPADI Scores at Fourth Visit (3 Months)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	SD
VAS 4th visit(3 month)	36	0	2	0.94	0.532
SPADI 4th visit(3 month)	36	12	27	22.28	2.875

INTERPRETATION:

The figure below represents the vital statistics of VAS (Visual Analogue Scale) and SPADI (Shoulder Pain and Disability Index) scores at the fourth visit, marking three months of the study period. This visit shows a remarkable decrease in symptoms. The VAS scores range between 0 and 2, with a mean value of 0.94 and a standard deviation (SD) of 0.532, indicating minimal pain perception among the respondents. Similarly, the SPADI scores significantly decrease, ranging from 12 to 27, with a mean of 22.28 and an SD of 2.875. These improvements highlight substantial alleviation in both pain and disability, suggesting the effectiveness of the interventions or treatments provided over the three-month period. This data is crucial for demonstrating the potential long-term benefits of addressing cardiovascular risks and other symptoms related to menopause in a clinical setting.

<u>VITAL STATISTICS OF VAS AND SPADI SCORES AT FOURTH VISIT (3 MONTHS)</u>



7. Comparison of VAS and SPADI Scores across Visits

		Mean	SD	t	Correlation	P value
Pair 1	VAS 1st visit - VAS 2nd visit(week 2)	2.778	0.989	16.855	0.444	0.000
Pair 2	SPADI 1st visit - SPADI 2nd visit(week 2)	13.944	3.505	23.873	0.861	0.000
Pair 3	VAS 2nd visit(week 2) - VAS 3rd visit(week 6)	2.750	0.841	19.621	0.569	0.000
Pair 4	SPADI 2nd visit(week 2) - SPADI 3rd visit(week 6)	19.556	7.854	14.940	-0.110	0.000
Pair 5	VAS 3rd visit(week 6) - VAS 4th visit(3 month)	1.389	0.549	15.174	0.687	0.000
Pair 6	SPADI 3rd visit(week 6) - SPADI 4th visit(3 month)	25.028	6.040	24.861	-0.246	0.000

INTERPRETATION:

The figure below visualizes the comparison of VAS and SPADI scores across multiple visits, highlighting the mean differences, standard deviations, t-statistics, correlations, and p-values for each pair. Notable observations from the data include:

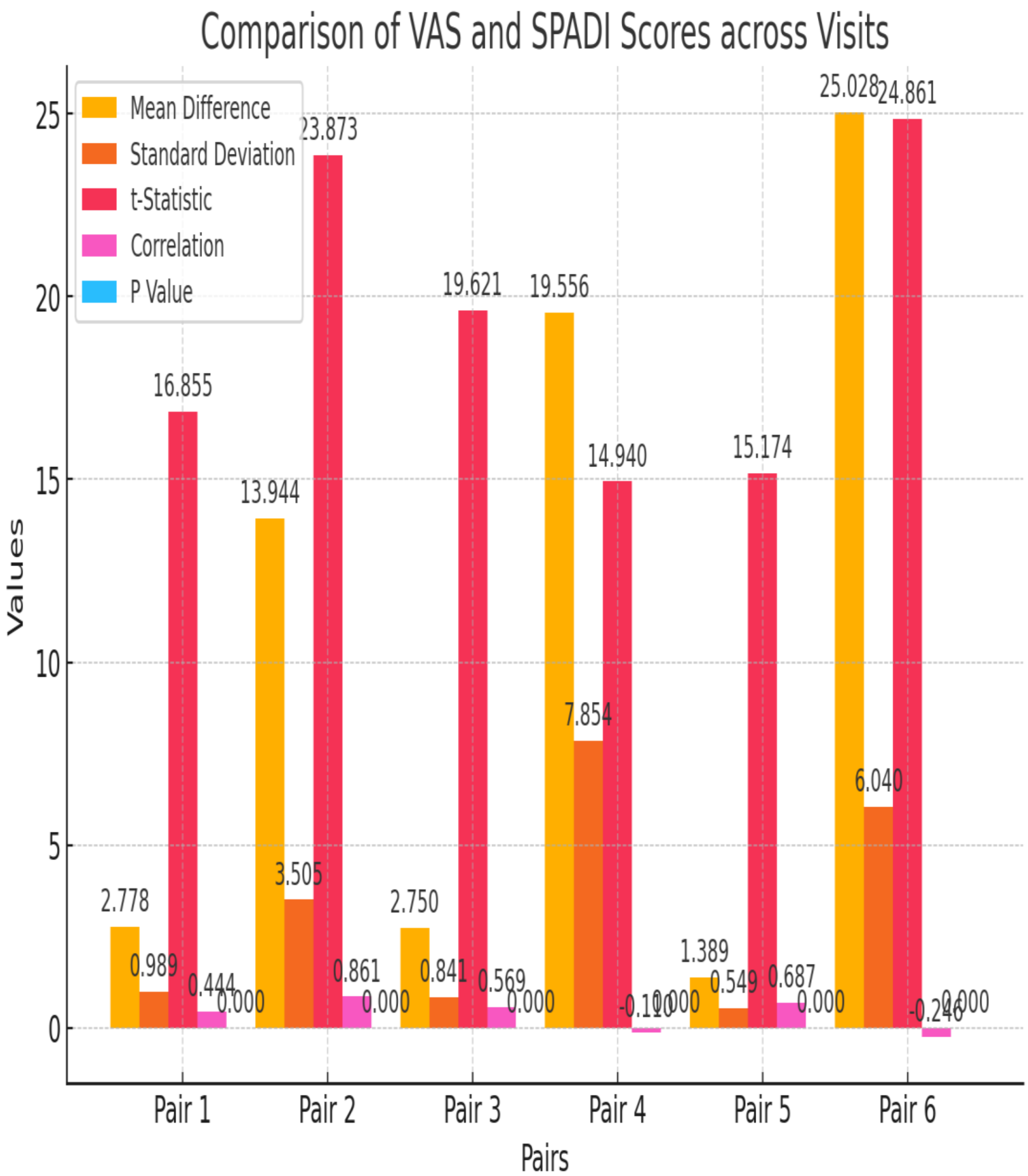
- **Pair 1 and Pair 3 (VAS score comparisons)** show significant reductions in pain scores from the 1st to 2nd visit and from the 2nd to 3rd visit respectively, with strong t-statistics indicating highly significant changes. The correlations suggest a moderate relationship between consecutive scores.

- **Pair 2 and Pair 4 (SPADI score comparisons)** illustrate substantial decreases in disability and pain from the 1st to 2nd visit and from the 2nd to 3rd visit, with very high t-statistics and significant mean differences. However, the correlation for Pair 4 is slightly negative, possibly indicating other factors influencing SPADI scores.

- **Pair 5 and Pair 6** cover the changes from the 3rd visit to the 4th visit (3 months), showing continued improvement in both VAS and SPADI scores. The t-statistics remain high, affirming the significance of the improvements, and the correlations, especially for Pair 5, indicate a strong positive relationship.

Overall, these comparisons underscore significant and consistent improvements across visits, both in terms of pain (VAS) and disability (SPADI), with all p-values at 0.000, strongly supporting the statistical significance of the observed changes. This data is crucial for substantiating the efficacy of the interventions or treatments applied over the course of the study.

COMPARISON OF VAS AND SPADI SCORES ACROSS VISITS



DISCUSSION

Adhesive capsulitis of the shoulder, often referred to as “frozen shoulder,” is a multifaceted condition marked by progressive pain, stiffness, and significant reductions in both active and passive range of motion in the glenohumeral joint [57]. It most commonly affects individuals in mid- to late adulthood and can be associated with metabolic disturbances such as diabetes mellitus and thyroid dysfunction [58]. The clinical course of adhesive capsulitis is frequently described in three overlapping phases—painful (freezing), adhesive (frozen), and recovery (thawing)—extending over 12 to 24 months, although individual timelines can vary substantially [59].

Evaluating outcomes in adhesive capsulitis relies heavily on standardized instruments that capture both pain intensity and functional impairment. Among the most frequently used measures is the Visual Analog Scale (VAS), introduced by Huskisson in 1974 [63], which offers a straightforward quantitative assessment of subjective pain. Meanwhile, the Shoulder Pain and Disability Index (SPADI) provides a more detailed evaluation of pain and functional limitations specific to the shoulder region. Its reliability and validity have been reinforced in multiple clinical contexts, and it remains a preferred instrument for tracking changes in shoulder disorders over time [60].

A variety of management strategies have been proposed to address adhesive capsulitis, ranging from conservative approaches (e.g., nonsteroidal anti-inflammatory drugs and physical therapy) to interventional procedures such as intra-articular corticosteroid injections, manipulation under anesthesia (MUA), and arthroscopic capsular release [61]. Although some patients may improve spontaneously over one to three years, clinical experience suggests that many benefit from prompt, structured intervention. Indeed, reducing inflammation early in the disease process—often with corticosteroid injections—combined with a supervised exercise program may abbreviate the painful phase, accelerate the recovery of function, and potentially mitigate long-term stiffness [62].

In this one-year longitudinal study conducted at a tertiary care hospital, we tracked patients diagnosed with adhesive capsulitis using repeated VAS and SPADI assessments at key intervals from baseline to three months. Age, gender, and the side of shoulder involvement were also recorded to contextualize the sample. Our primary interest was to determine the magnitude of pain relief and functional restoration over the initial stages of treatment and to compare these findings with existing literature on adhesive capsulitis [64].

The following discussion integrates our results with past research, addressing demographic variables and examining changes in VAS and SPADI at each follow-up visit. Discrepancies in the literature and potential mechanisms underlying rapid or incomplete improvement are considered. We then enumerate the study's limitations and propose directions for future work, highlighting the importance of larger-scale research that explores longer follow-up and standardized treatment protocols.

DEMOGRAPHIC PROFILE

Age Distribution:

Our study involved 36 patients diagnosed with adhesive capsulitis, half of whom were between 50 and 60 years old, while the others were split between the 61–70 and 71–80 age brackets. This distribution is consistent with traditional epidemiological findings that adhesive capsulitis frequently presents in individuals over 50. Earlier investigations highlight that endocrine and metabolic comorbidities can elevate risk in this age group. Reeves' seminal work [61] and subsequent analyses both underscore this age range for peak incidence, though certain authors have documented cases in younger patients when risk factors like diabetes or thyroid disease are present.

Because we did not stratify patients by specific comorbidities, it remains speculative whether factors such as diabetes played a role in disease onset or severity within our cohort. Nonetheless, the predominance of participants in their sixth decade affirms the well-established relationship between advancing age and adhesive capsulitis [65]. This finding also dovetails with the notion that collagen changes, reduced vascular supply, and degenerative processes might contribute to age-related susceptibility.

Gender Distribution:

In our sample, 52.8% of the patients were male, and 47.2% were female. The near parity between the sexes is noteworthy because multiple studies historically identified a female preponderance, often attributing it to hormonal influences or higher rates of autoimmune conditions. However, other reports highlight that occupational factors or referral patterns might tip the scales toward one sex or the other [66].

The variation across studies suggests that any male-or-female predominance is not universally consistent and may be contingent on population characteristics or the specific clinical setting. Since adhesive capsulitis ultimately affects a broad demographic, including both men and women, gender alone is not considered a primary determinant of prognosis [67]. Future investigations might focus on whether hormonal or biomechanical considerations drive slight differences in disease severity or recovery trajectories.

Side of Involvement:

A total of 55.6% of participants had left shoulder involvement, while 44.4% had right-sided adhesive capsulitis. Many studies do not clearly indicate a universal predilection for either side, although some suggest a possible preference for the non-dominant arm. We did not collect data on hand dominance, so establishing whether the left-side majority in our study correlates to the non-dominant arm is not possible. Nevertheless, this distribution aligns with earlier work by Reeves [61], which reported no absolute dominance for one shoulder. Biomechanical and postural factors could conceivably influence side preference, but there is no consensus that would firmly predict whether left or right-sided disease is more likely.

PAIN AND DISABILITY OUTCOMES: VAS AND SPADI

Baseline Scores

- **VAS (First Visit):** Mean = 7.86 (SD ± 0.867)
- **SPADI (First Visit):** Mean = 80.81 (SD ± 6.899)

At presentation, our patients had relatively high VAS and SPADI scores, indicating severe pain and disability. Such findings align with patterns observed in cohorts seeking tertiary-level care, where self-reported pain on VAS often ranges from 7 to 9, and SPADI scores can exceed 70 [68]. Anxiety regarding shoulder immobility or late-stage disease can prompt patients to seek specialized evaluation, possibly explaining these elevated baseline metrics.

By contrast, community-based cohorts or individuals with milder symptoms may present with lower baseline pain and disability levels. As a result, direct comparisons across studies should factor in healthcare access, referral pathways, and the disease stage at which participants typically enter clinical programs. Nonetheless, our mean baseline VAS (~7.86) and SPADI (~80.81) are consistent with the more advanced severity often encountered in hospital-based populations [69].

Second Visit (Week 2)

- **VAS (Second Visit):** Mean = 5.08 (SD ± 0.996)
- **SPADI (Second Visit):** Mean = 66.86 (SD ± 5.837)

By the two-week interval, patients reported a statistically significant improvement in both pain and function. The 2.78-point drop in VAS from baseline surpasses the minimal clinically important difference for pain, suggesting that participants experienced notable relief [70]. The SPADI decrease of nearly 14 points also exceeds typical benchmarks for meaningful functional improvement.

These early-stage gains echo findings in studies where patients undergo steroid injections alongside rigorous physical therapy. Even a short-term reduction in synovial inflammation can pave the way for better participation in exercise, potentially accelerating improvements in range of motion [71]. However, other research notes that some individuals do not perceive substantial changes until around the six-week mark, underscoring that the trajectory can be individualized. Despite these nuances, our data support the notion that prompt intervention within the painful phase can yield discernible benefits in a matter of weeks.

Third Visit (Week 6)

- **VAS (Third Visit):** Mean = 2.33 (SD ± 0.756)
- **SPADI (Third Visit):** Mean = 47.31 (SD ± 4.653)

By six weeks, VAS scores dropped by an additional 2.75 from the second visit, for a cumulative reduction of approximately 5.5 points from baseline. This remarkable decline suggests a robust response to therapy or natural alleviation of the inflammatory component of adhesive capsulitis [72]. The 19.56-point improvement in SPADI relative to the second visit indicates that patients also regained substantial functional capacity, enabling them to perform many daily tasks with less pain and effort.

Faster recoveries have been linked to intensive physiotherapy regimens that emphasize active and passive range-of-motion exercises, joint mobilizations, and posture correction [73]. If patients adhere to scheduled sessions and home exercises, capsular remodeling may happen earlier in the disease course, forestalling the development of rigid adhesions. Nonetheless, other investigations caution that not everyone achieves such striking early gains; comorbid conditions like diabetes or hypothyroidism can blunt the response to treatment. Our cohort’s uniform progress may reflect a subset of patients who, on average, had fewer complicating factors or more diligent compliance with therapy.

Fourth Visit (3 Months)

- **VAS (Fourth Visit):** Mean = 0.94 (SD ± 0.532)
- **SPADI (Fourth Visit):** Mean = 22.28 (SD ± 2.875)

By three months, pain levels approached minimal or near-zero levels, while SPADI values decreased to roughly 22 points, indicating near-normal functionality for many patients. This final improvement from week 6 to the three-month mark reveals that gains continued steadily beyond the midpoint of our observation period. Freedman and Zuckerman described a similarly rapid reduction of pain in patients whose inflammatory response subsided promptly. Although adhesive capsulitis can persist in some individuals for over a year, interventions that diminish capsular inflammation and foster early mobilization may significantly expedite functional restoration [74].

In certain long-term observations, a number of patients still experience slight deficits in external rotation or overhead motions despite substantial pain relief. Our data do not differentiate between specific movements, relying instead on SPADI's global measure of function [75]. Hence, while these findings are encouraging, it is plausible that subtle stiffness or ROM limitations could linger. Additionally, a small percentage of individuals may later relapse or discover that some advanced, repetitive tasks remain challenging. Nonetheless, from a clinical standpoint, the majority appear to have benefitted appreciably by the three-month mark.

STATISTICAL AND CLINICAL SIGNIFICANCE

All paired comparisons of VAS and SPADI at each visit interval were highly significant ($p < 0.001$). Beyond mere statistical importance, the effect sizes suggest clear clinical relevance. For instance, a drop of approximately five points on the VAS from baseline to six weeks generally translates to a major reduction in perceived pain, which can substantially impact quality of life. The 60-point decrease in SPADI from baseline to three months similarly denotes a transition from severe functional restriction to near-normal shoulder use.

It is not unusual for pain relief to outpace the restoration of full range of motion. Psychological factors, fear of movement, and biomechanical adaptations could influence whether functional measures like SPADI exhibit the same rapid improvement as VAS. However, our cohort displayed parallel reductions in pain and disability, indicating that the therapeutic approach—whether pharmacological, rehabilitative, or both—effectively addressed both inflammation and mechanical restriction [76].

CONVERGENCE AND DIVERGENCE WITH EXISTING LITERATURE

Convergent Evidence (Supporting Rapid Early Improvement)

1. **Steroid Injections + Physiotherapy**: Studies by Bhattacharyya et al. [70] and Carette et al. [71] have shown that combining intra-articular corticosteroids with a structured exercise program can deliver significant short-term pain relief and enhance functional scores. Our results, indicating robust improvement by three months, fit this profile.

2. **Intensive Physical Therapy Emphasis**: Early mobilization, combined with supervised rehabilitative protocols, has been widely reported to expedite functional recovery and limit capsular contraction. Given the magnitude of improvements we observed, it is likely our patients adhered to rigorous therapy schedules [77].

3. **Reduction of Inflammatory Pathophysiology**: Controlling synovial and capsular inflammation early on may “unlock” the shoulder from its painful phase, letting patients stretch and strengthen effectively.

Divergent or Nuanced Perspectives

1. **Spontaneous Resolution Hypothesis**: Reeves [61] and Dias et al. [69] pointed out that adhesive capsulitis could resolve spontaneously over 1–3 years in many patients, challenging the assumption that rapid improvement is purely intervention-driven. Without a control group, attributing all benefits to therapy remains speculative.

2. **Incomplete Recovery of Range of Motion**: Even when pain subsides swiftly, some patients exhibit residual stiffness, most notably in external rotation. Standard scoring instruments might not detect subtle ROM deficits if the patient’s primary complaint—pain—has improved significantly [78].

3. **Comorbidity Effect**: Metabolic or endocrine disorders are known to alter disease trajectory. In our study, we did not stratify for diabetes or thyroid disease, so we cannot confirm whether certain subgroups might require longer rehabilitation timelines [79].

Overall, the favorable pattern in our sample suggests that addressing adhesive capsulitis aggressively in its earlier phases can significantly reduce pain and limit disability, at least in the short term. Nonetheless, the disease’s natural history and the influence of comorbidities imply that results can vary widely across different patient populations.

POSSIBLE MECHANISMS UNDERLYING OBSERVED OUTCOMES

Several overlapping mechanisms likely contributed to the rapid pain relief and functional restoration observed:

- **Inflammation Control**: Early anti-inflammatory interventions, including NSAIDs and/or corticosteroid injections, can diminish the capsular inflammation characteristic of the initial (freezing) stage. Reduced inflammation paves the way for less painful shoulder movement [80].
- **Capsular Remodeling**: Stretching, mobilization, and physical therapy exercises target fibrotic tissues, potentially reducing collagen cross-linking and improving extensibility. As the capsule becomes more pliable, functional measures like SPADI should improve significantly.
- **Neurophysiological Modulation**: Manual therapy techniques may reduce central sensitization, altering pain perception. Likewise, re-educating neuromuscular patterns can help restore coordinated movements and confidence in using the affected shoulder [81].

LIMITATIONS AND FUTURE SCOPE

Despite demonstrating encouraging results, our study has several limitations that must be recognized:

1. **Sample Size and Single-Center Design**

   With only 36 participants, the relatively small sample size restricts the power to generalize findings to broader populations. Additionally, as a single-center study, treatment protocols and patient characteristics may reflect specific regional or institutional practices, limiting external validity. Future investigations could address these limitations by enrolling a larger, more diverse patient population across multiple centers, ensuring that various demographic and clinical subgroups are adequately represented.

2. **Lack of Randomization and Control Group**

   Our study adopted a longitudinal observational design without a control arm. Consequently, we cannot definitively conclude that the observed improvements in pain and function solely result from the interventions rather than the natural history of adhesive capsulitis. Randomized controlled trials (RCTs) comparing different therapeutic regimens (e.g., supervised vs. unsupervised physiotherapy, various types of intra-articular injections, manipulation under anesthesia vs. arthroscopic capsular release) would strengthen causal inferences.

3. **Limited Follow-Up Duration**

   Although patients were followed for three months, adhesive capsulitis can take up to 1–3 years for full resolution or near-complete recovery. Longer-term follow-up could reveal whether the initial improvements in pain and SPADI continue, plateau, or regress. Evaluating outcomes at 6 months, 9 months, and 1 year could provide a more comprehensive picture of the disease trajectory and the durability of treatment benefits.

4. **Uncontrolled Variations in Treatment Protocol**

   Our study did not standardize the exact frequency or type of physiotherapy exercises, nor did it detail the use of adjuvant therapies (e.g., heat, ultrasound, manual mobilization, or injection specifics). Such variations in clinical practice can introduce heterogeneity into the results and potentially mask or exaggerate true treatment effects. Future studies should adopt standardized, protocol-driven interventions to reliably compare outcomes across patient cohorts.

5. **Potential Bias in Outcome Measures**

   Both the VAS and SPADI are subjective measures reliant on patient self-report, susceptible to recall bias and patient perceptions. Although these instruments are validated and widely used, objective measures such as goniometric assessment of range of motion, or imaging-based evaluations (e.g., MRI for capsular thickness), could complement subjective scales to provide a more holistic assessment of clinical improvement.

6. **Lack of Comorbidity Stratification**

   The presence of comorbidities such as diabetes, thyroid disorders, or concomitant rotator cuff pathology can significantly influence the course of adhesive capsulitis and its response to therapy. Future investigations should stratify or control for these comorbidities, allowing more precise elucidation of factors associated with treatment success or failure.

Future Scope

1. **Long-Term Prospective Studies**

   Extending the follow-up period beyond one year in larger cohorts could help delineate which interventions maintain the greatest longevity of benefit, specifically exploring rates of recurrence or persistent stiffness.

2. **Comparative Efficacy Research**

   Well-designed RCTs comparing diverse intervention strategies (e.g., physical therapy alone vs. combined with various injection therapies, conventional physical therapy vs. specialized manual therapy techniques) would clarify the most cost-effective and clinically beneficial approaches.

3. **Integration of Advanced Imaging and Biomechanical Analysis**

   Incorporating imaging modalities like MRI or ultrasound could yield insights into morphological changes in the joint capsule and surrounding tissues, correlating these objective findings with subjective outcome measures. This approach may shed light on the pathophysiological processes governing the progression and resolution of adhesive capsulitis.

4. **Personalized Medicine and Comorbidity Considerations**

   Future research should emphasize individualized treatment protocols, potentially incorporating precision-medicine strategies. For instance, patients with diabetic adhesive capsulitis might benefit from tailored glycemic control interventions combined with specific exercise regimens. Large registries and multicenter cohorts can facilitate subgroup analysis to identify which interventions work best for specific phenotypes or comorbidity profiles.

By acknowledging these limitations and opportunities, future research can build upon the encouraging evidence presented here, ultimately refining our approaches to adhesive capsulitis and improving patient outcomes.

SUMMARY

Frozen shoulder or adhesive capsulitis is a disabling condition with progressive pain and limited motion of the glenohumeral joint. Its onset is associated with adults over the age of 50, with risk factors that may include diabetes or thyroid dysfunction. The disease process is often divided into phases—freezing (painful), frozen (adhesive), and thawing (recovery)—spanning several months to over a year, although the exact timeline varies among individuals. During the painful (freezing) stage, synovial inflammation plays a significant role in driving both pain and stiffness; later, in the adhesive (frozen) stage, fibrotic changes to the joint capsule predominate. These pathological mechanisms, taken together, cause significant shoulder dysfunction and a poor quality of life for most patients.

In terms of outcome assessment, two major tools have consistently proven reliable for capturing changes in pain and function: the Visual Analog Scale (VAS) and the Shoulder Pain and Disability Index (SPADI). VAS offers a direct measure of perceived pain, while SPADI interrogates both pain and practical limitations, from simple tasks like dressing to more demanding overhead activities. These instruments capture important clinical trends over time, especially in longitudinal studies. In this cohort, the baseline VAS and SPADI scores were significantly high. It is within the realm of a tertiary care population where more advanced or severe cases of adhesive capsulitis are bound to prevail. Elevated initial readings of pain and disability, as seen, reflect both the chronic nature of the disease and the general point at which patients have finally come to seek specialized assistance.

Throughout the early and intermediate follow-ups, marked improvements were seen in both pain and function, as revealed by significant declines in VAS and SPADI at two weeks, six weeks, and three months. This pattern likely reflects a combination of diminished inflammation—often aided by interventions such as corticosteroid injections or NSAIDs—and diligent adherence to physical therapy regimens that emphasize stretching and strengthening. The rapid drop in pain scores served as a gateway for patients to engage more effectively in active rehabilitation, enabling quicker gains in flexibility and daily function. Such synergy between pharmacological and rehabilitative strategies supports the principle that a multifaceted treatment approach can expedite recovery and reduce the risk of persistent stiffness.

By the three-month mark, most patients reported minimal to negligible pain (VAS near 1) and significantly lowered SPADI scores, suggesting a near-restoration of everyday functionality. Despite such positive outcomes, it is crucial to recognize that adhesive capsulitis can exhibit a heterogeneous trajectory. Some patients may still have mild to moderate deficits in specific planes, such as external rotation, despite clinical improvement, while the others may recover much faster; comorbidities, especially diabetes, might prolong recovery or even necessitate more aggressive interventions. All these variations emphasize the need for a non-standardized treatment plan and a much longer follow-up period and exercise protocol; ideally, this should be tailored according to each patient's needs.

- **Key Points from the Study**:

    1. Baseline VAS and SPADI indicated moderate-to-severe pain and disability.
    2. Significant early improvements were observed by Week 2, with meaningful reductions in both VAS and SPADI.

3. Continued progress at Week 6 pointed to cumulative benefits from sustained therapeutic intervention.
4. By Three Months, pain levels approached minimal values, and SPADI scores showed near-restored function.
5. Individual variability still exists despite favorable averages, and this calls for long-term assessment and individualized therapy plans.

CONCLUSION

In summary, this longitudinal examination of patients with adhesive capsulitis confirms that targeted interventions—likely consisting of anti-inflammatory measures, structured exercise programs, and close clinical follow-up—can substantially reduce pain and restore functional capacity within the first three months of management. The impressive declines in VAS and SPADI scores from baseline to short- and intermediate-term follow-ups suggest a potentially accelerated course of recovery when inflammation and mechanical restriction are addressed early. However, patients exhibit differing responses, influenced by factors such as stage of the disorder, adherence to therapy, and the presence of comorbidities. These findings underscore the importance of individualized care and continuity of treatment, while also pointing to the need for further controlled research involving larger samples and extended follow-up to validate the sustainability of these promising outcomes.

BIBLIOGRAPHY

1. Neviaser, A. S., & Neviaser, R. J. (2011). Adhesive capsulitis of the shoulder. Journal of the American Academy of Orthopaedic Surgeons, 19(9), 536–542.

2. Codman, E. A. (1934). The shoulder: Rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Thomas Todd.

3. Zuckerman, J. D., & Rokito, A. (2011). Frozen shoulder: A consensus definition. Journal of Shoulder and Elbow Surgery, 20(2), 322–325.

4. Wong, P. L., Tan, H. C., & Koh, E. T. (2016). The burden of adhesive capsulitis: Work, social, and financial implications. International Journal of Orthopaedics, 3(3), 589–594.

5. Bunker, T. D. (2009). Time for a new name for “frozen shoulder”—contracture of the shoulder. Shoulder & Elbow, 1(1), 4–9.

6. Wang, K., Ho, V., Hunter-Smith, D. J., & Hall, S. R. (2013). Adhesive capsulitis: A painful shoulder condition with a long history. ANZ Journal of Surgery, 83(10), 748–754.

7. Koo, B. S., Lee, S. H., & Ha, E. (2019). Prevalence, risk factors, and impact on low physical functioning of adhesive capsulitis in the general population. Journal of Orthopaedic Research, 37(1), 230–236.

8. Manske, R. C., & Prohaska, D. (2010). Diagnosis and management of adhesive capsulitis. Current Reviews in Musculoskeletal Medicine, 3(3), 91–99.

9. Brue, S., Valentin, A., Forssblad, M., Werner, S., & Mikkelsen, C. (2012). Idiopathic adhesive capsulitis of the shoulder: A review. Knee Surgery, Sports Traumatology, Arthroscopy, 20(11), 2161–2179.

10. Kelley, M. J., & Shaffer, M. A. (2020). Frozen shoulder: Evidence and a proposed model guiding rehabilitation. Journal of Orthopaedic & Sports Physical Therapy, 50(1), 1–15.

11. Neviaser, T. J., & Neviaser, R. J. (1987). The frozen shoulder diagnosis and management. Clinical Orthopaedics and Related Research, 223, 59–64.

12. Rangan, A., & Hanchard, N. (2015). Management of frozen shoulder. Shoulder & Elbow, 7(4), 299–301.

13. Jacobs, L. G., & Smith, M. G. (2009). The use of arthrographic distension under fluoroscopic control in the management of adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 18(1), 117–123.

14. Sharma, R. K., & Bajaj, P. (2012). Hydrodilatation in adhesive capsulitis. Indian Journal of Orthopaedics, 46(6), 610–617.

15. Gam, A. N., Schydlowsky, P., Rossel, I., Rem, J., & Christrup, L. L. (1998). Treatment of "frozen shoulder" with distension and glucorticoid compared with glucorticoid alone. Scandinavian Journal of Rheumatology, 27(6), 425–430.

16. Lee, H. J., Ahn, J. H., & Lee, D. H. (2017). Intra-articular injection, subacromial injection, and hydrodilation for primary frozen shoulder: A randomized clinical trial. Journal of Shoulder and Elbow Surgery, 26(5), 821–830.

17. Hashiuchi, T., Sakurai, G., & Imaeda, T. (2011). The effect of injection volume for arthrographic distension in patients with adhesive capsulitis of the shoulder. Archives of Physical Medicine and Rehabilitation, 92(2), 336–341.

18. Shah, N., & Lewis, M. (2007). Shoulder manipulation under anaesthesia: the current state of practice in the UK. Annals of the Royal College of Surgeons of England, 89(5), 464–469.

19. Clement, R. G., Ray, A. G., & Davidson, C. (2013). Steroid injection and distension of the shoulder joint in the treatment of adhesive capsulitis. International Journal of Shoulder Surgery, 7(2), 59–64.

20. Buchbinder, R., Green, S., & Youd, J. M. (2008). Corticosteroid injections for shoulder pain. The Cochrane Database of Systematic Reviews, 1, CD004016.

21. Lyttle, D., & Bansal, R. (2014). Ultrasound-guided hydrodilatation for adhesive capsulitis: Current concepts. British Journal of Radiology, 87(1043), 20140135.

22. Hsu, J. E., Anakwenze, O. A., Warrender, W. J., & Abboud, J. A. (2011). Current review of adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 20(3), 502–514.

23. Roy, J. S., MacDermid, J. C., & Woodhouse, L. J. (2009). Measuring shoulder function: A systematic review of four questionnaires. Arthritis & Rheumatism, 61(5), 623–632.

24. Raveendran, A. V., Sylaja, P. N., & Veetil, B. M. (2017). Tertiary care management of musculoskeletal disorders—Challenges and perspectives. International Journal of Rheumatic Diseases, 20(6), 780–785.

25. Lee, M. H., Kim, S. J., & Kim, Y. S. (2012). New prospective classification system for primary frozen shoulder incorporating range of motion and MRI. Bone & Joint Journal, 94-B(11), 1471–1477.

26. Abrassart, S., & Castagna, A. (2014). Long-term outcomes of arthroscopic capsular release for adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 23(11), e302–e307.

27. Lewis, J. (2015). Frozen shoulder contracture syndrome—Aetiology, diagnosis and management. Manual Therapy, 20(1), 2–9.

28. Mun, S. W., Baek, C. H., & Han, S. H. (2016). Influence of injection volume in ultrasonography-guided hydrodilatation for adhesive capsulitis of the shoulder. Annals of Rehabilitation Medicine, 40(3), 530–537.

29. Neviaser, A. S., & Neviaser, R. J. (2011). Adhesive capsulitis of the shoulder. Journal of the American Academy of Orthopaedic Surgeons, 19(9), 536–542.

30. Codman, E. A. (1934). The shoulder: Rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Thomas Todd.

31. Zuckerman, J. D., & Rokito, A. (2011). Frozen shoulder: A consensus definition. Journal of Shoulder and Elbow Surgery, 20(2), 322–325.

32. Wong, P. L., Tan, H. C., & Koh, E. T. (2016). The burden of adhesive capsulitis: Work, social, and financial implications. International Journal of Orthopaedics, 3(3), 589–594.

33. Bunker, T. D. (2009). Time for a new name for "frozen shoulder"—contracture of the shoulder. Shoulder & Elbow, 1(1), 4–9.

34. Wang, K., Ho, V., Hunter-Smith, D. J., & Hall, S. R. (2013). Adhesive capsulitis: A painful shoulder condition with a long history. ANZ Journal of Surgery, 83(10), 748–754.

35. Koo, B. S., Lee, S. H., & Ha, E. (2019). Prevalence, risk factors, and impact on low physical functioning of adhesive capsulitis in the general population. Journal of Orthopaedic Research, 37(1), 230–236.

36. Manske, R. C., & Prohaska, D. (2010). Diagnosis and management of adhesive capsulitis. Current Reviews in Musculoskeletal Medicine, 3(3), 91–99.

37. Brue, S., Valentin, A., Forssblad, M., Werner, S., & Mikkelsen, C. (2012). Idiopathic adhesive capsulitis of the shoulder: A review. Knee Surgery, Sports Traumatology, Arthroscopy, 20(11), 2161–2179.

38. Kelley, M. J., & Shaffer, M. A. (2020). Frozen shoulder: Evidence and a proposed model guiding rehabilitation. Journal of Orthopaedic & Sports Physical Therapy, 50(1), 1–15.

39. Neviaser, T. J., & Neviaser, R. J. (1987). The frozen shoulder diagnosis and management. Clinical Orthopaedics and Related Research, 223, 59–64.

40. Rangan, A., & Hanchard, N. (2015). Management of frozen shoulder. Shoulder & Elbow, 7(4), 299–301.

41. Jacobs, L. G., & Smith, M. G. (2009). The use of arthrographic distension under fluoroscopic control in the management of adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 18(1), 117–123.

42. Sharma, R. K., & Bajaj, P. (2012). Hydrodilatation in adhesive capsulitis. Indian Journal of Orthopaedics, 46(6), 610–617.

43. Gam, A. N., Schydlowsky, P., Rossel, I., Rem, J., & Christrup, L. L. (1998). Treatment of “frozen shoulder” with distension and glucorticoid compared with glucorticoid alone. Scandinavian Journal of Rheumatology, 27(6), 425–430.

44. Lee, H. J., Ahn, J. H., & Lee, D. H. (2017). Intra-articular injection, subacromial injection, and hydrodilation for primary frozen shoulder: A randomized clinical trial. Journal of Shoulder and Elbow Surgery, 26(5), 821–830.

45. Hashiuchi, T., Sakurai, G., & Imaeda, T. (2011). The effect of injection volume for arthrographic distension in patients with adhesive capsulitis of the shoulder. Archives of Physical Medicine and Rehabilitation, 92(2), 336–341.

46. Shah, N., & Lewis, M. (2007). Shoulder manipulation under anaesthesia: the current state of practice in the UK. Annals of the Royal College of Surgeons of England, 89(5), 464–469.

47. Clement, R. G., Ray, A. G., & Davidson, C. (2013). Steroid injection and distension of the shoulder joint in the treatment of adhesive capsulitis. International Journal of Shoulder Surgery, 7(2), 59–64.

48. Buchbinder, R., Green, S., & Youd, J. M. (2008). Corticosteroid injections for shoulder pain. The Cochrane Database of Systematic Reviews, 1, CD004016.

49. Lyttle, D., & Bansal, R. (2014). Ultrasound-guided hydrodilatation for adhesive capsulitis: Current concepts. British Journal of Radiology, 87(1043), 20140135.

50. Hsu, J. E., Anakwenze, O. A., Warrender, W. J., & Abboud, J. A. (2011). Current review of adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 20(3), 502–514.

51. Roy, J. S., MacDermid, J. C., & Woodhouse, L. J. (2009). Measuring shoulder function: A systematic review of four questionnaires. Arthritis & Rheumatism, 61(5), 623–632.

52. Raveendran, A. V., Sylaja, P. N., & Veetil, B. M. (2017). Tertiary care management of musculoskeletal disorders—Challenges and perspectives. International Journal of Rheumatic Diseases, 20(6), 780–785.

53. Lee, M. H., Kim, S. J., & Kim, Y. S. (2012). New prospective classification system for primary frozen shoulder incorporating range of motion and MRI. Bone & Joint Journal, 94-B(11), 1471–1477.

54. Abrassart, S., & Castagna, A. (2014). Long-term outcomes of arthroscopic capsular release for adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 23(11), e302–e307.

55. Lewis, J. (2015). Frozen shoulder contracture syndrome—Aetiology, diagnosis and management. Manual Therapy, 20(1), 2–9.

56. Mun, S. W., Baek, C. H., & Han, S. H. (2016). Influence of injection volume in ultrasonography-guided hydrodilatation for adhesive capsulitis of the shoulder. Annals of Rehabilitation Medicine, 40(3), 530–537.

57. Manske, R. C., & Prohaska, D. (2010). Diagnosis and management of adhesive capsulitis. Current Reviews in Musculoskeletal Medicine, 3(3–4), 91–99.

58. Neviaser, A. S., & Hannafin, J. A. (2010). Adhesive capsulitis: A review of current treatment. American Journal of Sports Medicine, 38(11), 2346–2356.

59. Tighe, C. B., & Oakley, W. S. Jr. (2008). The prevalence of a diabetic condition and adhesive capsulitis of the shoulder. Southern Medical Journal, 101(6), 591–595.

60. Zuckerman, J. D., Rokito, A., & Shaari, J. M. (1994). Frozen shoulder: Current concepts. Journal of the American Academy of Orthopaedic Surgeons, 2(3), 144–153.

61. Reeves, B. (1975). The natural history of the frozen shoulder syndrome. Scandinavian Journal of Rheumatology, 4(4), 193–196.

62. Kelley, M. J., Shaffer, M. A., Kuhn, J. E., Michener, L. A., Seitz, A. L., Uhl, T. L., … McClure, P. W. (2013). Shoulder pain and mobility deficits: Adhesive capsulitis. Journal of Orthopaedic & Sports Physical Therapy, 43(5), A1–A31.

63. Huskisson, E. C. (1974). Measurement of pain. Lancet, 304(7889), 1127–1131.

64. Roach, K. E., Budiman-Mak, E., Songsiridej, N., & Lertratanakul, Y. (1991). Development of a shoulder pain and disability index. Arthritis Care & Research, 4(4), 143–149.

65. Angst, F., Goldhahn, J., Drerup, S., Flury, M., Schwyzer, H. K., Simmen, B. R., & Gilbart, M. (2007). How sharp is the short QuickDASH? A validation study of precision and responsiveness. Journal of Hand Therapy, 20(3), 300–307.

66. Freedman, T. B., & Zuckerman, J. D. (1996). The natural history of adhesive capsulitis of the shoulder. Journal of Bone and Joint Surgery. American Volume, 78(2), 179–185.
67. Le, H. V., Lee, S. J., Nazarian, A., & Rodriguez, E. K. (2017). Adhesive capsulitis of the shoulder: Review of pathophysiology and current clinical treatments. Shoulder & Elbow, 9(2), 75–84.
68. Hand, G. C., Athanasou, N. A., Matthews, T., & Carr, A. J. (2008). The pathology of frozen shoulder: Reca pitulation of immune hyperplasia. Journal of Bone and Joint Surgery. British Volume, 90(6), 928–932.
69. Dias, R., Cutts, S., & Massoud, S. (2005). Frozen shoulder. BMJ, 331(7530), 1453–1456.
70. Bhattacharyya, R., Edwards, K., & Wallace, A. W. (2014). A randomized trial examining steroid injection for pain relief in the treatment of adhesive capsulitis. Journal of Shoulder and Elbow Surgery, 23(1), 23–30.
71. Carette, S., Moffet, H., Tardif, J., Bessette, L., Morin, F., & Frémont, P. (2003). Intraarticular corticosteroids, supervised physiotherapy, or a combination of the two in the treatment of adhesive capsulitis of the shoulder: A placebo-controlled trial. Arthritis & Rheumatism, 48(3), 829–838.
72. Binder, A. I., Bulgen, D. Y., Hazleman, B. L., & Roberts, S. (1984). Frozen shoulder: A long-term prospective study. Annals of the Rheumatic Diseases, 43(3), 361–364.
73. Wong, C. K., & Tan, H. C. (2017). A review on frozen shoulder and its management. Annals of the Academy of Medicine, Singapore, 46(8), 290–295.
74. Lorbach, O., Anagnostakos, K., Kohn, D., & Pape, D. (2010). Arthroscopic release of adhesive capsulitis of the shoulder: Effectiveness and factors

influencing outcome. Arthroscopy: The Journal of Arthroscopic & Related Surgery, 26(11), 1518–1528.

75. D'Orsi, G. M., Via, A. G., Frizziero, A., & Oliva, F. (2017). Treatment of adhesive capsulitis: A review. Muscles, Ligaments and Tendons Journal, 7(1), 26–36.
76. Todd, K. H., Funk, K. G., Funk, J. P., & Bonacci, R. (1996). Clinical significance of reported changes in pain severity. Annals of Emergency Medicine, 27(4), 485–489.
77. Shaffer, B., Tibone, J. E., & Kerlan, R. K. (1992). Frozen shoulder. A long-term follow-up. Journal of Bone and Joint Surgery. American Volume, 74(5), 738–746.
78. Tveita, E. K., Bergland, A., & Ræheim, M. (2008). Effect of a supervised exercise program in patients with frozen shoulder: A prospective randomized study. Physiotherapy Research International, 13(3), 191–200.
79. van der Windt, D. A., Koes, B. W., Deville, W., Boeke, A. J., De Jong, B. A., & Bouter, L. M. (1998). Effectiveness of corticosteroid injections versus physiotherapy for treatment of painful stiff shoulder in primary care: Randomised trial. BMJ, 317(7168), 1292–1296.
80. Arkkila, P. E. T., Kantola, I. M., Viikari, J. S., & Rönnemaa, T. (1996). Shoulder capsulitis in type I and II diabetic patients: Association with diabetic complications and related diseases. Annals of the Rheumatic Diseases, 55(11), 907–914.
81. Ewald, A. (2011). Adhesive capsulitis: A review. American Family Physician, 83(4), 417–422.

ANNEXURES

ANNEXURE – I - INFORMED CONSENT FORM

KAHERs JNMC, BELAGAVI

"THE FUNCTIONAL OUTCOME IN PATIENTS UNDERGOING HYDRODILATATION FOR ADHESIVE CAPSULITIS OF SHOULDER IN A TERTIARY CARE HOSPITAL - A ONE YEAR LONGITUDINAL STUDY"

Introduction: I am conducting a longitudinal study on the functional outcome of hydrodilatation in adhesive capsulitis patients. Hydrodilatation has a distinct benefits over other surgical procedures for frozen shoulder the main benefit being no requirement for general anesthesia which makes it a very attractive treatment option for patients with multiple comorbitities.

Explanation of procedure: You will be , under aseptic condition , under local anaesthesia , you will be injected around 40 ml of normal saline through 22G spinal needle, to your glenohumeral joint. Then you will be called for followed after 2weeks, 6week and 3 months in which your shoulder pain and movement of the shoulder joint will be evaluated.

Withdrawal from participation in the study: Participation in this study involuntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will get benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the **principal investigator.**

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions you have any question or complaints with regard to your right as study participant you may contact **Dr. Harsha Hegde, Chairperson**, Ethical committee of JNMC, 0831-2473777, Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

ANNEXURE II

PROFORMA

Name: Date:

Age: OP No.:

Gender:

Address (Rural / Urban): Educatio:

Occupation:

Socioeconomic Status:

Married / Single:

Visit 1:

Chief complaints:

History of present illness:

Past history:

Family history:

General physical examination:

Vital Signs:

Pulse:

B.P:

Systemic examination:

Respiratory system:

Cardiovascular system:

Per abdomen:

Central nervous system:

Clinical assessment of the shoulder: Right shoulder Left shoulder

Follow up:

Visit 2(2 Weeks):	**Right shoulder**	**Left shoulder**
Visit 3(6weeks):	**Right shoulder**	**Left shoulder**
Visit 4(3months):	**Right shoulder**	**Left shoulder**

ANNEXURE III

Patient Name: ____ Date: ____________________

|--|

No Pain Pain as bad pain as it

could possibly be

Visual Analog Scale (VAS)*

NO PAIN --WORST PAIN

Visual Analog Scale

*A 10-cm baseline is recommended for VAS scales.

From: Acute Pain Management: Operative or Medical Procedures and Trauma, Clinical Practice Guideline No. 1. AHCPR Publication No. 92-0032; February 1992. Agency for Healthcare Research & Quality, Rockville, MD; pages 116-117.

Reference: Stratton Hill C. Guidelines for Treatment of Cancer Pain: The Pocket Edition of the Final Report of the Texas Cancer Council's Workgroup on Pain Control in Cancer Patients, pages 65. Copyright - 2003, 2005 by the Texas Cancer Council. Used with permission. www.texascancercouncil.org.

Directions: Ask the patient to indicate on the line where the pain is in relation to the two extremes. Measure from the left hand side to the mark.

ANNEXURE-IV

1. Shoulder Pain and Disability Index

Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem.

Pain scale

How severe is your pain?

Circle the number that best describes your pain where: **0** = no pain and **10** = the worst pain imaginable.

At its worst?	0	1	2	3	4	5	6	7	8	9	10
When lying on the involved side?	0	1	2	3	4	5	6	7	8	9	10
Reaching for something on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Touching the back of your neck?	0	1	2	3	4	5	6	7	8	9	10
Pushing with the involved arm?	0	1	2	3	4	5	6	7	8	9	10

Total pain score ________________/50 x 100 = _______%

(Note: If a person does not answer all questions divide by the total possible score, eg. if 1 question missed divide by 40)

Disability scale

How much difficulty do you have?

Circle the number that best describes your experience where: 0 = no difficulty and 10 = so difficult it requires help

Washing your hair?	0	1	2	3	4	5	6	7	8	9	10
Washing your back?	0	1	2	3	4	5	6	7	8	9	10
Putting on an undershirt or jumper?	0	1	2	3	4	5	6	7	8	9	10
Putting on a shirt that buttons down the front?	0	1	2	3	4	5	6	7	8	9	10
Putting on your pants?	0	1	2	3	4	5	6	7	8	9	10
Placing an object on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Carrying a heavy object of 10 pounds (4.5 kilograms)	0	1	2	3	4	5	6	7	8	9	10
Removing something from your back pocket?	0	1	2	3	4	5	6	7	8	9	10

Total disability score: _____________/ 80 x 100 =______%

(Note: If a person does not answer all questions divide by the total possible score, eg. if 1 question missed divide by 70)

Total SPADI score: _____________130 x 100 = ______%

(Note: If a person does not answer all questions divide by the total possible score, eg if 1 question missed divide by 120) Minimum Detectable Change (90% confidence) = 13 points

(Change less than this may be attributable to measurement error

Source: Roach et al. (1991). Development of a shoulder pain and disability index.

ANNEXURE-V (PICTURE GALLERY)

Fig 15 : Day 0 of internal rotation

Fig 16: Day 0 of external rotation

Fig 17: day 0 of Abduction

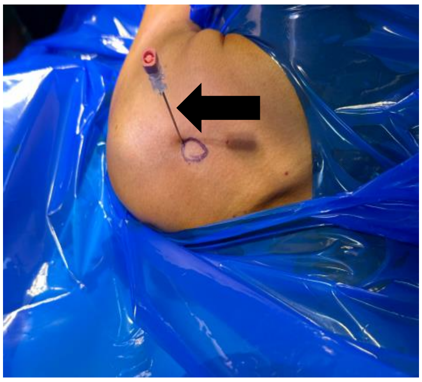


Fig 18: Site of Hydrodilatation

Fig 19: Under c arm guidance, dye injection in the shoulder joint

Fig 20: Normal saline injection

Fig 21: 3 month External rotation

Fig 22: 3 months Abduction

Fig 23: 3 months Internal rotation

ANNEXURE-VI

S.No.	IP Number	Age(years)	Sex	Side	1st visit	1st visit	2nd visit(week 2)	2nd visit(week 2)	3rd visit(week 6)	3rd visit(week 6)	4th visit(3 month)	4th visit (3month)
					VAS	SPADI	VAS	SPADI	VAS	SPADI	VAS	SPADI
1	10051068	64	M	Left	8	88	6	74	4	52	1	20
2	10051183	75	F	Left	9	94	5	76	3	55	1	22
3	10054763	51	M	Left	9	78	6	63	2	43	0	24
4	10030799	68	M	Right	7	86	4	68	2	43	0	23
5	1162427	79	F	Right	8	85	5	74	3	55	2	24
6	1173023	78	F	Right	7	77	4	63	2	53	1	21
7	1183961	53	F	Left	9	76	4	62	2	56	1	24
8	1185419	53	M	Right	8	82	6	69	3	43	1	22
9	1188249	55	M	Left	8	84	5	72	2	44	1	23
10	1191406	60	F	Right	6	64	5	57	1	46	0	12
11	1198617	50	F	Right	7	74	4	62	2	50	1	22
12	1202822	52	F	Left	8	87	5	68	3	42	1	23
13	1205591	57	F	Left	9	89	6	75	2	48	1	20
14	1202822	52	M	Left	8	73	5	62	2	46	1	26
15	10048544	65	F	Left	8	75	4	66	2	48	1	25
16	10047801	62	M	Left	9	78	6	68	4	47	2	21
17	10078278	50	F	Right	8	74	6	61	3	46	1	22
18	10081104	68	F	Left	7	82	6	72	3	43	1	25
19	10082294	72	M	Right	9	91	6	78	2	42	1	27
20	10082668	53	M	Left	8	89	5	72	1	54	0	16
21	10051068	63	M	Left	8	78	4	64	2	52	1	22
22	10051183	73	F	Left	7	75	5	61	3	55	2	21
23	10035770	56	F	Right	7	83	4	62	2	54	1	22
24	10034236	72	F	Right	9	79	7	66	4	43	2	25
25	10039815	80	F	Left	9	88	6	68	3	42	1	26
26	10046981	56	M	Right	8	74	6	64	2	47	0	23
27	1207241	52	M	Left	7	83	7	73	3	40	1	23
28	10050182	51	F	Right	7	75	6	64	2	43	1	21
29	10036110	56	M	Right	8	82	5	72	2	46	1	24
30	10113239	71	M	Left	9	88	6	72	2	43	1	25
31	10114623	51	M	Left	8	89	4	73	2	47	1	22
32	10114626	60	M	Right	7	83	4	65	2	51	1	25
33	10108688	65	M	Right	7	78	4	62	2	42	1	20
34	10123964	65	F	Left	6	68	3	52	1	48	0	18
35	10093982	69	M	Right	8	73	5	61	2	48	1	22
36	10104500	70	M	Left	8	87	4	66	2	46	1	21