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Physiotherapeutic Management of Adhesive Capsulitis of the Shoulder: A Narrative Review

Wojciech Garczyński[1], ORCID https://orcid.org/0000-0001-6724-0699
E-mail w.garczynski@gmail.com
Kazimiera Milanowska College of Education and Therapy, Poznań, Poland

Oliwer Andrysiak[1], ORCID https://orcid.org/0009-0003-2564-9789
E-mail andrysiakoliwer@gmail.com
Kazimiera Milanowska College of Education and Therapy, Poznań, Poland

Corresponding Author
Wojciech Garczyński, E-mail w.garczynski@gmail.com

Abstract

Adhesive capsulitis, also known as frozen shoulder, is a common musculoskeletal disorder characterized by progressive pain and a significant limitation of both active and passive glenohumeral range of motion. The condition results from chronic inflammation, fibrosis, and contracture of the joint capsule, leading to substantial impairment of upper limb function and reduced quality of life. The prevalence in the general population is estimated at 2–5%, with a considerably higher incidence among individuals with diabetes mellitus and thyroid disorders. This review aims to summarize current evidence regarding the pathophysiology, clinical presentation, diagnosis, and physiotherapeutic management of adhesive capsulitis. The review was based on scientific literature indexed in the PubMed and Scopus databases, with particular emphasis on recent systematic reviews, clinical guidelines, and randomized controlled trials. Contemporary evidence indicates that physiotherapy is the cornerstone of conservative treatment. Effective rehabilitation should be individualized according to the stage of the disease and tissue irritability, combining patient education, therapeutic exercise, manual therapy, and, when indicated, pharmacological interventions. In the painful stage, treatment should primarily focus on pain reduction, maintenance of shoulder mobility, and prevention of secondary functional impairments. During the stiffness stage, rehabilitation should emphasize progressive restoration of joint mobility, stretching, strengthening exercises, and neuromuscular control. Surgical treatment should be considered only in patients who fail to respond to comprehensive conservative management. Current

evidence supports a multimodal, evidence-based approach that integrates the best available scientific evidence with clinical expertise and patient preferences. Early diagnosis and stage-specific rehabilitation appear to be essential for optimizing functional recovery and improving long-term outcomes in patients with adhesive capsulitis.
Key words: adhesive capsulitis; frozen shoulder; physiotherapy

Introduction

Adhesive capsulitis (AC), commonly referred to as frozen shoulder, is one of the leading causes of shoulder pain and restricted glenohumeral joint mobility in adults. The disorder is characterized by the gradual onset of pain accompanied by progressive limitation of both active and passive range of motion resulting from inflammation, fibrosis, and contracture of the joint capsule. These pathological changes substantially impair upper limb function, restrict activities of daily living, and significantly reduce patients' quality of life (Kelley et al., 2009; Kelley et al., 2013).

Despite decades of research, the exact etiology and pathogenesis of adhesive capsulitis remain incompletely understood. Current evidence suggests that the condition is multifactorial, involving chronic inflammation, dysregulated immune responses, excessive fibroblast proliferation, and pathological remodeling of the extracellular matrix. These processes promote progressive capsular fibrosis and contracture, ultimately reducing joint volume and impairing normal shoulder biomechanics. Increasing attention has also been directed toward the role of pro-inflammatory cytokines, growth factors, and extracellular matrix remodeling mediators in the development and progression of the disease.

The prevalence of adhesive capsulitis in the general population is estimated to range from 2% to 5%, whereas among individuals with type 1 or type 2 diabetes mellitus the prevalence may exceed 20%. The condition most frequently affects individuals between 40 and 60 years of age and occurs slightly more often in women than in men. Well-established risk factors include diabetes mellitus, thyroid disorders, prolonged shoulder immobilization, trauma, previous shoulder surgery, and selected neurological and cardiovascular diseases. Patients presenting with these comorbidities often experience a more severe clinical course, prolonged rehabilitation, and less favorable functional outcomes (Kingston et al., 2018).

Therapeutic management should be individualized according to the stage of the disease, pain severity, tissue irritability, and the patient's functional requirements. Contemporary clinical guidelines emphasize that successful rehabilitation extends beyond restoration of joint mobility and should also include pain management, patient education, recovery of upper limb

function, neuromuscular control, and prevention of secondary compensatory movement patterns. Consequently, treatment strategies should be based on the principles of Evidence-Based Practice (EBP), integrating the best available scientific evidence with clinical expertise and patient preferences (Kelley et al., 2013).

Over the past decade, substantial progress has been made in evaluating the effectiveness of physiotherapeutic interventions for adhesive capsulitis. Numerous studies have investigated the clinical efficacy of manual therapy, Maitland and Kaltenborn joint mobilization techniques, therapeutic exercise, stretching protocols, dry needling, kinesiology taping, soft tissue therapy, and various physical modalities. Current evidence suggests that the most favorable outcomes are achieved through individualized rehabilitation programs that combine multiple therapeutic approaches according to the disease stage and the patient's clinical presentation (Kelley et al., 2009).

The aim of the present narrative review is to summarize the current evidence regarding physiotherapeutic management of patients with adhesive capsulitis of the shoulder. Particular attention is given to the pathophysiology of the disease, functional assessment, and conservative treatment strategies, with emphasis on contemporary evidence-based physiotherapy interventions. This review was developed using current scientific literature indexed in the PubMed and Scopus databases.

Definition of Adhesive Capsulitis

Adhesive capsulitis (AC), commonly known as frozen shoulder, is a chronic musculoskeletal disorder characterized by the spontaneous onset of shoulder pain accompanied by progressive restriction of both active and passive glenohumeral range of motion. The hallmark of the condition is a global loss of shoulder mobility, particularly affecting external rotation, abduction, and forward flexion, which cannot be explained by other shoulder pathologies such as rotator cuff tears, glenohumeral osteoarthritis, or shoulder instability.

Current definitions emphasize that the underlying pathological process involves chronic synovial inflammation followed by progressive fibrosis, thickening, and contracture of the joint capsule. These structural changes reduce the capacity of the glenohumeral joint and significantly impair normal shoulder biomechanics (Le et al., 2017; Hsu et al., 2011; Kelley et al., 2013).

Historically, adhesive capsulitis was regarded as a self-limiting disorder that resolved spontaneously within one to three years. However, contemporary evidence indicates that many patients continue to experience persistent pain, restricted shoulder mobility, and functional

impairment several years after symptom onset. Increasing evidence suggests that delayed diagnosis and insufficient conservative treatment may contribute to long-term disability and reduced quality of life (Le et al., 2017; Achilova et al., 2026).

Epidemiology

Adhesive capsulitis represents one of the most frequently diagnosed causes of shoulder pain and stiffness in adults. The prevalence in the general population is estimated to range from 2% to 5%, although reported values vary from 0.5% to 10%, depending on diagnostic criteria and study population. The condition most commonly develops between 40 and 60 years of age, with peak incidence occurring during the fifth decade of life. Epidemiological studies consistently demonstrate a slightly higher prevalence among women than men (Kingston et al., 2018; Georgiannos et al., 2017).

Diabetes mellitus is recognized as the strongest documented risk factor for adhesive capsulitis. Depending on the studied population, the prevalence among diabetic patients ranges from 10% to more than 30%, while the risk of developing the condition is estimated to be up to five times higher than in non-diabetic individuals. This increased susceptibility is attributed to chronic hyperglycemia, accumulation of advanced glycation end products (AGEs), increased synthesis of type III collagen, and enhanced capsular fibrosis. Patients with diabetes also tend to experience more severe symptoms, prolonged recovery, and poorer rehabilitation outcomes (Kingston et al., 2018; Sarasua et al., 2021).

Additional risk factors include thyroid disorders, particularly hypothyroidism and hyperthyroidism, Parkinson's disease, stroke, cardiovascular disease, shoulder trauma, prolonged immobilization, and previous surgical procedures involving the shoulder or thoracic region. Recent investigations have also highlighted the contribution of metabolic disturbances, chronic low-grade inflammation, and genetic predisposition to the development and progression of capsular fibrosis (Le et al., 2017; Sarasua et al., 2021; Georgiannos et al., 2017).

Population-based studies indicate that approximately 20–30% of patients eventually develop adhesive capsulitis in the contralateral shoulder, usually within several years after the initial episode. Simultaneous bilateral involvement is considerably less common but occurs more frequently in patients with metabolic and endocrine disorders. These observations support the concept that adhesive capsulitis should not be regarded solely as a localized shoulder disorder but rather as a disease influenced by systemic biological mechanisms (Georgiannos et al., 2017; Sarasua et al., 2021).

Classification of Adhesive Capsulitis

The most widely accepted classification distinguishes primary (idiopathic) and secondary adhesive capsulitis.

Primary adhesive capsulitis develops spontaneously without an identifiable precipitating event and accounts for the majority of diagnosed cases. Although its precise etiology remains unknown, current evidence suggests that immune dysregulation, chronic inflammation, and abnormal connective tissue remodeling play fundamental roles in disease development (Le et al., 2017; Hsu et al., 2011).

Secondary adhesive capsulitis develops as a consequence of other pathological conditions or traumatic events. It is commonly subdivided into intrinsic, extrinsic, and systemic forms. Intrinsic adhesive capsulitis is associated with shoulder pathologies such as rotator cuff disease or tendinopathy. Extrinsic forms result from conditions affecting structures adjacent to the shoulder or prolonged immobilization, whereas systemic adhesive capsulitis occurs in association with metabolic, endocrine, or neurological disorders. This classification has important clinical implications because the underlying cause influences treatment selection and prognosis (Georgiannos et al., 2017; Le et al., 2017).

From a clinical perspective, adhesive capsulitis is also classified according to its temporal progression into three consecutive stages: the painful (freezing) stage, the stiff (frozen) stage, and the recovery (thawing) stage. Each phase is characterized by distinct levels of pain, degrees of motion restriction, and specific histopathological changes within the joint capsule. Recognition of the disease stage is essential for selecting appropriate physiotherapeutic interventions, as treatment objectives and rehabilitation strategies should be adapted to the patient's current clinical presentation (Le et al., 2017; Achilova et al., 2026).

Contemporary Concepts of the Etiopathogenesis of Adhesive Capsulitis

The etiopathogenesis of adhesive capsulitis remains the subject of intensive scientific investigation. Despite significant advances in understanding the disease process, no single etiological factor has been identified. Current evidence indicates that adhesive capsulitis is a multifactorial disorder involving chronic inflammation, immune dysregulation, excessive fibroblast activity, and abnormal extracellular matrix remodeling. Together, these mechanisms lead to progressive fibrosis and contracture of the glenohumeral joint capsule, resulting in reduced joint volume, increased capsular stiffness, and impaired shoulder biomechanics (Hand et al., 2007; Le et al., 2017; Hsu et al., 2011).

In the early stage of the disease, inflammation predominantly affects the synovial membrane and joint capsule. Histopathological studies have demonstrated increased infiltration by macrophages, T lymphocytes, mast cells, and inflammatory cells, particularly within the rotator interval and the coracohumeral ligament. These changes are accompanied by increased expression of pro-inflammatory mediators, including interleukin-1β (IL-1β), interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), and cyclooxygenase-2 (COX-2), which contribute to progressive fibrosis and connective tissue remodeling. Persistent inflammation subsequently promotes fibroblast activation and transition toward chronic fibrotic remodeling (Rodeo et al., 1997; Hand et al., 2007; Le et al., 2017).

A key pathological feature of adhesive capsulitis is uncontrolled fibroblast proliferation. These cells are responsible for the synthesis of type I and type III collagen as well as other extracellular matrix components. During disease progression, fibroblasts differentiate into contractile myofibroblasts expressing α-smooth muscle actin (α-SMA). Myofibroblasts generate progressive capsular contraction and reduce the volume of the axillary recess, producing the characteristic restriction of glenohumeral motion. This fibrotic mechanism resembles pathological processes observed in disorders such as Dupuytren's contracture and liver cirrhosis (Bunker & Anthony, 1995; Hand et al., 2007; Le et al., 2017).

Increasing evidence also highlights the importance of cytokines and growth factors in regulating capsular fibrosis. Transforming growth factor-β (TGF-β) appears to play a central role by stimulating fibroblast proliferation, enhancing collagen synthesis, and suppressing extracellular matrix degradation. Other important mediators include platelet-derived growth factor (PDGF), connective tissue growth factor (CTGF), and vascular endothelial growth factor (VEGF), all of which contribute to angiogenesis, tissue remodeling, and maintenance of the fibrotic process (Cho et al., 2015; Lho et al., 2013; Le et al., 2017).

Normal capsular function depends on a dynamic balance between collagen synthesis and degradation. In adhesive capsulitis, this balance is disrupted through excessive collagen production together with reduced activity of matrix metalloproteinases (MMPs), while tissue inhibitors of metalloproteinases (TIMPs) are upregulated. Consequently, degradation of extracellular matrix components is impaired, resulting in progressive capsular thickening, loss of elasticity, and increased mechanical stiffness that directly contributes to shoulder motion restriction (Lho et al., 2013; Hand et al., 2007; Hsu et al., 2011).

Understanding these biological mechanisms has important therapeutic implications. During the inflammatory phase, rehabilitation should primarily focus on pain relief and reduction of tissue irritability. As fibrosis becomes predominant, treatment should

progressively emphasize restoration of capsular extensibility, improvement of arthrokinematics, and recovery of normal neuromuscular control. Therefore, physiotherapy should remain dynamic and continuously adapted to the stage of the disease and the individual patient's presentation (Kelley et al., 2013; Le et al., 2017; Challoumas et al., 2020).

Clinical Presentation

Adhesive capsulitis is characterized by a gradually progressive clinical syndrome consisting of shoulder pain, increasing restriction of both active and passive glenohumeral motion, and progressive functional impairment of the upper limb. Symptom onset is typically insidious and is usually unrelated to a specific traumatic event. Patients most commonly report deep, diffuse shoulder pain that progressively interferes with daily activities such as dressing, combing hair, fastening garments behind the back, or reaching into the back pocket. The coexistence of pain and stiffness is the defining clinical feature of adhesive capsulitis, although the relative predominance of each symptom changes throughout disease progression (Kelley et al., 2013; Le et al., 2017; Hsu et al., 2011).

Initially, pain occurs predominantly during shoulder movement but gradually progresses to pain at rest and nocturnal pain. Night pain is one of the most characteristic symptoms of adhesive capsulitis and frequently leads to sleep disturbance and chronic fatigue. Many patients experience severe discomfort when lying on the affected shoulder, while even minor nocturnal movements may provoke intense pain. These symptoms are attributed to both persistent inflammatory activity and increased density of nociceptive nerve endings and inflammatory mediators within the diseased joint capsule (Hand et al., 2007; Cho et al., 2015; Kelley et al., 2013).

The hallmark finding on physical examination is global limitation of both active and passive glenohumeral motion. External rotation is typically the most severely restricted movement, followed by abduction and internal rotation, reflecting the characteristic capsular pattern described by Cyriax. Importantly, this loss of mobility results primarily from capsular fibrosis and reduction of the axillary recess rather than pain inhibition alone. This feature distinguishes adhesive capsulitis from other common shoulder disorders, including rotator cuff tears and subacromial pain syndrome (Cyriax, 1982; Kelley et al., 2013; Le et al., 2017).

As the disease progresses, functional disability becomes increasingly pronounced. Patients frequently report difficulties performing overhead activities, dressing, driving, lifting objects, and occupational tasks. Prolonged reduction in shoulder use contributes to muscle weakness, secondary atrophy of the shoulder girdle musculature, and deterioration in overall quality of life. Clinical studies using validated outcome measures such as the Shoulder Pain

and Disability Index (SPADI), Disabilities of the Arm, Shoulder and Hand (DASH), and the American Shoulder and Elbow Surgeons (ASES) score consistently demonstrate significant impairment even during the early stages of the disease (Roy et al., 2009; Kelley et al., 2013; Challoumas et al., 2020).

Clinical Stages of Adhesive Capsulitis

The natural history of adhesive capsulitis is traditionally divided into three consecutive clinical stages: the painful (freezing) stage, the stiff (frozen) stage, and the recovery (thawing) stage. Although the duration and severity of each phase vary considerably among individuals, these stages reflect distinct pathological processes within the joint capsule and provide the basis for stage-specific rehabilitation strategies. Identification of the current disease stage is therefore essential for selecting appropriate physiotherapeutic interventions (Reeves, 1975; Kelley et al., 2013; Le et al., 2017).

Painful (Freezing) Stage

The painful stage typically lasts between 2 and 9 months and is characterized by progressively increasing pain accompanied by gradual loss of shoulder mobility. Clinical examination reveals marked tissue irritability, and movement is often terminated by pain before the physiological end range is reached. During this phase, inflammatory processes predominate within the synovium and joint capsule. Consequently, rehabilitation should primarily focus on pain reduction, minimizing tissue irritability, maintaining available range of motion, and preventing secondary functional impairments. Excessive stretching or aggressive joint mobilization should be avoided because they may exacerbate inflammation and prolong recovery (Kelley et al., 2013; Hand et al., 2007; Le et al., 2017).

Stiff (Frozen) Stage

The stiff stage generally lasts 4–12 months. During this period, pain gradually subsides, whereas capsular fibrosis and contracture become the dominant pathological features. Consequently, shoulder stiffness represents the primary clinical problem. Patients experience marked limitations in daily activities, and physical examination demonstrates substantial restriction of both active and passive glenohumeral motion.

Physiotherapy during this phase should emphasize progressive restoration of joint mobility through carefully dosed stretching exercises, manual therapy, and active rehabilitation. The objective is to improve capsular extensibility while avoiding excessive tissue irritation. Rehabilitation intensity should be increased gradually according to the patient's clinical response (Kelley et al., 2013; Challoumas et al., 2020; Le et al., 2017).

Recovery (Thawing) Stage

The recovery stage may last from several months to more than two years. During this phase, pain continues to decrease while shoulder mobility and function gradually improve. However, recovery rates differ substantially among patients, and complete restoration of pre-morbid shoulder function cannot be expected in every case. Some individuals continue to demonstrate residual motion deficits or mild pain despite apparent clinical improvement.

These observations emphasize the importance of early diagnosis, individualized rehabilitation, and long-term follow-up in optimizing patient outcomes (Le et al., 2017; Kingston et al., 2018; Challoumas et al., 2020).

Functional Consequences

Loss of glenohumeral mobility affects not only upper limb function but also the biomechanics of the entire shoulder complex. To compensate for restricted glenohumeral motion, patients commonly increase movement of the scapula and trunk, resulting in altered movement patterns and abnormal scapulothoracic kinematics. Persistent compensatory strategies may subsequently overload the cervical spine, acromioclavicular joint, and surrounding musculature, thereby complicating rehabilitation and increasing the risk of secondary musculoskeletal disorders (Kibler et al., 2013; Crosbie et al., 2008; Kelley et al., 2013).

The prolonged nature of adhesive capsulitis also has important psychological consequences. Chronic pain, reduced independence, occupational limitations, and prolonged disability increase the likelihood of anxiety, depression, and persistent psychological distress. Contemporary rehabilitation therefore follows a biopsychosocial model, recognizing that successful treatment requires attention not only to physical impairments but also to psychosocial factors influencing pain perception, treatment adherence, and overall recovery. Patient education and psychological support should therefore be integrated into comprehensive rehabilitation programmes whenever appropriate (Nicholas et al., 2019; Kelley et al., 2013; Challoumas et al., 2020).

Goals of Physiotherapeutic Management

Physiotherapy constitutes the cornerstone of conservative management for adhesive capsulitis and is recommended by current clinical guidelines as the first-line treatment for most patients. Rehabilitation programmes should be individualized according to disease stage, tissue irritability, pain intensity, patient age, comorbidities, and functional expectations.

The principal objectives of physiotherapy include: reduction of pain and inflammation; restoration of glenohumeral range of motion; improvement of upper limb function; recovery of neuromuscular control; prevention of secondary compensatory movement patterns; enhancement of quality of life.

Current rehabilitation strategies are based on the principles of Evidence-Based Practice (EBP), integrating high-quality scientific evidence, clinical expertise, and patient preferences. Systematic reviews and meta-analyses consistently demonstrate that the greatest clinical benefit is achieved through multimodal rehabilitation combining patient education, therapeutic exercise, manual therapy, and—when clinically indicated—pharmacological management or intra-articular corticosteroid injections. Isolated therapeutic modalities generally provide inferior outcomes compared with comprehensive rehabilitation programmes (Challoumas et al., 2020; Kelley et al., 2013; Canadian Orthopaedic Association, 2022; Wong et al., 2017).

During the painful stage, rehabilitation should prioritize pain relief while preserving available shoulder mobility. Exercise intensity should remain within the patient's pain tolerance, avoiding prolonged symptom exacerbation following treatment sessions. Excessive stretching and aggressive mobilization techniques are discouraged because they may increase inflammatory activity and delay recovery (Kelley et al., 2013; Chan et al., 2017).

An essential component of conservative management is patient education. Patients should receive clear information regarding the natural history of the disorder, expected duration of rehabilitation, and the importance of maintaining regular but appropriately graded physical activity. Education reduces fear-avoidance behaviour, improves adherence to therapeutic recommendations, and facilitates active participation throughout the rehabilitation process (Nicholas et al., 2019; Kelley et al., 2013; Le et al., 2017).

Therapeutic Exercise During the Early Stage of Adhesive Capsulitis

Therapeutic exercise constitutes the foundation of conservative management during the painful stage of adhesive capsulitis. At this stage, exercise should be performed at low intensity and within a pain-free or minimally painful range of motion. The primary objective is not to maximize mobility but rather to preserve capsular flexibility, maintain joint nutrition, and prevent further restriction of glenohumeral motion.

Commonly recommended interventions include Codman's pendulum exercises, assisted shoulder flexion and abduction using the contralateral upper limb or a stick, and gentle active-assisted range-of-motion exercises. Current evidence indicates that several short exercise sessions performed throughout the day are more effective than a single prolonged or intensive session (Kelley et al., 2009; Kelley et al., 2013; Chan et al., 2017).

Early rehabilitation should also incorporate submaximal isometric exercises targeting the rotator cuff and scapular stabilizing muscles. These exercises help minimize muscle atrophy, preserve neuromuscular control, and prepare the patient for more intensive rehabilitation during subsequent stages of recovery. Exercise intensity should always be individualized according to pain severity and should not provoke prolonged symptom exacerbation following treatment sessions (Kibler et al., 2013; Kelley et al., 2013).

Monitoring Treatment Outcomes

Systematic evaluation of treatment effectiveness is essential throughout the rehabilitation process. Pain intensity should be assessed using validated instruments such as the Visual Analogue Scale (VAS) or the Numeric Rating Scale (NRS). Shoulder range of motion should be measured with a goniometer, while functional recovery should be monitored using validated patient-reported outcome measures including the Shoulder Pain and Disability Index (SPADI), the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), the American Shoulder and Elbow Surgeons (ASES) score, or the Constant–Murley Score.

Regular reassessment enables clinicians to modify rehabilitation programmes according to patient progress and facilitates early identification of individuals requiring additional conservative interventions or referral for orthopedic evaluation (Roy et al., 2009; Michener et al., 2002; Kelley et al., 2013).

Manual Therapy in the Management of Adhesive Capsulitis

Manual therapy represents one of the principal components of comprehensive physiotherapeutic management for patients with adhesive capsulitis. Its primary objectives include pain reduction, restoration of glenohumeral mobility, improvement of periarticular tissue extensibility, and normalization of shoulder biomechanics. Contemporary clinical guidelines emphasize that manual therapy should not be used as a stand-alone intervention but rather as part of a multimodal rehabilitation programme incorporating therapeutic exercise, patient education, and home-based self-management. The greatest clinical benefit is achieved when manual therapy techniques are selected according to the current stage of the disease and the patient's tissue irritability (Kelley et al., 2013; Chan et al., 2017; Challoumas et al., 2020).

The therapeutic effects of manual therapy are considered to arise from both biomechanical and neurophysiological mechanisms. Biomechanically, joint mobilization improves accessory glenohumeral motion and increases capsular extensibility. Neurophysiologically, manual therapy stimulates mechanoreceptors, inhibits nociceptive input, and activates descending pain inhibitory pathways. Current evidence suggests that the clinical benefits result from the interaction of these mechanical and neurophysiological

processes rather than from structural tissue changes alone (Bialosky et al., 2009; Joel et al., 2018; Kelley et al., 2013).

Maitland Joint Mobilization

The Maitland concept is among the most widely applied manual therapy approaches in the management of adhesive capsulitis. It consists of passive oscillatory mobilizations performed with varying amplitudes and intensities and classified into Grades I–V. In clinical practice, Grades I–IV are used most frequently for frozen shoulder.

During the painful stage, Grade I and II mobilizations are recommended because they are performed within a limited range without provoking pain. Their principal objective is pain modulation through neurophysiological mechanisms while improving patient tolerance for subsequent therapeutic exercise. Since these techniques produce minimal capsular stretching, they are generally well tolerated in patients presenting with high tissue irritability (Kelley et al., 2013; Chan et al., 2017).

During the stiff stage, Grade III and IV mobilizations become increasingly important. These techniques are applied at or near the end range of motion with the objective of increasing capsular extensibility, restoring accessory joint motion, and progressively improving shoulder mobility. Clinical trials have demonstrated meaningful improvements in external rotation, abduction, and overall shoulder function when these mobilizations are combined with individualized exercise programmes (Vermeulen et al., 2006; Kelley et al., 2013; Challoumas et al., 2020).

Kaltenborn Mobilization Concept

The Kaltenborn concept is based on biomechanical principles governing accessory joint gliding according to the convex-concave rule. In adhesive capsulitis, posterior, inferior, and anterior glides are selected according to the patient's specific movement restrictions. The principal objective is restoration of normal arthrokinematics, thereby facilitating physiological active and passive shoulder movement (Kaltenborn, 2003; Edmond, 2006).

Anterior and posterior glides are commonly employed to improve external rotation, whereas inferior glides are frequently used to enhance shoulder abduction and flexion. Nevertheless, contemporary research indicates that mobilization direction should be individualized rather than determined solely by theoretical biomechanical principles, as optimal clinical outcomes vary considerably among patients (Johnson et al., 2007; Kelley et al., 2013).

Mulligan Mobilization with Movement (MWM)

The Mobilization with Movement (MWM) concept developed by Brian Mulligan combines sustained accessory joint mobilization applied by the therapist with simultaneous active movement performed by the patient. A defining characteristic of this technique is that movement should remain completely pain-free throughout the procedure.

Randomized controlled trials have demonstrated that MWM techniques can rapidly improve shoulder range of motion, decrease pain intensity, and enhance functional performance. Particularly favorable outcomes have been reported for external rotation and shoulder abduction when MWM is combined with structured home exercise programmes. These effects are believed to result from both improved joint mechanics and enhanced neuromuscular control together with central pain modulation (Doner et al., 2013; Chan et al., 2017).

Kinesiotherapy in the Management of Adhesive Capsulitis

Kinesiotherapy is considered the cornerstone of conservative treatment for adhesive capsulitis and represents the most important physiotherapeutic intervention for achieving long-term restoration of upper limb function. Although manual therapy may temporarily improve range of motion and reduce pain, maintenance of these therapeutic effects depends largely on the patient's active participation in a structured exercise programme. Current clinical guidelines recommend that rehabilitation protocols should be individualized according to the stage of the disease, tissue irritability, pain severity, and the patient's functional goals (Kelley et al., 2013; Chan et al., 2017; Challoumas et al., 2020).

Therapeutic exercise improves shoulder mobility through several complementary mechanisms. Progressive stretching increases the mechanical extensibility of the contracted joint capsule, enhances accessory glenohumeral motion, reduces secondary muscle shortening, and restores normal neuromuscular coordination. Regular exercise also minimizes muscle atrophy, improves proprioception, and prevents the development of maladaptive movement patterns. Furthermore, physical activity contributes to pain modulation through activation of endogenous analgesic mechanisms and favorable adaptations within the central nervous system (Lewis, 2015; Bialosky et al., 2009; Kelley et al., 2013).

A fundamental principle of rehabilitation is matching exercise intensity to the current stage of the disease. During the painful stage, treatment should primarily focus on reducing pain while preserving existing mobility without aggravating inflammatory processes. Exercises should remain within the patient's tolerance, and pain persisting for several hours after

treatment should be regarded as an indication that the rehabilitation programme is excessively intensive (Kelley et al., 2013; Chan et al., 2017).

During the stiff stage, rehabilitation priorities shift toward progressive restoration of shoulder mobility through systematic stretching and active utilization of newly acquired motion. Exercise intensity may gradually increase; however, forceful stretching at end range should still be avoided because it may provoke capsular irritation and delay recovery. During the recovery stage, rehabilitation focuses primarily on restoring muscle strength, endurance, coordination, and full functional capacity of the upper limb (Le et al., 2017; Kelley et al., 2013; Lewis, 2015).

One of the most important determinants of successful rehabilitation is adherence to a structured home exercise programme. Most authors recommend that patients perform their exercises two to four times daily throughout the rehabilitation period. Home programmes should remain simple, easy to understand, and regularly modified according to clinical progress. Proper instruction and continuous monitoring of exercise performance are essential for achieving sustained functional improvement (Kelley et al., 2013; Chan et al., 2017; Wong et al., 2017).

Current evidence consistently demonstrates that appropriately designed kinesiotherapy is the most effective component of conservative treatment. The greatest clinical benefit is achieved through programmes combining range-of-motion exercises, stretching, progressive strengthening, and neuromuscular control training integrated with manual therapy and comprehensive patient education. Individualization of rehabilitation protocols and long-term adherence to home exercises remain fundamental prerequisites for successful treatment outcomes (Challoumas et al., 2020; Kelley et al., 2013; Lewis, 2015).

Indications for Surgical Treatment

Although the majority of patients with adhesive capsulitis respond successfully to conservative treatment, a subgroup continues to experience severe pain and persistent functional limitation despite appropriately conducted rehabilitation. Contemporary clinical guidelines recommend that surgical intervention should be considered only after failure of comprehensive conservative management, including structured physiotherapy, pharmacological treatment, and, when indicated, intra-articular corticosteroid injections.

Most authors recommend a minimum period of three to six months of intensive conservative treatment before surgical intervention is considered. Nevertheless, treatment decisions should always be individualized according to clinical progression, symptom severity, and patient expectations (Kelley et al., 2013; Le et al., 2017; Itoi & Arce, 2015).

The principal indications for surgery include persistent restriction of shoulder motion, chronic pain significantly interfering with daily activities, failure of comprehensive rehabilitation, and marked deterioration in quality of life. Prior to surgery, clinicians should carefully confirm the diagnosis and exclude alternative causes of shoulder stiffness, including rotator cuff tears, glenohumeral osteoarthritis, shoulder instability, or cervical spine disorders (Le et al., 2017; Kelley et al., 2013).

Manipulation Under Anaesthesia (MUA)

Manipulation under anaesthesia (MUA) is one of the oldest surgical procedures used in the treatment of refractory adhesive capsulitis. The procedure consists of controlled passive movement of the shoulder through its full range of motion while the patient is under general anaesthesia, resulting in mechanical disruption of capsular adhesions and contractures. The principal advantage of MUA is the immediate improvement in joint mobility. However, the procedure is associated with potential complications, including humeral fractures, rotator cuff tears, glenohumeral dislocation, and brachial plexus injury (Kivimäki et al., 2007; Grant et al., 2013).

Recent systematic reviews indicate that MUA may provide favorable short-term outcomes, although its superiority over alternative treatment options remains uncertain. Current recommendations emphasize that manipulation should be performed only by experienced surgeons and should always be followed by an intensive postoperative physiotherapy programme to maintain the gains achieved during the procedure (Challoumas et al., 2020; Grant et al., 2013).

Arthroscopic Capsular Release

Arthroscopic capsular release is currently regarded as the gold standard surgical procedure for patients with refractory adhesive capsulitis. Arthroscopy enables precise release of contracted portions of the joint capsule while simultaneously allowing inspection and treatment of concomitant intra-articular pathology. Compared with manipulation under anaesthesia, arthroscopic release offers greater procedural control and reduces the risk of several mechanical complications (Snow et al., 2009; Le et al., 2017).

The extent of capsular release may include the anterior capsule, rotator interval, coracohumeral ligament, and, depending on individual clinical findings, the axillary recess and posterior capsule. Increasing evidence suggests that comprehensive capsular release provides greater improvements in shoulder mobility than selective anterior release alone, although the extent of surgery should always be tailored to the patient's clinical presentation (Le et al., 2017; Itoi & Arce, 2015).

Regardless of the surgical technique employed, early initiation of postoperative physiotherapy is essential for successful long-term outcomes. Rehabilitation usually begins on the first postoperative day, with the primary objective of preserving the range of motion achieved during surgery while preventing recurrent capsular contracture. Delayed rehabilitation substantially increases the risk of recurrent stiffness and inferior functional recovery (Kelley et al., 2013; Le et al., 2017).

Initially, treatment consists of passive and active-assisted exercises performed either by the physiotherapist or with the assistance of Continuous Passive Motion (CPM) devices, although the routine use of CPM remains controversial. As healing progresses, active range-of-motion exercises, progressive strengthening, proprioceptive training, and functional exercises are gradually introduced. Rehabilitation programmes should always be individualized according to the patient's postoperative status and functional goals (Chan et al., 2017; Kelley et al., 2013).

Most clinical studies demonstrate that both MUA and arthroscopic capsular release significantly improve shoulder mobility, reduce pain, and enhance functional performance in patients unresponsive to conservative management. The greatest improvements are generally observed in external rotation and shoulder abduction. Nevertheless, long-term success depends not only on the surgical procedure itself but also on the patient's commitment to postoperative rehabilitation (Challoumas et al., 2020; Le et al., 2017).

Less favorable outcomes have been reported in patients with diabetes mellitus, thyroid disorders, and secondary adhesive capsulitis following trauma or surgery. These patients frequently require prolonged rehabilitation and may experience persistent limitations in shoulder mobility. Such prognostic factors should be considered when planning treatment and discussing expected outcomes with patients (Kingston et al., 2018; Le et al., 2017).

Current Evidence on the Treatment of Adhesive Capsulitis

Adhesive capsulitis remains one of the most common causes of shoulder pain and restricted glenohumeral mobility in adults. Despite substantial advances in research over the past two decades, no single treatment strategy has demonstrated clear superiority over all other therapeutic approaches. This is largely attributable to the heterogeneity of study populations, differences in disease etiology, variations in inclusion criteria, and inconsistencies among rehabilitation protocols evaluated in clinical trials. Current clinical guidelines consistently emphasize that successful management should be individualized according to the stage of the disease, tissue irritability, associated comorbidities, and each patient's functional goals (Kelley et al., 2013; Le et al., 2017; Challoumas et al., 2020).

Contemporary management is firmly based on the principles of Evidence-Based Medicine (EBM) and Evidence-Based Physiotherapy (EBP). This approach integrates the best available scientific evidence with the clinician's expertise and the patient's preferences, thereby facilitating individualized rehabilitation and improving the likelihood of achieving sustained functional recovery (Herbert et al., 2022; Kelley et al., 2013).

Current evidence supports a multimodal rehabilitation strategy. Patient education, therapeutic exercise, manual therapy, and, where clinically indicated, pharmacological treatment or intra-articular corticosteroid injections should be regarded as complementary rather than competing interventions. Their selection should always reflect the patient's clinical presentation and stage of disease rather than adherence to a single therapeutic philosophy (Challoumas et al., 2020; Chan et al., 2017; Kelley et al., 2013).

Effectiveness of Physiotherapy

Recent systematic reviews and meta-analyses consistently demonstrate that physiotherapy constitutes the foundation of conservative management for adhesive capsulitis. The most favorable clinical outcomes are achieved through rehabilitation programmes that combine patient education, manual therapy, and individualized therapeutic exercise rather than relying on a single treatment modality (Challoumas et al., 2020; Kelley et al., 2013).

Therapeutic exercise remains the intervention supported by the strongest scientific evidence. Progressive range-of-motion exercises, stretching, strengthening of the rotator cuff and scapular stabilizers, and neuromuscular control training contribute to improvements in shoulder mobility, pain reduction, and restoration of upper limb function. These benefits are further enhanced when patients adhere to structured home exercise programmes throughout the rehabilitation process (Lewis, 2015; Chan et al., 2017).

Manual therapy provides additional short- and medium-term improvements in pain relief and shoulder mobility, particularly when combined with active exercise. However, current evidence does not demonstrate the superiority of any individual manual therapy concept, including the Maitland, Kaltenborn, or Mulligan approaches. Consequently, technique selection should depend on the therapist's clinical reasoning, experience, tissue irritability, and the patient's response to treatment rather than on theoretical preference alone (Page et al., 2014; Challoumas et al., 2020; Kelley et al., 2013).

Similarly, evidence supporting physical agents—including ultrasound therapy, laser therapy, transcutaneous electrical nerve stimulation (TENS), and extracorporeal shockwave therapy—remains inconsistent. These modalities may be considered adjunctive interventions

for selected patients but should not replace active rehabilitation, which continues to represent the principal component of conservative treatment (Chan et al., 2017; Kelley et al., 2013).

Overall, current evidence indicates that the greatest clinical benefit is achieved through individualized, stage-specific, multimodal rehabilitation programmes delivered according to Evidence-Based Practice principles and supported by active patient participation.

Limitations

Several limitations should be considered when interpreting the current evidence regarding physiotherapeutic management of adhesive capsulitis. First, substantial heterogeneity exists among published studies with respect to patient selection, disease stage, treatment protocols, duration of follow-up, and outcome measures. These differences limit direct comparison of individual interventions and complicate the interpretation of pooled analyses.

Second, many clinical trials include relatively small sample sizes and lack long-term follow-up, making it difficult to determine the sustained effectiveness of specific rehabilitation strategies. Furthermore, rehabilitation programmes frequently combine multiple interventions, preventing accurate identification of the independent contribution of each therapeutic component.

Another important limitation is the absence of universally accepted diagnostic criteria and standardized staging systems across clinical studies. This inconsistency contributes to variation in treatment recommendations and may partially explain conflicting findings reported in the literature.

Future high-quality randomized controlled trials employing standardized diagnostic criteria, clearly defined rehabilitation protocols, and long-term follow-up are required to determine the optimal management strategies for patients with adhesive capsulitis.

Conclusion

Adhesive capsulitis is a complex musculoskeletal disorder characterized by chronic pain, progressive capsular fibrosis, and marked restriction of shoulder mobility. Although its precise pathophysiological mechanisms remain incompletely understood, current evidence supports a multifactorial process involving inflammation, immune dysregulation, fibroblast proliferation, and extracellular matrix remodeling.

Physiotherapy remains the first-line treatment for the majority of patients and should be individualized according to disease stage, tissue irritability, associated comorbidities, and functional goals. The strongest evidence supports multimodal rehabilitation programmes integrating patient education, therapeutic exercise, manual therapy, and structured home

exercise. Treatment should be based on the principles of Evidence-Based Practice, combining scientific evidence with clinical expertise and patient preferences.

Successful rehabilitation depends not only on the selection of appropriate therapeutic techniques but also on early diagnosis, continuous reassessment, and active patient participation throughout the rehabilitation process. Future research should focus on developing standardized rehabilitation protocols and identifying patient-specific predictors of treatment response to further optimize outcomes for individuals with adhesive capsulitis.

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Author Contribution

Conceptualization: Wojciech Garczyński

Methodology: Wojciech Garczyński

Validation: Wojciech Garczyński, Oliwer Andrysiak.

Formal analysis: Wojciech Garczyński, Oliwer Andrysiak.

Investigation: Wojciech Garczyński, Oliwer Andrysiak.

Resources: Wojciech Garczyński

Data curation: Oliwer Andrysiak.

Writing -original draft preparation: Wojciech Garczyński, Oliwer Andrysiak.

Writing -review and editing: Wojciech Garczyński.

Supervision: Wojciech Garczyński

Project administration: Wojciech Garczyński

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