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Arthrodilation: a treatment algorithm as a conservative management option for adhesive capsulitis

Artrodilatación: un algoritmo de tratamiento como opción de tratamiento conservador de la capsulitis adhesiva

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ABSTRACT. Introduction: the management of adhesive capsulitis (AC) remains a topic of debate among orthopedic surgeons, with a wide variation in the literature. Conservative treatment relies as the first-line option as clinical studies report positive outcomes. However, there is variability in the effectiveness of different treatment modalities. **Material and methods:** this study aimed to analyzed functional and clinical outcomes of patients with AC who underwent the arthrodilation protocol, including three ultrasound-guided injections administered on a weekly basis: two corticosteroid injections and one injection of hyaluronic acid combined with corticosteroids. Additionally, patients received a specific rehabilitation therapy. Visual analogue scale (VAS), the university of California-Los Angeles shoulder score (UCLA) and Constant-Murley score were assessed before treatment and after 3-month follow-up period. **Results:** 23 patients were included, receiving the same treatment protocol with a mean onset of symptoms of 4.9 ± 1.7 months. Among these patients, there was a clear predominance of females (65.2%). Age distribution ranged from 39 to 74 years (mean = 56) indicating that individuals in their mid-50s were more susceptible to developing this condition. Furthermore, a slight majority (52.2%) exhibited AC in their right shoulder. VAS significantly decreased (-6.09 ± 1.9 [$p \leq 0.05$]). Similarly, UCLA score (10.9 ± 2.9 to 31.7 ± 2.2) and Constant-Murley score (22.3 ± 6.1 to 62.0 ± 6.2) improved significantly. Pre-to-post treatment evaluation showed improvement in both UCLA (mean

RESUMEN. Introducción: el tratamiento de la capsulitis adhesiva (CA) sigue siendo un tema de debate entre los cirujanos ortopedistas, con una variación amplia en la literatura. El tratamiento conservador se considera la opción de primera línea, ya que los estudios clínicos muestran resultados positivos. Sin embargo, existe variabilidad en la efectividad de las diferentes modalidades de tratamiento. **Material y métodos:** este estudio tuvo como objetivo analizar los resultados funcionales y clínicos de pacientes con CA que se sometieron al protocolo de artrodilatación, incluyendo tres inyecciones guiadas por ultrasonido administradas semanalmente: dos inyecciones de corticosteroides y una inyección de ácido hialurónico combinado con corticosteroides. Además, los pacientes recibieron una terapia de rehabilitación específica. La escala analógica visual (EVA), la puntuación del hombro de la Universidad de California-Los Ángeles (UCLA) y la puntuación de Constant-Murley se evaluaron antes del tratamiento y después de un período de seguimiento de tres meses. **Resultados:** se incluyeron 23 pacientes que recibieron el mismo protocolo de tratamiento con un inicio medio de síntomas de 4.9 ± 1.7 meses. Entre estos pacientes hubo un claro predominio del sexo femenino (65.2%). La distribución por edades osciló entre 39 y 74 años (media = 56), lo que indica que las personas de alrededor de 55 años eran más susceptibles a desarrollar esta afección. Además, una ligera mayoría (52.2%) presentaba CA en el hombro derecho. La EVA disminuyó significativamente (-6.09 ± 1.9 [$p \leq 0.05$]). De manera similar, la pun-

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= 20.8 ± 2.9 [p ≤ 0.05]) and Constant-Murley (mean = 39.7 ± 9 [p ≤ 0.05]). **Conclusion:** arthrodilation protocol demonstrated promising results, with patients achieving good to excellent outcomes and safely resuming their regular daily activities within a short-term follow-up period. These findings provide support for arthrodilation as a viable conservative management option and contribute valuable insights to the ongoing research aimed at identifying optimal treatment approaches for adhesive capsulitis.

Keywords: adhesive capsulitis, arthrodilation, injection, corticosteroid, hyaluronic acid, ultrasound.

tuación de UCLA (10.9 ± 2.9 a 31.7 ± 2.2) y la puntuación de Constant-Murley (22.3 ± 6.1 a 62.0 ± 6.2) mejoraron significativamente. La evaluación previa y posterior al tratamiento mostró una mejoría tanto en UCLA (media = 20.8 ± 2.9 [p ≤ 0.05]) como en Constant-Murley (media = 39.7 ± 9 [p ≤ 0.05]). **Conclusión:** el protocolo de artrodilatación demostró resultados prometedores, los pacientes lograron resultados de buenos a excelentes y reanudaron de manera segura sus actividades diarias regulares dentro de un período de seguimiento a corto plazo. Estos hallazgos respaldan la artrodilatación como una opción de tratamiento conservador viable y aportan conocimientos valiosos a la continua investigación destinada a identificar tratamientos óptimos para la capsulitis adhesiva.

Palabras clave: capsulitis adhesiva, artrodilatación, infiltración, corticoide, ácido hialurónico, ultrasonido.

Introduction

Adhesive capsulitis (AC) was initially described as scapulohumeral periarthritis in 1872 and later referred to as frozen shoulder in 1934.[1,2] The American Association of Shoulder and Elbow Surgeons (ASES) defines adhesive capsulitis as a condition characterized by a substantial limitation of both active and passive shoulder motion, with an unclear underlying cause and no identifiable intrinsic shoulder disorder.[3,4]

Pathophysiology consists in the development of fibrosis and contracture within the glenohumeral capsule, leading to progressive stiffness, pain, and limited shoulder mobility.[5] It can be classified as primary/idiopathic or secondary, depending on the presence of predisposing factors. While the exact mechanisms of adhesive capsulitis are not fully understood, inflammation of the joint capsule plays a significant role. Inflammatory cytokines such as transforming growth factor beta (TGF-β), tumor necrosis factor alpha (TNF-α), and collagen produced by myofibroblasts contribute to the destruction and transformation of fibroblasts into myofibroblasts. This process is primarily characterized by the deposition of type collagen I and III, leading to capsular hyperplasia, fibrosis, and subsequent contracture, ultimately causing limited range of motion (ROM), influenced by both intrinsic and extrinsic risk factors.[6,7,8,9] Intrinsic factors involve underlying tendon damage resulting from overuse, including conditions such as rotator cuff tendon tears, biceps tendinopathy, tears, or tendinitis. Extrinsic factors include previous shoulder surgery, cervical disc disease, or upper limb fractures. These factors contribute to tissue damage, which triggers an inflammatory process within the shoulder.[10] The incidence of AC in the general population is around 2-5%, with a higher prevalence in women between the ages of 40 and 65, as well as those with diabetes mellitus (DM). Additional risk factors include hyperthyroidism, previous shoulder surgery, breast or cervix cancer, previous spinal surgery, and in rare cases, immunizations.[8,10,11]

AC progresses through three distinct stages: the freezing stage, the frozen stage, and the thawing stage.[5,12] In the freezing stage, patients experience increased pain and stiffness, lasting from 2 to 9 months. Subsequently, the frozen stage sets in, characterized by persistent stiffness that can endure for 4 to 12 months. Finally, the thawing stage occurs, where spontaneous recovery occurs gradually over a span of 12 to 42 months. Although AC is often considered a self-limiting condition with a recovery timeframe of 2 to 3 years, it is important to note that approximately 40% of patients may continue to experience ongoing symptoms. Additionally, 7 to 15% of individuals may encounter some level of permanent functional loss as a result of the condition. Therefore, opportune conservative treatment is often essential when evaluating these patients.[6,13,14,15]

Currently there are non-surgical treatments which include steroid injection, oral analgesic therapy (particularly NSAIDs), physiotherapy and intra-articular hyaluronic acid injection, shock wave, intranasal calcitonin and ultrasound-guided hydrodistension.[16,17] In AC early stages, intra-articular corticosteroid injections are effective in reducing pain. A significant decrease in pain is observed between 6 and 12 weeks compared to a placebo, although effects appear to be no longer noticeable at 26 weeks.[17] There is no definitive advantage in terms of functional improvement when comparing single physical therapy to corticosteroid injections alone. However, the use of intra-articular steroid injections shows notable enhancement in passive external rotation, persisting for a longer period.[18,19] Intra-articular injection of hyaluronic acid (HA), a component of synovial fluid widely applied for the treatment of knee osteoarthritis (OA) has recently been proposed for AC.[20] HA, found in synovial fluid, has both viscous and elastic properties, making it an effective lubricant and reducing stickiness. By increasing joint viscoelasticity, HA promotes

the release of adhesions and improves synovial fluid concentrations. It also addresses abnormalities in synovial fluid properties, reducing friction. Additionally, HA has anti-inflammatory properties and provides protection to cartilage.[21,22] In systematic reviews, it has been determined that glenohumeral injection of HA resulted in significant improvements in shoulder ROM, constant scores, and pain reduction during short-term follow-up. Founding this pain-relieving effect to be similar to corticosteroid injection, without showing any clear superiority.[23,24]

Precision is a crucial aspect to consider when administering intra-articular injections, as the effectiveness of the treatment relies on proper technique. Ultrasound serves as a valuable tool in Orthopedics, allowing for radiation-free diagnosis and injections. Its popularity stems from its portability, affordability, and ability to generate real-time images that offer both cross-sectional and longitudinal views of anatomical structures. In a prospective randomized study conducted by Chul-Hyun,[25] ultrasound-guided injections exhibited an accuracy rate of 100% compared to 71.1% for blind injections in the treatment of frozen shoulders.[26]

Patients with AC have a range of treatment options available, including conservative measures such as physical therapy, as well as more invasive interventions like mobilization under anesthesia or surgical release of adhesions. However, there is no universally agreed-upon consensus regarding the optimal management strategy for these individuals. Hence, we introduce our proposed treatment algorithm, called «Arthrodilation», which offers a conservative approach and aims to achieve favorable functional and clinical outcomes.

Material and methods

In this cross-sectional analytical study, we included all patients diagnosed with adhesive capsulitis who underwent our recommended treatment protocol. Including three ultrasound-guided injections administered on a weekly basis. Additionally, patients underwent a specific rehabilitation therapy protocol to address this condition. The study aimed to analyze and report the functional outcomes after a 3-month follow-up period, based on data collected between 2020 and 2022.

Patients meeting the inclusion criteria for the diagnosis of adhesive capsulitis (AC) had to exhibit a restriction of both active and passive shoulder motion exceeding 50% of the full range. This restriction had to be accompanied by pain and a progressive worsening of symptoms lasting for more than three weeks.

The ultrasound examination was conducted on all patients using the BUTTERFLY IQ+ system. To ensure proper evaluation, the patients were positioned differently, and sterile gel was applied after the work area was aseptically prepared. The examination commenced by reviewing the bicipital groove with the shoulder externally rotated, followed by assessing the integrity of the subscapularis tendon in the same position with the addition of dynamic external rotation. The acromioclavicular joint was evaluated with the shoulder suspended and in a neutral position. To examine the posterosuperior rotator cuff and identify signs of subacromial impingement, dynamic shoulder abduction ranging from 0 to 90 degrees was performed. Additionally, the hand in the back pocket maneuver was utilized to expose most of the supraspinatus. Lastly, the injured shoulder's hand was placed on the contralateral shoulder to assess the posterior labrum, suprascapular notch, and infraspinatus tendon. During this assessment, guided infiltration was performed using echogenic needles, which could also be conducted in the lateral decubitus position *(Figures 1 and 2)*.

The protocol was established, involving ultrasound-guided intra-articular injections of corticosteroids and hyaluronic acid. The injections were administered over a period of 3 weeks, with a 1-week interval between each injection, as outlined below:

1. Diagnosis: 2 ml methylprednisolone acetate + 2 ml lidocaine injection.
2. 2nd week: 2 ml methylprednisolone acetate + 2 ml lidocaine injection.
3. 3rd week: 22 mg/ml high molecular weight cross-linked hyaluronic acid combined with 4.5 mg/ml triamcinolone hexacetonide injection.

Following injection, all patients underwent a minimum 30-minute observation period to monitor for any potential side effects. From the time of diagnosis and after the first injection, patients were referred to rehabilitation therapy. A team of physiotherapists developed a standardized rehabilitation therapy that was uniformly applied to all patients. This consisted of 10-30 sessions and involved documenting pre- and post-protocol photos to document progress *(Figure 3)*.

To ensure accurate and objective measurement of our patients ROM, we utilized the ANGULUS digital app for the Android system in collaboration with our rehabilitation team. The app facilitated precise assessments of flexion and abduction while in a standing position. For flexion, the fixed arm was aligned parallel to the trunk, while the mobile arm was positioned on the humerus, with the joint axis centered at the glenohumeral joint. Internal and external rotation measurements were conducted with the humerus abducted in a supine position, using the fixed arm perpendicular to the ground and the mobile arm on the humerus (as depicted in *Figures 4 to 6*). During the initial evaluation, it was observed that all patients exhibited limited mobility, with flexion measurements below 90º, abduction below 80º, and internal and external rotation below 25º.

Within this patient cohort, we conducted evaluations of scapulothoracic joint deficits, which play a crucial role in shoulder movements. We categorized these deficits as follows:

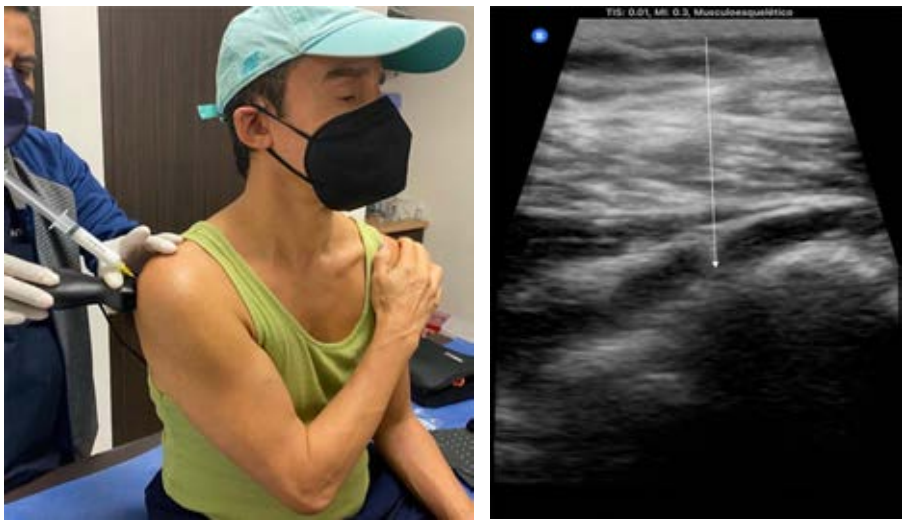

Figure 1:

Patient positions for echo-guided infiltration.

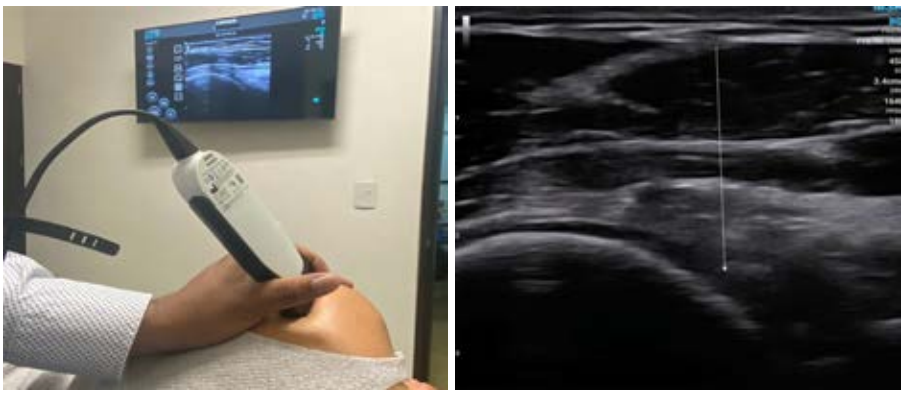

Figure 2:

Patient positions for echo-guided infiltration.

1. Deficit in superior rotation of the scapula: this is attributed to a weakness in the serratus anterior muscles and inferior fibers of the trapezius.
2. Deficit in the posterior tilt of the scapula: caused by either posterior capsular rigidity or a deficiency in the strength of the serratus anterior.
3. Excessive internal rotation of the scapula: resulting for inadequate strength in the middle fibers of the trapezius or the shortening of the pectoralis minor muscle.
4. Excessive elevation of the clavicle: this is due to the overactivation of the superior fibers of the trapezius.

Based on the level of tissue irritability and the specific deficits identified, we classified the patients and devised targeted interventions accordingly.[27,28]

Patients with a high degree of irritability

Patients in this group experienced elevated pain levels (> 7/10), frequently occurring at night. They also reported significant functional disability in performing activities of daily living, and pain was present throughout the entire ROM, which intensified during active movement. To address these issues, we implemented a combination of passive interventions, including analgesic electrotherapy and type IIIB laser treatment. Patient education was provided on optimal sleeping positions and modifications to activities of daily living to minimize pain. Additionally, low-grade passive mobilizations, mechanical percussion therapy, pain-free assisted passive, and active mobility exercises were incorporated into the treatment plan. Special emphasis was given to performing scapular exercises without inducing pain.

Patients with a moderate degree of irritability.

Moderate pain (4-6/10) intermittently during the night, moderate functional disability, and pain at the end of the ROM, whether active or passive. Passive strategies such as analgesic electrotherapy and resistive radiofrequency were used combined with passive mobilizations to tolerance and instrumented manual therapy. We add stretching exercises, progressing them in time and intensity according to the patient's response to pain and inflammation. To prevent incorrect movements and compensatory patterns, we initiated muscle reeducation as an integral part of the treatment approach.

Patients with low degree of irritability

Patients reporting minimal levels of pain (< 3/10) and exhibiting a low degree of functional disability. They experienced pain primarily in the last degrees of passive motion and during periods of overload. As a result, the use of passive physical agents was not deemed as necessary for this particular group. Instead, our focus shifted towards passive mobilizations, with emphasis placed on working the final degrees of each ROM. Furthermore, higher intensity stretching exercises were incorporated to promote further improvement with continued efforts made in muscle reeducation to enhance motor control and movement patterns.[29,30,31]

We utilized the visual analogue scale (VAS), The University of California-Los Angeles shoulder score (UCLA) score, and abbreviated Constant-Murley score. The VAS ranged from 0 to 10 for pain, while the UCLA and Constant-Murley scores ranged from 0 to 35 and 0 to 100 respectively, indicating the level of shoulder impairment and reflecting the overall shoulder function, with higher scores indicating better outcomes. To accommodate the short follow-up period, we used the abbreviated Constant-Murley score[32] by evaluating the total score out of 75 points, excluding the strength factor from our assessment. This modification allowed us to prioritize the immediate improvements in pain reduction and ROM achieved through rehabilitation therapy. Although progressive strengthening was recommended for the patients, it was not the primary objective of this study.

Results

A total of 32 patients diagnosed with adhesive capsulitis (AC) were included in this analysis, with 23 patients meeting the inclusion criteria and receiving the same treatment protocol between 2020 and 2022 with a mean onset of symptoms of 4.9 ± 1.7 months. Among these patients, there was a clear predominance of females, accounting for 65.2% of the cases. The age distribution ranged from 39 to 74 years, with an average age of 56 years, indicating that individuals in their mid-50s were more susceptible to developing this condition. Furthermore, a slight majority of patients (52.2%) exhibited AC in their right shoulder. A subset of 9 individuals had a comorbidity of diabetes mellitus (DM). However, it was observed that the presence of DM did not impact clinical results *(Table 1)*.

Prior to treatment, the mean VAS for pain was 7.0 ± 2.2. After undergoing arthrodilation, there was a significant decrease in pain levels (0.9 ± 1.1), resulting in a mean change of -6.09 ± 1.9 ($p \leq 0.05$). Similarly, the UCLA score improved significantly from 10.9 ± 2.9 to 31.7 ± 2.2, and the Constant-Murley score improved from 22.3 ± 6.1 to 62.0 ± 6.2. The pre-to-post treatment evaluation showed

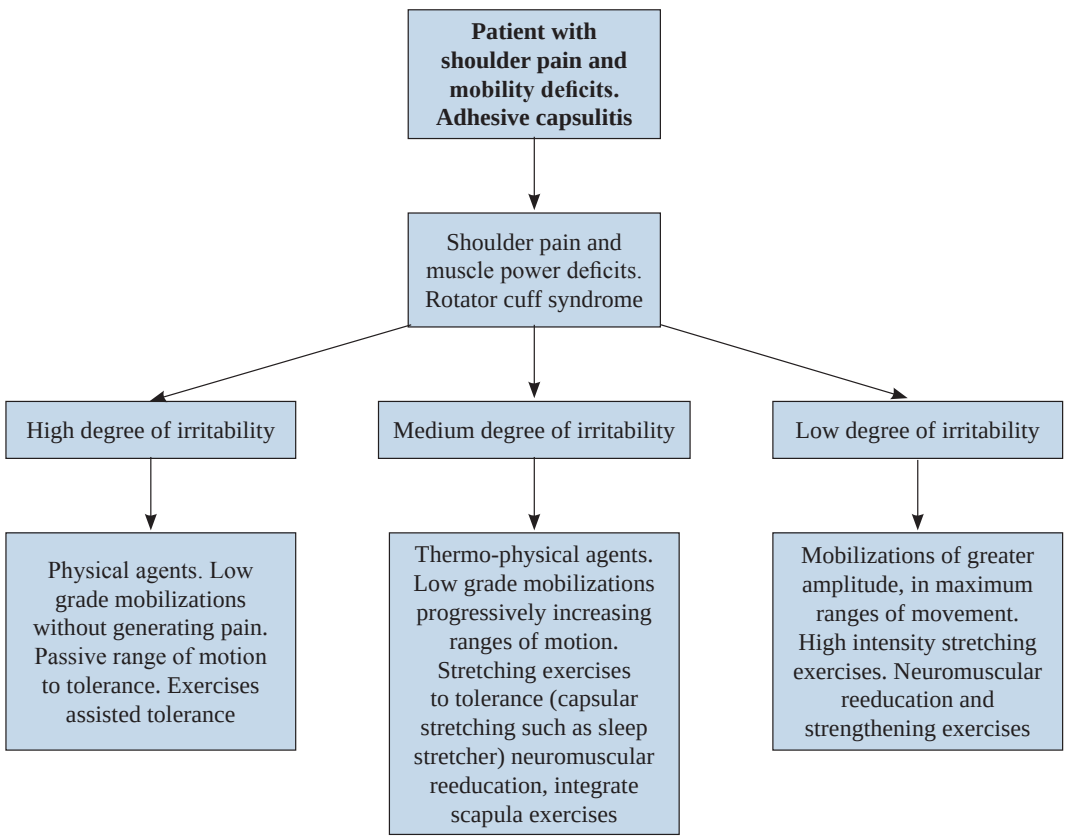

Figure 3:

Rehabilitation treatment algorithm.

Figure 4: Flexion and abduction differences at 4 weeks of treatment.

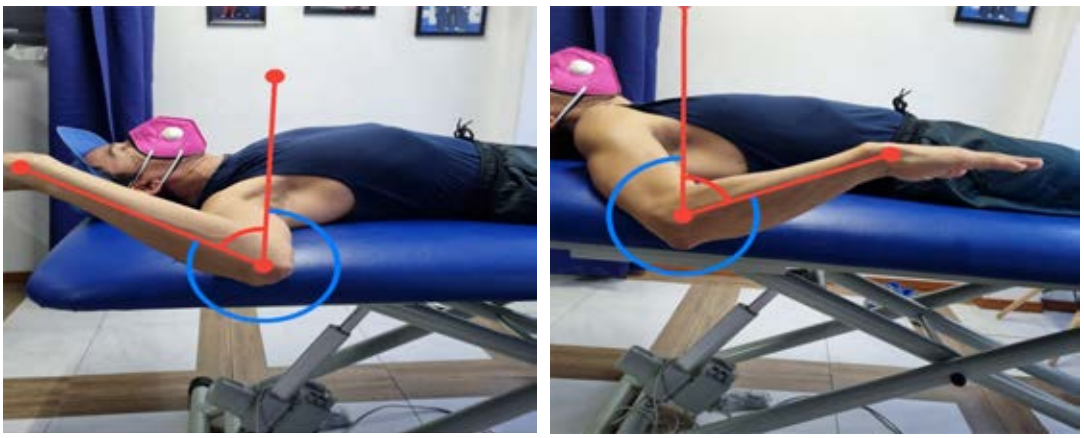

Figure 5:

Rotation differences at 3 weeks of treatment.

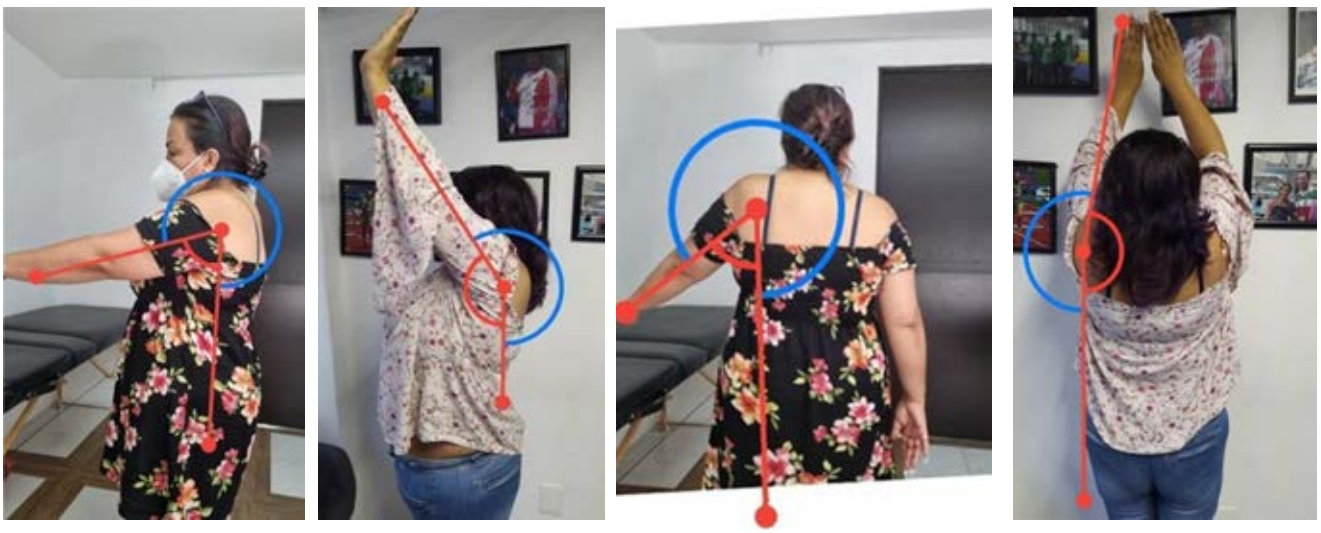

Figure 6: Flexion and abduction differences at 4 weeks of treatment.

Table 1: Baseline demographics. N = 23.

	AC
Age, (years)* [min-max]	56 ± 8.9 [39-74]
	n (%)
Gender	
Male	8 (34.8)
Female	15 (65.2)
Affected side	
Right	12 (52.2)
Left	11 (47.8)
DM type 2	
Yes	9 (39.1)
Duration of symptoms, (months)*	4.9 ± 1.7

* Data indicate mean ± standard deviation, [range].
AC = adhesive capsulitis. DM2 = diabetes mellitus.

a significant improvement in both UCLA (mean change = 20.8 ± 2.9, $p \leq 0.05$) and Constant-Murley (mean change = 39.7 ± 9, $p \leq 0.05$) scores. Reported functional outcomes were not significantly influenced by age, gender, or laterality *(Table 2 and 3)*.

Discussion

Our study findings demonstrate a positive response to the arthrodilation treatment protocol, as evidenced by significant improvements in pain reduction and functional capacity within a relatively short time frame. However, the extent of improvement in achieving full ROM was comparatively less pronounced.

As it continues to be a low-incidence pathology, during the COVID-19 pandemic, we observed a significant rise in the number of patients seeking care for AC. We believe this increase can be attributed to the systemic inflammatory response associated with SARS-CoV-2 infection. Recent evidence from a comprehensive review on the pathophysiology of AC suggests that a chronic state of low-grade inflammation plays a crucial role in the development of frozen shoulder. This chronic inflammation may be particularly relevant in patients with comorbidities. However, the specific triggers that initiate the onset of symptoms remain unclear. Further exploration of predisposing factors is warranted to enhance our understanding of the underlying etiology of this condition.[33] The pandemic and public health restrictions may also have influenced the incidence of other shoulder pathologies, which progressed to a state of joint stiffness, as well as the waiting time between the referral and the first appointment as a possible risk factor. Even because of the pandemic, patients waited longer before seeking specialist care, increasing the duration from symptom onset to presentation.[33] These findings provide encouragement for our team to establish a standardized protocol for patients, emphasizing conservative treatment options during challenging times in the global healthcare system.

Despite the wide range of treatment options available for AC, there is a notable lack of evidence regarding their effectiveness and the superiority of one approach over another. It is widely recognized that conservative treatment should be initially recommended, considering the possibility of spontaneous recovery. However, it is important to note that AC can progress gradually, leading to persistent pain and mobility limitations that can last for 12-18 months, ranging from mild to moderate severity. Some studies have even reported functional deficits persisting for up to 44 months.[6,34] Within conservative options, hydrodilation/distension has been previously reported as a viable procedure. Hydrodilation entails the injection of a substantial amount of fluid into the shoulder joint to physically expand the capsule, described as minimally invasive, fast, and relatively easy to perform.[35]

A systematic review conducted by Rymaruk et al. explored different therapeutic regimens utilized in various healthcare units. While specific protocols varied, a common approach involved injecting a combination of saline, steroids, local anesthetic, and contrast material into the glenohumeral joint under image guidance, typically using approximately 30 ml of fluid. The objective of the procedure is to achieve beneficial effects through hydraulic distension of the capsule, with the initial aim often being capsular rupture. However, the available evidence is limited in determining whether capsular rupture is a necessary outcome for the procedure to be considered successful, or if the primary focus should be on achieving adequate capsular distension.[36] In Catapano et al review, the combination of

Table 2: Pre-treatment status/post-treatment outcomes. N = 23.

	AC		CI 95%	
	Pre	Post	Pre	Post
VAS*	7.0 ± 2.2	0.9 ± 1.1	(6.0-7.8)	(0.4-1.3)
UCLA*	10.9 ± 2.9	31.7 ± 2.2	(9.6-12.1)	(30.7-32.7)
Constant-Murley*	22.3 ± 6.1	62.0 ± 6.2	(19.6-24.9)	(59.4-64.7)

AC = adhesive capsulitis. VAS = visual analogue scale.
UCLA = The University of California-Los Angeles shoulder score.
Abbreviated Constant-Murley shoulder score.
* Data indicate mean ± standard deviation.

Table 3: Pre to post-treatment change.

	AC (n = 23)	CI 95%	p
VAS*	-6.09 ± 1.9	(-6.9-[-5.2])	< 0.001
UCLA*	20.8 ± 2.9	(19.6-22.0)	< 0.001
Constant-Murley*	39.7 ± 9	(35.9-43.7)	< 0.001

AC = adhesive capsulitis. VAS = visual analogue scale.
UCLA = The University of California-Los Angeles shoulder score.
Abbreviated Constant-Murley shoulder score.
* Data indicate mean ± standard deviation.

hydrodilation and corticosteroid injection was found to contribute to a faster recovery of pain-free ROM. The most significant benefits were observed within the first 3 months following the intervention. Variations in hydrodilation techniques, inclusion of capsular preservation, anatomical approach, and duration of symptoms could account for the variability in demonstrated efficacy. Similarly, Ladermann et al. evaluated various factors such as physiotherapy, intra-articular and subacromial corticosteroid injections, and arthrography distension/hydrodilation with corticosteroids. The findings indicated that intra-articular injection and arthrography distension/hydrodilation with corticosteroids provided advantages over placebo in terms of short-term pain relief, ROM, and shoulder function. Moreover, improvements in ROM were observed in the medium and long term, concluding that corticosteroid hydrodilation yielded superior short-term pain relief and ROM improvements compared to corticosteroid injection or physiotherapy alone, across all time frames for frozen shoulder.[37,38]

Currently, our protocol involves performing hydrodilation using corticosteroids with ultrasound guidance through the posterior glenohumeral recess. This approach provides us with confidence and confirmation that the treatment is being effectively administered. However, a new intervention technique utilizing the rotator cuff interval has recently been described. Wang et al. conducted a prospective randomized trial comparing the efficacy of injection between both approaches. The injection consisted of 4 mL triamcinolone acetonide (40 mg) mixed with 4 mL 2% lidocaine hydrochloride and 12 mL normal saline, with reported outcomes favoring hydrodilation through the rotator cuff interval. This suggests that there are different therapeutic options to consider when performing echo-guided injection.[39] In terms of adding physical therapy, Koraman et al. have described a technique that utilizes multiple ultrasound-guided injections with a combination including triamcinolone, bupivacaine, and saline. These injections specifically target various areas, including the glenohumeral joint, joint capsule, subacromial space, long head of the biceps tendon, and coracohumeral ligament. Following the injections, targeted therapy was administered within a short period of 2 hours, and a total of 6 sessions were performed. This approach aims to address the different innervations of the joint and has shown better functional results and greater analgesia compared to a single infiltration. These findings highlight alternative therapeutic options that can be tailored to individual patients, considering the specific characteristics of their condition, and providing improved functional outcomes and pain relief.[40,41]

Although our study had a limited sample size, we believe that it contributes valuable insights to the existing literature, which remains highly debated due to the various treatment options and methodologies employed. Our arthrodilation treatment algorithm combines capsular dilation with its analgesic and anti-inflammatory effects, along with a well-defined physical therapy and rehabilitation protocol. These findings offer promising results in short-term follow-ups. Further research is needed to advance our understanding and validate the outcomes observed in this study, by conducting additional investigations that include long-term follow-up data in order to assess treatment efficacy.

Conclusion

Arthrodilation protocol demonstrated promising results, with patients achieving good to excellent outcomes and safely resuming their regular daily activities within a short-term follow-up period. These findings provide support for arthrodilation as a viable conservative management option and contribute valuable insights to the ongoing research aimed at identifying optimal treatment approaches for adhesive capsulitis.

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