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Shoulder pain in rehabilitation setting: from a standardized ultrasound protocol evaluation to specific subacromial disorders

Abstract

Shoulder pain (SP) is a very common and disabling complaint in general practice and in Rehabilitation setting. In the Rehabilitation setting, patients are usually treated based on clinical signs and symptoms as well as on clinical evolution. However, medical history and physical examination do not provide conclusive evidence on the patho-anatomical origin of the symptoms. SP is a consequence of a wide spectrum of disorders, being subacromial disorders the most common. Subacromial disorders have specific features and specific therapies for them are available. Ultrasound is the preferred technique in the evaluation of painful shoulder.

The objective of this review is to describe the main disorders that are involved in SP syndrome, and to propose a standardized US protocol to evaluate normal and/or pathologic subacromial disorders in the daily practice in Rehabilitation setting.

Keywords: shoulder pain, patients, rehabilitation setting, electrotherapy, physiotherapy, Ultrasound

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Abbreviations: SP, shoulder pain; US, Ultrasound; SASD, subacromial subdeltoid; AC, Acromioclavicular

Introduction

Shoulder pain (SP) is a very common and disabling complaint in general practice and in Rehabilitation setting, with a 17-20% prevalence in general population.[1,2] SP has poor prognosis, about 70% of patients with SP do not recover completely at six weeks, and 40% are not recovered after a year.[3] In fact, prolonged and recurrent episodes of SP result in frequent consultations.[4] Moreover, at least 30% of patients with SP report limitations in activities of daily life and work absenteeism in them is very common.[1,5] SP produces a great societal impact derived from direct and indirect costs. Prolonged and recurrent episodes impact on direct costs, while the indirect costs of sick leave and paid work could even have a higher impact on economy.[1,5–7] Therefore, it is very important to improve diagnosis and prognosis from both the particular patient perspective as well as from the common societal perspective.

To diagnose accurately patients with SP is a very difficult task.[2] In the Rehabilitation setting, patients are usually treated based on clinical signs and symptoms as well as on clinical evolution.[8] However, medical history and physical examination do not provide conclusive evidence on the patho-anatomical origin of the symptoms.[8] When there is no positive response to treatment, or a complex or severe disease is suspected, a more accurate diagnosis is needed.[8,9] SP is a consequence of a wide spectrum of disorders, being subacromial disorders the most common.[2] For the management of SP, on the short term, rest, ice, compression, elevation and NSAIDs are employed; while, on the long term, physical therapies (thermotherapy, electrotherapy, physiotherapy, magnetotherapy and Ultrasound therapy) are used.[5,8]

SP is considered a syndrome, meanwhile sub acromial disorders have specific features and specific therapies for them are available.[1] There subsides the importance of tailoring treatment to the underlying disorder. Specific therapy for specific pathology is a more effective approach to SP, and it can lead to better prognosis and less costs. Ultrasound (US) is the preferred technique in the evaluation of painful shoulder.[8] US is an accurate, dynamic, economic and cost/effective method to diagnose subacromial disorders.[8] The objective of this review is to describe the main disorders that are involved in SP syndrome, and to propose a standardized US protocol to evaluate normal and/or pathologic subacromial disorders in the daily practice in Rehabilitation setting.

Review of the literature

Subacromial disorders

Subacromial disorders are considered to be the most common pathology that affects the shoulder. In fact, in 80% of cases, the rotator cuff is the most affected anatomical structure.[3] The spectrum of subacromial pathology is diverse and extensive and includes rotator cuff tendinopathy (tendinosis), calcifying tendonitis, partial or full-thickness tears and subacromial subdeltoid (SASD) bursitis, whether acute or chronic.[1,2] Ninety percent of patients with SP syndrome are diagnosed and treated in general practice and only 10% are referred to a Rehabilitation specialist.[2] In secondary care the prevalence of subacromial disorders diagnosed by US varies from 30-39% for tendinopathy, 13-15% for calcifying tendonitis, 13-51% for partial-thickness tears, 24-70% for full-thickness tears and 12-56% for SASD bursitis.[9]

The mechanisms that lead to shoulder pathology are controversial, but it is believed that many shoulder complaints are originated from dynamic pathology, being subacromial impingement the initial stage and rotator cuff tears the final stage.[10] This would explain why full-thickness tears are more frequently diagnosed in patients older than 65years of age; on the contrary, shoulder pain without US-diagnosed disorders are more common in people younger than that age.[2] This comes in line with Fernandez-Cuadros et al who sustain that on

musculoskeletal pathology, disorders that involve muscle, tendon and ligaments are related to overuse due to work or sports; on the contrary, degeneration is due to aging.[8]

On SP syndrome the diagnosis is important because, depending on the anatomical alteration, treatment could vary considerably. Then, a more accurate diagnosis by the use of US is needed. In fact, for all the previous specific subacromial disorders, specific therapies are available. After initial pain management by rest, ice and paracetamol/NSAIDs, tendinopathy is preferably treated with physiotherapy (thermotherapy, electrotherapy), bursitis with subacromial corticosteroid injections, calcifying tendonitis by iontophoresis[11–13] or electroshock wave therapy,[5] partial-thickness tears with physiotherapy (kinesiotherapy), and in the case of full-thickness tears, if physiotherapy is not effective, surgery should be considered.[1,5]

US on musculoskeletal pathology

US can be a diagnostic, prognostic and therapeutic technique used in musculoskeletal pathology.[14] In 2012, the EUROMUSCULUS Group established 19 advantages of US in the Rehabilitation setting: 1) US is a complement to clinical and physical evaluation; 2)no formal contraindications, not invasive; 3) cheap and cost-effective; 4) easy to transport; 5) laterality can be evaluated; 6) dynamic evaluation; 7) eco-guided procedures can be performed; 8) sonopalpation can elicit pain and guide to diagnosis; 9) US has high resolution on images (0.15mm) if compared to magnetic resonance image (0.45mm) or to radiography (5mm);[8] 10) Doppler can distinguish vascular from inflammatory processes; 11) US has diagnostic (qualitative) and prognostic (quantitative) properties; 12) US is diagnostic and therapeutic; 13) US evaluates several disorders; 14) US can diagnose entrapment syndromes; 15) useful for follow-up evaluation; 16) US discriminates between solid from cystic masses (malignant or benignant); 17) US does not radiate as radiography; 18) US does not radiate as Tomography; 19) SU is accessible and available more than resonance imaging and it is even cheaper (25-30%).[15,16]

Disadvantages of US

US is the most difficult technique to perform by radiologists. US is operator dependent. The learning curve is time consuming. Specific operative knowledge on Knobology (knowledge of US equipment), sonoanatomy, patient's and probe's position are required.[8] On evaluation of images, radiographies and magnetic resonance imaging have an anatomical representation. On the contrary, US images are harder to understand.[8] The position of the patient may favor the exposition of anatomical structures, especially on shoulder evaluation (Figure 1). When evaluating an anatomical structure, the probe on long axis position (longitudinal evaluation) is quite different than the probe on short axis position (transversal evaluation).

US evaluation of the shoulder

US is very useful for the evaluation of shoulder pathology. In fact, US was intended to accomplish that goal in the early 1970s.[8] Shoulder pathology is the most frequent of musculoskeletal disorders. SP is very disabling and produces work absenteeism.[5] Ecographic signs could confirm disorders due to multiple causes such as overuse (tendinopathy), acute trauma (partial or full rupture), repetitive trauma (tendinosis) degeneration, inflammation and crystal deposition (calcifying tendonitis).[5]

Standardized protocol for shoulder US evaluation

US is the preferred technique for the evaluation of painful shoulder. US can diagnose subacromial impingement, rotator cuff pathology, tendonitis, bursitis and partial or full thickness rupture.[8] As International Guidelines state, a complete standardized protocol for shoulder evaluation should include at least 9 scan images involving routinely structures such as Acromioclavicular (AC) joint, Long Head of Biceps, Subscapularis, Supraspinatus and Infraspinatus tendons and SASD bursa.[17] Additional imaging may include dynamic evaluation of rotator cuff. Contralateral shoulder imaging may be performed immediately to assess normality, if needed.

Figure 1 (A) The position of the shoulder may favor the exposition of anatomical structures. Supraspinatus tendon is better exposed on the "Marilyn Monroe pose", (B) while supraspinatus tendon is better exposed on the "military position".

Superior Acromioclavicular (AC) joint (Figure 2)

Patient position: Patient is seated, arm at side, elbow flexed with palm up (supination).

Probe position: Long axis over distal clavicle.

Scan of structures: AC joint is a synovial articulation delimited by the end of clavicle, usually higher than the acromion.

Abnormal findings: Increased fluid in joint capsule, also called as "Geyser sign" might indicate inflammation, recent trauma or rheumatologic issues. Narrowed joint space and osteophytes may denote Osteoarthritis, or degenerative joint disease.[17,18]

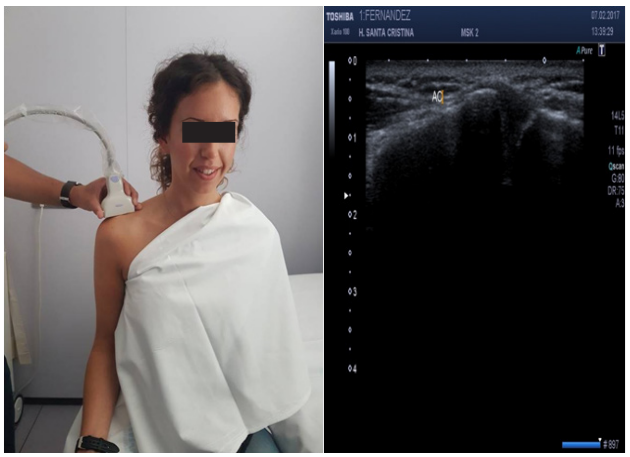

Figure 2 Sonoanatomy of the acromioclavicular joint.

Citation: Fernández-Cuadros ME, Albaladejo-Florín MJ, Cabrera-Rodríguez L et al. Shoulder pain in rehabilitation setting: from a standardized ultrasound protocol evaluation to specific subacromial disorders. *MOJ Orthop Rheumatol.* 2018;10(4):358–364. DOI: 10.15406/mojor.2018.10.00429

Long head of the biceps (short/transverse axis) (Figure 3)

Patient position: Patient is seated, arm at side, elbow flexed with palm up (supination).

Probe position: Probe over anterior deltoid, axial to upper arm. It shows transverse or short axis view of tendon.

Scan of structures: The biceps tendon is observed within the bony bicipital groove of the humerus. Normally, tendon has a bright appearance. Medially, the subscapular tendon is observed; laterally, the supraspinatus tendon is seen.[17,18]

Abnormal findings: fluid around the tendon might be a sign of tenosynovitis.[17,18]

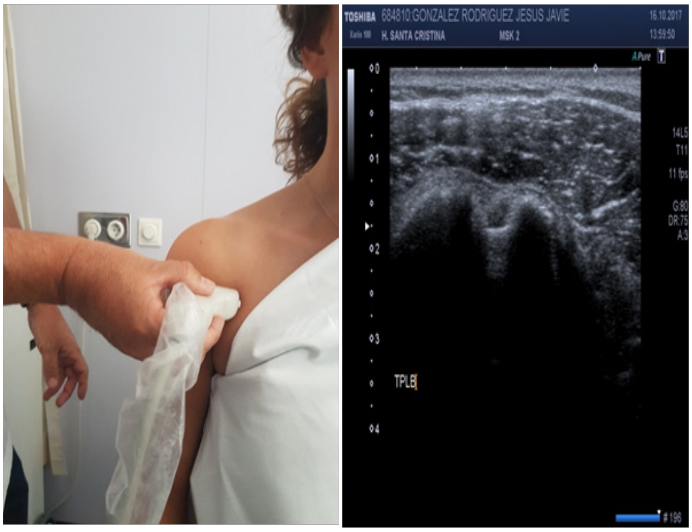

Figure 3 Sonoanatomy of the long head of the biceps (short/transverse axis).

Long head of the biceps (longitudinal axis) (Figure 4)

Patient position: Patient is seated, arm at side, elbow flexed with palm up (supination).

Figure 4 Sonoanatomy of the long head of the biceps (longitudinal axis).

Probe position: Probe over anterior deltoid, longitudinal to upper arm. Scan to find the musculotendionous junction, moving the probe slowly downwards.

Scan of structures: The parallel arrangement of fibers as a fibrillary pattern should be clearly visualized.

Abnormal findings: Fluid in this picture ("tear sign") might denote synovitis. Longitudinal defects might show tears in the tendon.[17,18]

Subscapularis tendon (short axis) (Figure 5)

Patient position: Patient is seated, arm at side, elbow flexed, arm externally rotated with palm up (supination).

Figure 5 Sonoanatomy of the subscapularis tendon (short axis).

Probe position: Probe over anterior deltoid, axial to upper arm, short axis view.

Scan of structures: Because of the orientation of fibers, short axis depicts the insertion of tendon on lesser tuberosity and it is seen as beak-shaped.[17,18]

Subscapularis tendon (long axis) (Figure 6)

Patient position: Patient is seated, arm at side, elbow flexed, arm externally rotated with palm up (supination).

Figure 6 Sonoanatomy of the subscapularis tendon (long axis).

Probe position: Probe over anterior deltoid, longitudinal to upper

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arm, long axis view.

Scan of structures: Because of the orientation of fibers, longitudinal view is actually a transverse view of the muscle´s tendon. Three or four bright tendon fiber bundles may be seen on this scanning. Do not interpret as rupture or tears on subscapular tendon.[17,18]

Supraspinatus tendon (long axis) (Figure 7)

Patient position: Patient facing direction of shoulder been studied, 90º to the examiner with hand on back pocket and elbow tucked in ("Marilyn Monroe position").

Probe position: Probe on coronal position gives a long axis view.

Scan of structures: Supraspinatus tendon looks like a bird peak. The superficial aspect of the supraspinatus must be convex.

Abnormal findings: If superficial aspect of supraspinatus tendon is concave or "dented", a tear must be suspected. Hyperechoic (bright) cartilage signal may indicate a tear.[17,18]

Figure 7 Sonoanatomy of the supraspinatus tendon (short/transverse axis).

Supraspinatus tendon (short axis) (Figure 8)

Patient position: Patient facing direction of shoulder been studied, 90º to the examiner with hand on back pocket and elbow tucked in ("Marilyn Monroe position").

Figure 8 Sonoanatomy of the supraspinatus tendon (long axis).

Probe position: Probe on sagittal position gives a short axis view. This view is obtained rotating the probe 90º from position as evaluating long axis of supraspinatus tendon..

Scan of structures: Supraspinatus tendon has a convex image like a "tire on a wheel".

Abnormal findings: A concave image or "flat tire" image may indicate partial tear. A dark line greater than 2mm between supraspinatus and deltoid may denote SASD bursitis.[17,18]

Infraspinatus tendon (long axis) (Figure 9)

Patient position: Patient is seated, back toward the examiner, arm on contralateral shoulder ("military position").

Probe position: Probe placed longitudinal to posterior glenohumeral joint.

Scan of structures: Scanning superior above scapular spine is supraspinatus tendon. Below the spine, infraspinatus and teres minor muscles can be seen. Suprascapular notch may be visualized, better if color Doppler is used.[17,18]

Abnormal findings: Suprascapular notch may have a cyst present.[17,18]

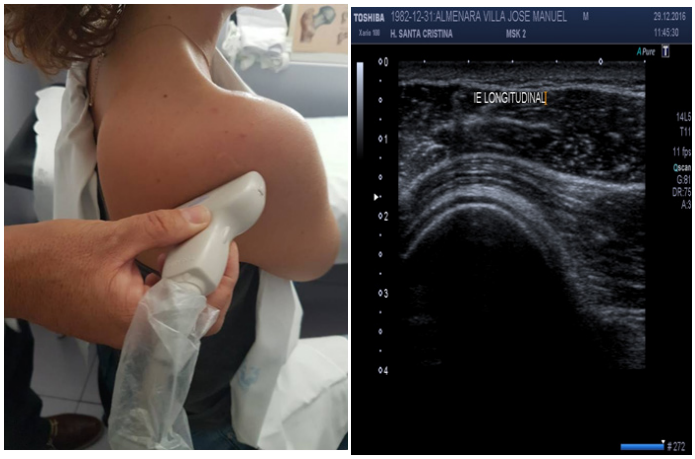

Figure 9 Sonoanatomy of the infraspinatus tendon (long axis).

Rotator cuff interval (subscapularis, biceps tendon and supraspinatus) (Figure 10)

Patient position: Patient facing direction of shoulder been studied, 90º to the examiner with hand on back pocket and elbow tucked in ("Marilyn Monroe position").

Probe position: Probe on coronal position.

Scan of structures: Axial over bicipital grove, sweep probe proximally to the acromion to view the supraspinatus, distally down to view the infraspinatus.[17,18]

Figure 10 Sonoanatomy of rotator cuff interval (Subscapularis, biceps tendon, supraspinatus tendon).

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Anterior glenohumeral joint and coracoid process (short axis view) (Figure 11)

Patient position: Patient is seated, arm at side, elbow flexed with palm up (supination).

Probe position: Probe over anterior deltoid and coracoid process, axial to upper arm.

Scan of structures: Subscapularis tendon can be seen. Sometimes, the superior portion of the labrum may be observed. This view is the preferred approach for anterior glenohumeral injection.

Abnormal findings: A distance between coracoid process and lesser troquiter of humerus lower than 6mm may denote anterior impingement.[17–19]

Figure 11 Anterior glenohumeral joint and coracoid process.

Dynamic Lateral view of the shoulder (subacromial impingement) (Figure 12)

Patient position: Patient is seated, shoulder in neutral position, arm at side and rotated internally and then lift the arm (abduction of the shoulder).

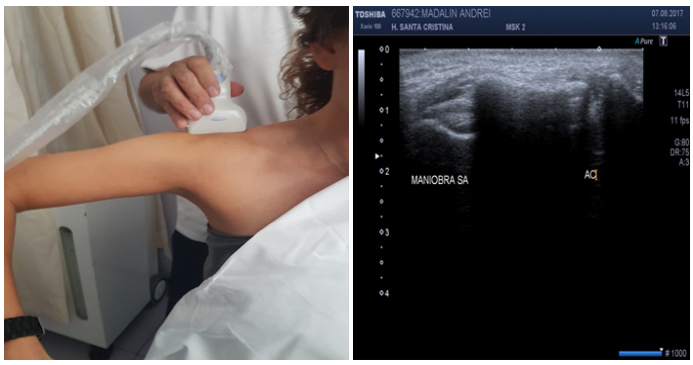

Figure 12 Subacromial impingement.

Probe position: Probe over lateral deltoid, longitudinal to upper arm.

Scan of structures: Supraspinatus tendon is seen as a beak-shaped structure protruding from under the acromion and attaching to the greater tuberosity.

Abnormal findings: A distance lower than 9mm from acromion to humerus may denote subacromial impingement.[17–19]

Discussion

The present review article presents a standardized shoulder US protocol to try to diagnose the most common subacromial disorders on the Rehabilitation setting. Shoulder pain is one of the most common complaints seen by Rehabilitation specialists.[8] SP is a very disabling condition that leads to work absenteeism.[5] Most of Rehabilitation specialists treat SP based on clinical signs and symptom and on clinical evolution.[8] However, 70% of patients persist symptomatic at 6weeks evolution and 40% at one year after onset of symptoms.[1,5]

There is debate on the utility of US in hands of a Rehabilitation specialist.[2] US is useful in the diagnostic workup of patients and in tailoring treatment to the underlying disorders.[2] As Fernández-Cuadros et al stated, US is an effective technique in diagnosing musculoskeletal disorders, which, in hands of a Rehabilitation specialist constitute a dynamic, accurate, economic and cost-effective tool. Indeed, US in the Rehabilitation setting would provide clinical, anatomical and technical integration to the shoulder evaluation, making the process faster and more efficient.[8]

In Rehabilitation setting, Rehabilitation specialists aim to treat pain and to recover function on an overall view. But, in the case of SP, if the underlying cause is identified by a thorough US evaluation, personalized treatment could be tailored to patient's needs.[1,2,8] In daily practice, combining clinical information to US findings could help to prescribe personalized treatment to SP patients. It is likely that patients will respond best to interventions that address the etiology, affected structures, impairments and relevant biomechanics that are specific to their diagnosis.[2] An standardized protocol of US evaluation is capable to diagnose subacromial disorders accurately.[1,19] Indeed, US is non-invasive, relatively inexpensive and it is capable to produce high-resolution dynamic images of the shoulder.[1]

A thorough evaluation using standardized US protocol, as the one described in our review article, would be capable to describe the most common pathologic conditions that can be seen on daily practice in Rehabilitation setting. Besides, a standardized protocol taking into account anatomical structure, patient position and probe position is highly reproducible.[15] With the help of US evaluation, the examiner should be able to ascertain if tears of the rotator cuff are complete or partial, and even locate them on the acromial or humeral side (Figure 13).

US can ascertain between normal versus diseased bicipital tendon (partial or full tears, tendinosis). Hyperechoic "fluid ring" around tendon may denote tenosynovitis in short axis, whether a "tear sign" may denote tenosynovitis in long axis (Figure 14). US may identify osteophytes in AC joint and joint effusion ("Geyser Sign") if inflammation subsides (Figure 15). Small calcific areas in the tendon can be observed specially when assessed dynamically (Figure 16). US is highly sensitive to diagnose SASD bursitis, especially if fluid on scan image is greater than 2mm distance (Figure 17). Dynamic evaluation is capable to determine biceps tendon subluxation or luxation and subacromial impingement (Figure 18).

Doppler evaluation may help discriminate vascularization on anatomical structures, then synovitis could be confirmed (Figure 19).

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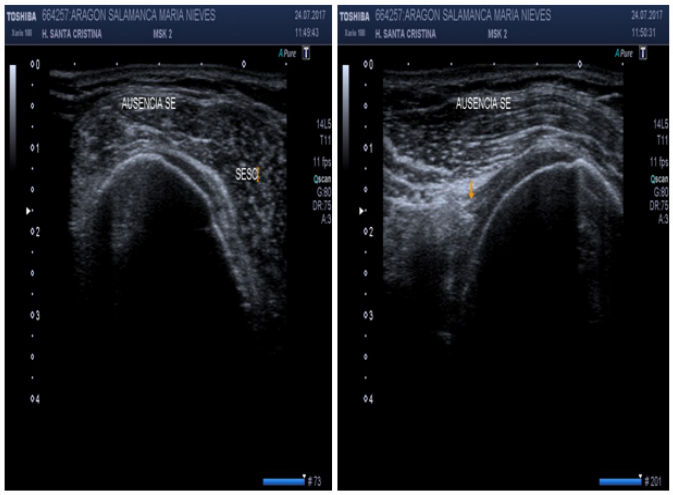

Figure 13 Full-thickness rupture of supraspinatus tendon. Sign of the "flat tire".

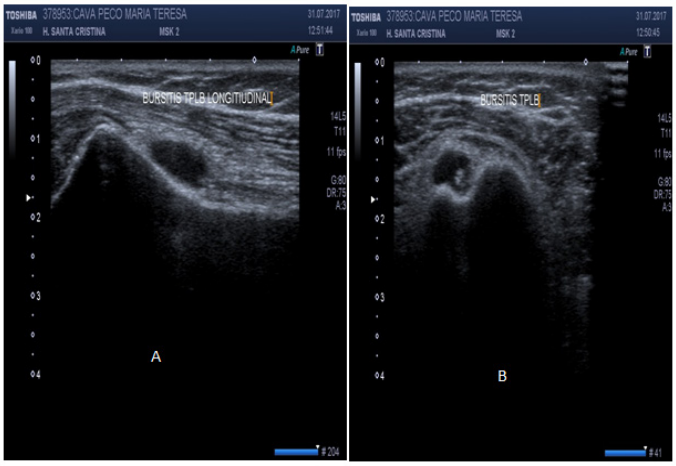

Figure 14 Bursitis of the long head of the biceps in short axis (hyperechoic ring in A) and in long axis (tear sign in B).

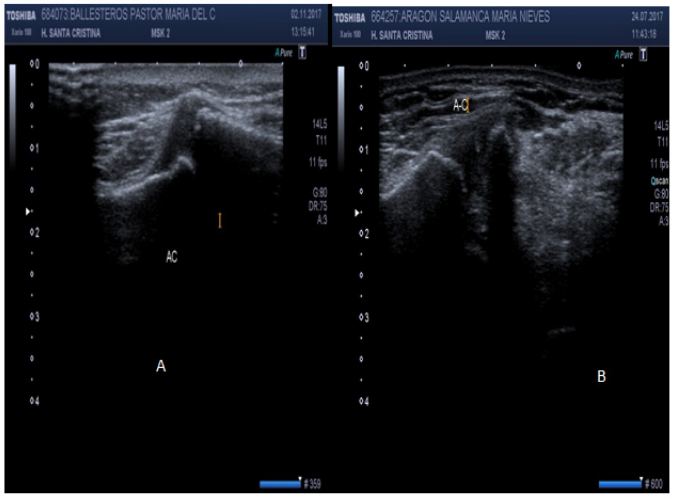

Figure 15 Acromioclavicular hypertrophy (A) and Acromioclavicular arthrosis (B).

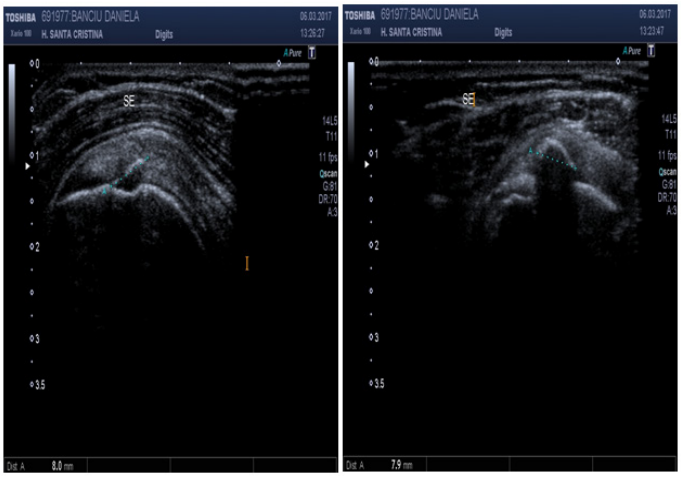

Figure 16 Calcific tendonitis of supraspinatus tendon.

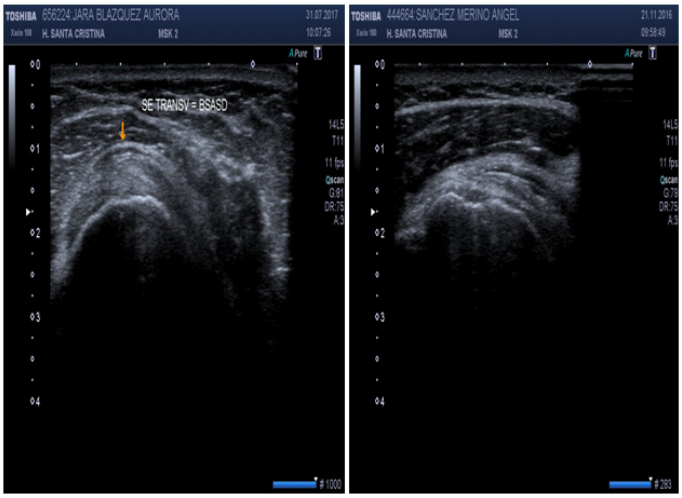

Figure 17 Subacromial subdeltoid bursitis greater than 2mm.

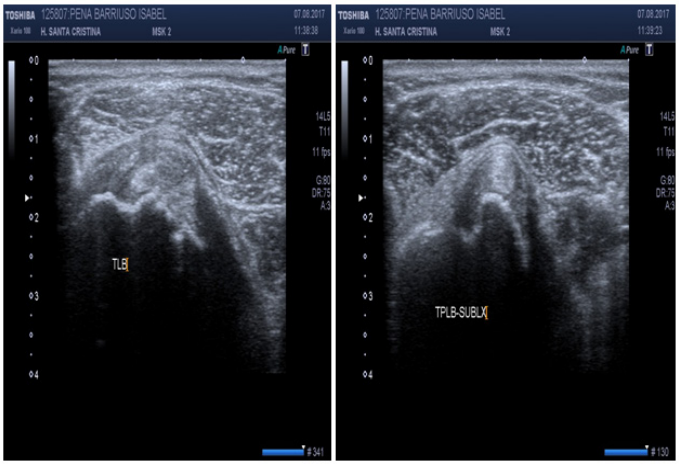

Figure 18 Dynamic evaluation that demonstrates subluxation of biceps tendon after external rotation of shoulder.

Conclusion

Shoulder Pain is one of the most common musculoskeletal disorders observed in the Rehabilitation setting. A standardized US protocol may evaluate in a reproducible manner all of the anatomical

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structures of the shoulder, taking into account anatomical hallmarks, patient´s and probe´s position. US in the hands of a Rehabilitation specialist are an inexpensive, accurate and cost-effective tool capable to evaluate normal and pathological shoulder.

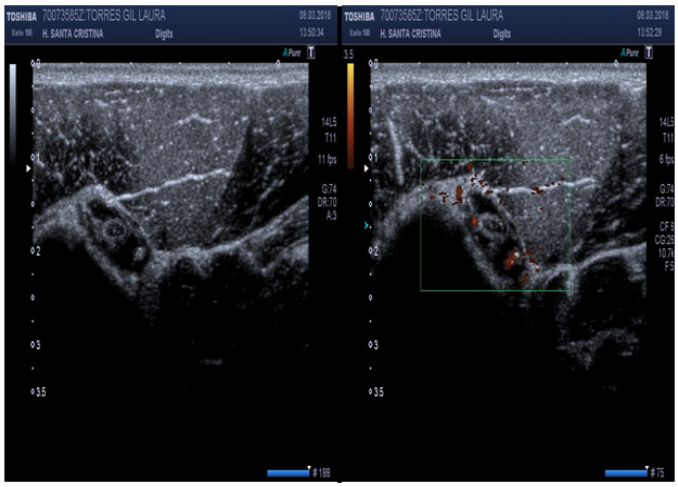

Figure 19 Doppler determines vascularization of biceps tendon, diagnosing tenosynovitis.

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Conflict of interest

The author declares no conflict of interest.

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