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Immediate improvement of pain and mobility in the postoperative stiff shoulder following release of the median nerve at Lacertus: a report of 2 cases

Vincent Martinel, MD[a,*], Nicolas Bonnevialle, MD, PhD[b], Thomas Apard, MD[c]

[a]Polyclinique de l'Ormeau ELSAN, Tarbes 65000, France
[b]Département d'orthopédie Traumatologie CHU de Toulouse, Hôpital Riquet, Toulouse, France
[c]Ultrasound Guided Hand Surgery, Hôpital Privé Les Franciscaines- Ramsey, Versailles, France

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The real cause of frozen shoulder (FS), presenting as a stiff and painful shoulder, is sometimes difficult to determine, especially if it is postoperative.[19,25] Indeed, it is easy to diagnose adhesive capsulitis (AC) or type 1 complex regional pain syndrome (CRPS1) without formal proof. The cause of a stiff and painful shoulder after surgery is usually capsuloligamentous.[24]

Very few authors have evaluated compression of a peripheral nerve of the upper limb, distal from the shoulder girdle, as a possible cause of shoulder pain and stiffness.[12] The physio-pathological hypothesis in these cases is that compression of a distal nerve branch affects the conduction of other proximal nerve branch impulses with a common origin.[7]

We report 2 clinical cases of patients who were treated more than 4 years after shoulder surgery. These patients underwent neurolysis of the median nerve of the elbow by Lacertus fibrosus release, resulting in immediate postoperative pain relief and improvement in shoulder range of motion (ROM).

Case n°1

A 41-year-old, right-handed patient who was a farmer presented with a calcific tendinopathy of the right supraspinatus tendon following unsuccessful conservative treatment (physical therapy, shockwave therapy, and glucocorticoid infiltrations).

In 2017, arthroscopic excision of the calcification was performed, and exploration of the glenohumeral joint was normal (Fig. 1). This intervention, associated with a postoperative physical therapy protocol only, partially relieved the pain and loss of passive and active shoulder ROM.

The patient consulted again 5 years later with permanent, more severe pain, making it impossible to sleep. The diagnosis of a type 2 pectoralis minor syndrome was suggested due to scapulo-thoracic instability, presenting as scapular tilting during anterior flexion and abduction which disappeared when push-up movements were performed standing against a wall. This allowed it to be differentiated from a scapula alata. The patient also had severe pain during coracoid process palpation and anterior forearm numbness despite normal electromyography (EMG) results. Arthroscopic surgery was performed again, with a combined anterior acromioplasty and a pectoralis minor tenotomy. Although there was marked regression of coracoid process pain after surgery, it recurred after 4 months. The patient continued re-education, but his/her shoulder was still painful, day and night.

One year after the second operation, the subjective shoulder value (SSV) was 30%, and the active ROM in the different sectors was Flexion (F) 135°, Type 1 External Rotation (ER1) 30°, Abduction (Abd) 110°, Type 1 Internal Rotation (IR1): S1. Passive ROM was identical due to pain (9/10 on the Visual Analog Scale [VAS]). The patient also reported a loss of thumb-index pinch grip strength, thus proximal compression of the median nerve of the elbow was suspected. The clinical examination showed a positive Hagert's triad (a triad of muscle testing, the scratch collapse test [SCT], and pain).[10] This included a loss of strength of the Flexor Carpi Radialis

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*Corresponding author: Vincent Martinel, MD, Polyclinique de l'Ormeau ELSAN, 28 Bvd du 8 Mai 1945, Tarbes 65000, France.
E-mail address: vmartinel@me.com (V. Martinel).

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Figure 1 (**A**) Preoperative AP X-ray of case 1 showing calcification of the supra spinatus tendon. (**B**) Postoperative AP X-ray; all calcifying deposits have been removed. *AP*, antero-posterior.

Figure 2 Comparison of internal rotation before surgery (*left*) and just after Lacertus release (*right*) in case 1.

(FCR), the Flexor Digitorum Profundis of the index finger (FDP2), and the Extensor Policis Longus, severe pain during palpation 1 cm below the anterior elbow flexion skin crease and a positive SCT at the same place. The SCT was negative at the carpal tunnel, the radial tunnel at Frohse's arch, and at the cubital nerve of the elbow. A diagnosis of Lacertus syndrome (LS) was suggested. Another operation was proposed to release the Lacertus fibrosus by mini-open surgery and to treat the loss of digital strength, in particular.

Measurement of passive ROM of the shoulder was performed immediately before surgery. Surgery was performed under Wide Awake Local Anesthesia No Tourniquet (WALANT), making it possible to immediately confirm recovery of strength in the 3 deficient hand muscles.[11] Immediately after surgery, the patient was asked to test the ROM in the shoulder with the following results: F: 170°, Abd: 150°, ER: 40°, and IR1: T12 (Figs. 2 and 3). The patient described relief and disappearance of tension in the entire shoulder, especially the coracoid process and the VAS was 1/10.

The 5-month postoperative clinical follow-up showed persistent very good thumb-index pinch grip strength as well as an SSV of 80% and regression of approximately 70% of overall shoulder pain compared to the preoperative status (2/10 on the VAS). Active ROM was F: 160°, Abd: 150°, ER1: 30°, and IR1: T10.

Case N°2

A right-handed 43-year-old patient with a stage 2 acromio-clavicular joint sprain after a fall from a horse was treated in another hospital with immobilization then re-education (Fig. 4). Three months after the injury, the shoulder was still very painful and arthroscopic resection of the lateral clavicle was performed in the same establishment (Fig. 5). The postoperative protocol included a splint for 3 weeks, then re-education. The patient rapidly developed severe stiffness and was diagnosed with FS.

More than 4 years after surgery and despite ongoing re-education, the shoulder remained quite stiff and painful (VAS 2/10 at rest and 9/10 during active elevation) and an SSV of 45%. After consulting several orthopedic surgeons, the patient was sent to us for an opinion and management of loss of thumb-index pinch grip strength but no real pain in the hand or elbow. A complete clinical examination showed the presence of all clinical signs of Hagert's

Figure 3 Comparison of preoperative abduction (*left*) and just after Lacertus release (*right*) in case 1.

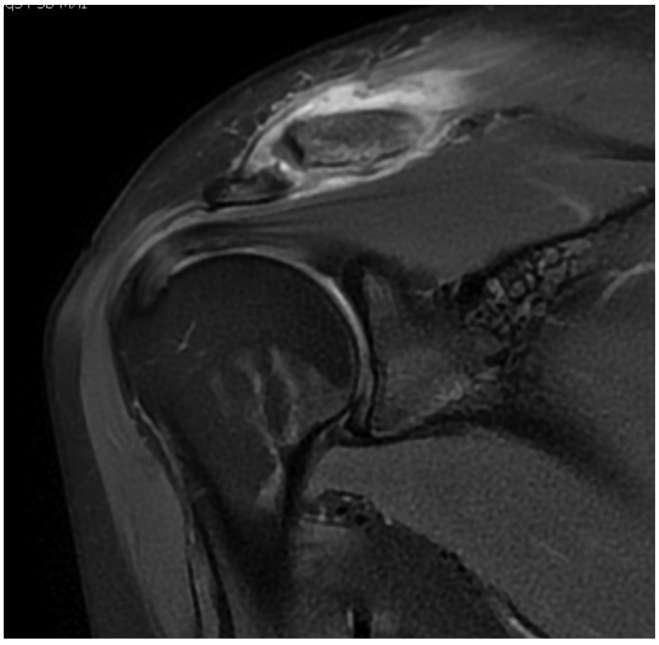

Figure 4 Preoperative DP fat sat MRI of right shoulder 3 months after injury in case 2. *DP*, density of proton; *MRI*, magnetic resonance imagery.

Figure 5 Postoperative AP X-ray in case 2 after arthroscopic lateral clavicle resection. *AP*, antero-posterior.

triad, confirming a diagnosis of LS.[10] Kinesio taping was used to recenter the pronator teres and confirm the diagnosis (Fig. 6). It improved the thumb-index pinch grip strength and decreased FCR weakness. There was also nearly complete recovery of active shoulder ROM: F 170°, ER1 45°, Abd 135°, and IR1 T6 (Figs. 7 and 8). When the Kinesio tape was removed, ROM decreased to F: 110°, ER1: 10°, Abd: 90°, and IR1 L3. Based on the results of the Lacertus antagonist test,[20] ultrasound-guided Lacertus release was performed under WALANT.[3] The patient recovered strength in FCR, FPL, and FDP2 as well as a glenohumeral ROM comparable to levels recorded in the preoperative consultation (the physical therapist who had been managing the patient for 4 years was present during surgery to test shoulder girdle ROM) (Fig. 9). At postoperative month 8, the ROM was maintained with an SSV of 90%. Active ROM was F: 170°, Abd: 150°, ER1: 50°, and IR1: T6.

Video 1 presents details of the history and clinical examination of both cases.

Discussion

It is sometimes difficult to identify the cause of chronic shoulder pain, especially after surgery because there may be several associated causes.[23,25] The terms FS, AC, and CRPS1 should not be considered synonymous.

- FS defines a clinically stiff and painful shoulder.
- CRPS1 may cause shoulder pain and stiffness, and in our opinion, CRPS1 is an etiology of FS.
- The estimated incidence of CRPS1 is between 5 and 25 per 100,000 inhabitants in the general population.[19]
- AC should be considered a separate form of CRPS1 of the shoulder.[9]

Shoulder surgery may result in AC or CRPS1.[19,24] The cause of postoperative loss of passive joint ROM is usually capsuloligamentous. The reported incidence of this event is between 2% and 40%, showing the difficulty of making a definite diagnosis[19] or

Figure 6 Kinesio tape placed on the medial side of the proximal forearm before testing active ROM of the shoulder in case 2. *ROM*, range of motion.

the risk of underestimating 2 other possible causes of FS[25] which are described below. However, severe pain can affect the outcome of a clinical examination, and incorrectly suggests stiffness, resulting in a misdiagnosis of AC.[24]

Arthrogenic muscle inhibition (AMI) may be the cause of pseudo FS, simulating joint stiffness. Although this phenomenon has been well described in the knee,[26] to our knowledge, it has not yet been reported in the shoulder. These patients are sometimes diagnosed with CRPS1 after conventional physical therapy protocols have failed.[5] When a diagnosis of AMI is suspected or confirmed, specific management with neuromotor reprogramming seems to be more beneficial than conventional physical therapy protocols.[8] The aim is to stimulate the action of a muscle or group of muscles ie, delayed, absent, or overactivated. Reprogramming involves the acquisition of proprioceptive sensations, cortical integration, and mentalization of the movement, then finally long-term anchoring of the movement at the subcortical level.

Very few studies have evaluated the incidence of distal peripheral nerve compression as the cause of shoulder pain and stiffness.[12,17] On the other hand, proximal causes (such as C4 and C5 cervical nerve damage) or nearby causes such as the thoracic outlet syndrome are well recognized.[2,23]

Nerve compression below the shoulder is rarely discussed because it is contradictory to the neurological mechanisms that are usually taught. Nevertheless, occasionally, a patient has described relief from old shoulder pain after carpal tunnel release.[18] Hagiwara et al reported their experience on the influence of the Carpal Tunnel Syndrome (CTS) and cubital elbow compression (CuTS) in chronic shoulder pain.[12] They reported a decrease in pain after medical or surgical management, as well as improvement in shoulder joint ROM, in particular F, Abd, and ER.

The proximal forearm is a rare but possible site of median nerve compression.[1,10,16] In 2013, Hagert described a new entity called the LS.[10] The diagnosis is almost always made by clinical examination alone. It is based on a clinical triad associating pain during Lacertus fibrosus/bicipital aponeurosis pressure; loss of strength and fatigue of the FCR, FPL, and FDP2; and a positive SCT just below the elbow flexion crease.[6,13] EMG is nearly always normal which excludes the participation of the CTS or CuTS in the painful shoulder. Like Hagiwara, and in addition to the 2 reported cases here, we have observed improvement or disappearance of shoulder pain following Lacertus fibrosus release surgery on several occasions in other patients. The pain has mainly been anterior, with retrograde neuropathic pain of the coracoid process in certain cases.

In the first case report, we emphasized the clinical presentation before the second operation. In particular, the presence of severe coracoid process pain and signs of nerve irritation that were not confirmed in the EMG suggested a diagnosis of type 2 pectoralis minor syndrome.[2] The transient improvement, then recurrence suggested a double crush syndrome rather than a diagnostic error.[11,27] The Lacertus release performed under WALANT made it possible to confirm the immediate perioperative relief of coracoid process pain (as well as recovery of thumb-index pinch grip strength[4]). One explanation may be found in the experimental model of Decosterd et al suggesting that irritation or a lesion of a peripheral nerve branch can affect the conduction of other nerve branch impulses with common proximal origins.[7]

These 2 cases, and case n°2 in particular, raise the question of recovery of active ROM immediately after surgery. Our hypothesis is that relieving compression of the nerve distal to the elbow could instantly release undiagnosed AMI of the shoulder.

Martinel and Apard described the Lacertus antagonist test using Kinesio tape during the consultation. This is helpful to evaluate whether preoperative thumb-index pinch grip strength is improved after recentering of the pronator teres.[20] In the present patient, the original technique was modified to evaluate the role of the LS in the loss of shoulder ROM. The test was positive, and surgery resulted in permanent improvement in shoulder ROM.

These 2 cases suggest that systematic clinical examination of peripheral nerves is essential in any case of pain and stiffness of the shoulder, even if it is not postoperative.[12,15] This is especially true since imaging studies and peripheral nerve assessment tests were all normal.

The method described by Hagert applies to compression of any nerves in the upper limbs.[1,11] It is easy and rapid to perform. A search for unilateral Sunderland 4 muscular weakness in the target muscles should first be determined (Table I). In case of unilateral weakness, the examination is completed by looking for a painful spot and a positive SCT at the suspected site, mainly the CTS, CuTS, and Lacertus or Supinator Arch.

One limitation could be the difficulty of performing or interpreting an SCT in a patient with severe shoulder pain. In these cases, collapse may be observed with muscles of the lower limbs when the scratch test is performed at different spots of potential nerve compression in the arm, such as those mentioned above for the CTS and CuTS.[14,22] We test the hip abductors in our daily practice: the patient lies on an examination table, with bilateral hip

Figure 7 Comparison of external rotation before (*left*) and just after taping (*right*) in case 2.

Figure 8 Comparison of anterior flexion before (*left*) and just after taping (*right*) in case 2.

abduction. The examiner asks him to resist and prevent his ankles from touching each other (Fig. 10). This is very helpful in daily practice with elderly patients and massive rotator cuff tears.

The simulation test using a Kinesio tape (Lacertus antagonist tape) may also be easily associated with the clinical examination of the shoulder to test ROM and for a visual evaluation of pain in the different sectors of motion. The examiner's hands are freed compared to the manual Lacertus antagonist test.[20] We have integrated this test into our clinical practice and patients can leave the consultation with the Kinesio tape in place. This provides

Figure 9 Immediate postoperative ROM of right shoulder in case 2 performed by physiotherapist who treated patient for 4 years. *ROM*, range of motion.

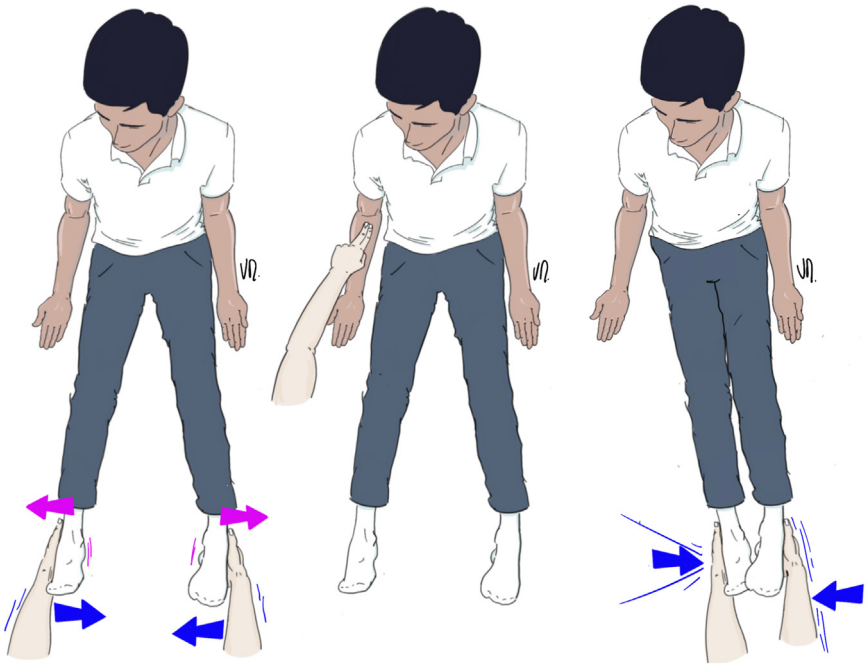

Figure 10 Testing of the hip abductors for an SCT to study the Lacertus. *SCT*, scratch collapse test.

significant clinical improvement, shows the tape placement to the physical therapist, and allows patients to continue functional physical therapy on the median nerve,[21] based on nerve glides and stretching of fascias of the upper limb.

This diagnostic approach based on a clinical examination and little-known clinical tests can help identify the actual cause of an FS. Even if it is usually due to AC, LS or another entrapment syndrome may be identified in certain cases (Fig. 11).

Table I
Combination of tests for muscular weakness to search for and site of the corresponding nerve compression.

A.P.B.	Median nerve at carpal tunnel
F.R.C + F.P.L + F.D.P-2	Median nerve at Lacertus
F.D.P-5 + A.D.M	Ulnar nerve at Elbow
A.D.M	Ulnar nerve at Guyon
E.C.U	Radial nerve at Frohse arcade

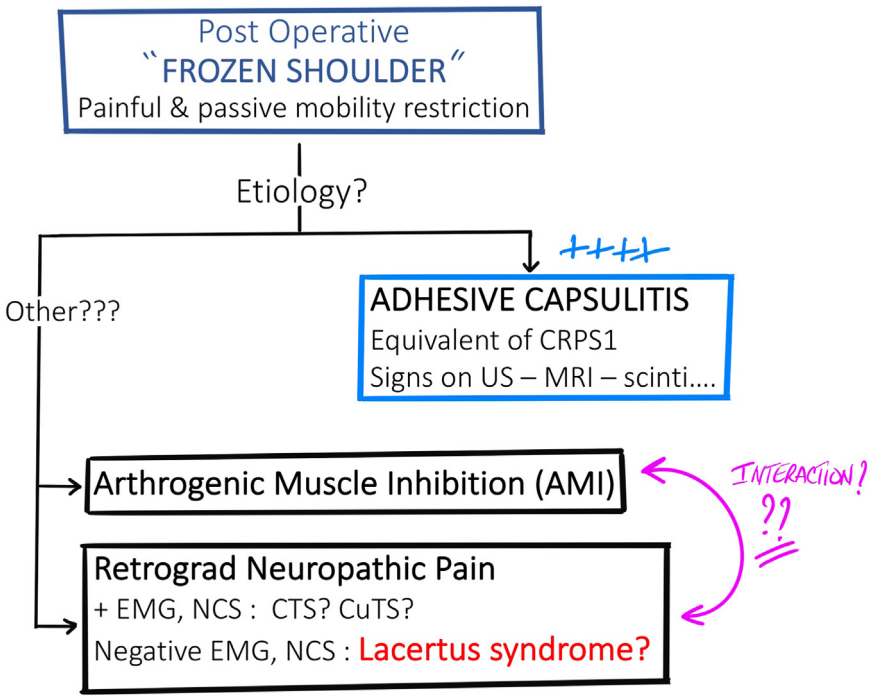

Figure 11 Relationships between frozen shoulder and the diagnoses of adhesive capsulitis, arthrogenic muscle inhibition, and Lacertus syndrome. *EMG*, electromyography; *CTS*, carpal tunnel syndrome; *CuTS*, cubital elbow compression; *NCS*, nerve conductive studies; *US*, ultrasound; *MRI*, magnetic resonance imagery.

Conclusion

Like the CTS and CuTS, the LS may be suspected in case of postoperative shoulder pain and stiffness, based on the concept of retrograde neuropathic pain. The presence of associated neurological signs should not only suggest the participation of the cervical spine or other nearby syndromes.

Besides a clinical examination of the shoulder and the cervical spine, a systematic neurological examination should also be performed based on Hagert's triad. The use of Kinesio tape in the consultation is also extremely helpful if the complementary tests are all normal.

Prospective studies are needed to confirm these 2 clinical cases as well as to evaluate the incidence of the LS and its role in shoulders that remain stiff and painful after surgery.

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Patient consent: Obtained.

Supplementary data

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