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Recent advance

Lacertus syndrome: recent advances

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ABSTRACT

Lacertus syndrome consists in proximal median nerve entrapment with median nerve compression at the lacertus fibrosus, causing hand weakness and fatigue, forearm pain and occasional numbness. Recent advances emphasized the importance of clinical examination, due to limitations in electromyographic diagnosis and delayed diagnosis. The Hagert clinical triad, lacertus notch sign, lacertus antagonist test and taping help accurate diagnosis. Non-operative treatment should be tried; and surgical techniques, whether open or ultrasound-guided under WALANT (wide-awake, local anesthesia, no tourniquet) show promising outcomes. Improved awareness, accurate diagnosis and innovative treatments enhance patient care for this challenging condition.

1. Introduction

Lacertus syndrome (LS) is caused by compression of the median nerve at the lacertus fibrosus, a fibrous band distal to the elbow joint (Fig. 1). It shows a distinct clinical presentation, primarily characterized by loss of hand strength and endurance and forearm pain, alongside occasional numbness in the median nerve territory [1]. The syndrome's hallmark is a diagnostic clinical triad: weakness in muscles innervated distally to the lacertus fibrosus, pain over the point of compression at the lacertus, and positive scratch collapse test [2–4]. The limitations of electrodiagnostic testing and imaging in detecting this specific dynamic nerve compression [5,6] highlight the need for heightened awareness and education among clinicians to make the diagnosis. [4,6].

1.1. Historical perspective and evolution of understanding

Initially, the condition was often grouped under the broader category of pronator syndrome, first described by Henrik Seyffarth in 1951 [7] as compression of the median nerve at the elbow between the two heads of the pronator teres muscle or at the proximal arch of the flexor digitorum superficialis. Later, the specific role of the lacertus fibrosus (LF) in median nerve compression was recognized.

Hagert's introduction of a clinical triad [8] provided a more structured approach to diagnosing LS. Also, the work of Donald Lalonde [9] in promoting the wide-awake local-anesthesia no-tourniquet (WALANT) technique for surgical release of the LF has not only advanced the treatment of LS but also emphasized its distinct nature compared to other compressive neuropathies [10].

1.2. Clinical significance

Studies have highlighted the tendency for LS to be misdiagnosed as carpal tunnel syndrome (CTS), with 32%–49% of patients undergoing unsuccessful carpal tunnel decompression before the

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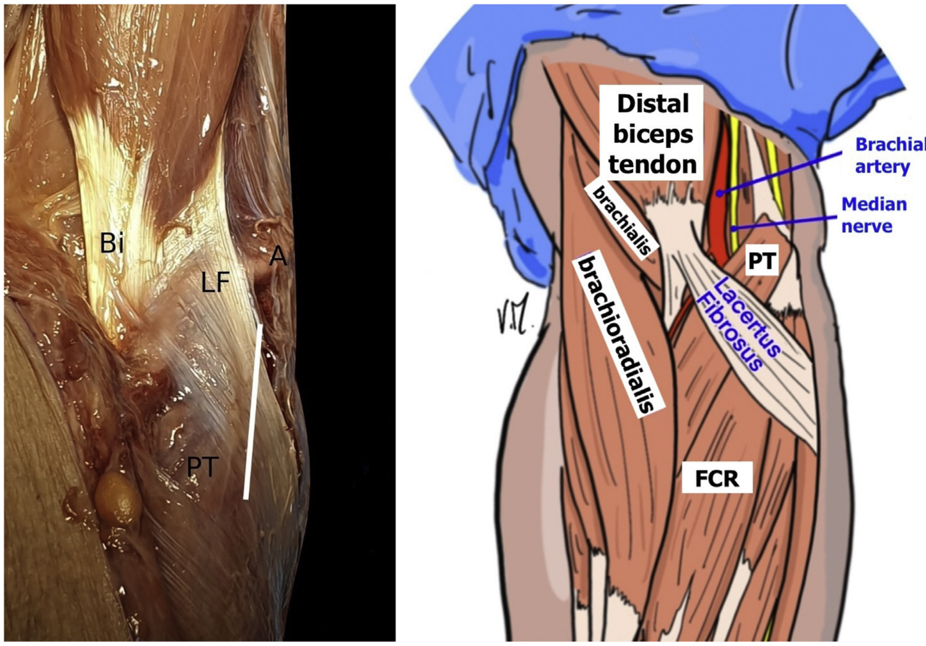

Fig. 1. Anatomy of the lacertus fibrosus (LF) (with permission of T Apard) and drawing (with permission of V Martinel). PT: pronator teres muscle; Bi: distal biceps tendon; LF: lacertus fibrosus; A: brachial artery; FCR: flexor carpi radialis muscle.

correct diagnosis of LS is made [11–14]. This underscores the importance of recognizing LS in patients with persistent forearm pain and median nerve paresthesia following CTS surgery.

1.3. Prevalence and incidence

The incidence and prevalence of LS have been subjects of increasing interest for specialists dealing with hand and upper-limb conditions. A substantial proportion of patients with median neuropathy exhibited double-crush syndrome involving the lacertus fibrosus and the carpal tunnel, with 78% of 320 upper limbs showing this pattern [1]. The same study reported that isolated LS and CTS were present in only 5% and 17% of affected limbs, respectively, indicating that LS as part of a double-crush syndrome [15] is more prevalent than isolated LS [1]. Twenty-six of the patients (12.7%) who underwent isolated lacertus release had prior carpal tunnel release with incomplete resolution of symptoms [1]. This finding suggests that LS may often coexist with CTS or may be misdiagnosed as such, leading to incomplete treatment when only carpal tunnel release is performed.

A retrospective study highlighted the significance of understanding patient demographics, including occupational and recreational activities, to better assess the risk and presence of LS [5]: sport, particularly when involving rigorous forearm and wrist use, such as tennis, golf or weightlifting, but also manual health-work, such as dentistry or surgery, may also predispose individuals to LS [16].

Hagert et al. [1] found no difference according to gender (49.8% female and 50.2% male, in 275 patients) whereas Ahmad et al. [5] reported clear female predominance of 77.4% in 93 patients.

The mean age of patients with LS or related conditions tends to fall within the middle-aged bracket (38–47 years).

2. Diagnosis

2.1. Diagnostic challenges and misdiagnosis

The diagnostic journey for patients with LS is fraught with complexities, primarily due to the clinical presentation that closely mimics other neuropathies, such as CTS [10,17,18]. Like other neuropathies such as CTS [19], peroneal nerve entrapment [20,21], etc., LS often presents with negative nerve conduction and electromyography (EMG) findings, as the mild or dynamic compression of the median nerve at the elbow may not be sufficient to cause axonal injury detectable by these tests [1,5,22,23].

2.2. Clinical presentation and symptoms

Patients commonly report forearm fatigue and pain, which may radiate to the elbow or upper arm, accompanied by numbness in the thenar eminence and/or the 3 lateral digits and lateral half of the 4th. The three most common presenting symptoms were loss of hand strength (95.6%), loss of endurance (hand fatigue) (73.3%), and forearm pain (35.4%) in the series of 388 releases reported by Hagert et al. [1].

According to Tang [11], the term "pronator syndrome" should not be used: lacertus syndrome (LS), superficialis-pronator syndrome (SPS), and Struthers' ligament syndrome (SLS) are all conditions involving compression of the median nerve, but differ in anatomic location and symptom presentation (see comparison with the CTS in Table 1). The present author considers LS much more frequent than SPS, and SLS is very rare. Distinguishing between these syndromes involves careful assessment of onset, specific location of pain, and provocative tests specific to each condition.

Nerve entrapment may cause symptoms proximally, at the shoulder, and distally, in the hand [24], and some cases of shoulder stiffness have been reported after treating LS [25].

2.3. The Hagert clinical triad

The Hagert clinical triad comprises three key components:

1) Manual muscle testing, revealing weakness in specific muscles distal to the nerve compression, notably, for LS, the flexor carpi radialis (FCR), flexor pollicis longus (FPL), and 2nd ray flexor digitorum profundus (FDP-II) [26].

Table 1
Clinical findings in carpal tunnel syndrome, lacertus syndrome and superficialis-pronator syndrome.

Feature	Carpal Tunnel Syndrome	Lacertus Syndrome	Superficialis Pronator Syndrome
Symptoms	Numbness, tingling in fingers	Forearm pain at elbow	Diffuse forearm pain
Sensory	Palmar side of fingers	Possible median nerve distribution	Generalized, less pronounced
Motor	Weakness in APB muscles	FPL, FDP2, FRC muscle weakness	FPL, FDP2-3, FRC muscle weakness
Night Symptoms	Common, worsen at night	Less common at night	Rare
Activities	Effect on Difficulty gripping, manual tasks	Fatigue with elbow flexion, forearm activities, difficulty in pinch	Discomfort with forearm movements
Provocative Tests	Positive Tinel's at wrist, Phalen's test	Elbow flexion, pain on LF	Provoked by pronation, repetitive movements, no pain on LF
Position		Worsens with wrist flexion Worsens in elbow pronation	Triggered by specific forearm activities
Onset Pattern	Gradual, repetitive strain	Abrupt or gradual, activity level dependent	Gradually, activity specific
Associated Features	Swelling sensation	Elbow tenderness	Diffuse forearm tenderness

2) Pain on compression and/or a positive Tinel's sign at the level of nerve compression (Fig.2 illustrates the tripod tips to find the LF).
3) Positive scratch collapse test (SCT) over the lacertus fibrosus.

2.4. The Lacertus Antagonist Test (LAT), taping and lacertus notch

In the lacertus antagonist test (LAT), if FPL and FDP-II strength is restored by compressing the elbow medially, this confirms diagnosis [27]. This maneuver can also be easily reproduced with taping [28].

Lacertus notch, an anatomical contour deformity on the anteromedial aspect of the proximal forearm, is a pivotal physical sign for diagnosis of LS. In a study of 56 patients (112 upper extremities), presence of lacertus notch was significantly associated with LS, with 65.1% of upper extremities with LS exhibiting the notch, compared to 31.0% of those without [29].

2.5. Limitations of EMG

The biomechanical role of the LF in force transmission during elbow flexion, lever arm adjustment and supination restraint could also explain the *dynamic* compression over the median nerve [1]. As a result, electrodiagnostic testing exhibits notable limitations when applied to LS. Used alone, it may not only fail to identify LS but also inadvertently lead to misdiagnosis of other conditions, as seen in cases where pronator syndrome was incorrectly identified as carpal tunnel syndrome, and treated without improvement [30]. Comparative sensitivity and specificity of electrodiagnostic tests for LS have not been not reported.

2.6. The use of ultrasound and other imaging modalities in the diagnostic process

Ultrasound (US) has advantages due to its dynamic comparative assessment capabilities, allowing real-time exploration of the median nerve [31–34]. Konschake et al. [35] described ultrasono-

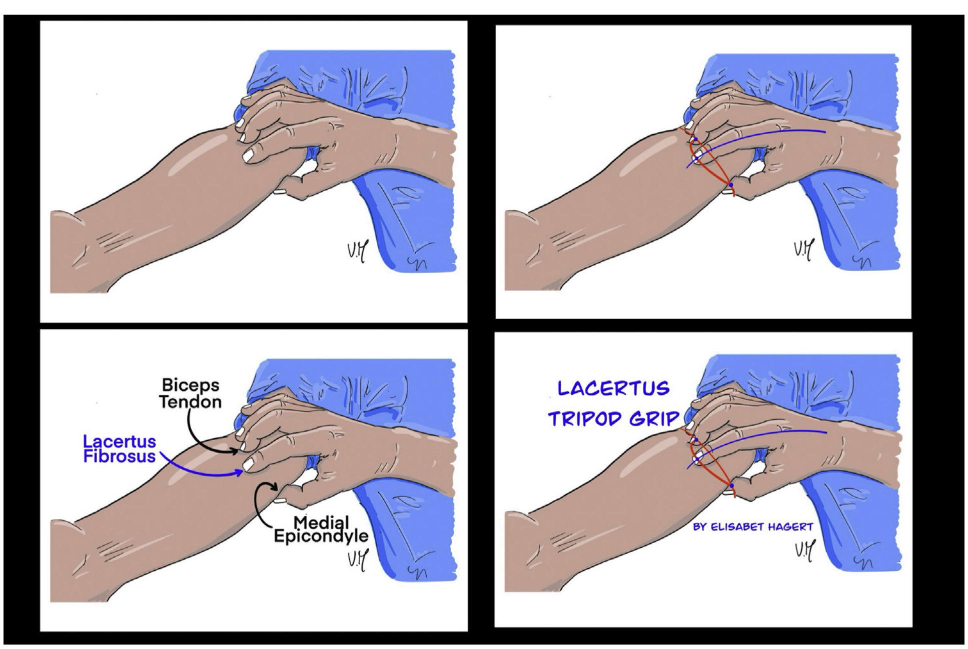

Fig. 2. Tripod grip according to E Hagert (with permission of V. Martinel).

graphic exploration of the bicipital aponeurosis to detect alterations and unusual ruptures and also several pathologies. If there is a median nerve artery, ultrasound can facilitate detection of local nerve compression by assessing compression of the median nerve in pronation against resistance [36].

Magnetic resonance imaging (MRI) provides complementary information, especially in complex cases where soft-tissue differentiation and potentially compressive structures other than the lacertus fibrosus need to be evaluated [37]. As stressed by Tang [11], suspected compression at the two rare sites (SPS and SLS) should be ruled out on ultrasound or MRI, and not by surgical exploration.

3. Treatment

3.1. Conservative management

Patients are advised to modify their activities to reduce repetitive elbow flexion, forearm pronation and forceful gripping, which are known to worsen symptoms [1,5]. In addition, physical therapy techniques with Kinesiotaping, such as nerve gliding, are particularly beneficial, as they help maintain the mobility of the nerve within its sheath, potentially reducing symptoms of nerve entrapment. The use of oral anti-inflammatory medications can also provide symptomatic relief during the initial management phase [1].

The decision to proceed to surgery is based on the patient's response to conservative management, the severity of symptoms, and the impact on quality of life [1,5,38–41].

3.2. Injection procedures for the median nerve at the elbow

Various injection methods have been reported, but efficacy compared to each other or to more traditional conservative or surgical approaches remains unassessed.

Corticosteroids [1,5,6] are recommended as a conservative measure, to confirm diagnosis and for treatment. Ultrasound-guided injections (Fig. 3) are advocated by numerous specialists for targeted delivery around the nerve [42,43] or precisely beneath the LF [44]. Botulinum neurotoxin type-A was assessed in a cohort of 12 patients, with no significant change in pinch strength, but with substantial enhancement of grip strength, two-point discrimination, and scores on both Q-DASH and VAS for pain [45].

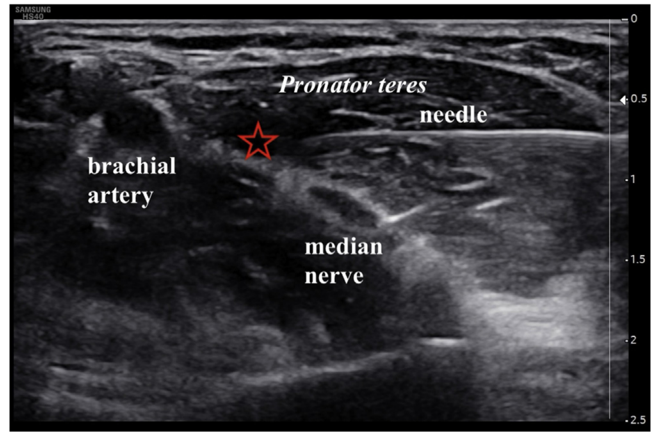

Fig. 3. Corticosteroid injection for lacertus syndrome (with permission of T. Apard).

3.3. Surgical intervention

The open surgical technique for lacertus release is carefully designed to ensure minimal invasiveness while effectively alleviating compression of the median nerve [1,3,42].

The lacertus fibrosus is identified as a thick and shiny white structure, and is carefully released.

The procedure is carried out under local anesthesia, so as to observe the immediate recovery of power in the 3 muscles (FPL, FCR and FDP2) [1–4,8,12], but can also be performed under axillary block or general anesthesia [36,37,46,47].

A recent technical note described microinvasive percutaneous ultrasound-guided release of the lacertus fibrosus under WALANT [44] (Fig. 4).

3.4. Postoperative care and long-term outcomes

Postoperative care includes 3 days' soft circular dressing, with encouragement for immediate unrestricted mobilization restrictions from day 1 after surgery [1,5].

Immediately after surgery, the mean Quick DASH score decreased to 7.8, indicating substantial alleviation of disability and discomfort [5]. This improvement was maintained at 6 months, with a slight but significant increase to 10.6 [5]. Another study reported similar results, with mean Quick DASH scores improving

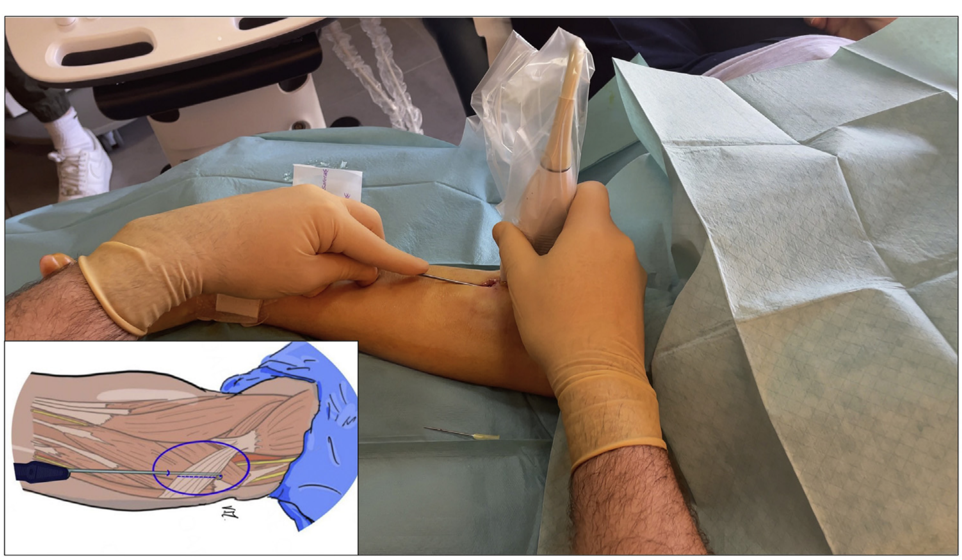

Fig. 4. Percutaneous ultrasound-guided surgery for lacertus syndrome (with permission of T. Apard and V. Martinel).

from 34.4 preoperatively to 12.4 postoperatively, particularly for the occupational and activity subscores [1].

Additionally, there was significant immediate postoperative recovery of grip and pinch strength. Mean grip strength increased from a 16 kg to 24 kg, and pinch strength from 9 kg to 13 kg [5].

88% of patients reported good or excellent satisfaction on VAS, which averaged at 8.5 postoperatively [1].

3.5. Postoperative complications

Complications reported in literature comprise: 6 cases of hematoma [40,41,48], 4 of residual median nerve compression at the superficialis arcade that required revision surgery [1], 3 of hypertrophic scar [40], and 1 complex regional pain syndrome [40].

No infections or neural injury were reported. There were no documented reports of LS recurrence, but rebound may occur, requiring the attention of surgeons, authors and reviewers when reporting outcome of surgery, as the immediate postoperative 'return to normal' without longer-term assessment over months or years may be misleading and inaccurate [49].

4. Conclusion

Management of lacertus syndrome has evolved significantly, with growing understanding of clinical presentation, diagnostic challenges and treatment. However, there remains substantial room for improvement in reporting outcomes, necessitating a multifaceted approach to future research and clinical practice. One promising avenue is the exploration of novel diagnostic techniques.

Conflict of interest

The authors have no conflicts of interest to disclose.

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