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GENERAL REVIEW

Lateral epicondylitis of the elbow: an up-to-date review of management

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Abstract
Lateral epicondylitis, also known as tennis elbow, is an overuse tendinopathy of the common extensor origin of the elbow in patients involved in repetitive movement of the wrist and forearm. Lateral epicondylitis is a self-limiting condition, with operative management only recommended in severe, recalcitrant cases. This article reviews the recent updates on operative and non-operative management of lateral epicondylitis.

Keywords Arthroscopy · ECRB · Lateral epicondylitis · Tennis elbow · Treatment

Overview

Lateral epicondylitis is a common overuse injury due to repetitive eccentric overloading of the origin of the extensor carpi radialis brevis (ECRB) tendon that leads to microtears. It is the most common cause of elbow pain in the general population with an annual incidence of 1–3% [1, 2]. Lateral epicondylitis, also referred to as tennis elbow, is reported to affect 50% of tennis players [3]. However, it also affects those who participate in other racquet-based sports such squash and badminton. Recreational players tend to be affected more frequently than professionals due to their poor swing technique, in particular the backhand stroke.[4].

Pathophysiology

In terms of pathophysiology, lateral epicondylitis is characterized by angiofibroblastic dysplasia which entails histologic features such as granulation tissue formation, microtears, vascular hyperplasia and collagen disorganization [5]. It is notable that inflammatory changes are often absent in lateral epicondylitis; however, it might occur in earlier stages of the disease.

Clinical and radiological evaluation

The diagnosis of lateral epicondylitis is clinical; hence, a thorough clinical evaluation is paramount. Clinical evaluation of lateral epicondylitis often reveals gradual onset of lateral elbow pain. Patients would often report a history of chronic overuse without an antecedent traumatic event. Pain is usually localized in the lateral epicondyle which occasionally radiates to the forearm and typically worsens with activity entailing wrist extension. It is important to inquire about risk factors that would predispose to lateral epicondylitis such as new equipment or changes in workout routine. Furthermore, it is important to inquire about potential improper equipment such as heavy rackets or high string tension. Physical examination often reveals tenderness when palpating the origin of the ECRB at the anterodistal aspect of the lateral epicondyle. Symptoms are often reproduced through provocative tests such as resisted wrist extension especially with forearm pronation. A thorough neurological examination is imperative to rule out other diagnoses such as radial tunnel syndrome.

Imaging is often unnecessary but may assist in confirming the diagnosis of lateral epicondylitis especially when other diagnoses are suspected. Elbow radiographs may reveal

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calcifications in up to 20% [6]. Ultrasonography can reveal thickened ECRB tendon; however, its efficacy is operator dependent. Magnetic resonance imaging (MRI) can demonstrate pathological changes in the ECRB tendon in 90% of cases; however, such findings can also be encountered in asymptomatic elbow. Thus, an MRI is often indicated when several working diagnoses are in mind.

Several differential diagnoses other than LE should be considered when evaluating patients with lateral elbow pain. Radial tunnel syndrome which entails compression of the posterior interosseous nerve (PIN) presents with lateral elbow pain distal to the lateral epicondyle. Radial tunnel syndrome might coexist with LE, and it can be provoked with typical examination techniques such as resisted forearm supination. A useful method to differentiate this condition from LE is through blocking the PIN with a local anesthetic. Another important differential diagnosis for lateral elbow pain is posterolateral elbow instability which can be evaluated with special tests such as the lateral pivot-shift test and the posterior drawer test. Moreover, inflammatory conditions such as inflammation of the anconeus or triceps tendinitis should be excluded. It is also essential to examine the cervical spine and perform a neurological exam to exclude cervical radiculopathy.

Management

Non-operative treatment

The first line of treatment for lateral epicondylitis is non-operative management with a reported success rate of 90% over a period between 12 and 18 months [7]. Non-operative treatment of lateral epicondylitis includes activity modification, physiotherapy, counterforce bracing, acupuncture, non-steroidal anti-inflammatory drugs, corticosteroid injections, platelet-rich plasma, autologous blood injections and extracorporeal shock wave therapy. These interventions generally aim to relieve tendon strain, diminish tendinous irritation, and allow tendon to heal. Up until recently, it was believed that non-operative treatment showed superiority when compared to placebo and therefore, the form of non-operative treatment that carried the least risk was recommended. However, many of the non-operative treatment modalities later proved to significantly improve symptoms of lateral epicondylitis in trials, such as electrophysiotherapy, physical therapy and counterforce bracing [8, 9].

Activity modification

It is essential to the treatment regimen that rest, activity modification and avoidance of painful activities are encouraged in order to relief symptoms. Modifications include improving the backhand technique, reducing time using hammer or tennis racket, and avoiding long periods with elbow statically flexed.

Physiotherapy

A wide range of physiotherapeutic interventions could be used in treating lateral epicondylitis, all of which aim to reduce pain and improve arm function through loading the tendon as close to its limit as possible without surpassing it. Recently, special emphasis has been placed on eccentric exercise strengthening programs as they demonstrated more effective treatment than other forms of physical therapy. In a randomized clinical trial, supervised exercise programs that included eccentric exercise displayed more favorable results compared to deep transverse friction and manipulation (Cyriax physical therapy) [10]. Additionally, Petersen et al. demonstrated eccentric graded exercises to be more effective in reducing pain and increasing muscle strength when compared to concentric graded exercises in chronic lateral epicondylitis in a randomized clinical trial [11]. In fact, eccentric exercises were recommended as part of a multimodal therapy program for improved outcomes in patients with lateral epicondylitis [12]. On the long term, physiotherapy demonstrates better improvements in pain and grip strength when compared to counterforce bracing according to a recent systematic review and meta-analysis [13].

Counterforce bracing

Counterforce bracing is commonly used in treatment and works by relieving tension in the wrist extensors. When compared to placebo, elbow straps and sleeve orthoses both proved to be equally superior for pain relief and grip strength. However, no significant difference is noted between placebo and wrist splints [14].

Acupuncture

While the effectiveness of acupuncture is a major controversial topic in literature, Zhou et al. in a meta-analysis of 10 randomized clinical trials reported superior outcomes of acupuncture in terms of clinical efficacy and pain scores compared to medications and blocking therapy [15]. A recent multi-center international randomized controlled trial by Gadau et al.[16] allocated 96 patients with LE to either acupuncture or sham laser, and they reported better functional outcome and pain scores with acupuncture at 3 weeks post-treatment.

Nonsteroidal anti-inflammatory drugs and corticosteroid injections

Pain control with nonsteroidal anti-inflammatory drugs (NSAIDs) is recommended especially during acute exacerbations. A Cochrane review found that the current evidence is limited to suggest the efficacy of oral over topical NSAIDs. [17]. However, oral NSAIDs resulted in gastrointestinal adverse effects, whereas skin rash can occur with topical NSAIDs.[17]. Corticosteroid injections can be beneficial in acute episodes of pain; however, judicious use of multiple corticosteroid injections is prudent as worsening of clinical outcomes has been reported with their use after 12 months [18]. Expected complications of corticosteroid injections such as muscle wasting and skin discoloration should be emphasized to patients as well.

Platelet-rich plasma and autologous blood injections

Injections of platelet-rich plasma (PRP) and utologous blood Injections (ABI) facilitate healing by providing growth factors directly at the target site. PRP is a non-operative treatment modality for lateral epicondylitis that has gained recent support in the literature. This method uses the patient's own plasma with high concentration of growth factors to promote tissue healing. Several randomized controlled trials have shown that PRP provided significant improvement in pain and disabilities of the arm, shoulder and hand (DASH) scores compared to corticosteroid injections in treating LE [19]. In a recent level I meta-analysis and systematic review, PRP had significant improvement in pain and functional outcomes compared to corticosteroid injections and ABI at a follow-up of 6 months [20].

ABI works through delivering blood cellular and humoral mediators to induce a healing cascade and therefore stimulate regeneration within the tendon [21]. Similar to PRP, ABI was proved to be more effective when compared to corticosteroid injections after 8 weeks in a randomized controlled trial [22]. Moreover, ABI improved pain and function in patients with chronic lateral epicondylitis who demonstrated no improvement from previously administered cortisone injections [23]. While some studies indicated no significant difference between PRP and ABI, other studies have found that PRP was more superior in terms of efficacy, cost efficiency and safety [24, 25].

Extracorporeal shock wave therapy (ESWT)

ESWT is becoming increasingly popular as a non-operative option in the treatment of a variety of musculoskeletal conditions, including lateral epicondylitis. It is employed to relieve pain and functional impairment by promoting tissue healing and exerting an analgesic effect through nerve fibers stimulation [26]. The mechanisms of ESWT for lateral epicondylitis are not completely clear yet. According to a recent meta-analysis and systematic review, ESWT showed better overall safety when compared to other techniques and was even recommended as a conventional noninvasive alternative [27]. Moreover, ESWT showed better long-term results in terms of grip strength and VAS compared to corticosteroid injections in a recent level 1 meta-analysis by Xiong et al. [28].

Operative treatment

Operative treatment of lateral epicondylitis is required when non-operative measures fail over a period ranging from 6 to 12 months. Physicians should refrain from implementing operative treatment if non-operative treatment is inadequately implemented. The basic principle behind the operative treatment of lateral epicondylitis is based on debridement of the ECRB tendon angiofibrotic fibers and to promote healing through drilling of the bone beneath the tendon. The operative treatment can be performed through open, percutaneous and arthroscopic techniques.

Open debridement

Open debridement has been viewed as the gold standard for effective treatment of lateral epicondylitis in the past. It is typically performed through a longitudinal incision made over the ECRB tendon insertion at the lateral epicondyle. According to intra-operative findings, the tendon could be debrided or released. Surgeons might elect to repair the tendon or lengthen it to relieve tension of the tendon. The surgery is completed following drilling of the epicondyle to stimulate healing through blood flow. Surgeons must be cautious of extensive posterior release which might affect the lateral ulnar collateral ligament (LUCL) leading to posterolateral instability. Good long-term outcomes have been reported with different open techniques [29]. Forty years ago, Nirschl introduced a surgical technique that included resection of the pathologic tissue within the ECRB tendon with repair of the remaining normal part of the tendon. A later modification of the technique excluded the need of tendon remnant repair. A recent retrospective study on the modified Nirschl technique by Lee et al. reported satisfactory long-term outcomes with no compromise of wrist extensors power at a mean of 8.5-year follow-up [30].

Arthroscopic debridement

Arthroscopic debridement was first described in 1995 as an alternative to open ECRB tendon debridement [31]. Arthroscopy entails smaller incisions and permits the debridement of the ECRB tendon without damage

to nearby tendons and structures. Therefore, it has the advantage of accelerated rehabilitations, earlier return to certain sports and work and the ability to address and treat intra-articular pathology. Similar to open debridement, a burr is used to achieve decortication of the lateral epicondyle to allow for blood flow and subsequent tendon healing (Fig. 1). Surgeons must also avoid resection of any tissue posterior to the equator of the radial head to avoid iatrogenic damage to the LUCL. Furthermore, arthroscopic debridement proved to be a reliable treatment for recalcitrant lateral epicondylitis as the high success rate post-operatively was maintained in patients at long-term follow-up [31, 32].

When comparing open with arthroscopic debridement for lateral epicondylitis, a significant reduction in infection rate was reported in the arthroscopic arm in several systematic reviews. On the other hand, no difference in post-operative pain and functional outcomes at 12 months, patient satisfaction, overall complication rate, time to return-to-work or revision rates were reported [33, 34]. Clark et al. compared open versus arthroscopic technique in the surgical management through a randomized control trial; they reported no difference in the DASH score, VAS score, PRTEE score, grip strength, or complication rate at 12 months postoperatively [35].

Percutaneous debridement

Percutaneous debridement is another operative treatment with the option of being performed in an office-based setting; however, it might preclude proper treatment through inadequate debridement or inability to reconstruct the ECRB tendon if needed. Therefore, ultrasound-guided percutaneous needle tenotomy (USPNT) has been recently popularized which can be performing in an office-based setting under local anesthesia. USPNT entails a 5-mm incision, and using ultrasonography to identify and tenotomize the pathologic tendon. At one-year follow-up, USPNT was proved to be safe and effective for the treatment of lateral epicondylitis [36]. Moreover, another case series reported continued improvement and maintenance of pain relief and functional improvement at 3-year follow-up[37]. USPNT has been also associated with sonographic improvement indicated by resolution of tendon hypervascularity by 55.6% at 6 months and 94.4% at 36 months[37]. Similar sonographic improvement has been reported by Valero-Garrido et al.[38] following USPNT with reduction in tendon hypervascularity and hypoechoic regions in 83.3% of patients. According to a retrospective review, when the efficacy of USPNT using the Tenex system (Tenex Health Inc., Lake Forest, CA, USA) was assessed in comparison with PRP, both minimally invasive procedures reported similar clinically significant improvements in patients with recalcitrant lateral epicondylitis [39].

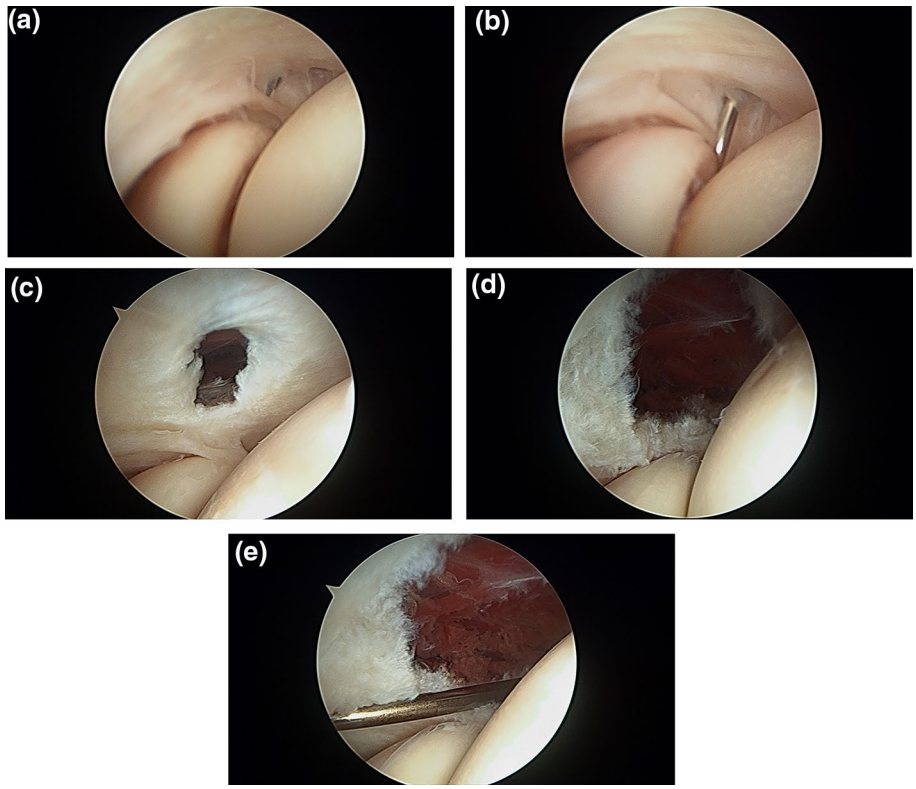

Fig. 1 **a** Arthroscopic view from proximal medial portal of a Type 2 Lesion. A type I lesion appears arthroscopically as a smooth capsule without irregularity. A type II lesion appears as a linear, or longitudinal, tear in the capsule. A type III lesion appears as a complete rupture and retraction of the capsule and the frayed ECRB ten-don, which is visible behind it [40]. **b** Proximal lateral portal identified with a spinal needle. **c** Initial debridement of capsule and viewing ECRL. **d** Debridement of capsule and release of ECRB. **e** Complete release of ECRB and burring of lateral epicondyle. (ECRB = Extensor carpi radialis brevis)

Conclusion

In conclusion, lateral epicondylitis is a self-limiting condition in the vast majority of patients. Non-operative measures are considered the first-line of treatment and should be implemented up to 12 months. Operative treatment is reserved for recalcitrant cases with satisfactory outcomes with most reported techniques.

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