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Review article

Management of lateral epicondylitis

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ABSTRACT

Lateral epicondylitis is the most common cause of lateral elbow pain. Although also known as tennis elbow, lateral epicondylitis often develops as a work-related condition and therefore constitutes a major public health issue. This article reviews the pathophysiological factors involved in lateral epicondylitis, as well as the tools available for establishing the diagnosis and ruling out other causes of lateral elbow pain. Finally, the non-operative and surgical treatment options are discussed in detail.

1. What is it?

Lateral epicondylitis (LE) is widely known as tennis elbow because it affects 50% of tennis players, notably beginners learning the one-handed backhand. Nonetheless, only 10% of all patients with LE play tennis [1]. LE is a public health issue due to its high frequency in manual workers, among whom 10.5% may experience lateral elbow pain and 2.4% have a confirmed diagnosis of LE [2]. The risk of LE is highest in heavy manual labourers and in workers whose job requires repetitive motions or fine motor skills [3]. Degenerative factors also contribute to the development of LE. In a study by Van Leeuwen et al. [4] of magnetic resonance imaging (MRI) scans from 369 patients with no clinical suspicion of LE, MRI signs consistent with LE were visible in 5.7% of individuals in the 18–30 year age group and in 16% of individuals older than 70 years, suggesting a role for degenerative tendon lesions as opposed to local inflammation. In specimens taken during surgery, Kraushaar and Nirschl found a transient inflammatory response in patients with recent-onset LE (stage 1) contrasting at the stage of chronic symptoms with angiofibroblastic hyperplasia characterised by high cell counts, blood vessel hyperplasia, and collagen fibre breakdown (stage 2) [5]. Thus, tendinosis may be a more appropriate term than tendinitis. The lesions may progress to partial- or full-thickness tendon tears (stage 3) then to fibrosis and calcification (stage 4).

Most studies on the initial site of the tendon lesions suggest that LE originates in the extensor carpi radialis brevis (ECRB). Playing tennis, and most notably executing a backhand, places far greater loads on the ECRB tendon than on the other epicondylar tendons [6], as demonstrated by several anatomical studies. Nimura et al., for instance, established from a study of 23 cadaver specimens that the ECRB is in direct contact with the joint capsule over the humeroradial joint line [7]. Thus, the joint loads would seem to be directly transferred to the ECRB. At this site, whereas the other extensors are muscular, the ECRB is tendinous and may therefore be less able to heal after injury [7]. Ando et al. also suggested greater fragility of the ECRB tendon based on their finding that the tendon footprint on the epicondyle was 13 times smaller than that of the extensor carpi radialis longus (ECRL) [8]. Finally, in a cadaver study of changes produced by elbow movements, Bunata et al. observed friction between the deep surface of the ECRB and the capitellum during flexion/extension [9]. By pressing directly on the ECRB, the ECRL may increase friction against the capitellum.

Several more recent studies suggest that LE may be a manifestation of elbow instability. Ando et al. highlighted the close anatomical proximity between the ECRB and the collateral ligaments [8]. An MRI study of 24 elbows classified according to LE severity showed that injuries to the lateral ulnar collateral ligament were significantly more common in the group with severe LE [10]. Kniesel et al. routinely looked for arthroscopic evidence of instability during surgery for refractory LE [11]. Of the 40 patients, 13 had greater than 3 mm of decoaptation in at least one of the elbow compartments and 2 others had more than 6 mm of decoaptation. Arrigoni et al. defined three arthroscopic signs of elbow laxity: anterior-posterior translation, loss of radial head coverage by the annular ligament, and slack radial collateral ligament [12]. Of 35 patients undergoing surgery for LE, 48.6% had at least one of

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these signs, suggesting that failure of the static stabilisers might result in ECRB overloading during dynamic stabilisation.

Alongside these pathophysiological mechanisms, other factors may increase the propensity to develop LE. Thus, low-income individuals may be at higher risk [2,3]. Aben et al. also suggested an at-risk psychological profile characterised by decreased sociability, less contact with co-workers, greater perfectionism, higher levels of anxiety, and lower autonomy [13].

2. Diagnosis - Pitfalls

Pain in the lateral elbow suggests the diagnosis. Radiation towards the distal forearm is common. Many patients complain of a decrease in grip strength impairing both athletic and everyday activities. Point tenderness at the lateral epicondyle is a nearly consistent physical finding, and tenderness of the epicondylar muscle bodies just distal to this point is frequent. Pain upon wrist flexion against resistance should be sought. The Thomsen test is positive if pain at the lateral epicondyle occurs during wrist extension against resistance produced by applying pressure to the dorsum of the third metacarpal. During the test, the shoulder is flexed to 60°, the elbow is extended, the forearm is pronated, and the wrist is extended to 30° [14]. In the chair test described by Gardner, attempting to lift a chair with the forearm pronated and the elbow extended causes pain at the lateral epicondyle [15].

Antero-posterior and lateral radiographs of the elbow should be obtained routinely to look for alternative diagnoses. Calcifications may be visible along the epicondylar tendons. Ultrasonography is the reference standard first-line investigation, as normal findings rule out LE [16]. The tendon may be abnormally thick or thin and may exhibit fissures or calcifications. Power Doppler images may show neovascularisation. Magnetic resonance imaging (MRI) is more reproducible and less operator-dependent compared to ultrasonography but is also more costly [17]. High signal is generated on T2-weighted images at the epicondylar tendon enthesis. Extension of the high signal to the adjacent soft tissues indicates peripheral oedema. The presence and severity of tendon fissures can be assessed by MRI [18]. MRI findings have been deemed helpful for selecting patients for surgery [19], although structural lesion severity may not correlate with symptom severity [20]. MRI provides an evaluation of concomitant lesions, such as synovial folds, which were found in all the patients studied by Kniesel et al. [11]. The lateral collateral ligaments must be routinely assessed [10–12].

The high incidence of LE should not lead to underestimation of the other causes of lateral elbow pain. Absence of pain during manoeuvres that load the ECRB and absence of ultrasonography or MRI abnormalities should suggest a diagnosis other than LE, such as humeroradial osteoarthritis, osteochondritis dissecans, foreign bodies, inflammation of the anconeus, inflammatory joint disease, or radial tunnel syndrome. The symptoms may also originate in a regional abnormality, and the entire upper limb should be examined, with particular attention to the shoulder. The cervical spine should be evaluated also [14].

3. Does lateral epicondylitis (LE) require treatment? What is the natural history of LE?

LE usually resolves spontaneously without treatment within 1–2 years [3,21]. Very few studies have compared outcomes with and without treatment. As a result, whether a favourable outcome should be ascribed to the treatments used or to the natural history of the disorder is unclear. Smidt et al. randomised 185 patients to corticosteroid injections, physiotherapy, or no treatment other than standard analgesics and non-steroidal anti-inflammatory drugs as needed [22]. After 1 year, outcomes were only slightly better in the physiotherapy group than in the wait-and-see group, prompting the authors to suggest that physiotherapy should be reserved for patients who want a rapid effect. In a similar study reported a few years later by Bisset et al., the 1-year outcomes were not better in the corticosteroid and physiotherapy groups than in the wait-and-see group [23]. More recently, a meta-analysis by Sayegh et al. found no convincing evidence that non-operative treatments were better than no treatment [24]. However, no distinction was made across types of non-operative treatment, precluding the identification of potentially effective specific treatment modalities.

Overall, the available data suggest that LE often resolves spontaneously. Therefore, considerable circumspection is in order before embarking on a course of treatment, regardless of the modality chosen. Studies comparing specific types of treatment versus placebo are needed.

4. Principles of physiotherapy for lateral epicondylitis (LE)

Physiotherapy is classically the first-line treatment for LE. Stretching exercises are among the most commonly used, despite a dearth of published data on their efficacy. Thus, the meta-analysis by Bisset et al. did not provide conclusions about the use of stretching exercises [25]. Mobilisation, in contrast, involving joint movements, Mill's manipulation, or regional mobilisation may be beneficial [26]. Eccentric epicondylar muscle strengthening exercises have been recommended by Cullinane et al. based on a literature review that identified two good-quality studies demonstrating benefits compared to patients who did not receive this physiotherapy modality [27]. Deep transverse friction massage is a component of most physiotherapy programmes for LE but was not found helpful in a literature review by Brosseau et al. [28].

Although increasingly used by many physiotherapists, most of the physical modalities used to treat LE have not been proven effective. Thus, no firm evidence exists that shockwave, laser, low-frequency transcutaneous electrical nerve stimulation, ultrasound, or pulsed magnetic wave therapies exert beneficial effects [25,29,30]. On the other hand, proof of inefficacy does not exist either, as the studied protocols varied in terms of dose and frequency of use. Among physical modalities, only low-level [31,32] and high-level [33,34] laser therapy may be effective treatments for LE.

Little or no data are available on the use of orthoses to treat LE. Neither wrist or forearm splints nor forearm strap braces have been proven effective. The few published studies usually compared various splinting methods without using a control group [35–37]. In contrast, taping was recently assessed in a few randomised trials [38–40]. However, these studies are methodologically flawed, included small numbers of patients, and failed to assess medium- and long-term outcomes. Their results are conflicting.

As pointed out in a literature review by Tang et al., acupuncture may provide some benefits in patients with LE [41]. Nonetheless, the level of evidence is low and the available data would not seem to allow definitive conclusions.

5. Local injections

Corticosteroid injection is currently among the most widely used treatments and provides substantial symptom relief for a few weeks. Nevertheless, adverse effects occur in the medium term and, even more so, the long term. The randomised trial by Smidt et al. comparing corticosteroid injection, physiotherapy, and no treatment provided the first evidence of a rebound effect of corticosteroids: outcomes in the corticosteroid group were better after 6 weeks but substantially worse than in the other two groups after

1 year. Similarly, in a more recent study by Olaussen et al., 26-week outcomes were less good after corticosteroid injections than after saline injections or no treatment [42]. Another study suggested that corticosteroid injection might increase the risk of failure of non-operative treatment [43], while Degen et al. reported that having had more than three corticosteroid injections was the strongest predictor of surgical treatment failure [44]. Finally, in comparative studies, corticosteroid injections produced greater short-term effects, but subsequent outcomes were better with platelet-rich plasma (PRP) injections [45–49].

The effects of PRP injections are still under evaluation, and the data remain conflicting. A literature review by Murray et al., which identified six articles, suggests benefits from PRP injections [50]. Another review, by De Vos et al. [51], included the same six articles and a seventh article and surprisingly arrived at the opposite conclusion [52]. A subsequent randomised controlled trial in 156 patients, reported by Lim et al. [53], found that a single PRP injection produced greater pain relief and better Mayo Elbow Performance Score values than did physiotherapy. However, the trial report does not describe the modalities of the physiotherapy programme. Insertion of a needle has been suggested to exert therapeutic effects irrespective of the product that is injected. A randomised trial found better 6-month outcomes after dry needling of the painful epicondylar area than after ibuprofen and forearm bracing [54]. An increase in the local blood supply combined with a healing response may explain these effects. The only reliable evidence about the effects of PRP comes from a randomised double-blind trial in which Mishra et al. compared needling with versus without PRP in 230 patients [55]. The pain scores after 24 weeks were significantly lower in the patients treated with PRP.

Concomitantly with the rapid development of PRP therapy, autologous blood injections have been evaluated as treatments for LE. The data, although less abundant, suggest greater medium- and long-term efficacy compared to corticosteroid injections and similar efficacy compared to PRP [56–59]. Botulinum toxin injections, in contrast, should probably be abandoned as a treatment for LE as the effects are controversial, seem short-lived, and nearly always include incapacitating extensor muscle weakness [60–62].

Developing recommendations about the surgical treatment of LE is challenging. At present, the decision to perform surgery is based more on personal conviction or expert opinion than on scientific evidence. Thus, if the initial physician visit is with a surgeon rather than a non-surgeon, the likelihood of receiving surgical treatment is 12 times higher [43].

Just as the physiological factors involved in LE remain unclear, the mechanisms underlying the benefits of surgery remain unelucidated. The most widely performed procedure is probably excision of the degenerative fibrous tissue as described by Nirschl and Pettrone [63]. Kroslak and Murrell, however, obtained similar outcomes after a sham procedure consisting in a skin incision and ECRB exposure [64].

A meta-analysis by Buchbinder et al. neither supported nor refuted the efficacy of surgery in relieving lateral elbow pain [65]. Only five trials were identified, the sample sizes were small, the interventions were heterogeneous, and the risk of bias was high.

To our knowledge, no study has compared outcomes of surgery versus no treatment, and few have compared outcomes after surgery versus non-operative treatment. In a retrospective study by Ford et al., outcomes were not significantly different after the Nirschl and Pettrone procedure compared to PRP therapy [66]. A more recent comparison by Karaduman et al. found that PRP therapy was more effective than surgery [67]. A randomised trial done by Merolla et al. to compare arthroscopic treatment and PRP injections showed greater improvements in strength, pain, and functional scores after 2 years in the surgical group [68].

Thus, whether surgery can supersede non-operative treatments cannot be determined based on the available evidence. In practice, the identification of risk factors for failure of non-operative treatment may assist in selecting patients to surgery. Risk factors for failed non-operative treatment in a case-control study by Knutsen et al. were older age; obesity; smoking; receiving workers' compensation; radial tunnel syndrome; prior corticosteroid injection, splinting, or orthopaedic surgery; and use of psychoactive medications [69]. However, among these risk factors, older age, obesity, smoking, and prior corticosteroid injections may also predict failure of surgical treatment [44]. Identifying those patients most likely to benefit from surgery is therefore challenging.

The decision to perform surgery is also influenced by the risk of post-operative complications, which may seem unacceptable if the achievement of functional gains is in doubt. In a literature review by Pomerantz, complications occurred in 3.3% of the 3436 patients [70]. The frequency of complications was 4.3% after open surgery, 1.9% after percutaneous surgery, and 1.1% after arthroscopic surgery.

In sum, whether surgical treatments are helpful remains unclear. In practice, however, it is often difficult not to offer a surgical option to patients who are seeking relief, particularly given the abundance of publications supporting a variety of operative techniques [63,71–76]. A reasonable criterion for reimbursement of LE surgery by statutory health insurance systems may be an inadequate response to more than 1 year of non-operative treatment [77]. In studies, however, a delay of 6 months after symptom onset is more often suggested [63,71,78]. With this strategy, 4.0% to 7.2% of patients may be eligible for surgery [63,71]. The main challenge is avoiding unnecessary surgery. An equally important goal, however, consists in releasing patients from the grip of a costly chronic condition that can have devastating social and professional consequences. In every case, patients should be fully informed of all these factors. Given that LE usually resolves spontaneously [3,21,22], the main goal of surgery is to reduce symptom duration, which cannot be predicted in the individual patient. Pain intensity can be expected to diminish significantly 3 months after surgery [79].

6. Which surgical procedure is best?

The open release procedure developed by Boyd and McLeod consists in removing the proximal part of the annular ligament and releasing the epicondylar enthesis [80]. This method was the first to gain widespread acceptance but has since been superseded by excision of the degenerative fibrous tissue at the epicondylar enthesis as described by Nirschl and Pettrone [63]. The bone decortication step of this procedure was gradually abandoned as it does not seem to improve outcomes and may result in greater post-operative pain [81]. Among open procedures, denervation is less well known but has produced promising results [82]. Radiofrequency microtenotomy has been described as an easily performed procedure that may produce similar outcomes to those of conventional open surgery [83–85] and arthroscopic surgery [86].

Baker et al. were the first to report encouraging outcomes after arthroscopic treatment of LE [87]. Subsequently, many publications supported the use of arthroscopy [72,79,88]. Concomitantly, minimally invasive percutaneous methods were developed [74].

Comparative studies have been performed to determine which surgical methods are optimal. Two groups of 34 patients managed by open surgery and arthroscopic surgery, respectively, were compared in a retrospective study by Kim et al. [89]. After 1 year, the open-surgery group had greater grip strength and lower pain scores. In a retrospective study of 59 elbows in 55 patients, Kwon et al. reported significantly but only slightly lower pain intensity during heavy labour after open surgical treatment [75] and, after more than 2 years, no differences were apparent in the Quick-DASH, resting pain intensity, or pain-free grip strength. In another retrospective study, Solhheinm et al. found better Quick-DASH values in 225 patients managed arthroscopically than in 80 patients managed by open surgery but concluded that both methods provided good outcomes [90]. A retrospective review of 87 patients by Peart et al. found that the only significant difference was an earlier return to work after arthroscopic surgery than after open surgery [91]. Szabo et al. evaluated percutaneous treatments in addition to arthroscopy and open surgery and obtained similar results with all three methods regarding the pain score and the Andrews-Carson score [92].

Othman reported a prospective study comparing 14 patients managed arthroscopically and 19 managed with percutaneous tenotomy [76]. Although the DASH, pain score, and satisfaction seemed better with arthroscopy, the differences were not statistically significant. A randomised trial by Dunkow et al. randomly allocated 47 elbows (in 45 patients) to open surgery or percutaneous tenotomy [93]. Recovery was significantly expedited and the return to work occurred 3 weeks earlier in the group treated percutaneously. Finally, Carlier reported an early return to work 3 months after ultrasound-guided percutaneous treatment combined with PRP injection [94].

A literature review by Pierce et al. collated information on 848 open surgery, 578 arthroscopy, and 178 percutaneous cases [95]. DASH values were poorer with percutaneous treatment and pain was more severe with open surgery. Satisfaction, however, was similar in all three groups. Complication rates were also similar, although infection was more common after open surgery.

In sum, there is no evidence to date that any of the surgical methods is superior over the others. Given the absence of studies providing a high level of evidence and the discrepancies among the available data, no specific treatment can be recommended at present.

7. Conclusion

The first-line treatment of LE is appropriate physiotherapy including epicondylar muscle strengthening exercises. Mobilisation, stretching, and deep friction massage can be provided also. No benefits have been demonstrated with shockwave, laser, low-frequency transcutaneous electrical nerve stimulation, ultrasound, or pulsed electromagnetic wave therapies. Among physical modalities, only laser therapy has been shown to improve functional outcomes. Although the factors involved in the development of LE should be eliminated, complete discontinuation of all activities is deleterious and should be avoided.

If this first-line treatment fails, a PRP injection can be given. Corticosteroid injection therapy is always inadvisable.

Patients should be informed that LE usually resolves spontaneously within 1-2 years.

Surgery can be considered in patients who have no response to non-operative treatment, want faster symptom relief, or have very protracted symptoms. The uncertainty regarding the efficacy of surgical procedures should be carefully explained to the patient.

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The authors declare that they have no competing interest.

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Authors' contribution

Hubert LENOIR conceived the study, performed the literature review, collected and interpreted the data, and drafted the manuscript.

Yacine Carlier conceived the study, performed the literature review, collected and interpreted the data, and revised and validated the manuscript.

Olivier Mares collected and interpreted the data.

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