Lateral epicondylitis

A REVIEW OF PATHOLOGY AND MANAGEMENT

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Lateral epicondylitis, or 'tennis elbow', is a common condition that usually affects patients between 35 and 55 years of age. It is generally self-limiting, but in some patients it may continue to cause persistent symptoms, which can be refractory to treatment. This review discusses the mechanism of disease, symptoms and signs, investigations, current management protocols and potential new treatments.

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Lateral epicondylitis was first described in the medical literature by Runge in 1873.[1] Rather than an inflammatory condition, it is a tendinosis (i.e., chronic symptomatic degeneration of the tendon) that affects the common attachment of the tendons of the extensor muscles of the forearm (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi and extensor carpi ulnaris) to the lateral epicondyle of the humerus.[2] In the United Kingdom it affects between 1% and 3% of the population, mainly those aged from 35 to 55 years, with an equal gender distribution.[3] It is generally self-limiting, and most cases require no more than treatment with simple analgesia. For patients with severe or persistent symptoms a number of different treatments are available. Conservative treatment includes physiotherapy and eccentric exercises,[4] shock-wave treatment,[5] laser therapy,[6] acupuncture,[7] topical nitrates,[8] epicondylar elbow straps,[9] and injections of corticosteroid,[10] botulinum toxin,[11] autologous blood[12] or platelet-rich plasma.[13] Numerous surgical techniques have been described for refractory cases,[14-17] including both open and arthroscopic methods, which we will discuss.

Aetiology

In most cases of lateral epicondylitis no obvious underlying cause can be identified.[18] However, any activity that involves overuse of the wrist extensor or supinator muscles may be incriminated. The most commonly affected muscle is the extensor carpi radialis brevis (ECRB), as originally described by Cyriax.[19]

Although popularly associated with tennis, lateral epicondylitis may develop from a variety of activities that involve excessive and repetitive use of the forearm extensors,[18] such as typing, playing the piano and various types of manual work. When affected, any movement that puts force on the extended wrist may be painful, as it increases the load on the diseased common extensor tendon.

Smidt and van der Windt[3] identified several contributory factors related to sport and occupation, the avoidance of which may help to relieve symptoms. These authors highlighted that racquet sports may cause the condition due to a combination of factors: 1) incorrect technique (snapping the wrist in a backhand play, incorrect positioning of the feet, and hitting the ball late or with a bent elbow all result in power generation from the forearm extensors rather than core muscles or the rotator cuff); 2) extended duration of play; 3) frequency of play; 4) size of the racquet handle (affecting the lever arm of the force applied through the forearm); and 5) racquet weight.[3]

Work-related lateral epicondylitis may be linked to handling tools heavier than 1 kg, loads heavier than 20 kg more than ten times per day, and repetitive movements for more than two hours.[20]

Pathogenesis

Lateral epicondylitis was previously considered to be a tendinitis, arising as inflammation of the tendon.[21,22] However, it has been shown histopathologically to have a paucity of inflammatory cells such as macrophages and neutrophils.[23,24] The condition is therefore now considered to be a tendinosis, which is defined as a degenerative process.

The application of stress to a tendon normally leads to increased cross-linkage and collagen deposition.[25] When the rate of stretching exceeds the tolerance of the tendon a

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micro-tear results, and the adaptation of the tendon to multiple micro-tears leads to tendinosis. There are several well-defined histological stages that result from such repetitive microtrauma.[25]

Stage 1: There is initially an acute inflammatory response, which can sometimes resolve completely during which time patients may seek medical help.

Stage 2: If the insult is sustained, a concentration of fibroblasts, vascular hyperplasia and disorganised collagen, known collectively as angiofibroblastic hyperplasia, can be seen histologically. There is hypercellularity in both an organised and disorganised fashion in relation to muscle fibre orientation. These factors combine to result in tendinosis. This is the most common stage at which patients present themselves for treatment.

Stage 3: Continuous accumulation of pathological changes leads to structural failure of the tendon, with partial or complete rupture.

Stage 4: The tendon exhibits features of a stage 2 or 3 injury, with other associated changes such as fibrosis, soft-matrix calcification within the disorganised loose collagen, and hard osseous calcification.

Although degeneration is considered to be a major cause of tendinosis recent studies have suggested other causes. 'Under-use' or stress shielding, where certain sections of the tendon regularly experience a lower than usual amount of load, may lead to structural weakening of the tendon, making it more susceptible to injury.[26] Histopathological studies of the extensor carpi radialis brevis (ECRB) in patients with long-standing lateral epicondylitis have shown defects and necrosis within fibres as well as signs of muscle fibre regeneration. It is thought that these defects result from underuse of the muscle due to pain-related inhibition or fear of pain.[27] Shearing forces, as opposed to tensile forces, lead to a progressively fibrocartilaginous composition of the ECRB enthesis. As a result, this forms a weaker junction with the bone and it has been hypothesised that this initiates development of tendinosis.[27]

Tendons have a limited blood supply when compared with muscle,[28] and are susceptible to injury when muscles remain contracted for long periods, effectively rendering the tendon avascular. This leads to the generation of destructive free radicals on reperfusion. Tendons undergoing repetitive use may experience a rise in temperature of up to 10%, which can lead to hyperthermic injuries. Another theory is that injury to the tendon activates protein kinases, which lead to apoptosis.[29] Further theories are still being investigated, which include altered gene expression and an imbalance of matrix metalloproteinases and growth factors.[30] A greater understanding of these mechanisms has the potential for guiding future interventions.

Although it is known that the structure of the affected tendon in lateral epicondylitis is degenerate with multiple micro-tears, in itself that is not sufficient to explain the variability in patients' symptoms. The cause of pain in lateral epicondylitis is thought to be due in part to an increased concentration of neurotransmitters such as glutamate, which sensitise the pain response, and to direct irritation from chemicals such as lactate, which have been found to be increased in tendinopathy.[31]

Both of these mechanisms can lead to a cascade of changes in neurons in the peripheral nervous system that ultimately leads to sensitisation of the central nervous system. This may be the explanation for why patients with lateral epicondylitis can present with pain in neurological regions distant to the site of injury. It has been reported that 56% of patients with lateral epicondylitis have associated pain in the neck.[27] However, neck and shoulder pain could be due to the overuse of or change in biomechanics as a result of the elbow pain.[32]

Clinical features

Patients most often complain of pain at or around the bony prominence of the lateral epicondyle that often radiates down the forearm in line with the common extensor muscle mass and occasionally proximally into the upper arm. This pain is usually triggered or exacerbated by contraction of the common extensor mass in response to a variety of activities. The intensity of the pain can range from intermittent and mild to constant and severe, affecting all daily activities, and even occur at night causing a disturbance in sleep.

Examination is unlikely to reveal obvious abnormalities on inspection alone. This is except in patients with long-standing disease or who have had previous corticosteroid injections, where there may be prominence of the bony epicondyle as a result of muscle wasting or of partial or complete rupture of the extensor tendon at its attachment. In addition there may be depigmentation or thinning of the overlying skin as a result of corticosteroid injection.

Tenderness is typically found on palpation at the site of insertion of the ECRB tendon, which is just anterior to the anterior border of the lateral epicondyle. However, not uncommonly the tenderness is more diffuse, centred around the lateral epicondyle, with a point of tenderness at the bony prominence itself.

Usually a full range of active and passive movement is maintained at the elbow with, in more severe cases, pain at the limit of elbow extension when the forearm is fully pronated. A number of tests have been described that reproduce this pain. Resisted middle finger extension can be painful owing to selective recruitment of the ECRB tendon (Maudsley's test)[33]; resisted wrist extension with the elbow fully extended and in pronation stresses the whole of the common extensor origin and can recreate the pain in mild to moderate cases.[34] The classic 'chair test' – asking the patient to lift a chair with the forearm pronated – makes use of this position.[35] Diminished grip strength has also been described as a diagnostic test for lateral epicondylitis.[18]

Differential diagnosis. Accurate diagnosis of lateral epicondylitis may be difficult as there are a number of other conditions with similar clinical features. A Finnish study[18] found that the true incidence of lateral epicondylitis was variable depending on the criteria used to confirm the diagnosis. They found it to be definitely present in 1.3% of the population between the ages of 30 and 65 years, and probably present in a further 2.98%.

Other conditions that should be considered include:

1. Cervical radiculopathy with pain in the elbow and forearm.[36]

2. Elbow overuse as a compensatory mechanism for ipsilateral frozen shoulder. The elbow is likely to continue to be painful despite local treatment until the shoulder pathology is addressed.[37]

3. Entrapment of the posterior interosseous nerve (PIN). Although PIN lacks a sensory component, entrapment in the lateral aspect of the forearm can result in neuropathic pain that masquerades as lateral epicondylitis.[38] However, this condition, also known as radial tunnel syndrome, does not cause increased pain with resisted wrist extension. Pain may be provoked by resisted forearm supination as the supinator muscle is one of the areas of compression of this nerve. An injection of local anaesthetic to the region of the PIN may relieve the pain, although care must be taken not to allow the anaesthetic to spread to the lateral epicondyle.[39]

4. Degenerative changes at the radiocapitellar joint and osteochondritis dissecans may also produce pain around that region. A study of 117 elbow arthroscopies of patients with lateral elbow pain found degenerative changes of the adjacent articular cartilage in 59%.[40]

5. Inflammation and oedema of the anconeus. A small study of patients with lateral epicondylitis found the anconeus to have high signal intensity on MRI suggestive of oedema and granulation tissue.[41] Fasciotomy for chronically raised compartment pressure in the anconeus that was related to exercise was associated with resolution of symptoms in the lateral elbow region.[42]

5. Infection[43] and inflammatory or degenerative arthritis[44] may also give rise to clinical signs mimicking lateral epicondylitis.

Investigations

In most cases a diagnosis of lateral epicondylitis can be made clinically. However, where the diagnosis is less clear, further investigations may be required. Haematological tests looking for raised inflammatory and other autoimmune markers may be considered if there is any concern about an infective cause or an associated inflammatory arthropathy.

Plain elbow radiographs can be helpful to exclude bony pathologies, including loose bodies, osteoarthritis and osteochondritis dissecans. In some cases patchy calcification in the overlying soft tissue may be seen on plain radiographs at the attachment of the common extensor tendon.

Ultrasound imaging can be useful by identifying structural changes in the affected tendons, including thickening or thinning, hypoechogenic foci indicating intra-substance degenerative areas, tendon tears, calcification, bony irregularity or calcific deposits. Doppler ultrasound is able to detect neovascularisation. The absence of this and of grey-scale changes have been shown to rule out lateral epicondylitis.[45]

MRI is a more reproducible form of imaging than ultrasound and can demonstrate other intra-articular pathology as well as reducing intra-operator variability.[46] An MR scan can confirm the presence of degenerative tissue and tears within the tendon and underlying capsule. Interestingly, positive findings on MRI have been shown to correlate poorly with patients' symptoms in a blinded study[47] which showed that the length of separation within the ECRB tendon was not related to the severity of symptoms. Another study compared CT arthrography with MRI to identify capsular tears on the deep surface of ECRB using arthroscopic findings as a reference. The study found CT arthrography to be more sensitive than MRI in identifying capsular tears (85% CT arthrograms correct compared with 64.5% for MRI).[48]

Electromyography can be used to help exclude PIN entrapment. Additionally, a local anaesthetic injection into the supinator muscle, just distal to the radial head, will relieve the pain associated with PIN entrapment and help differentiate it from lateral epicondylitis.

It is important to remember that the presence of an abnormality on various imaging modalities should not be used as a substitute for clinical judgement. Imaging abnormalities do not necessarily correlate with clinical symptoms, as they may represent incidental asymptomatic findings.

Treatment

Principles of treatment. The aims of treatment for lateral epicondylitis include: 1) control of pain; 2) preservation of movement; 3) improvement in grip strength and endurance; 4) return to normal function; and 5) control of further histological and clinical deterioration.

Non-operative treatment. Rest, avoidance of aggravating activities and modification of behaviour usually lead to a remission in symptoms. Bisset et al[29] have shown that at 52 weeks conservative management has similar or only slightly inferior outcomes to corticosteroid injections.

Physiotherapy. Bisset et al[50] were able to demonstrate the value of physiotherapy in reducing pain in patients with lateral epicondylitis by focusing on maintaining range of movement, as well as eccentric strengthening exercises. These measures were found to be superior to conservative management at six weeks.

Other studies show good outcomes following stretching and strengthening exercises,[4,51] although no definite regime has been proven to be superior to others.

Rehabilitation of the elbow requires proximal stability at the shoulder. This is achieved by strengthening and stabilising the scapula. The focus should initially be on the lower trapezius and serratus anterior muscles, beginning with simple open chain exercises followed by closed chain exercises, which will then also recruit the rotator cuff muscles.[52,53]

Bracing. Epicondylar counterforce braces work by reducing the level of tension in the forearm extensors. Several studies have shown that elbow straps, clasps or sleeve orthoses have superior results in terms of relief of pain and grip strength compared with a placebo orthosis or wrist splints.[9] However, a meta-analysis did not find one type of brace to be better than the others.[50]

Wrist splints have also been used. A randomised controlled study[54] compared wrist extension splints with forearm straps and found equal efficacy when measured using the American Shoulder and Elbow Society (ASES)[55] and Mayo Elbow Performance[56] scores, and showed that the pain component of the ASES score was significantly better in the wrist splint group.

Anti-inflammatory medications. Non-steroidal anti-inflammatory drugs (NSAIDs) may improve short-term function. A study showed diclofenac to be superior to placebo in relieving pain,[10] but naproxen had similar outcomes to the placebo.

Local injection of corticosteroids is a commonly used treatment in both primary and secondary care. The exact mechanism of action in a tendinopathic condition such as lateral epicondylitis is poorly understood, as the effects of corticosteroid are predominantly anti-inflammatory. Corticosteroids have been found to be superior to NSAIDs at four weeks, but no long-term differences were noted between steroid injections and NSAID treatment.[10]

Injections may be administered using a single-injection technique or peppered injections into multiple areas of the tendon. This is thought to stimulate local blood flow: a randomised trial[57] compared single *versus* peppered injections of corticosteroids and found slightly better improvements in the peppered injection group in terms of Disabilities of the Arm, Shoulder and Hand (DASH) score,[58] visual analogue scale (VAS) for pain and grip strength. However, corticosteroids have been associated with local skin atrophy, depigmentation and muscle wasting, resulting in an increase in the bony prominence of the lateral epicondyle.[59]

Surgery. Surgery is reserved for patients who fail to respond to non-operative treatments. Open, percutaneous and arthroscopic approaches have been described.

Multiple variations on an open technique have been described.[60-63] A standard longitudinal incision is made over the lateral epicondyle and dissection is then deepened to expose the common extensor origin. Division of the common extensor origin and varying releases or excision of the orbicular ligament or the tendinotic tissue from the ECRB have been described: some authors have left the tendon divided,[64] whereas others have described various types of lengthening or repair.[17] Other authors have included decortication or drilling of the epicondyle to stimulate healing.[65]

In 1955, Bosworth[64] reported on the long-term follow-up of several different surgical procedures, and found that resection of the orbicular ligament and division of the common origin of the extensor muscles of the forearm brought significant relief of symptoms with no instability. Nirschl and Pettrone[65] reported prospectively on 88 operations where they excised the tendinotic tissue within the ECRB, decorticated or drilled the lateral epicondyle, and then performed an anatomical repair of the extensor carpi radialis longus (ECRL) and extensor digitorum communis (EDC). They found that 97.7% of patients improved following this procedure.

There is no clear evidence to support the decortication of the lateral epicondyle,[66] and many authors advocate a simple extensor tendon release as described by Spencer and Herndon.[14] Calvert et al[15] described a simple lateral release in which the common extensor origin is divided next to the lateral epicondyle and the ECRL is separated. They reported the prospective results on 42 elbows undergoing this procedure and found that satisfactory pain relief was obtained in 80% of patients. Verhaar et al[16] prospectively evaluated the lateral release of the common extensor origin in 63 patients and at five years they found good to excellent results in 89% of cases.

A recent retrospective study[17] reviewed the outcome of the Garden procedure.[67] In this technique, a small incision is made over the dorsolateral forearm at a short distance proximal to the abductor pollicis and the extensor pollicis brevis. The ECRL is retracted and the ECRB is divided by a step-cut, lengthened by 1 cm and repaired. Kumar et al[17] reported good to excellent results in 78% of patients using this technique.

There is no consensus regarding the optimal open surgical technique. The benefits of open release are that it allows careful inspection of the under-surface of the ECRB, which can reveal tears, and allows careful separation of the ECRL from the anterior surface of the extensor aponeurosis, allowing for anatomical repair. The disadvantage is that excessive debridement may compromise lateral stability.

In 1982 Baumgard and Schwartz[68] described a percutaneous release, which can be undertaken using local anaesthetic. The wrist is flexed and the forearm pronated to put the common extensor tendon under maximal tension. A stab incision with a scalpel blade is then used to release the ECRB. They reported on 34 elbows treated with a percutaneous release, and at the three-year follow-up 91% had complete relief of symptoms.[68]

An arthroscopic technique was first described by Grifka, Boenke and Krämer[69] in 1995. The method involves a 'soft spot' posterior lateral portal, an anteromedial viewing portal and an anterolateral working portal. Baker and Baker[70] reported prospectively on 42 elbows in 40 patients who underwent arthroscopic debridement, with a satisfaction rate of 87% at a mean follow-up of 130 months. The potential advantages of an arthroscopic approach are that it can diagnose and treat concomitant intra-articular pathology; it also potentially minimises damage to healthy tissue, and allows visualisation of the under-surface of the ECRB tendon. However, an arthroscopic procedure is more likely to take longer than an open operation, and associated with the potential risk of damage to the radial nerve.[71,72]

Patients are usually discharged on the same day as their open and arthroscopic surgery, and are prescribed a rehabilitation programme involving eccentric strengthening exercises. They are advised to avoid the offending activity for a minimum of three months, and to return to work within four to 12 weeks (if a manual worker). Desk workers can return to work immediately but will still require modified duties to enable them to recover properly.

Although surgery has a good outcome in most patients, the associated risks, such as infection, haematoma and nerve injury,[72] and the not infrequent clinical failures have led to the exploration of alternative treatment methods.

Alternative methods of treatment

Percutaneous radiofrequency thermal lesioning. This involves using a radiofrequency electrode to perform a micro-tenotomy and remove pathological tissue. It may be performed under ultrasound guidance to improve accuracy and is sometimes considered a form of surgery, with the advantage of not requiring a formal incision.[73] Lin et al[73] treated 34 patients with persistent lateral epicondylitis using percutaneous radiofrequency ablation and found that 85% had a significant reduction in pain. They did not find a reduction in the thickness of the origin of the tendon on ultrasound.

Extracorporeal shock wave (ECSW) therapy. This method involves sound waves directed at specific frequencies on to the affected area of the tendon by the application of a generator to the overlying skin. The mechanism of action is not fully known. A Cochrane review[5] analysed nine studies of > 1000 patients with lateral epicondylitis treated with ECSW. Although five studies showed that there was some benefit of shock-wave therapy over sham therapy, it was not possible to demonstrate an overall statistically significant benefit. The National Institute for Clinical Excellence (NICE) has updated its guidelines to reflect this, but advises further research into the method.[74]

Laser therapy. Low-level laser therapy works on the principle that lasers are able to stimulate collagen production within tendons. It was previously felt that laser therapy had little or no clinical benefit in tendon disorders, but a recent systematic review[6] indicated that laser therapy could be clinically beneficial in the short term if an optimal dose and wavelength are used.

Acupuncture. Acupuncture has been shown to have short-term clinical benefits. In a systematic review, Trinh et al[7] found pain reduction at two to eight weeks after the treatment. However, the long-term benefits are still unclear.

Botulinum toxin. Botulinum toxin affects the neuromuscular junction by reducing resting muscle tone. By effectively reducing the resting tension at the ECRB insertion it may potentially reduce pain. Wong et al[11] showed that injection of botulinum toxin into the ECRB reduced pain in patients at four to 12 weeks. However, the sample size of 60 patients was relatively small and composed mainly of women. Several patients experienced side effects, such as weakness of finger extension. Hayton et al[75] found no significant difference in a randomised controlled trial (RCT) comparing botulinum toxin injection with saline injection. The differences in the findings of these two RCTs may be related to the technique, dose and operator experience. At present there is no consensus on the use of botulinum toxin in lateral epicondylitis.

Topical nitrates. A study has shown that topical nitrates are effective in the reduction of pain in lateral epicondylitis.[8] The nitrates are thought to stimulate collagen production through an increase in local blood flow and so promoting healing of the ECRB tendon.

Autologous blood injection. Autologous blood injections are thought to work by initiating an inflammatory response and delivering nutrients and components necessary to promote the healing process. Often several passes of the needle into the tendon are used to help stimulate the inflammatory response and to distribute the blood more evenly. Several small studies have reported a significant reduction of pain in patients with lateral epicondylitis.[76,77] Kazemi et al[12] performed an RCT comparing autologous blood injection with corticosteroid injection and showed that the outcome of the autologous blood injections at four and eight weeks were superior to those of corticosteroid injection. However, the studies performed so far have only been conducted on a small scale and so it is not possible to draw firm conclusions. NICE guidance[78] notes that there are some studies suggesting that this treatment may be useful where other forms of treatment have failed, but should only be performed with the patient's understanding that this is not yet a routinely recommended treatment with no long-term data supporting its use.

Platelet-rich plasma. Platelet-rich plasma (PRP) is a concentrate of platelets derived from the patient's own blood and is known to contain a high content of growth factors that have the potential to enhance the healing process of the tendon.[13,79] A blood sample is taken and centrifuged to extract the plasma content, and the blood is then re-injected around the lateral epicondyle. A number of RCTs have shown that PRP is superior to autologous blood and bupivacaine injections.[80,81] However, the number of studies is small, and there is a great variation in the way that different commercial systems prepare and activate the PRP, and so it is difficult to draw clear conclusions on the efficacy of PRP.

Persistent symptoms

Despite exhaustive non-operative management and adequate surgical intervention there is a small group of patients who continue to experience significant symptoms, usually in the form of pain. Faced with these patients, it is important to consider the possibility of a wrong initial diagnosis or of an associated pathology.

Conclusions

In conclusion, lateral epicondylitis is generally a self-limiting condition with a natural history of between ten and

18 months. In the vast majority of patients the condition will eventually resolve, and symptoms are usually adequately controlled by activity modification, physiotherapy and non-operative measures.

Numerous non-operative treatments have been described, none of which have been sufficiently successful to support a general recommendation. Surgical intervention may be indicated in refractory cases using various techniques, none of which has been universally successful. New forms of treatment, such as stem cell therapy,[82] are in the early stages and show much promise.

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