INTRODUCTION

Lateral epicondylopathy, or tennis elbow is a common cause of lateral elbow pain in the general population and in athletes, with a reported prevalence as high as 3.5 per 1000 people [1]. The condition occurs classically with degeneration of the extensor carpi radialis brevis (ECRB) origin on the lateral epicondyle. Extensor tendons, including the supinator, extensor carpi radialis longus, and the extensor digitorum longus, and the extensor digitorum also can be involved. It is thought that the condition results from chronic overuse and is often seen in tennis players, heavy laborers, and even string musicians [2]. Tennis in particular can place strain on the elbow through the high forces and torque experienced while striking the ball with the player’s racket. It has also been reported that up to 50% of all tennis players may experience this condition [3]. It is more common in older, professional athletes than amateur athletes but it can be seen at all ages [4].

Multiple theories exist as to the cause of lateral epicondylopathy. Primarily it is considered a condition of overuse, however in tennis it may be due to the force of striking the ball that hits the racket causing the forearm muscles to experience eccentric loading and micro trauma [3]. The distinct tennis backhand also contributes largely to the lateral sided loading. This may be more pronounced in amateur players as it has been found that they are more likely to hit a backhand using a flexed wrist versus more experienced players [5].

Although previously believed to be an inflammatory process within the forearm extensor tendons, it has been shown that within the pathologic tendons there is a lack of inflammatory cells. Histologically, tendons involved show disorganized collagen structure, fibroblast hypertrophy and vascular hyperplasia [6]. The pathologic tissue is usually on the deeper surfaces of the tendon closer to the center of force or rotation relative to the muscle load and joint movement.

CLINICAL PRESENTATION

Lateral epicondylopathy is one of the most common causes of lateral elbow pain in patients. The patient often presents with pain on resisted extension, such as hitting a backhand shot, lifting heavy objects, or when using a screwdriver. They may also complain of pain with strong grip, or even with decreased grip strength. Workers and laborers may complain of pain with duties that require repetitive wrist extension. Range of motion is often preserved and no gross deformities are usually seen with inspection.

It is important to differentiate lateral epicondylopathy from other conditions that may affect the elbow. Cervical radiculopathy may cause radiating pain to the elbow. Radial tunnel syndrome may also be a concurrent finding with lateral epicondylopathy and must be properly differentiated [5]. Key findings for radial tunnel syndrome are pain more distal to the forearm extensor mass origin (greater than 3 cm) compared to lateral epicondylopathy, as well as paresthesias or pain in the hand. Clinical conditions that mimic lateral epicondylopathy include degenerative joint disease, osteochondritis dissecans, elbow overuse, lateral and posterolateral elbow instability, and even anconeus inflammation. When pain is refractory to conservative approaches, a broader differential diagnosis must be entertained. There appears to be a high incidence of refractory lateral elbow pain (up to 59%) with patients with underlying osteochondral defects [7].
A number of provocative tests can be employed during physical examination, on top of palpation at the lateral epicondyle. These include Maudsley’s test and Cozen’s maneuver, with sensitivities of 66% and 91% respectively [8]. Maudsley’s test involves having the patient perform resisted extension of the long finger while the examiner palpates the lateral condyle. A positive test recreates the pain. Cozen’s maneuver is similar and is positive when pain is elicited with resisted wrist extension while the elbow is extended to isolate the ECRB [9].

Imaging

The diagnosis of lateral epicondylopathy is a clinical one. Given the history, physical exam, and positive provocative tests the diagnosis can be made. If there is concern for a congruent or separate etiology more diagnostic imaging can be undertaken. Radiographs are often normal, and may be employed if there is concern for bony abnormalities such as loose bodies or osteochondral defects (OCD). Ultrasound is also useful to rule out the disease. Often times if no tendon changes including neovascularization, thinning, thickening or tears are identified on ultrasound then an alternate diagnosis should be sought [3]. Sensitivity of ultrasound imaging ranges from 64-82% and specificity ranges from 67-100% [10]. Magnetic resonance imaging (MRI) is often used to better clarify anatomic pathology including edema in the ECRB tendon, tendonopathic changes, underlying OCD lesions, or edema in the insertion onto the epicondyle. Sensitivity in MRI is greater than ultrasound at 90-100% while specificity is similar at 83-100% [10]. The clinician needs to interpret MRI findings with caution as clinical symptoms and MRI findings may not always be congruent in their severity.

Non-Operative Treatment

There are multiple treatment modalities for lateral epicondylopathy. A very high success rate can be expected with classic non-operative treatment, which includes the following physical and rehabilitation modalities:

Activity Modification, Rest, Ice

These modalities are the initial treatment of any case of lateral epicondylopathy. The athlete should reduce their load intensity when symptoms present with early treatments targeted initial injury and appropriate time to healing. Loading assessment including frequency and intensity should be carefully monitored and controlled on the athlete’s return to play. Modifications to the way the patient plays the game of tennis can include things such as two fist or a single fist backhand, a more flexible or shock absorbent racquet designs, lower string tension, selecting a slower playing court surface, broader racquets with larger sweet spots, as well as modifying the racquet to larger grips have all been done to target a decreased strain on the extensor muscle mass.

Bracing

Counterforce braces act to decrease the force on the extensor mechanism [11]. They are designed to be placed on the arm distal to the area of tendinopathy with the goal of shifting the loading site on the tendon. The use of counterforce braces have shown some improvement versus other braces in some studies, but risks of nerve compression while using is real and the patient should be instructed to stop using them if numbness or weakness develop [12]. A randomized crossover study by Jafarian et al. showed no differences between brace type [13].

Physical therapy

There are various modalities via physical therapy treatment for tennis elbow. As is the case for most tendinopathies, eccentric strengthening should be among the cornerstones of treatment, with adjuvant stretching of the extensor mass also shown to be helpful. Strengthening and optimizing all links of the kinetic chain (core, shoulder, scapula) is fundamental to the treatment of most elbow injuries since the kinetic chain so often contributes to the problem. Deep friction massage, electrical stimulation, cryotherapy and dry needling are alternative treatments that can be provided by the therapist who is trying to target the underlying process and motivate a healing response. Dry needling has shown short term benefits (2-8 weeks) but no long term differences versus placebo [12]. There have been limited long-term studies for manipulation and stretching of the extensor mass, however in the short term it does appear to be helpful in reducing pain [12].

Prolotherapy

Injection of platelet rich plasma (PRP) is an area of investigation that may provide positive results in lateral epicondylopathy. The procedure is completed in office by drawing blood from the patient, placing the blood in a centrifuge and reinjecting the spun down platelet products into the affected area in the patient. Autologus blood injection is done in the similar manner, without the necessity for centrifuge of the withdrawn blood. Both procedures can be done under ultrasound guidance to ensure injection directly into the tendon.

Recent studies have show conflicting results using PRP. A cohort study by Mishra et al. found that PRP injected patients were more likely to have successful treatment, defined as a 25% reduction in pain on DASH scores, than bupivicaine injected patients. However, 60% of the control patients dropped out of the study prior to 8 weeks, limiting analysis versus a control in the long term. The PRP injected patients did report a 93% success rate at 2 years post injection, and therefore may be a useful treatment [14].

A randomized control trial by Thanasas et al. between PRP injection and whole blood injection found that pain was decreased in PRP injected patients, however this difference was only significant for the first 6 weeks. There also was no control group that did not receive an injection and was treated conservatively throughout this time period [15]. There is still work to be done regarding PRP injection and the treatment of tennis elbow. Given costs and difficulty in preparation of PRP it must be carefully considered before treatment is offered. Stem cells are an even more recent option, which hope to deliver healing cells to the area. Unfortunately, they continue to be expensive and may be considered experimental by many insurance providers.

Corticosteroid Injection

Corticosteroid injection has classically been one of the staples of treatment for lateral epicondylopathy. However, further investigation with randomized trials has shown worse outcomes at one year for steroid injected patients versus placebo, and...
no difference for steroid versus physical therapy. Short-term benefits have been shown to decrease pain, and may be used for midterm treatment. When we recognize that the underlying pathology is tendinopathy with inherent apoptosis of tenocytes, and not inflammation; then it should not come as surprise that steroid injection is not effective over the long term as it fails to target the underlying disease process. Ultimately it appears that the risks of injection, including tendon tear, failure, and muscle atrophy, do not outweigh the long-term benefits [16].

**Radiofrequency Thermal Treatment**

A case series by Lin et al. found that radiofrequency ablation can be an effective treatment with a 78% reduction in pain after 14 months of follow up. There also was found to be no decrease in extensor tendon mass on ultrasound. This was however only a case series, with no controls, and at this point high level randomized control studies are not available to confirm the efficacy of radiofrequency ablation. Although outcomes appear to be positive, with limited side effects, more investigation is needed into this treatment modality prior to recommendation for or against its use [17].

**Extracorporeal shock wave**

A systemic review by Buchbinder et al. of randomized control trials investigating this treatment modality found that there was no benefit in its use for lateral elbow pain and that other treatment modalities may be superior, including corticosteroid injection [18]. Endpoints for this study were pain reduction at 4-6 weeks. Given the short time frame and no significant changes noted this may not be the most beneficial treatment for lateral epicondylopathy.

**OPERATIVE TREATMENT**

Should conservative non-operative treatment fail over a span of six to twelve months, and the symptoms of lateral epicondylitis are debilitating enough for the patient, operative treatment can be undertaken. Although there is no consensus as to the best operative approach (open, arthroscopic or percutaneous), there have been a number of techniques described for treatment.

**Open**

Multiple open techniques to addressing lateral epicondylopathy have been described. One technique is to expose the ECRB, excise any angio-fibrotic tissue and finally repair the lesion if necessary. Gunn et al. reports a success rate of 85% when defined as return to sport [19]. Other techniques described include extensor releases, V-Y tendon slide of the ECRB and anconeus excision [3]. No matter the open technique chosen, a lateral approach to the elbow is used, ECRB is identified and debridement, release or a combination of the two with or without repair of the tendon is completed. Denervation of the lateral epicondyle can also be undertaken, with up to 80% success rate, which involves resection of the posterior branches of the posterior cutaneous nerve of the forearm [20].

Long term analysis of the open release of the extensor tendon over a span of 10 years through a retrospective review has shown positive results. 97% of the 139 procedures completed had improved outcomes postoperatively up to 10 years after the initial procedure in terms of decreased pain, function, and elbow range of motion [21]. The major risk in using the open technique is that extensive release can affect elbow stability if lateral ligaments are attenuated. However, this risk is low, and given the beneficial long term outcomes open surgical release is a useful treatment method should conservative measures fail.

**Percutaneous**

Percutaneous release offers the benefit of being able to complete the procedure in a quick manner with minimal anesthesia. The technique involves releasing the common extensor mass from the lateral epicondyle. A major disadvantage of this procedure however is that repair is not possible and may limit extension strength. Good outcomes in pain reduction have been reported with this technique however [22]. Although not significant, a systemic review by Pierce et al. found that there may be a better functional outcome with arthroscopic and open release rather than percutaneous approach to lateral epicondylopathy treatment. The review analyzed 848 open, 578 arthroscopic, and 178 percutaneous releases. Scores for the disabilities of the arm, shoulder, and hand were significantly better for open or arthroscopic versus percutaneous. There was also reported to be lower pain scores with percutaneous and arthroscopic than open approach post operatively [23].

Although the pain scores may initially be lower for the percutaneous approach, it does appear that functional outcomes are not as superior as the other surgical methods. This may be due to the fact that using the percutaneous approach the tendon can not be repaired after release. Given the high quality systemic review, with over 1,000 cases reported on, it would appear to be more beneficial to undertake an arthroscopic or open surgical procedure for lateral epicondylopathy.

**Arthroscopic**

Arthroscopic treatment of lateral epicondylopathy is another useful surgical approach [19]. A major advantage of using arthroscopic technique is that the joint can be visualized. If there are intra-articular lesions such as loose bodies these can be addressed at the same time as extensor tendon debridement. The viewing portal is placed medially, and the working portal is superolateral [11]. Szabo et al. showed in a retrospective review that there was no statistical difference between arthroscopic and open treatment of lateral epicondylopathy for pain and functional scores post operatively at a mean follow up of 47.8 months with improvement in Andrews-Carson scores from 160 preoperatively to 195 postoperatively [24-26].

With operative treatment there is the possibility of injury to the structures around the elbow. Given the anatomic position of the radial nerve in relation to the operative field, it can be damaged during the procedure. The lateral ulnar collateral ligament can also be damaged, leading to posterolateral instability of the elbow [11]. Therefore debridement should not extend beyond the midline of the radial head to avoid excessive resection of the ligament.

**CONCLUSION**

Lateral epicondylopathy is one of the most common causes of lateral elbow pain. ECRB irritation and angiofibroblastic changes...
in the tendon are most commonly attributed to the causation of pain in patients. The mainstay and initial treatment should be non-operative, using rest, bracing and physical therapy, with as high as 90% success rate [3]. When conservative treatment fails, operative treatment can be considered using an open or arthroscopic approaches with expected 85-95% success, and better functional outcomes than the percutaneous technique [11,21,23,26].

REFERENCES


