Case study: Lateral Epicondylitis
By Gary Stuart Edwards

Clinical History:
A 47- year old male, semi professional tennis player presented to the clinic with 8-month history of episodic right elbow pain. The patient denies any trauma and the pain had gradually got worse over several weeks. The pain day to day was rated zero out of ten however, playing tennis, especially one handed backhand caused low grade irritation which persisted for some time after. He also complained of stiffness to the elbow after playing which lasted 1-2 days. He originally received extensive conservative treatment and rehabilitation programme which seemed to help initially, but gradually got worst in the last few weeks prior to our consultation. The Patient wanted to try a different treatment modality, and to avoid the need for surgery.

Orthopaedic and neurological Examination:
The patient had normal range of motion of the elbow and shoulder, palpation caused some discomfort over the lateral epicondyle. Resistive Tennis Elbow Test (Cozen's Test) reproduced the pain. All neurological signs were normal, and the patient did not complain of numbness, tingling, pins & needles or weakness. Ultrasound scan was performed in order to confirm the diagnosis of Lateral Epicondylitis.

Ultrasound scan:
Machine used: A Konica Minolta SONIMAGE HS1 ultrasound machine was used. A Linear transducer was selected for the scan. Dynamic ultrasound examination of anterior, posterior, lateral and medial aspect of the elbow was performed in longitudinal and cross-sectional plans. The depth, focus, TGC, overall gain and frequency were adjusted through the scanning to optimise the image. Doppler was used to ascertain if increased inflammation mediators where present in the lateral epicondyle. A scan of the contralateral elbow was also obtained for a comparison.

Patient positioning: The patient lied supine to maximise comfort and easy arm positioning.

Ultrasound findings:
longitudinal image of the lateral aspect of the elbow showed some small hyperacohoic area noted on the proximal tendon which could indicate a mild sign of tendinosis. Power Doppler was normal. The common extensor tendon was fully intact. The radio-humeral and ulnar-humeral appeared normal. There were no erosions, osteochondral defects, joint fluid or synovial thickening. The radial and ulnar collateral ligaments appeared normal. The triceps muscle, tendon and olecranon fossa appeared normal.

Lateral Epicondylitis (Tennis Elbow) is a painful condition affecting the tendon of the lateral epicondyle of the humerus, leading to loss of function of the affected limb which can have a major impact on the patient's social and personal life. The incidence of lateral epicondylitis varies from approximately 1% to 3% in the general population. However, tennis players' account for only about 5% of all suffers of lateral epicondylitis. It is equally common among men and women, occurs more frequently among whites and in the dominant arm, and increases with age, peaking between the ages of 30 and 50. It is often caused by repeated extension of the wrist against resistance. (Ahmad et al, 2013)

The onset of pain is usually gradual. With repeated micro-trauma, an inflammatory condition of the periosteum may develop, which can lead to formation of granulation tissue and adhesion. Swelling or ecchymosis is rare, except in cases of external trauma. The arm is painless at rest and during passive range of motion. Tenderness is most notable at the anterior aspect of the lateral epicondyle and the lateral forearm. Palpation of the radial collateral ligament may elicit exquisite tenderness. Grip strength may be decreased, but the articular and neurological signs are normal. (Waseem et al, 2012)

Tendons subject to repetitive trauma, and in particular those that pass over a convex surface or cross two joints, are especially susceptible to overuse injury and microscopic tears. The extensor carpi radialis brevis (ECRB) tendon is one such tendon and accounts for 90% of all cases of lateral epicondylitis (Bhabra G et al, 2016).

Clinical examination and Diagnostic imaging:

Lateral epicondylitis is the leading cause of elbow pain; however, similar pain caused by other diseases should be carefully identified to avoid misdiagnosis. These potential diseases mainly include cervical radiculopathy, frozen shoulder, radial tunnel syndrome, lateral plica syndrome of the elbow, posterolateral elbow instability, and inflammatory oedema of the elbow muscle. Other causes of pain include low-grade infection or other inflammatory diseases, such as rheumatoid arthritis (Ma and Wang ,2020).

Special tests are commonly used during the physical examination, such as the chair test, Cozen's test, and Mill's test. Chair test requires the patient to lift a chair with the shoulder adducted, elbows extended, and forearms pronated. Pain on the lateral epicondyle indicates lateral epicondylitis. Cozen's test requires the patient seated, with the elbow extended, forearm maximal pronation, the wrist radially abducted, and the hand in a fist. Then, the examiner moves the wrist to dorsal flexion and moves the wrist towards palmar flexion. Mill's test requires the patient seated, elbow extended, and forearm pronated. then, the examiner moves the wrist passively in palmar flexion and hereby stretching the extensors (Zwerus et al, 2018)

The validity, specifically sensitivity and specificity of the Cozen's test and Mill's test has not been determined. Tissue observation noted by imaging may serve as the standard for determining the validity of the special tests. (Waseem et al, 2012)

When clinical symptoms cannot be well defined based on physical examination and history, diagnostic imaging is needed. Imaging techniques such as magnetic resonance imaging or diagnostic ultrasound are useful to identify the calcification, tears or ruptures of the ECRB. Imaging studies are the only non invasive way to provide some evidence of tissue changes.

US is an excellent option for diagnostic imaging evaluation of lateral epicondylitis, with a reported sensitivity of approximately 80% and specificity of approximately 50%. Tendinosis appears as tendon enlargement and heterogeneity. Tendon tears are depicted as hypoechoic regions with adjacent tendon discontinuity. Surrounding fluid and calcification also may be seen (Walz DM et al, 2010).

Treatment options:

1. Manual therapy and rehabilitation exercises:
   Appropriate physiological loads are necessary for optimal tendon development and maintenance and thought to be best achieved by controlled exercise rehabilitation. (Khan & Scott A, 2009). Although there is a clear tendency in favour of physical therapy(PT) modalities compared with ''relative rest'', up to 10% of patients continue to deteriorate and develop chronic symptoms. It is possible that these patients have a higher grade of tendinopathy, either with an immature vascular supply preventing cytokine-induced tendon repair, cell depletion, or even large tendon tears. Therefore, introducing mechanical loading via exercise therapy is considered beneficial in the early stages of LET (Bhabra G et al, 2016).
   In any case, before deciding to perform surgical intervention, it is crucial to deplete all the conservative therapeutic options (drugs and PT), regardless of their economic cost. In addition, there are many PT tools that can complement the manual techniques, such as cryotherapy, electrotherapy, ultrasound therapy, and the application of tapes or orthoses. (Landesa & Leirós, 2021)

2. Focused shockwave therapy:
   Extracorporeal shock waves are single-pressure pulses of microsecond duration that can be focused on a site using ultrasound guidance. Although the exact mechanisms for pain reduction are unclear, the basic premise is that these shock waves may stimulate tissue healing, reduce calcification, inhibit pain receptors, and cause denervation (Speed et al. 2002). Based upon systematic review of 9 placebo-controlled trials, there is "platinum" level evidence that ESWT provides little or no benefit in terms of pain and function in lateral elbow pain. There is "silver" level evidence based upon one trial that steroid injection may be more effective than ESWT (Buchbinder et al, 2006).

3. Radial Shockwave therapy:
   A radial shock wave stimulates a much larger area of tissue than a focused shock wave. The effective focal zone of the latter is very small, thus, the area of affected tissue that can be treated is also small. The radial shock wave allows treating the original site of the disease (e.g. the lateral epicondylar area), as well as other affected areas.
   Focused and radial shock waves comparably and gradually reduce pain in tennis elbow patients. With subsiding

pain, strength of
the affected extremity improves. Neither focused nor radial shock waves improve the function of affected tissues quickly, but they apparently initiate a chain reaction restoring physiological function to affected structures (Król P et al, 2015).
The most frequently reported side effects in the ESWT-treated group were transitory reddening of the skin, increased pain, and
small hematomas. Some patients report nausea during the treatment and less commonly there were reports of Migraine and syncope in participants following ESWT (Buchbinder et al, 2006).

4. Autologous blood injections (ABI) and platelet- rich plasma (PRP):
Autologous blood injections are thought to work by initiating an inflammatory response and delivering nutrients that are necessary to initiate the healing process by distributing the blood more evenly. Kazemi et al, 2010 found that autologous blood injections were more effective to those of corticosteroid injection.

Platelet-rich plasma is a volume of the plasma fraction of autologous blood having a platelet concentration of 5 times more than base line. Platelets in PRP contain more than 300 bioactive cytokines and growth factors that operate via paracrine and autocrine mechanisms to coordinate cellular communication and enhance reparative processes. Platelets also release vasoactive substances such as serotonin, calcium, histamine, and adenosine via their dense granules. The action of PRP therapy in chronic tendinopathies is varied and hypothesized to include angiogenesis, increase in growth factor expression and cell proliferation, increase the effect of repair cells and tensile strength (Mishra AK et al, 2014).

Ultrasound findings of common extensor tendon (CET) including echo texture, thickness, cross section, partial tear and calcification improves in majority of patients treated with PRP (Khattab and Mohamad, 2017).

A number of RCTs have shown that PRP is superior to autologous blood and bupivacaine injections. 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 (Ahmad et al, 2013). Nevertheless, a more recent meta-analysis investigating the efficacy of PRP for treatment of various tendinopathy has shown sound evidence to support the use of leukocyte-rich PRP in tendinopathy when used under ultrasound guidance. (Fitzpatrick et al, 2017)

a single injection of PRP is able to keep the patient without symptoms of lateral epicondilitis for up to one year, while the injection of corticosteroids shows the same result in only 51% of cases. It is assumed that this more long-lasting effect of PRP is due to the remodelling of new tendon, which can persist and to respond better to mechanical trauma (Marcio E et al, 2021)

Both PRP and Extra-Corporeal Shock Wave Therapy are feasible andsafe options for the treatment of chronic lateral epicondylitis with low risk of complications and with acceptable mid-term follow-up results (Alessio-Mazzola, M et al, 2018). However, Otheman and Ahmed (2014) Concluded that PRP achieve superior results when compared to ESWT as regards to pain relief, improvement of elbow function and patient satisfaction at follow-up.

Application of ESWT to PRP increases the expression of growth factors *in vitro*. This suggests that the combination therapy of local PRP injection followed by ESWT may stimulate release of growth factors from platelets after they have been injected into the area of injury. The combination of PRP and ESWT might result in synergism of two modalities previously utilized individually for tendon and ligament injuries (Seabaugh et al, 2017).

Ultrasound guided injection ensures precise targeting of tissue needle placement and real-time visualization of needle during injection with documentation of changes in tendon morphology and structure after PRP injection (Lee KS et al. 2011).

5. Corticosteroid injection: Corticosteroid (CS) injections are only available on prescription. They're usually given by a specially trained doctor in a GP's surgery or hospital clinic and therefore is not offered in our clinical setting. CS injection used to be the treatment of choice for Lateral Epicondilitis. CS suppresses the immune system by suppressing the pro-inflammatory proteins. CS injection provide short term, symptomatic relief, however, it results in tendon degeneration and other potential side effects include lipodystrophy, skin pigmentation changes, and tendon atrophy and/or ruptures.
Also, it has been shown that PRP injection is superior to CS injection for chronic LE. The recurrence rate and

need for repeated injection or surgery are higher in the CS than PRP injections. Ultrasonography reveals a decrease in thickness of the tendon after CS injection and an increase in thickness after PRP injection. Increase in tendon vascularity following PRP injection is associated with improved tendon morphology (Gautam, V.K. et al, 2015).

Avoiding the risk of infection:
Therapeutic musculoskeletal injections require a clean or sterile skin preparation to minimize the risk of infections. Ultrasound guidance for this procedure requires the use of transmission gel in proximity to the injection site which results in greater contamination in simulated intra articular injections of the shoulder. As such, sterile preparation with an antiseptic or cleaning agent of the entire injection field, including the adjacent skin where the gel and probe are applied, is needed. The recommendations of the FDA suggest that exclusive use of sterile ultrasound gel is advisable. (Sherman et al, 2015)

Obtaining consent:
Prior to the treatment, the patient was fully informed about the procedures and their potential risks and/or hazards. The assumption underpinning the implementation of informed consent is that doing so will protect the rights and welfare of individuals by offering them the opportunity to make free and informed choices (Corrigan O, 2003)

There are three components to valid consent:
• capacity
• information
• Voluntariness
Capacity indicates that a person can make a decision or take an action about their own care and treatment. Clinicians must ensure that patients are aware of any material risks involved when undergoing a proposed treatment, and of reasonable alternatives.
The practitioner should usually include the following information when discussing benefits and harms.

A. *recognised risk of harm that may arise from the professional knowledge and experience.*
B. *The effect of the patient's individual clinical circumstances on the probability of a benefit or harm occurring.*
C. *Risks of harm and potential benefits that the patient would consider significant for any reason. These will be revealed during discussions with the patient about what matters to them.*
D. *Any risk of serious harm, however unlikely it is to occur.*
E. *Expected harms, including common side effects and what to do if they occur* (Douglas L, 1997)**.**

Procedure:
A few treatment options were discussed. As the patient has already undergone an extensive conservative treatment and rehabilitation and wanted to avoid any surgical procedures, the next line of treatment options was the focused shockwave therapy ESWT or ultrasound guided PRP injection. Informing the patient with the pros and cons to using this two options, the patient made an informed decision and opted to receive the PRP injection.

PRP Technique
50 ml of the patient own blood was withdrawn. This amount was centrifuged at 1,200 rpm for 6 min and the platelet rich plasma portion was collected in a syringe, taking care to avoid contamination with the buffy coat containing the leukocytes. The plasma was kept at room temperature and then, it was injected into the tendon using 23G needle by peppering technique. Ultrasound scanning provided accurate needle placement into the effected tendon. To avoid blood lipids in the PRP, the patient was asked to fast or follow a fat-free diet during the six hour prior to blood extraction.

Post-Injection Protocol
The patient was asked to rest in supine position for 15 minutes and was sent home with instructions to limit the use of the arm for 24 hours, use Paracetamol for pain relief and to avoid NSAIDs.
After 5 Days the patient was advised to continue with his rehabilitation programme. Four weeks after the procedure the patients was encouraged to proceed with normal tennis training.

Conclusion:
Further imaging was needed in order to confirm the diagnosis of lateral epicondylitis post the orthopaedic examination. Both MRI and Ultrasound have their advantages in diagnosing tissue damage. However, given the low level of pain and the chronicity it was decided that ultrasound is the preferred image modality that is required for diagnosing the condition in this case. Another advantage of the ultrasound scan is that it can be used as dynamic scanning that could help identify subtler changes to the lateral epicondyle especially for this particular patient who had pain only while playing but not at rest. Also, the ultrasound scanning allowed for accurate needle placement when injecting the PRP.

Some studies show that ESWT provides little or no benefit in terms of pain and function in lateral elbow pain. Other studies Concluded that PRP achieve superior results when compared to ESWT as regards to pain relief, improvement of elbow function and patient satisfaction. It appears that there is a great potential in using shockwave therapy with PRP injection simultaneously, however more clinical, in *Vivo*, trials should take place in order to determine the effectiveness of this combined treatment.

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