A review of the histopathology, assessment, measurement and three commonly used manual therapy treatment options for lateral epicondylalgia.

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**Introduction:**

First described as ‘writers cramp’ by Runge (1873) and later called ‘Lawn Tennis Arm’ in the Lancet by Henry Morris (1882) this common condition has been known as tendonitis, lateral epicondylitis and tendinosis to name but a few. Also commonly known as ‘tennis elbow’, it is rarely found in elite tennis players but more commonly in recreational tennis players (Giangarra, 1993). Studies investigating the pathophysiology of ‘tennis elbow’ have failed to show inflammatory cells (Macrophage, Lymphocytes and Neutrophils) in the affected tissues so it is now agreed that the prefix ‘itis’ is inaccurate (Maffulli, 2003). More accurately and recently the terms tendinopathy and epicondylalgia are being used to describe this condition which affects office workers and sports people alike. This condition can be characterised by a spectrum of severity from mildly irritating to a debilitating condition that can have a significant social and occupational impact.

Allander (1974) and Varhaar (1999) found 1-2% of the general population had this condition and it is particularly common in the 40-50 year-old age group. Chiang et al. (1993) and Ranney et al. (1995) proposed that 15% certain manual occupations suffered lateral epicondylalgia and Haahr (2003) found that while most recovered within three months, 17% still had symptoms a year later and Hamilton (1986) found 7 in 1000 doctor visits were for lateral epicondylalgia.

Whereas a diagnosis is relatively easy to arrive at, an effective evidence based treatment that is successful across age, sex and activity level has to date been elusive. Mills (1928) speculated that ‘There is probably nothing that brings the surgical profession into greater discredit at the present time than the inability to cure ‘tennis elbow’'.

Cyriax (1936) describes it arising from a single instance of exertion involving wrist extension (macroscopic tears) or it can develop typically 24-48 hours after overloading the wrist extensor tendons (particularly the extensor carpi radialis brevis tendon) 1-2 cm distal to the humeral insertion (microscopic tears). The cardinal symptoms of this condition are sharp pain or diffuse ache (may radiate into forearm) and decreased function (particularly gripping).

By understanding the histopathology, assessment criteria, and multimodal treatment options of lateral epicondylalgia we can facilitate pain reduction and accelerate the return to sport or employment.

The purpose of this report is to provide a review of the current information regarding lateral epicondylalgia. I begin by considering the histopathology and then briefly describe the assessment techniques and measurement scales and end by considering the efficacy of the conservative treatment modalities being used by physical therapists.
Discussion:

Clinical Findings:
Tendons function by joining muscle to bone through contributions from the continuous parts of the deep fascia (the epimysium, perimysium and endomysium) and providing leverage (Tortora and Grabowski, 1993) to create movement. Tendons are primarily composed of large diameter type 1 collagen fibrils with some type 3 collagen and proteoglycans and elastic fibers supported in the matrix.

One popular but early theory proposed by Cyriax (1936) is that tendonitis results from microscopic or macroscopic tears in the common extensor tendon. This theory has been refined by Khan et al. (1999) who describes under microscope, mucoid degeneration, loss of collagen tight bundled structure, fibrosis and what Kraushaar and Nirschl (1999) called neo-vascularization. Additionally, there is an excess of both fibroblasts and blood vessels which Alfredson (2007) calls ‘neovessels’. The degenerative program is characterised by dense populations of fibroblasts, vascular hyperplasia and disorganised collagen (angiofibroblastic hyperplasia), Nirschl (1975 and 1995).

Tendinopathy is the result of overuse of the hypovascular zone which leads to neovascularisation. This abnormal tissue has a large number of nociceptors which may be responsible for the pain (Frontera, 2003). Additionally, Substance-P and CGRP (calcitonin gene related peptide) are peptide markers indicating the possibility of neurogenic inflammation as another possible cause of pain (Zeisig, 2006).

Frequently, a chronic complaint by the time the client attends for treatment due to the insidious nature of the problem and a wait-and-see approach by the many clients.

Figure 1.
Histology of a normal tendon.

Figure 2.
Histology of a damaged tendon. Note the collagen disorientation and fibre separation.
Cook (2008) provides a new pathology model to explain the clinical presentation of load induced tendonopathy in a continuum of at least 3 phases. This has similarities to Nirschl (1988) where he proposed 4 progressive phases.

1. Reactive tendonopathy is often brought on by acute tensile or compressive loading of a tendon. A non-inflammatory proliferate response occurs in the cells and matrix. This thickens the tendon to adapt to the force unlike normal tendon adaption where there are little changes in tendon thickness (Magnusson, 2008). Here the collagen and neurovascular structures remain unchanged and given time and rest between loadings the tendon can revert to normal.

2. In the degenerative tendon disrepair phase there is failed healing response and greater matrix breakdown. Proteins produced from an increase of chondrocytic cells result in collagen separation and a disorganised matrix. There is a vascularity increase and neural ingrowths develop (Danielson, 2003).

3. The third phase is the degenerative phase which has little chance of being reversed. Here there is evidence of tenocyte death from exhaustion and the matrix is disorganised and invaded with neovessels. Most of the type 1 collagen is absent. (Nirschl 1989; Regan et al. 1992; Verhaar et al. 1993). Degenerative changes have also been shown in other chronic tendinopathies (Nirschl, 1989; Khan & Cook, 2000; Khan et al, 2000).

Cook also mentions a tendon can have each of these phases going on in different parts of a tendon at the same time.

**Diagnosis:**

MRI and Ultrasound are the ‘gold standard’ tests but rarely needed. However, a detailed case history must be taken to decide on the possible aggravating activities/factors so appropriate advice regarding activity can be given.

The physical examination should include observation, palpation and orthopaedic tests to differentiate between differential diagnoses as well as the acute and chronic presentation. Specific orthopaedic tests for an effective physical examination of the elbow joint includes: Gripping test (dynometer), Maudolsky’s middle finger test (Roles N, Maudsley R, 1972), Chair test (Gardner, 1970), Crozens Test and Mills Test (Mills, 1928) amongst others which are outlined in Bruckner and Khan (2006).

One of the chief problems encountered by clinicians is the classification of the condition and a number of scales have been developed to address this issue.

The Visual Analogue Thermometer (VAT) (Choiniere, 1996) although subjective, this is the scale in commonest use for pain intensity today. Pain is plotted along a line. It is good to look at individual case changes but less so across groups.

The DASH (Disabilities of the Arm, Shoulder and Hand) (Atroshi et al, 2000), it is a self-reported questionnaire of 30 items concerned with symptoms and function developed by the American Academy of Orthopaedic Surgeons. There is also a shortened version the QuickDASH. Both are valid and reliable.

McDiarmid was involved in the PRFEQ (Patient Rated Forearm Evaluation Questionnaire) devised in Canada 1999 that looks specifically at the elbow. It is made up of 15 questions you plot on a visual analogue scale (VAS). It was updated by McDiarmid (2005) after being validated by Overend (1999).
The Gotenburg Quality of Life instrument (GQL) (Sullivan, 1993) is validated and used extensively. It looks at Yes/no answers for 30 symptoms over the past 3 months. The Roles-Maudsley a subjective pain scale between 1 = no pain and 4 = pain limiting activities.

Hand held dynometers are reliable with an 8.2% coefficient of variables (Bonhonnnon, 1986). They are a useful in quantifying changes. Two separate tests are considered, maximum grip test and start of pain grip test.

**Physical Therapy Treatment Options:**

**Eccentric Exercising:**
Resistive training aims at progressively overloading by the gradual increase of stress placed upon a body during training.

One of the earliest recommendations in favour of the use of eccentric exercises was Standish et al. (1986) where they suggested that eccentric exercise effectively ‘lengthened the muscle tendon complex resulting in structural remodelling of the tendon with hyperthrophy and increased tensile strength of the tendon’.


The Nicholas Institute of Sports Medicine and Athletic Trauma developed the novel Theraband Flexibar (They recommend 3 sets of 15 each daily).

Tim Tyler further developed this with the ‘Tyler Twist Technique’ because eccentric loading helps collagen cross fibres. (Tyler 2010).

In his prospective, randomised, quasi control study 22 tennis elbow sufferers were split up between a control group (getting standard physical therapy) or a physical therapy group with the Theraband Flexibar exercise.

Using the Visual (VAS), Disability of the arm, shoulder and hand DASH and hand held dynameter it was found that the group using the Theraband Flexibar’s pain level reduced by 81% against 22% for the control group and The DASH score was 76% for the Theraband Flexibar group against 13% for the control.

Eccentric and concentric resistance exercises stress the wrist extensors and produce dense collagen scar tissue at the attachment site reducing pain. (Curwin and Standish, 2000).

Eccentric exercises appear to work by reversing neovascularization although the mechanism is not clearly understood (Alfredson & Cook 2007). There is general agreement to following Alfredson’s heel drop protocol of 3 X 15 repetitions twice a day for 12 weeks with theses exercises.
Cross fibre friction:
Deep Transverse Friction (DTF) was popularised by Dr James Cyriax (Cyriax 1936) for the treatment of tendonitis. He proposed it would reduce fibrous adhesions and maintain scar mobility by breaking the cross bridges and reduce pain producing metabolites (Lewis’s substances). However a Cochrane Review (level 1, grade c for pain) (Philadelphia 2001) found poor evidence to support deep transverse friction (DTF) for treating tendonitis. This is supported by Brosseau et al, (2003) and Stasinopoulos (2007). Interestingly Cyriax only called it ‘Cyriax Treatment’ when the Mills Manipulation was also carried out as part of the treatment.

Mulligan Concept: Mobilization with Movement.

Brian Mulligan, a New Zealand physiotherapist launched his first book on manual therapy in 1989 and it is now in use throughout the world by physiotherapists and manual therapists alike.

The Mulligan Mobilization with Movement (MWM) (Mulligan 1999) has become popular as there is no high velocity thrust involved. Here the therapist provides a lateral glide to the extended elbow as the patient clenches his fist. This technique is supported by a number of placebo controlled studies Vincenzino (2001) and Paungmali (2003) and further develops the theories of Freddie Kaltenborn with whom he worked. One recent single blind randomised controlled trial of 189 compares the efficacy of physiotherapy (MWM), wait and see and corticosteroid injection over a year period (Bisset, 2006). It concluded that Physiotherapy (MWM) was superior to wait and see in the first 6 weeks and better than corticosteroid injections after 6 weeks as there was a substantial number of reoccurrences. After a year follow 72 % of those injected reported reoccurrences compared to the wait and see group (9%) and the physiotherapy group (8%).
I followed the CONSORT guidelines (Moher et al, 2010) to appraise the Blinding, Concealment of allocation and Intention to treat analysis. This trial used a blinded assessor and statistical analysis was carried on out on an intention to treat basis and an individual per protocol analysis was also carried out.
**Conclusion:**

Despite all the research, there is no consensus in how to treat epicondylalgia. Moher et al. (2010) are continually updating the Consort Statement with a view to improve the quality of reporting in randomised controlled Trials (RTC).

As the purpose of this review was to consider the efficacy of manual therapy modalities I did not consider (sclerosing agents, blood injections, electro therapy or acupuncture) as they are not available or used by all physical therapist.

In my view large Randomised Controlled Trials (RCT) are required to investigate the benefits between eccentric exercises and combination eccentric and concentric exercises. Although promising, the Mulligan MWM and Tim Tyler’s research are limited by the small group sizes and that it only looked at the groups in the short term. However the fact that a client need attend the therapist less frequently and can assist in their own healing has many benefits including both time and financial aspects.

So despite the frequency of visits to the doctor and the large number of studies there is insufficient evidence for most physiotherapy treatments of lateral epicondylalgia.
References:


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Correct posture is important throughout any exercise and it is important to involve ‘Core Bracing’.
Initially, the weight can be adjusted closer to the patient's hand to reduce the stress.

Advanced and incorporating proprioception training.
Daily homecare mobility exercises in conjunction with strengthening exercises prescribed by therapist following assessment.
The Progressive Stages of the Rehabilitation Program are:

1. Provide the correct management to reduce pain and promote healing during the early phase of an injury.
   - Identify and correct predisposing factors,
   - Restore full range of motion (ROM) and flexibility.
2. Restore function: Muscular strength, power and endurance.
   - Re-establish neuromuscular control.
3. Improve postural stability and co-ordination and proprioception.
   - Graduated return to activity/sport.
   - Educate and support client to avoid re-occurrence and chronicity developing.

Eccentric exercise was proposed by Standish et al (1986) to ‘lengthen the muscle tendon complex resulting in structural remodelling of the tendon with hyperthrophy and increased tensile strength of the tendon’. This idea of forming dense collagen scar tissue appears to reverse neovascularisation and reduce pain (Alfredson and Cook, 2007).

Day 1 program:
Acute presentation with high SIN (Severity, Irritability, Nature of condition) use RICE protocol. For example complete rest if there is significant elbow pain lifting a cup.

Therapist treatment:
The Mulligan Concept elbow MWM technique can be applied and should be pain free, immediate and long lasting if suitable.

Client:
Active pain free (almost) elbow and wrist Range of Motion (ROM) from the first day. 30sec each joint per day.

Between 3 and 7 days the inflammatory phase should be eased sufficiently to implement treatment plan.

Therapist: Soft tissue massage to release muscular hypertonicity in wrist flexors and extensors. Grade 1 and 2 joint mobilizations to elbow joint if restrictions present. Transverse friction to epicondyle and ice massage for pain control.

Daily client self care:
Continue elbow and wrist active ROM (allow a small amount of pain). 30sec each joint twice a day.
Isometric Wrist flexion (ie; elbow stretch with elbow extended and also with elbow flexed to 90 degrees) 3 of each with 30 sec. hold, once a day.

Low resistance eccentric strength exercise. 8 sec. for 3 sets or until fatigued. After a few days when client is able to complete 8 sec for 3 sets you may add light Theraband (yellow) resistance. Wringing out a tea towel with arms out straight. Squeeze and hold a tennis ball 10 sec. for 3 reps to improve grip strength.

Begin addressing any postural factors:
Commonly you will find short internal rotators and protractors of the shoulder while the lower trapezius, rhomboid, infraspinatus, teres minor, serratus anterior and deep neck flexors muscles are weak and lengthened.
From the beginning, shoulder and trunk exercises to maintain conditioning levels and retrain the kinetic chain system as shoulder dyskinesis may be a contribution factor. (Bruckner and Khan, 2006).

Low row and robbery exercises for any shoulder dyskinesis. (Kibler, 2008)

Self massage and icing ice in towel (10min. on every 2 hours).

Maintain general fitness levels by walking in a pool or a stationary bike. High intensity exercises can maintain fitness levels for 15 weeks.

Always go back a step back if you aggravate symptoms significantly.

Neurodynamic stretching for the radial nerve if weak supination present.

The Theraband Flexibar (3x15 reps twice daily for 12 weeks)
Tim Tyler because eccentric loading helps collagen cross fibres. (Tyler, 2010)

Concentric loading is not recommended as it continues the condition.
Mahieu (2007) found although static stretching has no affect on tendon stiffness ballistic stretching causes tendon compliance.
All home exercises to be preformed while engaging the core muscles. Also Carroll (2006) recommends the use of contralateral training while the involved limb is rested.

Cyriax (1936) popularised Deep Transverse Friction (DTF) for treating tendonitis but recent trials (Brosseau et al, 2003 and Stasinopoulos, 2007) did not show consistent benefits in a Cochrane review (2002). This is supported by Brosseau et al, (2003) and Stasinopoulos (2007). Interestingly Cyriax only called it ‘Cyriax Treatment’ when the Mills Manipulation was also carried out as part of the treatment.

The criteria for progressing to Phase 2 are ‘full pain free AROM, minimum pain and good strength’. Bandy and Sanders (2001).
Day 7
Continue the early phase program and progress the exercises.
Do not increase the time under tension (reps) but rather increase the resistance by using a darker Theraband.
Additionally introduce a dowel (stick) for supination and pronation. 5-8 reps 3 sets.

Introduce proprioception exercises. Throwing up a ball and catching it. This can be progressed by throwing a ball against a wall and catching it. Later standing on a wobble board or altering the weight of the ball can create new challenges.

Therapist can apply:
The active release technique (ART) breaks down scar tissue which lessens the load to restore elasticity.

Therapeutic exercise and home care program:
Exercises to improve muscle endurance progress from isotonic to isometric.

‘The goals in this phase are to increase muscular strength, muscular endurance and neuromuscular control. The majority of exercises in this stage are isotonic. The criteria for progressing to Phase 3 are full pain free AROM, no pain on palpation and at least a minimum of 70% strength’. Bandy and Sanders (2001).

Day 20
Introduce radial and ulnar deviation of the wrist using a hammer (hold close to the top initially and progress to holding further down the shaft to increase the load).
Progress all the exercises and proprioception
Introduce plyometrics. Early plyometrics (jumping explosive exercises) are used to get a person ready for the return to sport and should be specifically tailored to the client’s sport.

Address psychological issues around return to sport/activity. Discuss their concerns and offer support and advice.
Only return to sport when able to perform functional sport specific exercises properly with normal strength and power and no pain.

Note:
Without completing appropriate rehabilitation, epicondylalgia can result in physiological and functional losses that predispose to further re-injury.
Clients tend to expect tendons to heal quickly and then fail to complete the rehabilitation program developing chronic conditions that are easily aggravated with repetitive activities.

Load, Velocity and Frequency are key element of eccentric exercising:
Load- increased based on patient’s symptoms.

Velocity (speed). Increasing velocity is recommended by Standish (1986) to facilitate a return to activity but Alfredson does suggest altering his exercise velocity.
Frequency. This varies between authors but 3 sets of 10 is commonly used (Standish 1986). This is similar to Alfredson’s 3 sets of 15 twice a day for 12 weeks.

The Therapist Role:

The therapist role is very important for a number of reasons:
To identify aggravating factors.
To decide at what stage a client is so the appropriate phase of rehab can begin.
To decide when to progress to the next phase.
To educate the client to avoid re-injury.
To consider bio-psyco social factors involved in each case.
To refer for further evaluation if a client is not making progress while doing the rehabilitation program.
Client education/support and commitment to the rehabilitation program is important for return to activity and avoid re-occurrences.
Maintaining cardiovascular fitness has psychological benefits for an athlete.

Check for elbow capsular flexion contractures or valgus deformity particularly with throwing sports. The anterior joint capsule can develop micro tears, scarring and calcification. This will need to be addressed by active stretching in Phase 1 and 2 (within clients comfort zone).
In Phase 2 the addition of joint mobilizations if full elbow range has not returned.
In Phase 2 and 3 active assisted and passive stretching to improve wrist, elbow and forearm motion.
Phase 3, adding increased resistance and diagonal motions prepare for plyometric exercises. As the highly irritable acute phase reduces rehabilitation begins.

Cautions/Red Flags:

Particular attention with children involved in throwing sports as bony changes can develop with repetition and more serious pathologies progress more quickly in the young.

Psychological considerations:

A therapist should develop a rapport with his client. This will assist him in motivating the client and recognising potential problems.
To much rest has a detrimental effect on recovery. Appell (1991).
Client education ensures client empowerment and supports compliance. This can also be used to prevent re-occurrences.
An effort should be made to make the program interesting and varied to prevent de-conditioning and again to ensure compliance.
The setting of long and short term objective and measurable goals helps motivate client.
Bibliography:


