

The Elbow

(Current Concepts in Lateral Epicondylagia)

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Elbow Conditions

- Acute
 - Fracture/dislocation of the elbow
 - Olecranon bursitis
- Acute on chronic
 - Elbow instability - MCL rupture
- Chronic
 - Lateral epicondylalgia
 - Medial epicondylalgia
 - Osteochondritis dissecans
 - Radial nerve entrapment
 - Arthritis

Lateral Epicondylagia 'Tennis Elbow'

Ellenbecker et al., (2010)

Evaluation of the patient/athlete with epicondylagia involves a **complete upper extremity approach** and a corresponding treatment approach that addresses the identified deficiencies to restore normal function.

Overview

- The common disorder of tennis elbow presents with pain on the lateral aspect of the elbow occurring mainly during gripping activities or resisted movements.
- Clinical diagnosis can be made on history and examination alone.
- It is usually a self-limiting condition and mostly resolves with non-operative management, which includes activity modification, pain relief and physiotherapy.
- Resolution of symptoms can take between 6 and 24 months before completely settling down, with 20 per cent of cases taking more than one year.
- Resistant cases may require surgery.

Epidemiology - Sports

- Lateral epicondylitis, is the **most common sports related injury of the elbow** and a primary cause of elbow pain. These injuries occur mostly in overhead athletes, throwers, racket sports, and gymnasts (Chorley, 2012)
- 40%-50% of all tennis players (Hume et al, 2006; Kelley et al. 1994)
- It occurs much more frequently than medial epicondylitis, which has been diagnosed 7-10x more often. (Ciccotti and Ciccotti, 2004)

Epidemiology – General Population

- Mean age 40 – 60 years – Why? – Ability to recover?
- Female (1.1-4.0%) > Male (1.0–1.3%) general population
- Associated with forceful activities, high force combined with high repetition, or awkward postures
- Dominant side > non dominant side
- Prone to recurrence

Shiri and Viikari-Juntura, 2011

Prevalence of lateral and medial epicondylitis.

Population	Lateral		Medial		Lateral or medial	
	%	Reference	%	Reference	%	Reference
General populations	0.7–4.0	[7,13,44,104]	0.3–1.1	[7,44]	1.0–3.0	[7,13,35]
Working populations	0.3–12.2	[11,17,20,37,39,40,45,46,48–51]	0.2–3.8	[11,15,20,39,40]	0.8–29.3	[11,36–43]
Construction foremen					1.4	[14]
Textile workers					2.0	[36]
Aeroengineering factory workers					2.0	[51]
Shop assistants	2.3	[40]	0	[40]	2.3	[40]
Plastic surgeons	13.5	[47]				
Nursery school cooks	10.5	[11]	1.4	[11]	11.5	[11]
Nursery school workers other than cooks	2.5	[11]	0	[11]	2.5	[11]
Kindergarten teachers and traffic policemen	0.3	[45]				
Automobile manufacturing workers	3.3	[39]	2.2	[39]	5.5	[39]
Meat cutters					8.9	[14]
Fish-processing factories workers					14.5	[38]
Shoe factory workers	2.0	[50]	0	[50]		
Supermarket cashiers	4.8	[17]				
Clothing and shoe industry workers	4.8	[17]				
Food industry workers	7.0	[17]				
Engineering industry workers	7.4	[17]				
Auto assembly workers					16.0	[41]
Assembly line packers in a food production factory	2.6	[40]	3.3	[40]	5.9	[40]
Assembly line workers of the manufacture of small electrical appliances, motor vehicle accessories, or ski accessories	20.0	[17]				
Vibration-exposed forestry workers					29.3	[43]
Sewing machine operators	4.9	[42]	0	[42]	4.9	[42]



Pathomechanics

- Degenerative changes to ECRB (EDC)
- Neovascularisation & Changes to the Nociceptive System (excitatory neurotransmitter glutamate - Alfredson et al., 2000), (Neurokinin 1 -receptors and sensory neuropeptides substance P (SP) and calcitonin gene-related peptide (CGRP) in tendon insertions at the medial and lateral epicondyles of the humerus - Ljung et al., 2004)
- NOT INFLAMMATORY! (Alfredson et al., 2000)
- Impaired ability to perform motor tasks:
 - Sports - Tennis (Kelley et al. 1994)
 - Grip Strength deficits (Waseem et al, 2012, Bisset et al. 2006; Stratford et al. 1987, 1993)
 - Reaction times and speed of movement with results indicating implication of unaffected side (Bisset et al, 2006; Pienimaki et al. 1997)
 - Wrist posture (Bisset et al. 2006)
- Muscle function and pain measures show a greater impaired function of the arm than in chronic medial epicondylitis (Pienimaki, et al., 2002)

Alizadehkhayat et al. 2009

- Study included three age-matched female groups (N=21) of **C** (no history of musculoskeletal problems), **RTE** (asymptomatic for at least 6 months, no lateral epicondyle tenderness), and **TE** (local tenderness at the lateral epicondyle and pain with resisted wrist and middle finger extension)
- Measurements included MCP, wrist, shoulder and grip isometric strength, and EMG measures of muscle fatigue and activity for five forearm muscles (wrist extensors and flexors).
- **Strength was greater for all measurements in C compared to RTE and TE. MCP extension was stronger in RTE than TE. EMG revealed increased activity of extensor carpi radialis (ECR) in RTE, decreased in TE.**
- LE = reduction in grip strength, reduction in rate of force development and an increase in electromechanical delay (Chourasia et al., 2012)

Murgia et al., 2011 – Kinematic analysis

- A 42-year-old right-handed male, with no history of LE, performed a repetitive movement involving pushing and turning a spring-loaded mechanism
- Motion capture data were acquired for the upper limb and an inverse kinematic and dynamic analysis was subsequently carried out.
- Results illustrated the presence of eccentric contractions sustained by the extensor carpi radialis longus (ECRL), together with an **almost constant level of tendon strain of both extensor carpi radialis brevis (ECRB) and extensor digitorum communis lateral (EDCL) branch.**
- It is believed that these factors may partly contribute to the onset of LE as they are both responsible for the creation of microtears at the tendons' origins.

Diagnosis

- **Area of pain** = lateral epicondyle +/- into forearm - NOT cervical, shoulder or radiating above the elbow
- **Behaviour of symptoms** = grip/twist/lift activities - NOT head or shoulder movts
- **History** = Usually associated with repetitive use , sometimes unknown
- **Physical Exam** ((Pienimaki et al, 2002):
 - Pain on isometric resisted wrist extension or ECRB (2nd/3rd finger extension)
 - Tender on palpation over lateral epicondyle
 - Pain on gripping ***
 - Pain on stretch (rare) – NOT tight
 - Negative joint signs (i.e. full active and passive ROM)
- **Exclude:**
 - Radial nerve compression in the Arcade of Frohse
 - radial head dislocation or radio-ulnar joint pain
 - somatic referred pain C5-6
 - nerve root pain C5-6 origin

Shiri and Viikari-Juntura, 2011

Diagnostic criteria for lateral and medial epicondylitis.

Reference	Lateral epicondylitis
Harrington et al., 1998 [23]	1) Epicondylar pain and 2) Epicondylar tenderness and 3) Pain on resisted extension of the wrist with the elbow extended
Sluiter et al., 2001 [31]	1) At least intermittent, activity-dependent pain localised around the lateral epicondyle for more than 4 of the past 7 days and 2) Local pain on resisted wrist extension

- Therapists tend to rely on generic maximum grip strength and numeric pain rating to measure the outcomes of treatment, and less on more responsive measures of pain; free grip and self-report scales that were designed specifically for LE (MacDermid et al., 2010)

Wixon and LaStayo, 2012

TABLE 1. Tennis Elbow Classifications

	<i>Severe Symptoms</i>	<i>Moderate Symptoms</i>	<i>Mild Symptoms</i>
<i>Signs and Symptoms</i>	<i>Cyriax Acute Galloway Severe (Protocol 1) Nirschl Phases 5, 6, and 7</i>	<i>Cyriax Subacute Galloway Mild/Moderate (Protocol 2) Nirschl Phases 3 and 4</i>	<i>Cyriax Chronic Galloway Symptoms Resolved (Protocol 3) Nirschl Phases 1 and 2</i>
Pain	Pain at rest—significantly limits participation in all activities	Pain with sports and work activities. Mild pain with activities of daily living. Pain limits performance in sports/work	Mild pain after activity, which resolves within 72h after cessation of activity pain does not limit participation in activities
ROM	≥5° Motion loss at wrist/elbow	+/- Motion loss may or may not be present	No motion loss
Resisted test	Pain with minimally resisted wrist extension (elbow flexed)	Pain with resisted wrist extension (elbow flexed or extended)	Pain with resisted wrist extension (elbow extended)
Grip test	Pain/≥50% GSD with elbow flexed or extended	Pain/≥50% GSD with elbow extended. Pain/<50% GSD with elbow flexed	Mild pain with grip strength test with elbow extended and minimal to no pain with elbow flexed—may not have significant GSD
Palpation	Pain with palpation at lateral epicondyle—no blanching of finger(s) (minimal pressure)	Pain with palpation at lateral epicondyle with mild blanching of examiner's finger(s) (moderate pressure)	Pain with palpation at lateral epicondyle only with full blanching examiner's finger(s) (firm pressure)

Wixon and LaStayo, 2012

- **Severe**; rest, wrist control orthotic device (splint) with or without a counterforce elbow strap, and pain management.
- **Moderate** or **Mild**; restorative exercise program that incorporates progressive resistance exercises. The intensity of the restorative exercise program should be lower for those in the “moderate” category and progressively increased as the patient transitions into the “mild” category.
- It is important to note that **individuals may transition from one classification level** to another over a multi-week course of treatment, and treatment

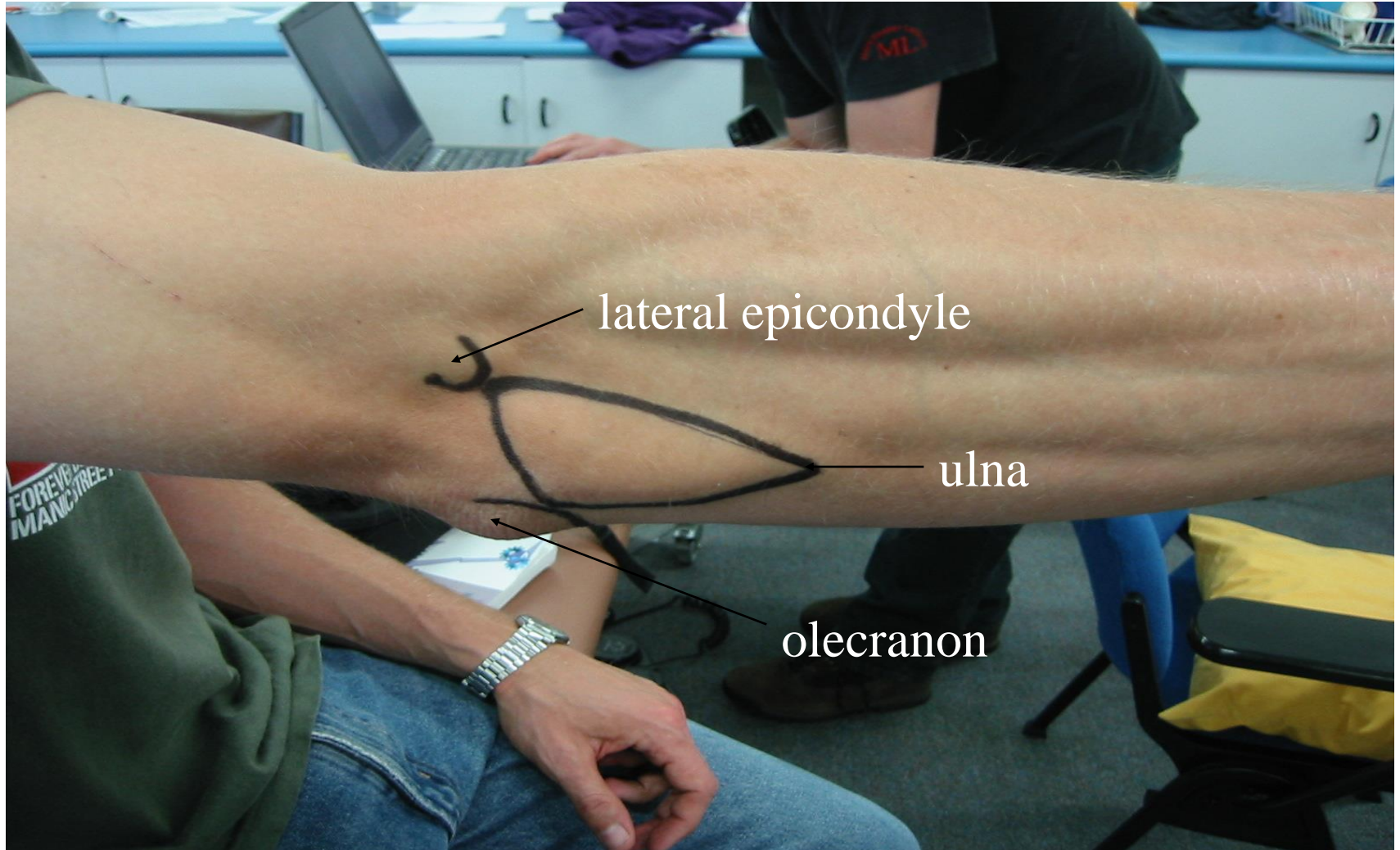
Psychosocial (Garnevall, Rabey and Edman, 2013)

- The Orebro Musculoskeletal Pain Screening Questionnaire (OMPSQ) differentiated Nirschl's sub-groups more effectively than the pressure pain threshold (PPT), isometric maximal load pain tolerance and isometric low load (sustained hold of 0.5 kg weight) pain tolerance (LLT) of the wrist extensors, but the control group did not complete the OMPSQ, so a comparison of the subjects with LE to symptom free subjects was not possible
- Elevated somatic anxiety in the most symptomatic patients may indicate possible alexithymia or an **inability to understand or cope with somatic symptoms of distress**. The subjects in this study with epicondylalgia exhibited widespread, likely central nervous system mediated hypersensitivity, motor impairment and psychosocial factors in keeping with a modern model of LE

Radiographic Imaging

- Regardless of whether the tendinosis is located medially or laterally, MR imaging demonstrates the **same epicondylitis features on either side**. T1-weighted images show **tendon thickness and signal intensity changes**. Abnormalities of the tendon and signal changes are highlights of MR tendon pathology (Melloni and Valls, 2005)
- Ultrasonography can find **calcifications or hypoechoic areas in the lateral epicondyle region and may be useful in diagnosing tendinosis** (Fritz and Breidahl, 2004)

What about Anconeus?





Treatment & Rehabilitation

Treatment Techniques

- Non-operative treatment is very successful in lateral epicondylitis/ tendinosis, and the rate of success is as high as 90%.⁴ (Van Hefwegen, Baker and Baker, 2010)
- Mainstays of nonsurgical treatment include physical therapy, bracing, and injections. Elimination (modification) of the offending activity is important for the success of non-operative treatment.
- Physical therapy generally involves massage as well as stretching and strengthening the common extensor complex. Electrotherapy is also typically used.

Systematic review (Trudel et al., 2004)

Conservative treatment of lateral epicondylitis from the years 1983 to 2003. A total of 209 studies were located; however, only 31 of these met the study inclusion criteria.

Treatments, including acupuncture, exercise therapy, manipulations and mobilizations, ultrasound, phonophoresis, Rebox, and ionization with diclofenac **all show positive effects in the reduction of pain or improvement in function for patients with LE**

Laser therapy and pulsed electromagnetic field therapy is ineffective in the management of this condition

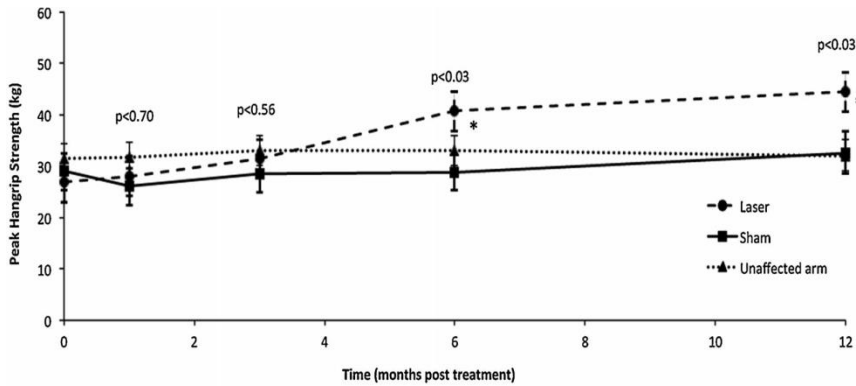
There is a lack of evidence for **the long term** benefit of physical interventions; manual therapy, acupuncture, orthotic and taping, exercise, laser, electromagnetic field and ionisation, US and phonophoresis, extracorporeal shock wave therapy (Bisset et al., 2005)

Laser Therapy

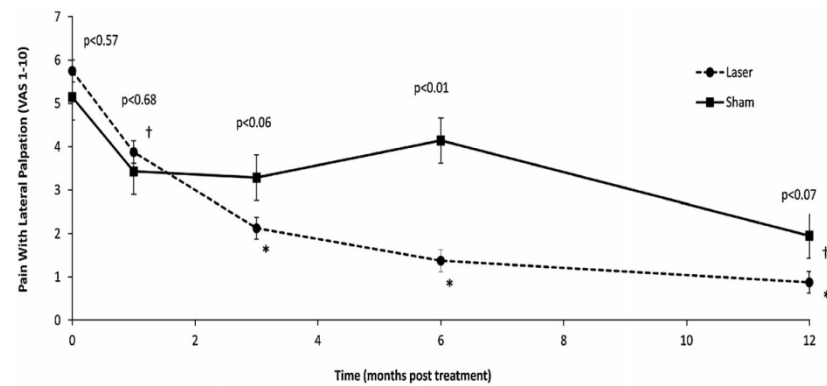
- A systematic review by Bjordal et al., (2008) reported on 7 trials that used 904 nm wavelength applied to the tendon pathology that demonstrated positive results. The authors found that more rapid recovery was seen in patients who had low-level laser therapy combined with an exercise regime.
- No significant differences were observed between the laser and the placebo group in relation to the subjective or objective outcome after 10 treatments or at the follow-ups. Laser treatment applied to acupuncture points in lateral humeral epicondylalgia. A double-blind study (Haker and Lundeberg, 1990)

Laser (Roberts, Kruse and Stoll, 2013)

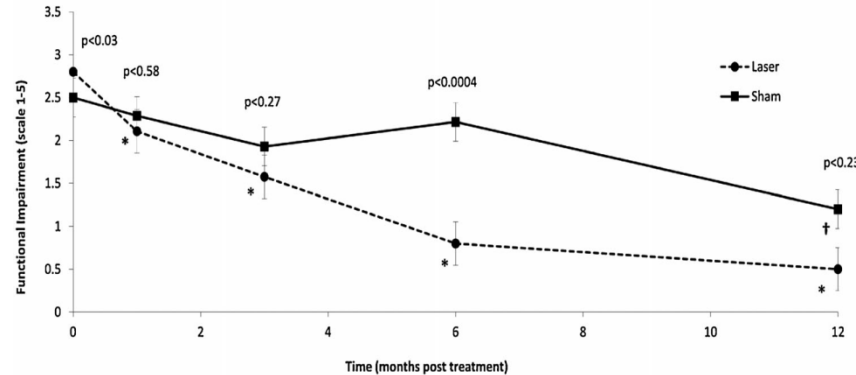
Peak Grip



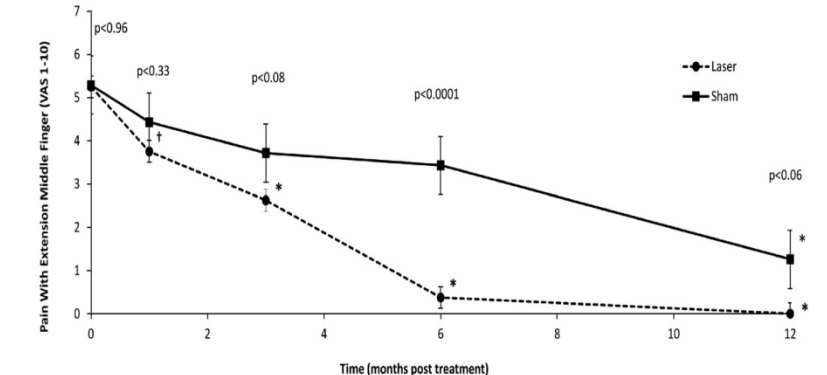
Lateral Pain with Palpation



Functional Impairment



P with resisted middle finger ext.



ESTW

- Extracorporeal shock wave therapy: One systematic review and one subsequent RCT found **no significant difference in symptoms between extracorporeal shock wave therapy and sham treatment at 3 months** (Assendelft et al., 2004)
- Pettrone and McCall (2005) reported statistically **significant pain improvement at 12 weeks** in those treated with ECSW when compared with placebo and concluded that ECSW was a safe and effective treatment for tennis elbow.
- **Whereas in vitro studies often show the effects of ESWT on tendon tissue, results of clinical studies are inconsistent** (Van der Worp et al., 2013 – Patellar tendonopathy)

ESTW (Smith and Finoff, 2009)

Effectiveness of ESWT may **depend on the stage of tendinopathy**. A recent model of tendinopathy differentiates between a reactive tendinopathy/early tendon disrepair phase and a late tendon disrepair/degeneration phase. ESWT seems most appropriate in the latter where the tendinopathy is degenerative and when conservative treatment has no effect

Diagnostic ultrasound provides excellent imaging of the common extensor tendon. Not typically required for initial diagnosis, ultrasound assists in management of refractory cases lateral epicondylitis (also called tennis elbow) by **characterizing the extent of tendon tearing** and identifying the presence of concomitant RCL injury

Acupuncture & STM (Gliedt and Daniels, 2014)

- 41yr old male with 5 week h/o pain over lateral epicondyle
- H/o trauma – fall over area
- **2 sessions of acupuncture** (four acupuncture needles were superficially inserted into palpated areas of tenderness, just distal to the insertion site of the common wrist extensor muscles, for fifteen minutes) = TrP?
- **1 Session of Active release Therapy**
- A home exercise program consisting of Brugger's exercises (Postural)
- ?Lateral Epicondylagia

Acupuncture (Short term effect/Combo)

- Anti-inflammatory drugs, corticosteroid injections and **acupuncture** provide **short-term** beneficial effects (Shiri and Viikari-Juntura, 2011)
- There is **clinical evidence suggesting that acupuncture may have a role in the treatment** of tendinopathy, through the facilitation of tendon blood flow and fibroblastic activity (Rees et al., 2009)
- A group of interventions have shown evidence of **short term benefit (up to three months)**. This includes **US, ionisation, and acupuncture**. This effect appears to disappear, and there is evidence of no difference from placebo in the long term. To determine the applicability of these modalities in the management of LE therefore, the cost of the treatment needs to be weighed against the temporary relief in symptoms gained (Bisset, 2005)
- **Acupuncture, exercise therapy, manipulations and mobilisations, Ultrasound, phonophoresis, and ionization with diclofenac all show positive effects** in the reduction of pain or improvement in function. Laser and pulsed electromagnetic field therapy were found to be ineffective (Trudel et al., 2004)
- Insufficient evidence from small, methodologically weak RCTs about effects of **needle acupuncture, laser acupuncture, or electroacupuncture in people with tennis elbow** (Assendelft et al., 2004)

MFR (Ajimsha, Chithra and Thulasyammal, 2012)

- N = 68
- The Patient-Rated Tennis Elbow Evaluation (PRTEE) scale used to assess pain severity and functional disability. Week 1 (pre-test score), week 4 (post-test score), and [follow-up at week 12](#)
- [MFR group performed better than the control group](#) (Sham US) in weeks 4 and 12. Patients in the MFR and control groups reported a 78.7% and 6.8% reduction, respectively, in their pain and functional disability in week 4 compared with that in week 1, which persisted as 63.1% in the follow-up at week 12 in the MFR group.
- Good description of MFR techniques

MWMs

- Vicenzino and Wright (1995) conducted a single case study on a 39 year old female to explain the effectiveness of MWM in Tennis elbow.
- Study conducted by utilized specific mobilization with movement (MWM) technique indicate improvement in symptoms in 92% of subjects - 25 subjects. Mobilization with movement applied to the elbow affected shoulder range of movement in this group. Surprisingly, these ROM increases were also apparent on the 'unaffected' limb. These findings suggest that the MWM causes a neurophysiologically mediated decrease in resting muscle tone?. (Abbott et al., 2001)

MWMs (Amro et al., 2010)

- A combination of Mulligan techniques (MWMs and Taping) and traditional treatment (thermal treatment, massage, and US, as well as strengthening and stretching exercises) compared with that of traditional treatment alone in patients with lateral epicondylitis
- N = 34 (11 sessions of treatment)
- Evaluated before treatment and after 4 wks
- Both experimental and control group showed improvement
- Significant improvement in VAS and Grip strength in the Experimental group

Exercise

The recommended approach to clinical manual therapy management of LE is based on the findings from physical examination and matching the treatment approach to the deficits highlighted in the clinical examination. Essentially, **therapeutic exercise forms the mainstay of the program. Manual therapy and sports tape are useful adjunctive therapies to achieve rapid pain relief** that allow for effective and timely physical conditioning of the affected muscles (Vincenzino, 2003)

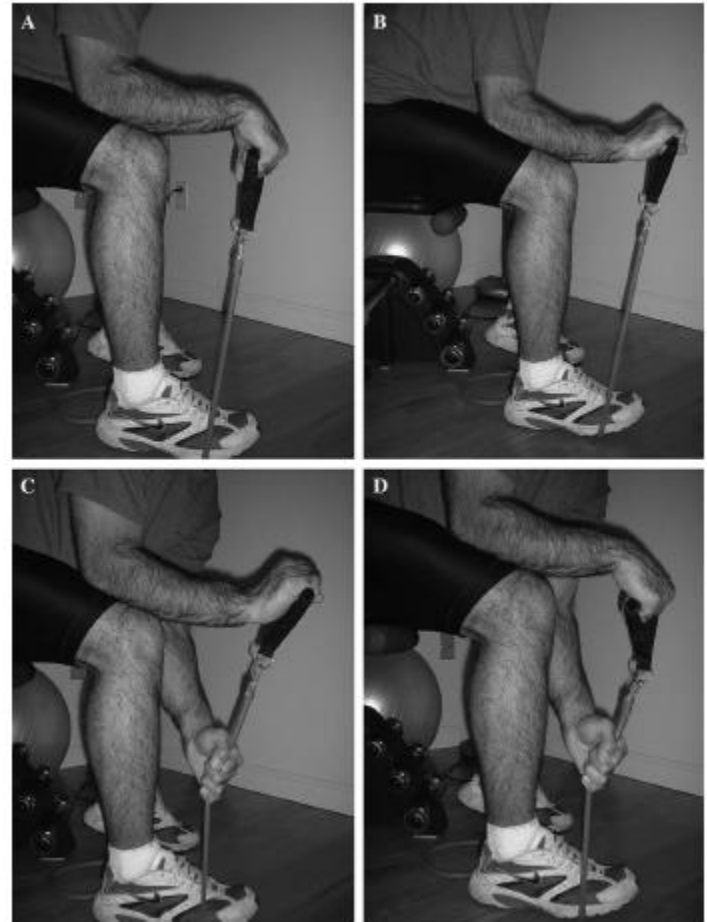
Exercise

- Progressive **exercise therapy** is more effective than ultrasound in treating chronic lateral epicondylitis, reducing pain and improving patients' ability to work (Pienimaki et al, 1996)
- In a follow-up study, the patients in the **exercise group** had a better outcome and prognosis in the 36-month follow-up. They had significantly less pain and they had retained the good effect of the primary exercise intervention and had made fewer doctor and physiotherapy visits and had fewer sick-leave days than before the original treatment intervention (Pienimaki et al, 1998)

Exercise (Martinez-Silvestrini et al., 2005)

- Stretching vs Concentric vs Eccentric
- Sx > 3mo, N = 94 subjects (M50, W44)
- No significant differences in outcome measures were noted among the three groups.

Although there were no significant differences in outcome among the groups, eccentric strengthening did not cause subjects to worsen



.....T-twists



.....T-twists



- Tyler et al., (2010). **Addition** of isolated wrist extensor eccentric exercise to standard treatment for chronic lateral epicondylitis: A prospective randomized trial
- N = 21 (11; 6 M, 5W)
 - **DASH: 76%** Tyler Twist vs. 13% control, P = .01
 - **VAS: 81%** vs. 22%, P = .002
 - **Tenderness: 71%** vs. 5%, P = .003;
 - **Strength** (wrist and middle finger extension combined - HHD): **79%** vs. 15%, P = .011.

Exercise (Peterson et al., 2014)

- Eccentric vs concentric exercises
- N = 60 vs 60 (random allocation)
- 20-75yrs, pain > 3mo, verified diagnosis
- Pain during muscle contraction and muscle elongation, as well as strength, was assessed at baseline and after 1, 2, 3, 6, and **12 months**. Function and quality of life was assessed at baseline and after 3, 6 and **12 months**.
- VAS measured at all visits = Cozen's Test, Maximum muscle elongation of the ECRB and ECRL muscles with a load (90° abduction of the arm followed by full pronation of the forearm with a 3-kilogram dumbbell, i.e. a modified empty can test).

Exercise (Peterson et al., 2014)

- **Tertiary outcomes** = general arm function and quality of life aspects (measured at baseline, and at the 3, 6, and 12-months follow-up visits with the Disability of Arm, Shoulder, and Hand questionnaire and the Gothenburg Quality of Life instrument questionnaires)
- The **eccentric exercise group** had faster regression of pain, with an average of 10% higher responder rate at all levels of pain reduction, both during muscle contraction and elongation
- **Significant differences** were found in Cox's analysis from two months onwards
- This represents an absolute pain reduction of 10% in the eccentric vs. the concentric group. The **eccentric group** also had a greater increase of muscle strength than the concentric
- The **differences** persisted throughout the follow-up period.
- **There were no significant differences** between the groups regarding function or quality of life measures.

Exercise (Raman, MacDermid, and Grewal, 2012)

- 12 studies (1990-2010); 9 addressed the effects of isotonic (eccentric/concentric) exercises, 2 studied the effect of isometric and one studied isokinetic exercises.
- Programs ranged over a period of 4 to 52 weeks. Exercises were prescribed 1 to 6 times per day, with an average duration of 15 minutes per session, and average of 15 repetitions (range: 3 to 50), with 1 to 4 sets per session.
- All studies reported that resistance exercise resulted in substantial improvement in pain and grip strength; eccentric exercise was most studied.
- Strengthening using resistance exercises is effective in reducing pain and improving function for lateral epicondylitis but optimal dosing is not defined

IT vs IK Eccentric (Guilhem et al., 2010)

- The synthesis of the studies found in the literature and reported in this review allowed for identifying differences in the adaptive process induced by IT and IK eccentric trainings
- Greater muscle hypertrophy after IK training (eccentric training)
- Greater increase in neuromuscular activation after IT (eccentric training)
- Effective Therapeutic Exercise Prescription; The Right Exercise at the Right Dose (Brody, 2012)

Multimodal approach

Smidt et al., 2002

- There was evidence of a marginal advantage over the long term (more than six months) in using a combined physical approach of deep friction massage, US, and exercise in the treatment of LE when compared with a corticosteroid injection, but not compared with a wait and see (no treatment) condition.

Bisset (2006): Case Study

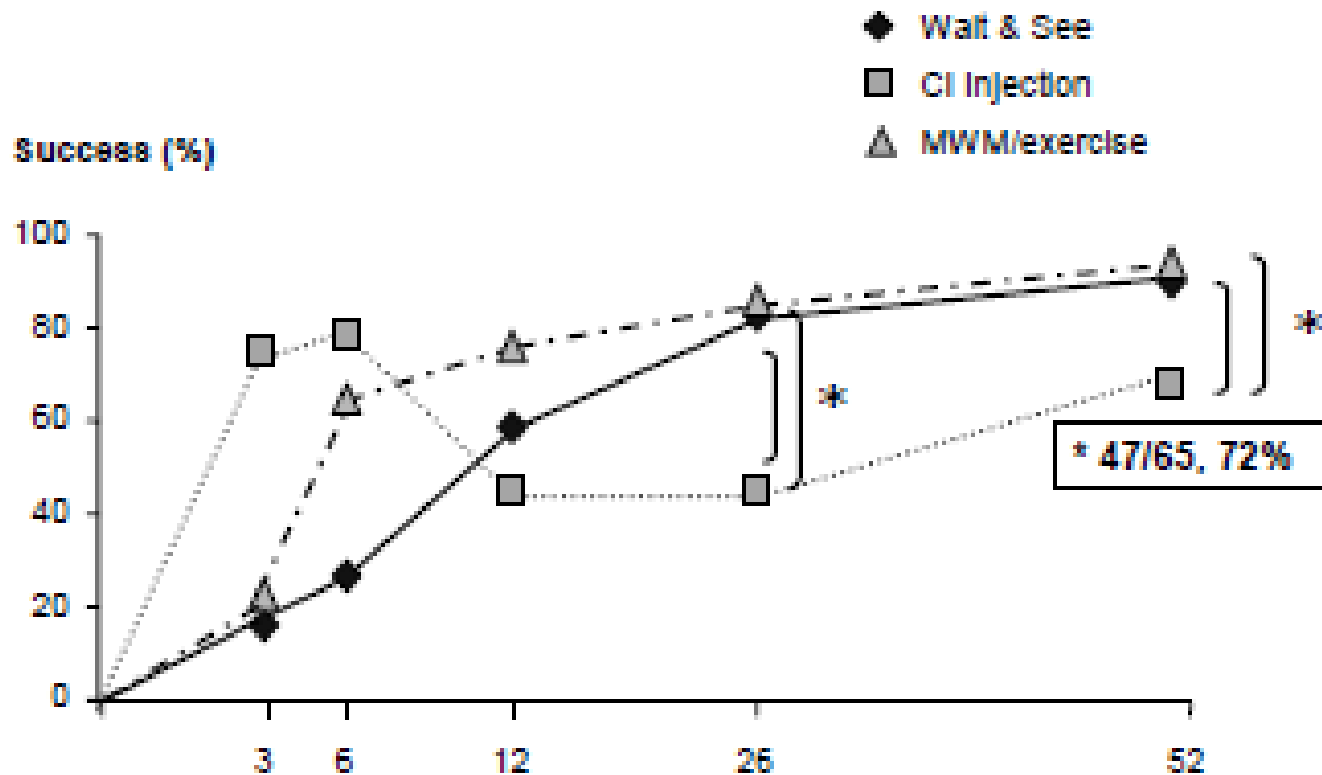
- A combined therapeutic approach of elbow manipulation, taping and an exercise programme was undertaken by a 50-year-old male with unilateral chronic, recalcitrant LE (12 year history). LE in his right (dominant) elbow developed whilst working as an aircraft maintenance engineer in 1991.
- Improvement was recorded at 3, 6 12, 18, 24 and 52 weeks from the start of treatment.

Bisset et al., (2006)

- Physiotherapy combining elbow manipulation and exercise has a superior benefit to wait and see in the first six weeks and to corticosteroid injections after six weeks, providing a reasonable alternative to injections in the mid to long term.
- The significant short term benefits of corticosteroid injection are **paradoxically reversed** after six weeks, with high recurrence rates, implying that this treatment should be used with caution in the management of tennis elbow

Bisset et al., 2006

Success



Radpasand (2009): Case Study

- Treatment of a 57-year-old woman with chronic lateral epicondylitis
- This case report presents a simple systematic approach consisting of a **10-week specific sequential multimodal conservative management approach**
- High-velocity and low-amplitude manipulation, high-voltage pulsed galvanic stimulation, a hard-padded elbow brace, ice, and exercise, along with restricted use of the affected elbow
- Overall, there was a systematic reduction of pain (92.86%), specific activity (100%), and usual activity (96.87%), and even after **3 weeks of follow-up**

(Radpasand and Owen, 2009): Pilot

- 2 Groups (N = 6) using multimodal approaches; A = high-velocity low-amplitude manipulation, high-voltage pulse galvanic stimulation, counterforce bracing, ice, and B = ultrasound, counterforce bracing, and exercise
- Both groups demonstrated changes in all of the outcome variables from the baseline to the end point (12 weeks) of treatment.
- Good discussion of modalities utilised



Bracing/Support (Meyer et al., 2003)

- This study (on both cadaveric and clinical models) showed that the support band provides a mechanical inhibition of **13% to 15% of the distal load of the ECRB during use of the hand.**
- The success of this forearm support band has been considered to be due to decrease in the tension in the ECRB origin off the lateral epicondyle during forearm use
- **Orthoses:** One systematic review found insufficient evidence about the effects of orthoses (braces) compared with placebo or physiotherapy. It found **limited evidence of a short term improvement in symptoms compared with corticosteroid injections** (Assendelft et al., 2004)

Graston + Rehab (Papa, 2012): 2 Cases

- 47 and 48 old females presented with gradual onset of lateral elbow pain over the course of six week and four week respectively associated with work activities.
- Intervention and outcome: The conservative treatment approach consisted of **activity modification, bracing, medical acupuncture with electrical stimulation, Graston Technique®**, and **rehabilitative exercise prescription**. Both patients attained resolution of their complaints, and at **eight month follow-up** reported no recurrence of symptoms.
- The Graston protocol for epicondylosis uses distinctively designed stainless steel instruments, which are applied soft tissues with multidirectional strokes. Preliminary studies utilizing the Graston Technique for this condition have shown promising results when compared with a traditional physiotherapy protocol (Smidt et al., 1995)

Injections: Corticosteroids

- **Stop Injecting corticosteroid** (Editorial, Sports Medicine, 2009)
- Coombes et al., (2010), meta-analysis, demonstrated **worse results** from glucocorticoid use when compared with other treatments and placebo **in the intermediate and long-term** follow-up of treatment for **tennis elbow**
- Due to inconsistent and often marginal long-term results of corticosteroid injections to treat CE tendinopathy (lateral epicondylitis), researchers have attempted to more directly stimulate a healing response . **Ultrasound-guided percutaneous tenotomy, PRP injection, sclerosing therapy, and autologous blood injections** have all produced promising short-term improvements in refractory cases, (Smith and Finoff, 2009)

Injection: Prolotherapy

- Prolotherapy is the iatrogenic stimulation of tissue repair through the **injection of an irritant solution** into the involved tissues. This irritant typically consists of **dextrose and sodium morrhuate** but can also include **glycerin and phenol**.
- Scarpone et al (2008) reported **short term pain relief** in patients at 8 and 16 weeks compared with control subjects (dextrose and sodium morrhuate).
- Carayannopoulos et al (2011) conducted a randomized controlled trial comparing prolotherapy (phenol, glycerin, dextrose, sodium morrhuate) with corticosteroid injections. Both groups demonstrated improvement at **6 months**. However, because of **small sample sizes, no difference was found between the 2 groups**.

Injection Therapy: PRP & Autologous

- Treatment of chronic tennis elbow with leukocyte-enriched PRP is safe and **results in clinically meaningful improvements** compared with an active control group (Taylor & Hannafin, 2012)
- Platelet-Rich Plasma **Significantly Improves Clinical Outcomes** in Patients With Chronic Tennis Elbow: A Double-Blind, Prospective, Multicenter, Controlled Trial of 230 Patients. (Mishra et al., 2013)
- 22 patients in whom nonsurgical modalities had failed were **completely relieved of pain even during strenuous activity** after receiving the treatment of Autologous blood injections. Edwards and Calandruccio (2003).

Injection Therapy: PRP & Autologous

- **Autologous blood** and corticosteroid provide **no advantage over placebo saline injections** in the treatment of lateral epicondylitis. Patients within each injection group demonstrated improved outcome scores over a 6-month period (DASH score) (Moriatis et al, 2011)
- Existing research suggests an improvement in clinical symptoms of tennis elbow following **PRP injection** compared with either glucocorticoids or autologous whole blood injections (Mishra et al., 2012)
- Mishra and Pavelko (2006) found a **93% reduction** in pain using a **leukocyte-rich PRP** and the **peppering technique**

Injection: PRP

- Peerbooms et al (2010) have conducted a double-blind prospective randomized trial **comparing corticosteroid with PRP**, and published results on **1, and 2 year follow-ups** (Gosens et al, 2011).
- They randomized 100 patients to a leukocyte-rich PRP group or corticosteroid group. At the 2-year follow-up, they found that **the PRP group experienced a statistically significant reduction in pain and an improvement in functionality based on VAS and DASH scores.**
- The potential complications to injecting autologous blood or autologous PRP are less than corticosteroids given that **skin discoloration, fat atrophy, and tendon rupture have never been reported.**

Banffy and ElAttrache (2012)

- There is an inflammatory event that does occur after injection of the leukocyte-rich PRP, secondary to the presence of leukocytes, which can be quite painful.
- Injection of autologous conditioned plasma (ACP), which has a significantly reduced amount of leukocytes, with the addition of ketorolac, has the benefits of a leukocyte-rich PRP injection, with mitigation of the painful inflammatory response.
- Ultrasound guidance to the hypoechoic area of the pathologic tendon, and then perform a peppering technique.

Surgery

- Even though the **spontaneous recovery from a first episode of LE is 12 months in approximately 80 per cent of cases** (Smidt et al 2003), there are some cases which become recalcitrant to all treatments and prone to repeated episodes.
- **Chronic or recurrent cases and treatment failures may eventually undergo surgery** (Buchbinder et al 2002).
- Surgical intervention is reserved for those patients who **remain symptomatic for greater than 6 months**, despite myriad conservative measures. The gold standard remains **6 to 12 months of conservative care prior to surgical intervention**.

Surgical

- Clarke et al (2010) used **diagnostic ultrasound** to evaluate the size of the intra-substance tear and correlated it with patient outcome. **Patients with large tears were more likely to have a negative response to conservative treatment as measured by scores on the Patient-Rated Tennis Elbow.**

Surgical

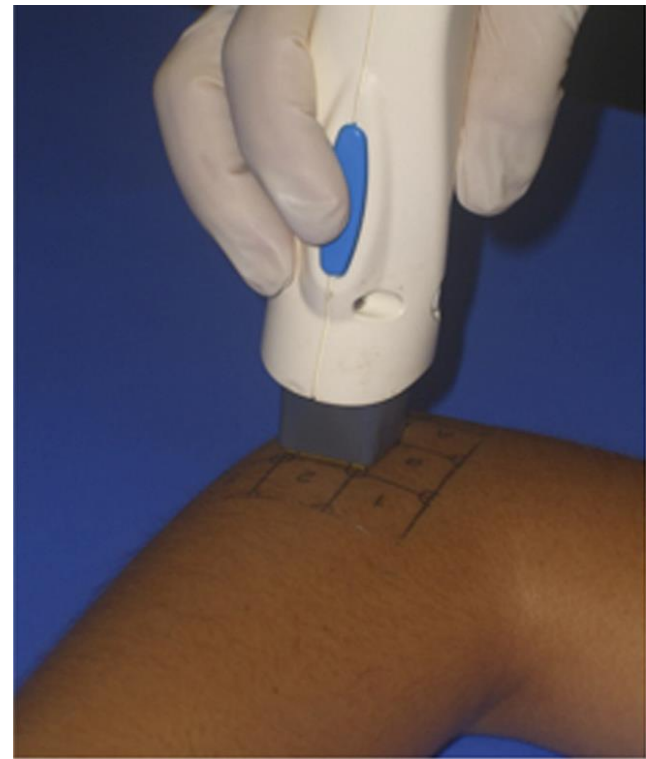
- There are **different types of surgical interventions which all seem to yield favourable results** (Othman, 2011)
- These include **percutaneous, open, and arthroscopic techniques**. Percutaneous treatment involves release of the extensor tendon origin at the lateral epicondyle. This technique has been advocated as safe, reliable, and cost-effective. Othman (2011) = similar outcomes for arthroscopic and percutaneous techniques at 12 months' follow-up.
- Post-op Management of the injured tendon (2012)



New Concepts

Noninvasive Monopolar Capacitive-Coupled Radiofrequency (mcRF) (Weber & Kabelka, 2012)

- 42 Elbows
- Unsuccessfully treated before 3mo.
- VAS at rest, with regular activity, and with triggering events were gathered at 3, 6, and 12 months.
- Nirschl Tennis Elbow Questionnaire and patient satisfaction also were used to evaluate study outcomes
- 81% of participants had successful outcomes
- No control group



Surgical (Joyce et al., 2013)

- A new **minimally invasive mode** of treatment that delivers focused, **calibrated ultrasonic energy**, effectively **microresecting the pathological tendon and removing only pathological tissue**
- 7 male and 13 female patients aged 33 to 65 years averaging **12.5 months** (range, 4-48) of failed nonoperative therapy underwent the **ultrasonic microresection** procedure in an outpatient clinic setting.
- Procedure; 3 steps = **approx. 12mins**
- Good evidence of **some level of efficacy in 19 of 20 patients (95%)** that is sustained for at least 1 year.

Conclusion

A detailed review of the available treatment modalities fails to identify any clear definitive choice to address pain levels; however, a combination of appropriate modalities and exercise should can be considered tailored for the individual symptoms and required activities.

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