Tennis Elbow Treatment Approaches
Physiotherapy management of lateral epicondylalgia

KEY WORDS
Tennis elbow
Physiotherapy
Lateral elbow
Physical therapy

Introduction

Lateral epicondylalgia (LE), more commonly known as tennis elbow, is the most common chronic musculoskeletal pain condition affecting the elbow, causing significant pain, disability and lost productivity. Despite decades of research investigating treatments and the underlying mechanisms of LE, it remains a challenging condition for physiotherapy clinicians and researchers alike. This topical review outlines the prevalence, burden and risk factors associated with LE. Diagnosis, assessment and the principles of management are also presented. The contemporary evidence for treatment efficacy and directions for future research are also discussed.

Prevalence of lateral epicondylalgia

Approximately 40% of people will experience LE at some point in their life.1 It most commonly presents in men and women aged between 35 and 54 years.2–4 The reported point prevalence of LE is between 1 and 3% within the general population,5–7 and four to seven per 1000 patients visiting general medical practitioners.3,6,8,9 Up to 50% of all tennis players also experience some type of elbow pain, with 75 to 80% of these elbow complaints attributable to LE.1,10,11

The burden of lateral epicondylalgia

LE most commonly affects the dominant arm, particularly when performing repetitive activity, so it is not surprising that the greatest burden of LE is among manual working populations where musculoskeletal upper limb injuries account for some of the longest work absences.1,12 Up to 17% of workers within industries that involve highly repetitive hand tasks, such as meat processing and factory workers, experience LE.13–16 This results in an absence from work of up to 219 workdays, with direct costs of US$8099 per person.17,18 Data from Workcover Queensland indicates that upper limb (shoulder and elbow) injuries account for 18% of all work-related claims (2009 to 2013), which is equal to the prevalence of back injuries.19

Clinical course and risk factors for lateral epicondylalgia

In his seminal paper on tennis elbow in 1936, Dr James Cyriax proposed that the natural history of LE was between 6 months and 2 years,20 which has since been widely cited. In contrast, recent reports have shown that symptoms may persist for many years and recurrence is common.21–23 Over 50% of patients attending general practice for their elbow pain report not being recovered at 12 months.21,22 Follow-up of participants in a clinical trial13 of non-surgical treatments for LE identified that 20% of respondents (27/134) reported ongoing pain after 3 to 5 years (mean 3.9 years) regardless of the treatment received, and that those with high baseline severity were 5.5 times more likely to still have symptoms of LE. Therefore, LE is not self-limiting and is associated with ongoing pain and disability in a substantial proportion of sufferers.

Workers in manual occupations involving repetitive arm and wrist movements are at increased risk of LE27,28 and are more resistant to treatment, with a poorer prognosis.29,30 Office work, older age, being female,31 previous tobacco use and concurrent rotator cuff pathology are also significantly associated with LE.32

One plausible reason for persistent pain in LE is the presence of sensitisation of the nervous system,33,34 given the reduced thresholds to nociceptive withdrawal35 and greater temporal summation.36 It has previously been shown that people with LE exhibit widespread hyperalgesia (ie, enhanced pain response to various stimuli), which is associated with high pain scores, decreased function and longer symptom duration.33,34,37,38

Diagnosis and assessment

LE is a diagnosis based on clinical history and physical examination, with diagnostic imaging best used when a differential diagnosis is likely. LE is typically diagnosed by the presence of pain over the lateral humeral epicondyle that may radiate distally into the forearm. This pain is aggravated by palpation, gripping and resisted wrist and/or second or third finger extension.2,39 While LE is thought to result from an overload of the forearm extensor muscles,13 the pain may have an insidious onset with no specific causal activity.21
To assist prognosis, assessment of pain and disability should be performed at baseline, as there is some evidence to show that people who present with higher pain and disability are more likely to have ongoing pain at 12 months.72,74 The Patient Rated Tennis Elbow Evaluation is a condition-specific questionnaire that includes both pain and function subscales, which are aggregated to give one overall score of 0 (no pain or disability) to 100 (worst possible pain and disability).41,42 A minimum change of 11 points or 37% of the baseline score is considered to be clinically important.43 The most common functional limitation in LE is pain on gripping, and this can be measured as pain-free grip strength, which is a reliable and valid measure that is more sensitive to change than maximal grip strength.44 With the patient lying supine, the elbow in relaxed extension and the forearm pronated, the patient is asked to grip a dynamometer until the first onset of pain, and the mean of three tests at 1-minute intervals is then calculated.45

Elbow, wrist, and forearm range of motion, stress testing of the medial and lateral collateral elbow ligaments, and specific tests for elbow instability (e.g., Posterolateral Rotary Drawer Test46 and Table Top Relocation Test47) should be assessed to aid the symptoms of LE.51 The role of cervical and thoracic spine impairments in the prognosis of LE requires validation; however, in light of these exploratory studies, the clinician should include testing of the radial nerve are also helpful in identifying spinal extension in people with localised symptoms of LE.51 The role of cervical and thoracic spine impairments in the prognosis of LE requires validation; however, in light of these exploratory studies, the clinician should include cervical and thoracic spine assessment in their examination of the patient presenting with LE.

Imaging studies, such as ultrasound (US) and magnetic resonance imaging, have high sensitivity but lower specificity in detecting LE.52-54 Structural abnormalities identified on imaging tend to be consistent across all tendinopathies, and include focal hypoechoic regions, tendon thickening, neovascularisation, disruption of fibrils and intrabursal tears.52-55 Importantly, structural changes on imaging are present in approximately 50% of healthy, asymptomatic age-matched and gender-matched individuals.23,54 indicating that caution must be applied in interpreting the relevance of such findings. Notwithstanding this, negative image findings can be used to rule out LE as a diagnosis22,53 and assist with alternative diagnoses such as instability and/or joint pathology.54,56 A notable differential diagnosis is the presence of a large tear (> 6 mm) within the tendon or lateral collateral ligament, which has been linked to failed conservative treatment.57

Management of lateral epicondylalgia

Physical interventions for LE have been widely investigated, with the publication of more than 200 clinical trials and several systematic reviews. Conservative management is recommended as the first line of treatment for LE. In order to facilitate summary and interpretation of this volume of literature, the present review has focused on summarising the findings for conservative interventions that have been compared to a control, placebo or other interventions in randomised, controlled trials (RCTs) of sound methodological quality (defined for this review as a rating ≥ 5/10 on the PEDro scale). It has predominantly focused on physical therapies and has not comprehensively reviewed other medical interventions, including injection therapies (see Coombes et al.58 for further information). A prevailing notion in tendinopathy management is to regard exercise and load management9,69 as the key element, with all other physical modalities being adjuncts to speed the recuperation or to enhance the effects of exercise and outcomes. While acknowledging that a variety of outcomes and follow-up times are reported in the literature, this review has focused on short-term follow-up data, wherein the primary aim of adjunctive treatment is to speed up recovery. Outcomes of pain (converted to a 0 to 100 scale; 0 = no pain, 100 = worst pain imaginable) and global rating of success are presented in terms of point estimates of effect (e.g., MD, RR), whereas other outcomes are qualitatively reported. A summary of the findings from English language papers (or reports therein of non-English original papers), along with the level of evidence that underpins their use, is provided. The interventions reported in this review include exercise, manual therapy/manipulation, orthoses, laser, US, shock wave therapy (SWT), and multimodal physiotherapy treatment – many of which have been compared to placebo or control.

Figure 1 is a graphic representation of the number of patients in RCTs that have investigated the effects of different interventions in LE, which interventions have demonstrated a superior effect compared to the comparator group, as well as where interventions have not yet been compared head-to-head.

Exercise

Exercise is rarely delivered as a treatment in isolation, with many RCTs studying a variety of exercise types in combination with other interventions. This review identified eight RCTs of sound methodological quality from five systematic reviews61-65 that investigated the effects of isometric, isokinetic, concentric and eccentric exercises in LE. Three of the trials compared eccentric exercise to other treatments. Tyler et al (n = 21)66 found a significant benefit of 9 (SD 2) sessions of eccentric exercise over 10 (SD 2) sessions of isometric extensor exercises, with participants in both groups receiving a multimodal program of stretches, US, friction massage, heat and ice. The eccentric exercises produced greater pain relief and functional improvement, with nine of the 11 participants reporting at least 50% improvement in their pain following eccentric exercise, compared to three out of 10 reporting the same level of improvement in the comparator group. Viswas et al (n = 20)67 also found that a supervised program of eccentric exercises improved pain and function more than friction massage with Mill’s manipulation at short-term follow-up. Similarly, a program of eccentric exercises with an elbow orthosis may provide greater global improvement at the end of treatment (6 weeks RR 4.7, 95% CI 1.1 to 19.8) but no difference in pain relief compared with an elbow orthosis alone (n = 37).68 In contrast, a 3-month home program of eccentric exercises produced variable results when compared with a program of concentric forearm exercises, with both exercise interventions demonstrating significant improvement over short-term and long-term follow-up.69

For exercise programs other than eccentric-only regimens, there was evidence from one RCT that isometric, concentric and eccentric exercises may be superior to US for pain relief (MD 21, 95% CI 1 to 41) and grip strength (MD 101 N, 95% CI 11 to 1914) at 8 weeks.70 Compared to placebo US, Selvanetti et al (n = 62)71 found a significant benefit after 4 weeks of eccentric exercises in combination with contract/relax stretching for pain relief at the end of treatment (MD, 95% CI 17 to 21). A 3-month home program of concentric/eccentric forearm exercises reportedly produced greater reductions in pain but not function, when compared with a wait-and-see approach.72 However, one other study found no
difference in pain and function outcomes at 6 weeks between concentric exercises, eccentric exercises and stretching (n = 81). 73
In summary, despite conflicting findings, there was evidence from several RCTs of sound methodological quality that exercise may be more effective at reducing pain and improving function than other interventions such as US, placebo US, and friction massage, but there may be no difference in effect between different types of exercises.

**Manual therapy and manipulation**

Six RCTs, 74–79 reported within four systematic reviews, 61,62,64,80 investigated the effects of manual therapy techniques on a range of outcomes in people with LE, but importantly, most of these measured the immediate effects of a single treatment session or the short-term effects after several sessions of manual therapy. Three of the RCTs studied elbow treatments, two studied neck treatments and another treatment to the wrist. There was evidence from two within-subject lab-based studies (n = 48) 77,79 that Mulligan’s Mobilisation-with-Movement at the elbow to placebo in providing immediate improvement in pain-free grip (WMD 43 N, 95% CI 30 to 57) and pain on palpation measured as the pressure pain threshold (WMD 25 kPa, 95% CI 6 to 45). 65 A study of 23 participants in which six sessions of a craniosacral technique called ‘oscillating-energy manual therapy’ (the therapist delivers ‘oscillating energy’ to the affected elbow via movement of his/her fingertips) reported a significantly greater improvement in pain severity at the end of treatment (2 to 3 weeks in total), compared to placebo (MD 21, 95% CI 1 to 42). 76

Two further studies of sound methodological quality investigated the effects of spinal manual therapy in the management of LE. 74,75 One small pilot trial (n = 10) investigated the effects of local elbow treatment (stretching, concentric/eccentric strengthening exercises, joint mobilisations to the elbow and wrist), alone and in combination with cervical and thoracic manual therapy techniques (Maitland mobilisations). 74 Extraction of data found a significant difference between groups for pain-free grip strength at the end of treatment (MD 15 kg, 95% CI 10 to 19) but no difference on pain or function outcomes. Another small study investigated the immediate effects of a single cervical spine manipulation versus placebo (manual contact) in a within-subjects study design of 10 people with LE. 75 There was a significant immediate improvement in pressure pain threshold of the affected arm (MD 77 kPa, 95% CI 37 to 116) following cervical manipulation compared with the placebo, but there was no difference between interventions for heat or cold pain threshold. 75

In a separate trial, a maximum of nine treatments of manipulation/mobilisation of the wrist (posteroanterior glide of the scaphoid) provided superior improvement in pain during the day (MD 20, 95% CI 3 to 37) but not global assessment (RR 1.3, 95% CI 0.8 to 1.9) compared at 6 weeks with a multimodal program of US, friction massage and exercise. 78

In summary, manual therapy techniques to the elbow, wrist and cervicothoracic spine may reduce pain and increase pain-free grip strength immediately following treatment, although in many instances, meta-analysis was not possible due to heterogeneity between manual therapy techniques and timing of follow-up assessment. There was insufficient evidence of any long-term clinical effects for manual therapy alone.

**Orthotics and taping**

Due to differences in the types of orthoses, comparator groups, timing of follow-up and outcome measures used, pooling of data was not possible for studies investigating the effects of orthoses in LE. The reported effects of an orthosis compared with placebo or control were contrasting between studies. Data from two RCTs suggested that a dynamic wrist extensor brace 6 and a forearm counterforce orthosis might provide significant improvement in pain and function at 4 to 12 weeks follow-up compared with no treatment or elbow taping (n = 63). 81,82 In contrast, both a standard counterforce orthosis 6 and a forearm-orthosis 6 provided no immediate improvement in pain or grip strength compared with no treatment 6 or placebo. 83 Similarly, there appeared to be little or no added benefit of one orthosis over another in improving pain and function in the short term, when comparing a standard counterforce orthosis against a counterforce orthosis with the addition of a wrist splint, (n = 43) 64 or a forearm extension bar that limits supination. 65 Although this latter study found a statistically significant difference in the pain subscale of the Patient Rated Tennis Elbow Evaluation, the between-group difference was too small to be clinically relevant. 65

Unpooled data from two RCTs revealed that compared with corticosteroid injection, an elbow orthosis might be as effective at
relieving pain, improving function or influencing self-perceived improvement in the short term (2 to 6 weeks).\textsuperscript{57,86} Compared with a multimodal program of friction massage plus US and exercise, an elbow orthosis\textsuperscript{5} alone was inferior in relieving pain and overall satisfaction, but was superior in improving function (ability to perform daily activities) at 6 weeks. There was no difference in overall success between treatments at 6 weeks (RR 1.2, 95% CI 0.9 to 1.7).\textsuperscript{80} but adding an elbow brace to the multimodal program did not provide additional pain relief or risk of a successful outcome at 6 weeks (RR 1.1, 95% CI 0.8 to 1.7).

In summary, there was conflicting evidence for the effectiveness of orthoses in providing pain relief or improvement in function compared with placebo or no treatment. Elbow orthoses may be as effective as corticosteroid injection in the short term; however, there was only one study to support this claim. There was no compelling evidence that any one orthosis is superior to another in the short term, or that adding an orthosis to another treatment provides any additional benefit.

\textbf{Acupuncture/dry needling}

Results from four studies indicated that acupuncture may be more effective than placebo in providing pain relief and improvement in function at the end of treatment.\textsuperscript{90–93} but this effect was equivocal at 2 to 3 months of follow-up.\textsuperscript{90,91} Acupuncture may provide superior pain relief and functional improvement compared with other interventions such as US, where results from two studies suggest that acupuncture was more effective at the end of treatment and at the 6-month follow-up.\textsuperscript{94,95} One other study (n = 86) compared acupuncture plus corticosteroid injection with corticosteroid injection alone. Extracted data indicated a significant difference in success (RR 1.5, 95% CI 1.0 to 2.3) but not pain relief (MD 0.95, CI –1 to 1) between treatments immediately after treatment.\textsuperscript{96} While there appears to be conflicting evidence, acupuncture might be more effective than placebo and more effective than US at relieving pain and improving self-assessed treatment benefit in the short term.

\textbf{Laser}

In one systematic review,\textsuperscript{97} a subgroup of five trials that used 904 nm lasers and doses from 0.5 to 7.2 Joules, reported significantly improved pain relief (MD 17, 95% CI 9 to 26) and likelihood of global improvement (RR 1.5, 95% CI 1.3 to 1.8) for laser compared with placebo. The present review found an additional three RCTs that used a 904 nm laser, all of which found no benefit from laser compared with the comparator groups in the short term, perhaps because the comparison groups received active interventions such as exercise.\textsuperscript{98,99} Two recent RCTs not included in the earlier systematic review\textsuperscript{97} studied dual wavelength 980/810 nm (versus placebo)\textsuperscript{100} or 820 nm (versus US)\textsuperscript{101} and reported no differences. The lack of benefit from laser might be due to an inappropriate selection of wavelength or, in one study, a type II error (n = 16).\textsuperscript{100,101} In summary, 904 nm laser might be beneficial in the short term compared with placebo, but there is likely no difference between laser and other active interventions in the short term or long term. Laser wavelengths other than 904 nm do not appear to have any benefit over that of a placebo.

\textbf{Ultrasound and phonophoresis}

Pooled data from four RCTs (n = 266)\textsuperscript{102–105} found no difference in the likelihood of global improvement in the short term (up to 12 weeks) between US and placebo (RR 1.3, 95% CI 0.9 to 1.9). There was low-level evidence from three RCTs that US is no different to phonophoresis alone,\textsuperscript{106} combined with an elbow orthosis,\textsuperscript{96} acupuncture,\textsuperscript{94} or friction massage in relieving pain.\textsuperscript{107} The conclusions drawn from previous systematic reviews\textsuperscript{5,6} remain unchanged: US appears to be no more effective than placebo for pain relief or self-perceived global improvement in the short term.\textsuperscript{5,6}

\textbf{Shock wave therapy}

Based on the results of nine placebo-controlled trials (1006 participants), a 2005 Cochrane review concluded the SWT provides little or no benefit in reducing pain or improving function in LE.\textsuperscript{108} There is clinical controversy as to which method of application for SWT is most efficacious (eg, radial or extracorporeal, with or without local anaesthetic), but no studies could be found that have validated one technique over another. The present review found an additional five RCTs comparing SWT with placebo,\textsuperscript{109,110} US with hot pack and friction massage,\textsuperscript{111} corticosteroid injection,\textsuperscript{111,112} and surgery.\textsuperscript{113} One study reported significant differences in favour of SWT over a placebo for pain and function measures after treatment and at a 6-month follow-up, but that data were not included in pooled analyses due to a lack of clarity in the statistics reported therein.\textsuperscript{113} Gunduz et al found no difference in pain relief or function between SWT, US with friction massage and corticosteroid injection at any time point.\textsuperscript{111} Shock wave therapy appeared to be no different to corticosteroid injection or autologous blood injections in improving pain or function at 12 weeks\textsuperscript{112} and no better than surgical percutaneous tenotomy in providing pain relief or functional improvement.\textsuperscript{113} Pooled data from the Cochrane review plus one additional study\textsuperscript{110} found that compared with placebo, SWT induced no greater pain relief (MD = 8, 95% CI –17 to 3) at 6 weeks. Similarly, the pooled mean difference for pain on resisted wrist extension (Thomsen test) at 4 to 6 weeks follow-up was not significantly different between SWT and placebo (MD = –15, 95% CI –36 to 6).

In summary, pooling data from a previous review and new data supports the conclusion that SWT is no more effective than placebo or other treatments for relieving pain in LE.

\textbf{Multimodal programs}

Several studies have combined a range of physical modalities in the rehabilitation program. A commonly reported multimodal program involving friction massage in various combinations with Mill’s manipulation, US, and stretches has been compared with exercise,\textsuperscript{66,114} laser,\textsuperscript{78} wrist manipulation,\textsuperscript{78} manual therapy,\textsuperscript{116} elbow brace,\textsuperscript{89} wait-and-see,\textsuperscript{117} and corticosteroid injection.\textsuperscript{117,118} While the heterogeneity between comparator groups limits pooling, in most all studies, this approach was either inferior or no different to the comparison. One study (n = 60) did show superior pain relief and functional improvement after 4 weeks of a Cyriax program (friction massage plus Mill’s manipulation) compared with phonophoresis plus supervised exercise.\textsuperscript{114} A second study (n = 125) found equivocal results between a program of friction massage, US and exercise compared with an elbow orthosis\textsuperscript{5} at a 6-week follow-up, with the multimodal treatment delivering superior pain relief and functional improvement, but the brace treatment favoured ability of daily activities and less inconvenience, with no difference between groups for measures of success (RR 1.2, 95% CI 0.9 to 1.7), severity of complaints, pain-free grip strength, maximum grip strength and pressure pain threshold.\textsuperscript{85} Despite the diversity of comparisons and outcomes, it seems that on balance, the majority of the evidence does not support the use of friction massage in combination with other treatments in the management of LE.

Two large RCTs compared a multimodal program of Mulligan’s Mobilisation-with-Movement and exercise (one with placebo injection) with wait-and-see (or placebo injection) and corticosteroid injection.\textsuperscript{22,23} Pooled data (n = 205) revealed that physiotherapy was superior to wait-and-see in providing a successful outcome in the short term (6 to 8 weeks, RR 2.3, 95% CI 1.6 to 3.3). At 52 weeks there was a significant, but very small, benefit of physiotherapy over wait-and-see in terms of the number of participants deeming their treatment a success (pooled data RR
1.1, 95% CI 1.0 to 1.1). Physiotherapy was similar to corticosteroid injection in providing a successful outcome in the short term (pooled data RR 0.9, 95% CI 0.7 to 1.1), but was superior to corticosteroid injection at 52 weeks follow-up (RR 1.3, 95% CI 1.1 to 1.5).22,23

In summary, a multimodal program of Mobilisation-with-Movement and exercise is likely superior to wait-and-see and placebo injection in the short term, and superior to corticosteroid injection in the long term. Multimodal treatment involving friction massage may be no different or worse than other treatments in providing pain relief.

**Evidence-informed clinical reasoning**

While many treatments for LE have been researched, many have small effects that occur in the short term (eg, 6 to 12 weeks) and few have shown consistent effectiveness over other treatments. Figure 1 highlights the lack of between-intervention superiority, with significant treatment effects largely seen only when an intervention is compared with placebo or control (no treatment). It is also apparent from Figure 1 that several treatments have not yet been compared head-to-head. Notwithstanding these limitations, the current evidence suggests that exercise may be beneficial in the short term compared with other interventions such as US, friction massage, and stretches for reducing pain and improving function. The issue with exercise for the clinician is that there is insufficient evidence to support any one type of exercise over another, and the optimal dose of exercise for LE has yet to be established. Elbow orthoses may also be useful in providing pain relief and improvement in function compared with placebo or doing nothing; however, as with exercise, the type of orthosis appears to be less critical. Manual therapy techniques to the elbow, wrist and cervicothoracic spine may be helpful in providing immediate pain relief and improvement in function in people with LE. A multimodal program of Mulligan’s Mobilisation-with-Movement and exercise may be superior to wait-and-see and placebo injection in the short term, and superior to corticosteroid injection in the long term. In contrast, multimodal treatment involving friction massage may be no different or worse than other treatments in providing pain relief. For electrophysical agents, laser using 904 nm wavelengths may be beneficial in the short term compared to placebo; however, there is likely no difference between laser and other active interventions in the short or long term. Laser wavelengths other than 904 nm do not appear to have any benefit over that of a placebo. Ultrasound appears to be no more effective than placebo in the short term; however, acupuncture may be more effective than US and/or placebo in the short term. Lastly, despite the addition of new RCTs, the conclusions drawn from a previous Cochrane review remain unchanged for SWT, which appears to be no more effective than placebo for relieving pain in LE.

It is proposed that when consulting a patient with LE, there might be merit in considering treatment recommendations on the basis of presenting patient characteristics that are known to be associated with the risk of a good or poor prognosis (Figure 2). It is recommended that patients with features indicating a good prognosis (eg, pain duration of <3 months, no concomitant neck or other arm pain, Patient-Rated Tennis Elbow Evaluation (PRTEE) <54/100) be counselled on their condition, load management including tools and work station, self-management and that adopting a wait-and-see approach is likely to be of benefit within 12 weeks. This approach is likely of merit for those patients who are unwilling to perform exercises or visit the physiotherapist for a number of sessions of Mobilisation-with-Movement with exercise. In contrast, if the patient would prefer to speed up the process, then exercise and Mobilisation-with-Movement would be undertaken because there is evidence of its benefit.

If a patient presents with features that are known to be associated with poorer outcomes (eg, concomitant neck and arm

![Figure 2. Evidence-based clinical pathway for the physiotherapy management of lateral epicondylalgia (assuming accurate clinical diagnosis at outset). The green arrows represent the clinical pathway for patients with characteristics indicative of a good prognosis; the orange arrows represent the clinical pathway for patients with characteristics highly indicative of a poor prognosis; the blue arrows represent the initial clinical pathway for patients that fall within the prognostic continuum (ie, exhibit one or more poor prognostic indicators); the yellow arrows represent the additional treatment options for patients at risk of a poor prognosis who fail to respond to evidence-based treatment with education, advice, exercise therapy and Mobilisation-with-Movement manual therapy techniques. MWM = Mobilisation-with-Movement, PRTEE = Patient-Rated Tennis Elbow Evaluation, SWT = shock wave therapy, US = ultrasound.](image-url)
pain, highly repetitive manual work, higher levels of pain and disability such as a PRTEE > 54/100, cold hyperalgesia with cold pain thresholds above 13 °C) then a more involved process ought to be considered. The approach should be more in line with management of persistent or chronic pain, possibly involving pain education, referral for medication and – in severe protracted cases – the involvement of pain clinic specialists, in addition to the education and advice that all patients with LE should receive. In addition, there should be a confirmation of the diagnosis/differential diagnosis through use of diagnostic imaging. It is important to understand that patients are likely to present along a continuum of prognostic features, which requires the clinician to use clinical reasoning skills to navigate the management approach in consultation with the patient. For example, a patient that appeared to have a good prognosis at the initial consultation but is no better at 6 to 12 weeks could be encouraged to undertake exercise and Mobilisation-with-Movement. If the condition does not improve with a graduated progressive exercise program, other passive pain relieving techniques might be introduced to speed up the resolution (eg. Mobilisation-with-Movement (if not already trialled), laser, acupuncture, spinal manipulation,orthoses). When introducing passive interventions it is important not to engender a patient’s reliance on these interventions, as most of them have only small effects of short-term duration and they do not facilitate self-management by the patient. A patient’s failure to respond when incorporating passive techniques and exercises over 8 to 12 weeks should be regarded by the clinician as an indication to escalate the management program to one like that for the patient presenting with features associated with a poor prognosis (Figure 2).5,37,40,51

**Future directions for research and practice**

A significant gap in the current literature, and an area of growing interest, is the effect of potentially confounding variables on treatment outcomes. Certain clinical characteristics and/or underlying pathophysiological characteristics may modify treatment effects. For example, one study has found that the presence of a tear in the lateral collateral ligament and the size of an intrasubstance tendon tear detected by US were each significantly associated with poorer prognosis in patients with LE, and indicated greater likelihood of failing conservative management, including an eccentric exercise program.57 While certain characteristics are known prognostic factors for long-term pain and disability, the question remains: what is the optimal treatment for individuals who exhibit one or more of these characteristics? Prognostic factors that have been identified through retrospective data analysis obtained from clinical trials require confirmation of their role in modifying treatment effects through prospective evaluation. If clinical outcomes for LE are to be improved, it is important to understand how these prognostic factors modify treatment effects.

The role of exercise in managing LE across the severity spectrum should be clarified, including optimal dosage and type of exercise for people with mild, moderate or severe symptoms of LE. Given that exercise is considered to be the cornerstone of rehabilitation, it is understood compared with other interventions. There is a need for further well-controlled RCTs investigating the effects of exercise and the role that supervision of exercise has to play in terms of patient compliance. Recent work on patellar tendinopathy has highlighted the effectiveness of isometric exercises compared with isotonic exercises in producing pain relief in the short term,60 which corresponded to normalising cortical inhibition.119 While exercise is generally considered to have an analgesic effect and prevent the development of chronic pain, exercise-induced analgesia is impaired in some musculoskeletal conditions that exhibit central sensitisation, and in some cases, may even increase pain.120 The effectiveness of alternative exercise regimens such as isometric exercise in people with LE is worthy of investigation, as an exercise treatment that specifically targets central sensitisation.

LE is a challenging tendinopathic condition with a complex underlying aetiology. There is a growing body of evidence that provides some clarity as to what we should and should not be considering in our management of the patient with LE. With contemporary knowledge of pain processes as well as local tendon changes, physiotherapists who use a clinical-reasoning-based approach to managing musculoskeletal conditions are well placed to manage patients with LE, as conservative treatment remains the best practice approach for this population.

**References**


43. Fernandez-Carnero J, Fernandez-de-las-Penas C, Cleland JA. Immediate hypoalgesia of the upper extremity and low back. NIOSH Publication 97–141.


47. Lim J, Ng SW, Coombes B. Evidence Based Clinical Practice: hyperexcitability as measured with nociceptive flexion reflex (NFR) threshold in chronic lateral epicondylalgia with or without a positive neurodynamic test. J Pain. 2012;13:676–680.


Effectiveness of Cyriax Physiotherapy in Subjects with Tennis Elbow

Abstract

Pain over the lateral epicondyle, which is exacerbated by work or recreational activities that involves gripping action of the hand, such as holding tools, shaking hands, and lifting a kettle, usually signals that the individuals has a condition termed lateral epicondylalgia, epicondylitis, or what is more commonly known as tennis elbow.

Keywords: Pain; Epicondylitis; Handling tools

Introduction

Pain over the lateral epicondyle, which is exacerbated by work or recreational activities that involves gripping action of the hand, such as holding tools, shaking hands, and lifting a kettle, usually signals that the individuals has a condition termed lateral epicondylalgia, epicondylitis, or what is more commonly known as tennis elbow [1]. This condition was first named by Morris (1882) who called it lawn tennis arm [2].

Tennis elbow is a syndrome characterized by an insidious onset of elbow pain brought on by wrist extension with pronation or supination and aggravated by gripping [3].

Lateral epicondylalgia affects 1-3% of the population, only 5% of all patients seen are recreational tennis players [4]. Although the syndrome has been identified in patients ranging from 20 to 60 years old, it predominantly occurs in the fourth and fifth decades. Male and female prevalence rates are reportedly equal. Seventy-five percent of patients are symptomatic in their dominant arms [5-7].

The specific muscle most often implicated clinically and surgically is the extensor carpi radialis brevis with occasional involvement of the extensor digitorum communis, extensor carpi radialis longus, and extensor carpi ulnaris. The possible reason for this more frequent involvement of the extensor carpi radialis brevis is its location as one of the most laterally situated muscles on the lateral epicondyle with slips taking origin from the radial collateral ligament. The extensor carpi radialis brevis is intimately attached to the joint capsule, which is continuous with the radial collateral ligament and because of this proximity adhesions are more likely [3].

Cyriax advocated the use of deep transverse friction massage in combination with mill’s manipulation in treating lateral epicondylalgia [5,8].

Deep transverse friction (DTF) is also known as deep friction massage is a specific type of connective tissue massage applied precisely to the soft tissue structures such as tendons. It was developed in an empirical way by cyriax and is currently used extensively in rehabilitation practice [5].

Mill’s manipulation is the most common manipulative technique used by physiotherapists. Cyriax stated that it should be performed immediately after the DTF is provided that the patient has a full range of passive elbow extension. If passive elbow extension is limited, the manipulative thrust will affect the elbow joint, rather than the common extensor tendon, possibly causing traumatic arthritis. It is defined as a passive movement performed at the end of range—that is, once all the slack has been taken up-and is a minimal amplitude, high velocity thrust. The aim of this technique, again without properly designed controlled studies to prove this, is to elongate the scar tissue by rupturing adhesions within the teno-oseous junction, making the area mobile and pain free [5].

Cyriax physiotherapy is the technique where DTF and Mill’s are used, but very few studies on cyriax physiotherapy using various outcome measures have been conducted. However, the present study is been undertaken to study the effect of cyriax on pain, grip strength and to see change in functional activities level following treatment in cases of tennis elbow.

Method

Design

This study was conducted at the physiotherapy OPD of KLE Dr. Prabhakar Kore hospital and MRC, Belgaum Karnataka.

Participants were referred by public and private medical practitioners for treatment of chronic tennis elbow. 20 subjects were recruited and received Cyriax physiotherapy, Therapeutic ultrasound and exercisers. The intervention was provided at 7 visits occurring over 1 week. Measurements were recorded once pretreatment i.e 1\textsuperscript{st} day and once post treatment i.e 7\textsuperscript{th} day.

Participants

People entering the trial had to meet the following inclusion criteria, both male and female between 20 to 50 years of age, pain on the lateral side of the elbow, tenderness over the forearm extensor origin, pain with 1 of the following tests: Mill’s test, Cozens test, all subjects with symptoms for duration of more than 3 months. Exclusion criteria were previous surgical history for elbow, fractures around elbow, restricted extension and laxity at elbow, sensitive skin, allergies to adhesive tape, a recent steroid injection for same complaints (3 months).

Intervention

The purpose of this study was explained and a written informed
The subjects received the selected treatment for 7 sessions at 1 session per day.

**Therapeutic Ultrasound:** Subject received ultrasound and exercises before performing deep friction massage and manipulation. Subject were seated on the chair with shoulder in neutral position, elbow in right angle and fully supported. The ultrasound was administered for 10 minutes in pulsed mode at 1 w/cm² with ultrasound gel Binder, over the later epicondyle or area of tenderness.

**Exercises**

Each exercise were repeated 10 times in 3 series, Clenching fist strongly, resisted wrist flexion and extension, wrist rotation with a stick and end range stretching for wrist flexors and extensors for at least 30 sec.

Following these subjects received Cyriax physiotherapy.

**Cyriax physiotherapy**

Position of the patient-the patient sits with elbow bent to right angle and full supination. The physiotherapist places one hand at the patients’ wrist and holds the forearm in supination.

The pad of the index finger, middle finger or thumb is placed directly over the involved site, the remaining fingers should be used to provide further stabilization of the therapists hand, no lubrication is used, the patient’s skin must move along with the therapist’s fingers.

Beginning with light pressure, the therapist moves the skin over the site of the lesion back and forth in a direction perpendicular to the normal orientation of the fibers of the involved part.

The massage is given for 2 minutes then stopped for 1 to 2 minutes then repeated of 2 minutes, working up to 12 to 15 minutes, followed by the manipulation.

**Manipulation**

Position of patient- patient sits upright with the arm abducted to the horizontal and so far medially rotated that the olecranon faces upward. The physiotherapist stand behind the patient, the patients forearm must be fully pronated and the wrist flexed.

The physiotherapist now places his left hand on the olecranon, thus extending the elbow, while the tension is strongly maintained; he suddenly forces full extension at the elbow with his left hand with a smart jerk.

This is carried out once each visit, immediately after friction.

**Outcome Measures**

**Pain intensity**

By Visual analogue scale- A scale of 10 cm to evaluate intensity of pain where 0 represents no pain and 10 represent unbearable pain.

**Grip strength**

Grip strength was measured by hand held dynamometer.

**Physical function outcome**

Patient rated forearm evaluation questionnaire for lateral epicondylitis.

**Statistical Analysis**

Statistical analysis for the present study was done using statistical package of social sciences (SPSS) version 14 so as to verify the results obtained. For this purpose data was entered into an excel spread sheet, tabulated and subjected to statistical analysis. Comparison of the pre and post intervention outcome measures within the group was done by using paired-t test. Probability values less than 0.05 were considered statistically significant and probability values less than 0.0001 were considered highly significant.

**Results**

VAS-VAS score pre session on 1st day and post session on 7th day was 6.0 ± 1.3 and 1.3 ± 1.0 respectively. On comparing these values there was significant difference.

Grip strength- The mean grip strength score pre session on 1st day and post session on 7th day was 15.3 ± 2.3 which increased to 18.3 ± 2.3 respectively.

Finally on comparing the pre and post treatment values of PRTEEQ i.e, pre 55.4 ± 14.0 following which post treatment decreased to 21.0 ± 6.2.

**Discussion**

The present experimental trial was conducted to study the effect of, Cyriax physiotherapy with conservative treatment of therapeutic ultrasound and supervised exercise in subjects with lateral epicondylitis (Tennis elbow). Results of this study were focused on pain relief where Pain assessment was done by visual analogue scale (VAS), [9] improvement of grip strength, grip strength was measured with the help of hand held dynamometer, [10] and reduction in function activity impairment scores based on Patient rated forearm evaluation questionnaire for lateral epicondylitis. It was noticed that there was improvement in all the above parameters.

In this study the age group of the participants was between 20 to 50 years, the mean was 41.15 ± 7.73. According to a study by Halpren it was stated that, peak age at which tennis elbow occurs is 40 to 50 years [11]. There is a decrease in the occurrence of tennis elbow cases after 50 years of age, this may be due to diminished intensity of play or activity at these older ages as suggested in a study by Gruchow et al. [12].

Subjects of present study consisted of 11 males and 09 females. According to a study by Alireza Shamsoddini et al. [8] and few others, tennis elbow is equally distributed between men and women. But according to Gruchow et al. [12] there was a fourfold increase in prevalence among men and nearly two fold increases among women. In this study men had a marginally higher prevalence rate than women, but there was no statistically significant difference between men and women prevalence.

The mean values of data from present study showed reduction in pain score on VAS, improved grip strength on hand held dynamometer and functional improvement graded on PRFEQ.

When the intra group mean values of VAS were analyzed it was found statistically significant. In the present study reduction in
pain level, as quantified by the VAS with the application of Cyriax is consistent with the findings of previous studies.

It is a common clinical observation that application of DTF leads to immediate pain relief. The patient experiences numbing effect during the session and reassessment immediately after the application of DTF shows reduction in pain and increase in strength and mobility [13] several theories have been put forth to explain the pain relieving effect of DTF. According to Cyriax and Cyriax, DTF also leads to increased destruction of pain provoking metabolites such as Lewis’s substances [5]. Another mechanism by which reduction in pain may be achieved is through diffused noxious inhibitory controls, a pain suppression mechanism that releases endogenous opiates.

The latter are inhibitory neurotransmitters which diminish the intensity of pain transmitted by higher centres [5].

Mill’s manipulation is performed immediately after DTF, where it is done to elongate the scarred tissue by rupturing adhesions within the teno-osseous junction making the area mobile and pain free [5,8].

Amit V Nagrale et al. in his study between Cyriax and phonophorosis found Cyriax physiotherapy to be superior treatment approach compared to phonophorosis in terms of pain, pain-free grip, and functional status [14].

It is important to note that all participants were given ultrasound and supervised exercises as a common conventional method. Ultrasound refers to mechanical vibrations which are essentially the same as sound waves but of a higher frequency. Such waves are beyond the range of human hearing and can therefore also be called ultrasonic [15].

In a study by D’Vazet al. [16], they studied the effect of pulsed low-intensity ultrasound therapy for chronic lateral epicondylitis. They concluded that low-intensity ultrasound (LIUS) was no more effective for a large treatment effect than placebo for recalcitrant LE. This is in keeping with other interventional studies for the condition.

Ultrasound has been used over a period of time to control acute and chronic pain over a localized area. Several studies have demonstrated the effectiveness of ultrasound in reducing pain. In a study by Binder et al., they checked for the effectiveness of ultrasound in treating soft tissue lesions, where they conclude that Ultrasound enhances recovery in most patients with lateral epicondylitis [17].

Timnoteboom et al. [18], in his study mentioned that chronic symptoms are commonly associated with inadequate muscle power and endurance. Reduction in grip strength was noted in these subjects and to overcome supervised exercises were prescribed.

This strengthening of these muscles strengthening the damaged attachment of wrist extensors resulted in better repetitive wrist movements performed by the subjects with tennis elbow [19].

It was claimed that the eccentric training results in tendon strengthening by stimulating mechanoreceptors in tenocytes to produce collagen, which is the key cellular mechanism that determines recovery from tendon injuries. Strengthening may improve collagen alignment of the tendon and stimulate cross linkage formation both of which improve the tensile strength of tendon [19].

Literatures suggest that strengthening and stretching both are main components of exercise program, because tendons must be flexible along with strong. Positive effects of exercise program for tendon injuries may be attributable to lengthening of muscle tendon unit by stretching and strengthening exercise which could achieve loading effect within muscle tendon unit along with hypertrophy and increased tensile strength of the tendon [20].

The results of this study showed significant increase in grip strength.

PRTEE Formerly known as the Patient-Rated Forearm Evaluation Questionnaire (PRFEQ) seems to be a reliable tool for assessing pain and function in patients with chronic lateral epicondylitis. The PRTEE has shown greater reliability and has sufficient width scale to reliably detect improvement or worsening in most subjects. For these reasons, the PRTEE appears to be the one of most commonly reported measure of health status in patients with Tennis elbow [21].

In the present study the means of PRTEE were analyzed, where intra group analyses showed significant improvement.

On comparing pre and post values it showed significant improvement in terms of pain, grip strength and functional performance in subjects with tennis elbow. Therefore it can be concluded that Cyrix physiotherapy can be incorporated with conservative physiotherapy management for better results.

Limitations of the study were, subjects could not be followed up for longer period of time, to assess long term benefit, and occupation relevance was not compared.

Future Scope of the Study, studies with longer follow-up period are recommended to assess long term benefits, Conduct the study with larger sample size, Range of Motion could be taken in to consideration

Conclusion

The present study provided evidence to support the use of Cyriax physiotherapy in relieving pain, improving grip strength and functional performance in subject with tennis elbow.

References
11. Darlene Hertling, R M Kessler Management of common musculoskeletal disorders, Lippincott Williams and Wilkins


“This course was edited and developed from the document: Physiotherapy Management of Lateral Epicondylalgia – Bisset LM, Vicenzino B (2015), Journal of Physiotherapy 61: 174–1, (DOI: http://dx.doi.org/10.1016/j.jphys.2015.07.015), used under the Creative Commons Attribution License.”

“This course was edited and developed from the document: Effectiveness of Cyriax Physiotherapy In Subjects with Tennis Elbow – Prabhakar AJ, Kage V, Anap D (2013), J Nov Physiother 3: 156. (DOI:10.4172/2165-7025.1000156), used under the Creative Commons Attribution License.”