Washington State Department of Labor & Industries

Occupational Health Practice Resource

Conservative Care Evidence Summary

2011 Industrial Insurance Chiropractic Advisory Committee (IICAC)

Conservative Care Options for Work-Related Epicondylitis

Purpose

This document provides concise summaries of published literature regarding effectiveness of commonly used approaches for evaluation and treatment of epicondylitis. Emphasis is given to literature that addresses occupation-related epicondylitis. Included are key management recommendations for work-related epicondylitis based on the IICAC's review and synthesis of evidence and practical application approaches; practical clinical resources including outcomes and progress tracking surveys and forms (useable without licensing/charge in practice for non-commercial use).

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Development

This document was developed by the Industrial Insurance Chiropractic Advisory Committee (IICAC) of the Washington State Department of Labor and Industries. It offers a summary of current evidence for practitioners. It is not a practice guideline, standard of care, claim management standard, or a substitute for clinical judgment in an individual case. This practice resource does not change L&I coverage or payment.

A comprehensive search of available scientific literature on epicondylitis was conducted by the Policy, Practice, and Quality (PPQ) Subcommittee of the IICAC and department staff during Summer 2011. Literature was reviewed, assessed for relevance and quality, and summaries were drafted by consensus of the subcommittee with expert content input from consultants in September 2011. It was posted for public comment and revision and approved for distribution by the IICAC in November 2011. This resource is expected to be updated periodically by the IICAC. Interested parties may submit new published scientific report for consideration for future revisions.

This and other practice resources are available for download at the State of Washington Department of Labor & Industries website. Contact information for public input and submission of studies for future revisions is available there.

http://www.Lni.wa.gov/ClaimsIns/Providers/Treatment/IICAC/

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PRACTICAL APPLICATION POINTS

- Several conservative interventions provide rapid relief of pain and improved pain-free grip including: eccentric extension exercise, elbow manipulation, soft tissue procedures (e.g. trigger point pressure in extensor muscles), and corticosteroid injections
- Set outcome goals for sustainable self management (exercise, massage, activity modification) to maintain pain reduction and improved function.
- One tennis elbow specific questionnaire and two more general upper arm function questionnaires have been shown to be sensitive to measure functional change in epicondylitis.

Work-Related Epicondylitis

Epicondylitis is characterized by medial or lateral elbow pain that worsens when muscles originating from the condyles are contracted, placing stress on the attachments. Lateral epicondylitis or "tennis elbow" is more common and is often associated with direct trauma to the lateral elbow. Repetitive work by itself does not appear to be a risk factor; however there appears to be a relationship between combined risk factors such as force, posture, trauma, and repetition. Diagnosis is clinical; no studies on diagnostic accuracy or reliability of clinical examination were found. Literature suggests that pain is related to degenerative change more so than acute inflammation. The condition is frequently self-limiting within 6-24 months.

Case Definition

- Work-related lateral epicondylitis (LE) is lateral elbow pain subsequent to a documented workplace exposure that is worsened by gripping and resisted wrist extension.

Evaluation Summary

- Rule out non-mechanical causes (typically by assessing for red flags for trauma/fracture, tumor, etc.)
- Pain over the epicondyles provoked by resisted extensor contraction (e.g. griping, twisting motions) is consistent with epicondylitis.

Intervention Summary

- Most acute/sub-acute cases self-resolve within weeks to months. Rapid resolution has been reported with slow stretching, eccentric resisted contraction exercise, elbow manipulation, soft tissue wok (effleurage massage, trigger point pressure, mechanically assisted tissue work). Extension bracing and/or activity modification may be helpful.
- Benefit has been reported in lesser quality studies with iontophoresis and phonophoresis applied NSAIDs. Ultrasound does not appear to provide any advantage over placebo.
- Short term relief for corticosteroid injection may be outweighed by poorer one year outcomes compared to physiotherapy or wait and see approaches
- Chronic conditions are thought by some to be related to tendon degeneration more than an inflammatory process from microtears. Treatment options are similar with some consideration

Improvement Progress

- Achieving and monitoring functional progress is central to effective care of epicondylitis. The best overall long term outcomes are believed to be associated with consistent, incremental increases in functional ability (e.g. pain-free grip strength, improving mobility, return to usual activities including work)
- Refractory cases warrant consideration for additional diagnostics to assess for tendon rupture or muscle tear.

Typical Interventions and Response Thresholds

1-2 wks	3-6 wks	7-8 wks	Beyond 8 wks
• *Ice and avoidance of provoking activities. 30-45° wrist extension splint may be helpful.* • *Rapid improvement is reported with eccentric extensor contraction exercise, manipulation, and soft tissue work. Utility of iontophoresis and phonophoresis is mixed.* • *Combined exposures of higher force wrist extension and repetition may be associated with development of epicondylitis.* • *Steroid injections are associated with poorer long term outcomes.*	• *Improvement is best assessed by increasing functional gains, including ability to return to work.* • *Sustained functional gains should be tracked using a functional questionnaire specific to tennis elbow or the upper extremity.* • *Myofascial release and manipulation of elbow structures are effective. Rapid transition to self-management using eccentric resistance contraction exercise and massage should be encouraged.*	• *Good Improvement: Condition should be mostly resolved or primarily self managed* • *Inadequate improvement: Persistent, recurrent pain on wrist activity may point to need for more attention to activity modification and if not address may warrant consideration of additional diagnostics (e.g. imaging to assess for muscle or tendon tears/ruptures.)*	

PROGRESS CHECKLIST *(Voluntary educational / practice aid. This is not an L&I documentation requirement.)*

	Baseline	1-2 wks	3-6 wks	7-8 wks / Beyond 8 wks
ASSESSMENT / PROGRESS	Date: Baseline Function Score: ________ Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities* Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain* Work Status ☐ Full Duty ☐ Modified ☐ None	Date: Function Score: ____________ Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities* Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain* Work Status ☐ Full Duty ☐ Modified ☐ None	Date: Function Score: ____________ Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities* Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain* Work Status ☐ Full Duty ☐ Modified ☐ None	Date: Function Score: ____________ Pain Interference 0 1 2 3 4 5 6 7 8 9 10 *None* … *Unable to do any activities* Self-control of pain 0 1 2 3 4 5 6 7 8 9 10 *Complete control of pain* … *No control of pain* Work Status ☐ Full Duty ☐ Modified ☐ None
INTERVENTION OPTIONS	**Function score:** *from standard survey (e.g. PRTEE, UEFI, ULFI, QuickDASH)* **Pain Interference:** *ask, 'In past week, how much has pain interferred with your daily activities?'* **Self-control of pain:** *ask, 'In past week, how much have you been able to control/help/reduce your elbow pain on your own?'* **Discuss Recovery** • Most recover rapidly with resisted contraction and stretching exercise, myofascial work and manipulation. Splinting and making modifications to proving activities are also helpful. • Address concerns with work activity.	**Assess Functional Recovery** • Recheck function score, pain interference, and ability to control pain. These scores are sensitive to overall change/improvement. according to magnitudes descibed on the questionnaires (and/or scoring sections of Epicondylitis Terminology section). **Incrementally Increase Activity** • Goal to maintain normal activities & routines (including work). • Consider activity, ergonomic modifications, bracing, etc. when tasks continue to provoke pain.	**Assess Functional Recovery** • Functional score/pain interference. • Should approach pre-episode capacities. • Poor/worsening self control scores may reflect underlying psychosocial concern to screen for (anxiety, depression, fear avoidance), or may warrant further diagnostics to rule out underlying pathology). **Continue to Increase Activity** • Assess potential cognitive barriers (e.g. catastrophising, significant fear avoidance, low recovery expectation, depression) if response is poor. • Consider additional diagnostic assessment for muscle and tendon damage if improvement does not meet expectation. Patient Name: ______________________________	

Patient-Rated Tennis Elbow Evaluation (PRTEE) *(Voluntary educational / practice aid. This is not an L&I documentation requirement)*

Name _____ Date _____ Affected Arm ☐ Left ☐ Right

*Describe your **average** arm symptoms **over the past week** on a scale 0-10. Please provide an answer for all questions. If you did not perform an activity because of pain or because you were unable, circle a "10". If you are unsure, please estimate to the best of your ability. If you never perform that activity, please draw a line completely through the question.*

1. PAIN in your affected arm

*Rate the average **amount of pain** in your arm over the past week by circling the number that best describes your pain on a scale from 0-10. A **zero (0)** means that you **did not have any pain** and a **ten (10)** means that you had **the worst pain imaginable.***

RATE YOUR PAIN:	No Pain										Worst Imaginable
When you are at rest	0	1	2	3	4	5	6	7	8	9	10
When doing a task with repeated arm movement	0	1	2	3	4	5	6	7	8	9	10
When carrying a plastic bag of groceries	0	1	2	3	4	5	6	7	8	9	10
When your pain was at its least	0	1	2	3	4	5	6	7	8	9	10
When your pain was at its worst	0	1	2	3	4	5	6	7	8	9	10

2A. FUNCTIONAL ABILITY - SPECIFIC ACTIVITIES

*Rate the **amount of difficulty** you experienced performing each of the tasks listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0-10. A **zero (0)** means you did not experience any difficulty and a **ten (10)** means it was **so difficult you were unable to do it at all**.*

RATE DIFFICULTY OF EACH ACTIVITY:	No Difficulty										Unable To Do
Turn a doorknob or key	0	1	2	3	4	5	6	7	8	9	10
Carry a grocery bag or briefcase by the handle	0	1	2	3	4	5	6	7	8	9	10
Lift a full coffee cup or glass of milk to your mouth	0	1	2	3	4	5	6	7	8	9	10
Open a jar	0	1	2	3	4	5	6	7	8	9	10
Pull up pants	0	1	2	3	4	5	6	7	8	9	10
Wring out a washcloth or wet towel	0	1	2	3	4	5	6	7	8	9	10

2B. FUNCTIONAL ABILITY - USUAL ACTIVITIES

*Rate the **amount of difficulty** you experienced performing your **usual** activities in each of the areas listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0-10. By "usual activities", we mean the activities that you performed **before** you started having a problem with your arm. A **zero** (0) means you did not experience any difficulty and a **ten** (10) means it was so difficulty you were unable to do any of your usual activities.*

RATE DIFFICULTY OF EACH ACTIVITY:	No Difficulty										Unable To Do
Personal activities (dressing, washing)	0	1	2	3	4	5	6	7	8	9	10
Household work (cleaning, maintenance)	0	1	2	3	4	5	6	7	8	9	10
Work (your job or everyday work)	0	1	2	3	4	5	6	7	8	9	10
Recreational or sporting activities	0	1	2	3	4	5	6	7	8	9	10

COMMENTS:

Complete scoring instructions can be found in the ***Epicondylitis Terminology*** section.

Macdermid J. Update: The Patient-Rated Forearm Evaluation Questionnaire is now the Patient-Rated Tennis Elbow Evaluation. J Hand Ther 2005;18(4):407-10.

Upper Extremity Functional Index (UEFI) *(Voluntary educational / practice aid. This is not an L&I documentation requirement)*

Name _____ Date _____ Affected Arm ☐ Left ☐ Right

Please indicate if are having any difficulty at all with the activities listed below because of your upper limb problem for which you are currently seeking attention. Please check (√) an answer for **each** activity.

Today, do you or would you have any difficulty at all with:

Activities	Extreme Difficulty or Unable to Perform	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit Of Difficulty	No Difficulty
1) Any of your usual work, household, or school activities	0	1	2	3	4
2) Your usual hobbies, recreational or sporting activities	0	1	2	3	4
3) Lifting a bag of groceries to waist level	0	1	2	3	4
4) Lifting a bag of groceries above your head	0	1	2	3	4
5) Grooming your hair	0	1	2	3	4
6) Pushing up on your hands (e.g. from bathtub or chair)	0	1	2	3	4
7) Preparing food (e.g. peeling, cutting)	0	1	2	3	4
8) Driving	0	1	2	3	4
9) Vacuuming, sweeping, or raking	0	1	2	3	4
10) Dressing	0	1	2	3	4
11) Doing up buttons	0	1	2	3	4
12) Using tools or appliances	0	1	2	3	4
13) Opening doors	0	1	2	3	4
14) Cleaning	0	1	2	3	4
15) Tying or lacing shoes	0	1	2	3	4
16) Sleeping	0	1	2	3	4
17) Laundering clothes (e.g. washing, ironing, folding)	0	1	2	3	4
18) Opening a jar	0	1	2	3	4
19) Throwing a ball	0	1	2	3	4
20) Carrying a small suitcase with your affected limb	0	1	2	3	4
Total circled numbers in each column:					

Score (add all circled numbers) _____/80 MDC (minimum detectable change) = 9 pts /15% Error +/- 5 scale points

Complete scoring instructions can be found in the ***Epicondylitis Terminology*** section.

Stratford PW, Binkley JM, Stratford DM. Development and initial validation of the upper extremity functional index. Physiotherapy Canada Fall 2001;259-266.

Upper Limb Functional Index (ULFI)

(Voluntary educational / practice aid. This is not an L&I documentation requirement)

Name _____ Date _____ Affected Arm ☐ Left ☐ Right

Your upper limb (arm) may make it difficult to do some of the things you normally do. This list contains sentences people often use to describe themselves when they have such problems.

Think of yourself over the last few days. **If an item describes you, mark the box. If not, leave the box blank. DUE TO MY ARM:**

☐ 1. I stay at home most of the time.

☐ 2. I change position frequently for comfort.

☐ 3. I avoid heavy jobs e.g. cleaning, lifting more than 5kg or 10lbs, gardening etc.

☐ 4. I rest more often.

☐ 5. I get others to do things for me.

☐ 6. I have pain almost all the time.

☐ 7. I have difficulty lifting and carrying (e.g. bags, shopping up to 5kg or 10lbs).

☐ 8. My appetite is now different.

☐ 9. My walking or normal recreational activity is affected.

☐ 10. I have difficulty with normal home or family duties and chores.

☐ 11. I sleep less well.

☐ 12 .I need assistance with personal care (e.g. washing and hygiene).

☐ 13. My regular daily activities (work, social contact) are affected.

☐ 14. I am more irritable and / or bad tempered.

☐ 15. I feel weaker and / or stiffer.

☐ 16. My transport independence is affected (driving, public transport).

☐ 17. I have difficulty putting my arm into a shirt sleeves or need assistance dressing.

☐ 18. I have difficulty writing or using a key board and / or "mouse".

☐ 19. I am unable to do things at or above shoulder height.

☐ 20. I have difficulty eating and /or using utensils (e.g. knife, fork, spoon, chop sticks).

☐ 21. I have difficulty holding and moving dense objects (e.g. mugs, jars, cans).

☐ 22. I tend to drop things and/or have minor accidents more frequently.

☐ 23. I use the other arm more often.

☐ 24. I have difficulty with buttons, keys, coins, taps/faucets, containers, or screw-top lids.

☐ 25. I have difficulty opening, holding, pushing or pressing (e.g. triggers, lever, heavy doors).

ULFI Score: Add the checked boxes _____ **% Score (x 4) =** _____ **%**

Patient Specific Index (PSI): List 5 activities that are important to you and affected by your arm problem. If you cannot think of 5, choose from the ones you have marked at the left.

Score each activity on a scale of 0-5 with 0 being best (never affected/can do activity normally) and 5 being WORST (Always affected/can't do activity at all). You may use Half (½) marks if you wish

ACTIVITY	***Score***
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

PSI Total = _____ **% Score (x 4) =** _____

Think of yourself **over the last few days. Due to your arm,** assess your **Overall Status** compared to your normal or pre-injury level on the following scale

0 1 2 3 4 5 6 7 8 9 10

Pre-Injury or Normal — Worst Possible

Minimum Detectable Change (MDC, 90% Confidence): 10.5 % or 2.6 ULFI points. Change less than the MDC may be due to error. Complete scoring instructions can be found in the ***Epicondylitis Terminology*** section.

Gable CP, Michener LA, Burket B, Neller A. The Upper Limb Function Index: Development and determination of reliability, validity, and responsiveness. J Hand Therap 2006; 19:328-49.

EPICONDYLITIS CLINICAL ASSESSMENT SUMMARY	
Occupational Epicondylitis Case Definition	**Clinical presentation of lateral epicondylitis (LE)** • Lateral elbow pain worsened by gripping and resisted wrist extension. • Symptoms may be associated with degenerative change more so than acute inflammation. • Frequently self-limiting within 6-12 months. • No studies on diagnostic accuracy or reliability of clinical examination for LE. **Clinical presentation of medial epicondylitis (ME)** • Medial elbow pain worsened by gripping and resisted wrist /forearm flexion • Symptoms may be associated with degenerative change more so than acute inflammation. • Frequently self-limiting within 6-12 months. • No studies on diagnostic accuracy or reliability of clinical examination for ME. **Work place exposure to LE inducing activity** • Evidence for relationship between combined risk factors (e.g. force, repetition, and posture).[1] • Poor association with repetitive work by itself. • Onset following blunt elbow trauma at work indicates occupational causation.
HISTORY – Diagnostic/Severity Indicators	
Patient Presentation	• Persistent elbow pain that is aggravated by resisted contraction, gripping, arm and/or hand use. Lateral epicondylitis (LE) is most common and is known as tennis elbow due to prevalence in tennis players, especially amateurs with poor backhand technique.[2] Frequently attributed to repetitive work activity, but may be that certain work activities increase symptoms of a chronic tendinosis that originated with a strain of extensor carpi radialis brevis (ECRB), extensor digitorum communis (EDC), and/or extensor carpi radialis longus (ECRL) origin tendons.
Symptom Questionnaire	• **Visual Analog Pain Scale (VAS) -** Anchored pain scales are commonly used for musculoskeletal pain, including arm pain. Typically a component of functional questionnaires and typically more useful and reliable within the context of a functional instrument.[3]
Function Questionnaires	• **Disability of Arm, Shoulder, and Hand (DASH) Scale** - has the best clinometric properties and has a work component. It has been used increasingly as an outcome measure for upper limb pathology. It assesses entire upper limb function including elbow and hand. Reliability and reproducibility have been demonstrated in several studies.[4] • **QuickDASH** - is easier to use than the full DASH but measures different content. QuickDASH is a validated measure of arm function but is reported to be less specific than the DASH in the subdomains, especially in symptoms. It has also been reported to underestimate symptoms and overestimate disabilities. The QuickDASH can be recommended for a summary assessment of arm symptoms and function based on the score to save time. [5] The Quick DASH is available for use with registration and may be obtained online without charge at http://www.dash.iwh.on.ca/conditions.htm.

	• **Patient-Rated Tennis Elbow Evaluation (PRTEE)** – has been validated specifically for lateral epicondylitis and is a straightforward, one-page questionnaire easily administered in clinical settings.[6] • **Upper Extremity Functional Index (UEFI)** – is a validated, one-page form that addresses general arm function with specific incorporation of activities that involve the elbow and wrist extensors and flexors.[7] • **Upper Limb Functional Index (ULFI)** – is a validated, one-page form that has been compared to the UEFI as well as the DASH questionnaires and is considered by the developers to be particularly practical in clinical settings.[8]
HISTORY – Prognostic Indicators	
Risk Factors for prolonged disability	• Age over 40 years. • Repetitive keyboarding jobs and cervical joint signs in women are associated with higher final VAS and DASH scores. • Concurrent nerve symptoms are associated with poorer outcomes from physiotherapy. [9,10]
CLINICAL EXAMINATION – Physical Exam	
	• Tenderness is typically elicited at the lateral epicondyle especially a few millimeters distal and anterior to the lateral condyle at the origin of ECRB. • Wrist extension, particularly against resistance, provokes pain. • Grip strength measured using a dynamometer may be weaker in the affected arm. • Several other conditions may mimic epicondylitis symptoms including supinator syndrome and other upper arm and shoulder muscle trigger points that radiate to the epicondylar regions. Eliciting for myotendonous radiation patterns that reproduce the epicondylar pain may help assess this.
CLINICAL EXAMINATION – Provocative Maneuvers	
Cozen's Forearm Extensor Muscle Test (Extensor Grip Test)	• Wrist is extended against resistance with elbow in flexed and extended positions in an attempt to recruit and stress muscle and tendon of the ECRB. Pain at the extensor insertion at the lateral epicondyles is considered positive. Literature evaluating sensitivity, specificity, or predictive value is lacking, however one cohort study comparing outcomes of extension bracing alone, physical therapy (ultrasound, friction massage and strengthening-stretching exercise) and combination of brace and physical therapy reported that a positive extensor grip test was predictive of a good outcome with bracing alone.[11]
Mill's Maneuver	• Wrist is passively flexed with elbow in extended position aimed at recruiting and stressing ECRB muscle and tendon. Pain at the extensor insertion at the lateral epicondyles is considered positive. Literature evaluating sensitivity, specificity, or predictive value is lacking.
Book or Chair Test	• Patient attempts to pick up a book or chair by its back with elbow extended and forearm pronated. Inability to do so due to pain at the lateral epicondyle is considered positive. Literature evaluating sensitivity, specificity, or predictive

	value is lacking.
Middle Finger Extension Test	• Resisted contraction of the middle finger or ring finger recruits and stresses the EDC muscle and tendon. Pain at the lateral epicondyles is considered positive. Literature evaluating sensitivity, specificity, or predictive value is lacking.
Range of Motion	• Slight decrease in extension range of motion and joint play at the radiocapitellar joint has been speculated to exist with epicondylitis. Literature evaluating sensitivity, specificity, or predictive value is lacking.
IMAGING	
Plain film radiography	• Less than a quarter of LE and ME patients demonstrate calcific infiltration in the extensor or flexor tendons; however, imaging does not clarify diagnosis nor inform conservative or arthroscopic management decisions. Radiography is not initially indicated. • MRI, CT, or diagnostic ultrasound may be helpful in determining differential diagnoses (e.g. ligament and tendon tear) in refractory cases.[12,13]
Ultrasonography	• Diagnostic ultrasound has been shown to differentiate thickening of the extensor tendon in symptomatic LE subjects compared to asymptomatic individuals.[14] It is not clear that additional diagnostic accuracy would have any impact (therapeutic yield) on care however. • Presence of larger ligament tears on diagnostic ultrasound correlated to poorer 6 month outcomes (PRTEE scores) in 62 lateral epicondylitis patients. [13]
PROGNOSTIC AND MANAGEMENT ISSUES	
	• Most cases of epicondylitis resolve without intervention within 6-24 months.[15] • Repeated exposure to forces that stress extensor tendons may impede recovery.
WORKERS' COMPENSATION ASSESSMENT ISSUES	
Causation & Work Relatedness	• Epicondylitis is typically believed to be a chronic tendinosis that may be related to or aggravated by excessive repeated force to wrist flexor or extensor muscles. Occupations such as meat cutter, plumbers and weavers include activities that may exemplify such exposure. Repetitive work by itself (e.g. keyboarding) does not appear to be a causative factor. Overall prevalence for epicondylitis ranged between 4-30% depending on the type of work. [2,16] • Work-related causes of epicondylitis account for somewhere between one third and two thirds of all cases. [17,18] • Lateral epicondylitis may account for an average of 12 weeks of time loss in approximately one third of affected workers. [19] • Risk factors for medial and lateral epicondylitis are different; medial epicondylitis is more frequently associated with other work-related upper limb disorders and has a stronger correlation with forceful work. [20]

EPICONDYLITIS CONSERVATIVE INTERVENTIONS SUMMARY	
Physiotherapy Modalities	**Ice & Avoidance of Provoking Activity** • Frequently considered useful in an acute episode for pain control, however, specific high quality studies for most physiotherapeutic modalities on epicondylitis are lacking.[10,2] **Ultrasound** • A recent randomized controlled trial (RCT) including 55 subjects with LE of >6 weeks duration reported that pulsed, low-intensity ultrasound therapy appears to be no more effective than placebo.[21] • Some lesser quality studies report short term benefit from ultrasound and phonophoresis. [22,23] However reports are mixed.[24] There also appears to be no difference between phonophoresis and iontophoresis using Naproxin gel; both may reduce acute symptoms.[25] **Pulsed Electromagnetic Field Therapy** • No difference was identified in 30 subjects with LE of several months duration comparing pulsed electromagnetic field therapy to placebo. [26]
Splinting/Bracing	• In an RCT (n=58), bracing (used during the day for 2 weeks) yielded shorter-term pain relief than ultrasound (frequency of 1MHz and intensity of 1.5 W/cm2 for 5min/5 days/week for 2 weeks plus a hot pack on lateral elbow area) and laser therapy (low level laser (He-Ne laser, wavelength 632.8nm output of 10mV) for 10 min/5 days/week for 2 weeks plus a hot pack). Laser therapy was more effective in improving grip strength than bracing and ultrasound treatment.[27] • In a prospective randomized study, both a forearm counterforce strap (compression) and a wrist extension splint demonstrated improved outcomes at 6 weeks. The extension splint group, however, had significantly better pain relief.[28]
Manipulation/Mobilization	**Cervical Manipulation** • Lateral glide cervical mobilization showed immediate positive effect for VAS pain scale & pressure pain but not pain-free grip strength (PFGS).[29] **Upper Extremity Manipulation** • Local elbow manipulation of affected LE elbow showed positive immediate effect on PFGS and pressure-pain threshold.[30,31] • A RCT (pilot study) on 28 LE patients (at least 6 weeks duration) reported that wrist manipulation (up to 9 sessions in 6 weeks) was more effective than ultrasound, friction massage, and strengthening/stretching exercise in improving self-reported 6 point global improvement scale (completely recovered or much improved) at 3 week & improvement in VAS scores at 6 week follow-ups.[32] • A systematic review and meta-analysis of 76 RCTs (28 meeting meta-analysis inclusion) of physical interventions for lateral epicondylalgia, there was a general lack of evidence for determining long term benefit. However, there

	was evidence to conclude that extracorporeal shockwave therapy was not effective and that manipulation and exercise showed short term benefit and warranted further research into longer term effects.[9] • In a small RCT (n=18), patients were randomized to receive 1 treatment session of cervical or thoracic spine manipulation. Outcome measures included pressure pain threshold (PPT) and PFGS. Cervical spine manipulation had a greater hypoalgesic effect when compared to thoracic spine manipulation, increasing PPT scores (35.1% vs. 0.8%, p<0.001). There was also greater improvement in PFGS scores in the cervical spine manipulation group compared to the thoracic spine manipulation group (24.7% vs. 19.8%, p<0.001).[33] **Manipulation With Movement (MWM)** • Of 25 LE patients who were treated with MWM, 92% were able to perform previously painful movements without pain and had improved grip strength immediately after treatment. Although both PFGS and maximum grip strength significantly increased in LE patients, the difference in pre- and post-PFGS was larger than the difference between pre- and post-maximum grip strength.[34]
Massage/Deep Tissue	**Deep Tissue Friction Massage** • One small RCT (N=40) of deep transverse friction massage for lateral epicondylitis (the only one identified in a Cochrane review of the subject) showed that 9 sessions of DTFM combined with concurrent physiotherapeutic modalities over 5 weeks offered no benefit over modalities alone in reported pain relief, grip strength, or functional status scores.[35] The study broke down comparisons into two trials of about 10 subjects each - DTFM & therapeutic ultrasound/placebo ointment versus ultrasound placebo ointment and DTFM and phonophoresis versus phonophoresis alone.[36] • DTFM combined with Mills manipulation was less effective than corticosteroid injection in improving pain, function, grip strength, and global assessment.[37] **Effleurage/Myofascial Release** • In 52 healthy subjects with fatigued power grip (from 3 minutes maximal isometric exercise consistently leading to 60% of baseline strength) 5 minutes of forearm/hand muscle massage (friction and effleurage) had greater effect in increasing grip performance than 5 minute rest period or 5 minutes passive elbow and shoulder motion.[38]
Exercise	**Stretching (extensor)** • In an RCT(n=21), isolated eccentric wrist extensor strengthening, using a rubber bar (Hera-Band FlexBar), along with standard physiotherapeutic modalities and manual interventions (wrist extensor, ultrasound, cross friction massage, heat and ice isotonic wrist extensor strengthening exercises) demonstrated marked improvement in pain (VAS scores) and function (DASH scores) at 7 weeks compared with standard physiotherapy alone.[39] • In an RCT (n=120), phonophoresis, with supervised exercise and stretching, and Cyriax physiotherapy both demonstrated significant improvement in pain (VAS scores) and grip strength. Cyriax physiotherapy (12 treatments, 3x/4 weeks), however, was superior to phonophoresis in improving pain, PFGS and functional status in 2-8 weeks.[40] **Strengthening** • In a prospective randomized study (n=29), a forearm support band (used throughout the day but not at night for at

	least 3 months), strengthening exercises, or a combination of both were not effective in improving pain or grip strength at 6 weeks, 3 months or 1-year.[41] • In an RCT (n=92), an eccentric training program (non-strengthening rehabilitation including ice, analgesic, TENS, US, deep friction massage and stretching, 3x/wk for 9 weeks plus isokinetic eccentric training) significantly reduced pain intensity and prevented forearm supinator and wrist extensor strength deficits compared to a program that did not include isokinetic eccentric training.[42]
Shockwave Therapy	• In a systematic review and meta-analysis of 76 RCTs (28 meeting meta-analysis inclusion) of physical interventions for lateral epicondylalgia, there was a general lack of evidence for determining long term benefit. However, there was evidence to conclude that extracorporeal shockwave therapy was not effective and that manipulation and exercise showed short term benefit and warranted further research into longer term effects.[9]
Laser Therapy	• In an RCT (n=50), a combination of low level (904 nm, 40 mW at 60 HZ, 2.4 J/cm^2) laser therapy (12 sessions) and plyometric exercises (5 sets of 8 reps with 1 minute rest between sets) was more effective than placebo laser therapy with the same plyometric exercises in improving pain, grip strength, and ROM at the end of treatment (8 weeks) and at 16 weeks.[43] • A systematic review and meta-analysis of 18 RCTs concluded that low level laser therapy (LLLT, administered at 904 nm and 632 nm wavelength) directly to the lateral elbow tendon insertions, offer short-term pain relief and less disability, both alone and in conjunction with exercise.[44]
Injections	**Corticosteroids** Corticosteroid injections are commonly used to alleviate pain in LE patients. Injections are effective in treating LE in the short term (2-6 weeks), but show no long term benefit. Recurrence of LE after injection is higher than after other treatment modalities. • In a systematic review, including 5 randomized controlled trials, corticosteroid injections were found to be more effective than physiotherapy (ultrasound, electrotherapy, frictions, taping, acupuncture, mobilizations, manipulations, exercises, home exercise programs and Mills manipulation) at short-term (6 weeks) follow-up in improving pain, grip strength, and disability; however the recurrence rate of LE was as high as 72% in one study. Physiotherapy was found to be more effective in improving outcomes in the long term.[45] • In a meta-analysis of 16 randomized controlled trials (n=1731), corticosteroid injections were more effective in improving shoulder and elbow tendinosis-related pain and functional disability in the short-term (weeks 1 to 3 and weeks 4 to 8) compared to other treatment types (e.g. 'wait and see' approach, physiotherapy, not otherwise described). However, corticosteroid injections were not more effective than NSAIDs in the short-term.[46] • In a RCT (n=198) physical therapy (8 treatments of elbow manipulation and exercise, 30 min each time/ 6 weeks, patients taught self-manipulation and given resistance bands and booklet for exercise) had a superior benefit to wait and see in the first 6 weeks and to corticosteroid injections after 6 weeks, providing a reasonable alternative to injections in the mid to long term. Although the corticosteroid injection had significant short term benefit, this benefit reversed after 6 weeks with high recurrence rates. Due to this, corticosteroid injection treatment should be used with caution when treating LE.[47] • A corticosteroid injection early in the course of LE (symptoms less than 4 weeks) did not significantly improve pain

	and function at 4 weeks, 8 weeks, or 6 months. A rehabilitation program, including ice massage (5-7 minutes, 3x/day), stretching and strengthening exercises (3 sets of 10 repetitions), improved pain and function over a longer duration of time.[48] **Botox** Botulinum toxin A has demonstrated some benefit in the treatment of LE. This possible alternative is less invasive, can be performed in an outpatient setting, and does not impair a patient's ability to work. Further studies are needed to evaluate the effect on LE. • Corticosteroid injections significantly improved pain and grip strength at 4 weeks when compared to botox. At later follow-up points (8, 12 weeks), however, the difference between groups was not significant. In fact, as time progressed, patients treated with botox, but not those treated by corticosteroids, showed a continued trend toward improvement in pain.[49] • Botulinum toxin A significantly improved pain in 68 LE patients beginning at 6 weeks when compared to a placebo injection. Improvement in clinical and VAS scores significantly continued throughout the 18-week follow-up period.[50] • At 6, 12, and 24 months, botulinum toxin A (injected into the wrist extensor) yielded similar results in the improvement of pain, range of motion, and sick leave rates when compared to operative treatment (surgical release of the wrist extensor).[51] **Autologous Blood Injections** Autologous blood injections have improved pain and function in patients with LE. Injections may enhance tendon healing and could serve as an effective non-operative alternative. Further studies of better quality and longer follow-up evaluation are needed to assess the effect on LE. • At 4 weeks, autologous blood injections and local corticosteroid injections both improved pain (VAS scores) and function (DASH scores) in patients with LE symptoms for at least 2 months (average). At 8 weeks, however, improvement in pain and function diminished in the corticosteroid injection group. Results were more promising for the autologous blood injection group.[52] • At 4 weeks, corticosteroid injections (1 ml of prilocaine followed by 1 ml of methylprednisolone) were significantly more effective in improving functional scores than autologous blood injections (2 ml) and shock wave therapy (1 treatment/week for 3 weeks). This effect diminished at 12 weeks and at 26 and 52 weeks, a significant decrease in improvement occurred for the corticosteroid group. Yet, improvement observed for the autologous blood group and shock wave group at 12 weeks continued throughout the 1 year follow-up.[53] • In LE patients with symptoms of at least 6 months, a single autologous blood injection improved pain (VAS scores) and function (DASH scores) significantly more than a corticosteroid injection at 26 and 52 weeks.[54] • Autologous blood injections improved pain for 22 of 28 LE patients with symptoms lasting for at least 3 months. Maximal benefit was reached at an average of 3 weeks after initial injection.[55]
Topical Nitric Oxide	• Nitric oxide administered by 24 hour topical patch over the affected tendons has had mixed result in RCT studies.[56] Although short term benefit may be possible, a long term (5 year) prospective study reported no advantages over a rehabilitation program.[57]

Acupuncture	• A 2008 Cochrane Review, including 4 small randomized controlled trials, concluded that there is insufficient evidence to support or refute the use of acupuncture (needle or laser) in the treatment of LE. Further studies of better quality are needed to evaluate the effect of acupuncture on LE.[58]
WORKERS' COMPENSATION INTERVENTION ISSUES	
Ergonomic Interventions	• Avoidance and/or modification of activities that place stress on the upper arm muscles originating from the humoral epicondyles is generally considered to be a first-line intervention for epicondylitis. (Souza 2009) Specific studies of ergonomic and activity modification programs in work-related epicondylitis patients were not identified. General reports suggesting utility for ergonomic programs for reducing exposure risk for upper extremity problems for workers such as computer users were found.[59]

MISCELLANEOUS TERMINOLOGY

Lateral Epicondylitis synonyms - Extensor carpi radialis tendinitis (ECRT), Tennis Elbow, Lateralis Epicondylitis Humeri, Lateral Epicondylagia are all synonyms for this condition which is a clinical diagnosis including presenting pain over the lateral epicondylar region that is aggravated by gripping and wrist extension and may be associated with exposure to repetitive and prolonged wrist and forearm loading (e.g. back hand swings in tennis)

Plyometric Exercises – Rapid, high-load movement sequences used for improving sports performance with the goal of strengthening tissue and improving nervous system response/coordination.

Autologous Blood Injection (ABI) , Autologous Conditioned Plasma Injection (ACP), and Platelet Rich Plasma (PRP) Injection are similar techniques that use an individual's own blood or plasma to inject (usually under ultrasound guidance) in and around tendons with the intent of healing small tears and/or degeneration.

STUDY METHODOLOGY TERMINOLOGY

Randomized Controlled Trial (RCT) – A study that randomly allocates patients to treatment groups, usually blinding patients, therapists and/or study evaluators.

Reviews – Studies that review previously published clinical trials. Ideally includes quantitative comparisons (e.g. meta-analyses) typical of Cochrane reviews. Systematic reviews imply screening for higher quality designs comprehensive inclusion of all relevant studies.

PROGRESS QUESTIONAIRRES – Implementation & Scoring Instructions

Administer at baseline, then every 2-4 weeks. Scores should reduce over time. Clinically meaningful changes have been reported to be 9 points (15% change) on the PRTEE and 6 points on the UEFI.

Patient-Rated Tennis Elbow Evaluation (PRTEE) (MacDermid 2005) - Pain Score: Add the numbers circled by patient for the 5 items in the Pain section (1). Function Score: Add the numbers circled by the patient for the 10 items in the function sections (2A & 2B) and divide by 2. Each section represents a number out of 50 with lower score indicating better pain & function. A total score sums both numbers and would be out of 100 possible.

Upper Extremity Functional Index (UEFI) (Strattford 2001) - Add the point value of all numbers circled to reach a total out of 80 points. A higher score on the UEFI indicates better pain & function.

Upper Limb Functional Index (ULFI) (Gable 2006) – The ULFI has 3 scores: The basic ULFI score is the total of boxes checked in the main section out of 25. Multiply by 4 for a percentage score. A higher score mean worse function. The mean detectable change is 2.6 ULFI points or 10.5%. The Patient Specific Index (PSI) section is scored by adding the total points given by the patient for activities most affected by their condition out of 25 possible. Again multiply by 4 to get a percentage score. The third section is a 10 point global status rating scale. The last two sections are primarily reflective of the patient's perceptions of their condition.

BRACING APPROACHES

Upper Forearm Compression braces – Various designs range from Velcro straps applied to the upper forearm, flexible sleeves that fit over the elbow, to more sophisticated devices that localize pressure to particular muscles or tendons in the upper forearm.

Wrist Motion Limiting braces (e.g. wrist extension) – Typically fixed splints that hold the wrist in a flexed, neutral or extended position, usually applied during daytime exposure to provoking activities. Wrist extension splints appear to be effective for lateral epicondylitis.

EXERCISE and SELF-MANAGEMENT APPROACHES

Stretching- Systematic approaches involving extremes of wrist and elbow position aimed at stretching wrist extensors or flexors.

Resisted Contraction - Typically isometric approached involving holding the hand/fist of the affected arm with the opposite hand and contracting the affected muscles intermittently and/or through various degrees of wrist flexion and extension

Strengthening – various approaches used to strength forearm and upper arm using isometrics or weights with wrist and/or elbow motion (e.g. wrist, biceps curls).

Self-administered Myofascial Work- Patient applies massage and pressure of variable duration and force to forearm muscles especially in the upper and mid forearm region, especially ones that exhibit tightness and tenderness.

Citations

1. Bernard B. Musculoskeletal Disorders (MSD) and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back. Cincinnati: National Institute for Occupational Safey and Health, Centers for Disease Control and Prevention, 1997.
2. Souza TA. Differential Diagnosis and Management for the Chiropractor: Protocols and Algorithms. Fourth ed. Boston: Jones and Bartlett Publishers, 2009.
3. Newcomer KL, Martinez-Silvestrini JA, Schaefer MP, Gay RE, Arendt KW. Sensitivity of the Patient-rated Forearm Evaluation Questionnaire in lateral epicondylitis. J Hand Ther 2005;18(4):400-6.
4. Angst F, Goldhahn J, Drerup S, Flury M, Schwyzer H, Simmen B. How sharp is the short QuickDASH? A refined content and validity analysis of the short form of the disabilities of the shoulder, arm, and hand questionnaire in the strata of symptoms and functions and specific joint conditions. Qual Life Res 2009 2009;18:1043-1051.
5. Kocher M, Horan M, Briggs K, Richardson T, O'Holleran J, Hawkings R. Reliability, validity, and responsiveness of the American Shoulder and Elbow Surgeons subjective shoulder scale in patients with shoulder instability, rotator cuff disease, and glenohumeral arthritis. J Bone Joint Surg Am 2005;87(9):2006-2011.
6. Macdermid J. Update: The Patient-rated Forearm Evaluation Questionnaire is now the Patient-rated Tennis Elbow Evaluation. J Hand Ther 2005;18(4):407-10.
7. Stratford P, Binkley J, Stratford D. Development and initial validation of the upper extremity functional index. Physiotherapy Canada 2001:259-267.
8. Gable P, Michener L, Burkett B, Neller A. The upper limb functional index: development and determination of reliability, validity, and responsiveness. J Hand Ther 2006:328-349.
9. Bisset L, Paungmali A, Vicenzino B, Beller E. A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. Br J Sports Med 2005;39:411-422.
10. Smidt N, Assendelft WJ, Arola H, Malmivaara A, Greens S, Buchbinder R, van der Windt DA, Bouter LM. Effectiveness of physiotherapy for lateral epicondylitis: a systematic review. Ann Med 2003;35(1):51-62.
11. Struijs PA, Assendelft WJ, Kerkhoffs GM, Souer S, van Dijk CN. The predictive value of the extensor grip test for the effectiveness of bracing for tennis elbow. Am J Sports Med 2005;33(12):1905-9.
12. Bussieres A, Peterson C, Taylor J. Diagnostic imaging guideline for musculoskeletal complaints in adults- an evidence-based appraoch-part 2: upper extremity disorders. J Manipulative Physiol Ther 2008;31(1):2-32.
13. Clarke A, Ahmad M, Curtis M, Connel D. Lateral elbow tendinopathy: correlation of ultrasound findings with pain and functional disability. Am J Sports Med 2010;38(6):1209-1214.
14. Lee M, Cha J, Jin W, Kim B, Park J, Lee H, Hong H. Utility of sonographic measurement of the common tensor tendon in patients with lateral epicondylitis. Am J Roentgenol 2011;196(6):1363-1367.
15. Bot S, van der Waal J, Terwee C, van der Windt D, Bouter L, Dekker J. Course and prognosis of elbow complaints: a cohort study in general practice. Ann Rheum Dis 2005;64(9):1331-1336.
16. Werner R, Franzblau A, Gell N, Hartigan A, Ebersole M, Armstrong T. Predictors of persistent elbow tendonitis among auto assembly workers. J Occup Rehabil 2005;15(3):393-400.
17. Kivi P. The etiology and conservative treatment of humeral epicondylitis. Scand J Rehabil Med 1983;15(1):37-41.
18. Kurppa K, Viikari-Juntura E, Kuosoma E, Huuskonen M, Kivi P. Incidence of tenosynovitis or peritendinitis and epicondylitis in a meat-procesing factory. Scand J Work Environ Health 1991;17(1):32-37.
19. Verhaar JA. Tennis elbow: anatomical, epidemiological and therapeutic aspects. Int Orthop 1994;18(5):263-267.
20. Descatha A, Leclerc A, Chastang J, Roquelaure Y. Study group on repetitive work: medial epicondylitis in occupational settings: prevalence, incidence and associated risk factors. J Occup Environ Med 2003;45(9):993-1001.

21. D'Vaz AP, Ostor AJ, Speed CA, Jenner JR, Bradley M, Prevost AT, Hazleman BL. Pulsed low-intensity ultrasound therapy for chronic lateral epicondylitis: a randomized controlled trial. Rheumatology (Oxford) 2006;45(5):566-70.
22. Kohia M, Brackle J, Byrd K, Jennings A, Murray W, Wilfong E. Effectiveness of physical therapy treatments on lateral epicondylitis. J Sport Rehab 2008;17:119-136.
23. Trudel D, Duley J, Zastrow I, Kerr ED, R., MacDermid J. Rehabilitation for patients with lateral epicondylitis: a systematic review. J Hand Ther 2004;17:243-266.
24. Hoppenrath T, Ciccone CD. Is there evidence that phonophoresis is more effective than ultrasound in treating pain associated with lateral epicondylitis? Phys Ther 2006;86(1):136-40.
25. Baskurt F, Ozcan A, Algun C. Comparison of effects of phonophoresis and iontophoresis of naproxen in the treatment of lateral epicondylitis. Clin Rehabil 2003;17(1):96-100.
26. Devereauz M, Hazleman BL, Thomas P. Chronic lateral humerus epicondylitis- a double blind clinical assessment of pulsed electromagnetic field therapy. Clin Exp Rheumato 1985;3:333-336.
27. Oken O, Kahraman Y, Ayhan F, Canpolat S, Yorgancioglu ZR, Oken OF. The short-term efficacy of laser, brace, and ultrasound treatment in lateral epicondylitis: a prospective, randomized, controlled trial. J Hand Ther 2008;21(1):63-7; quiz 68.
28. Garg R, Adamson GJ, Dawson PA, Shankwiler JA, Pink MM. A prospective randomized study comparing a forearm strap brace versus a wrist splint for the treatment of lateral epicondylitis. J Shoulder Elbow Surg 2010;19(4):508-12.
29. Vicenzino B, Collins D, Wright A. The initial effects of a cervical spine manipulative physiotherapy treatment on the pain and dysfunction of lateral epicondylalgia. Pain 1996;68(1):69-74.
30. Paungmali A, O'Leary S, Souvlis T, Vicenzino B. Hypoalgesic and sympathoexcitatory effects of mobilization with movement for lateral epicondylalgia. Phys Ther 2003;83(4):374-83.
31. Vicenzino B, Paungmali A, Buratowski S, Wright A. Specific manipulative therapy treatment for chronic lateral epicondylalgia produces uniquely characteristic hypoalgesia. Man Ther 2001;6(4):205-12.
32. Struijs PA, Damen PJ, Bakker EW, Blankevoort L, Assendelft WJ, van Dijk CN. Manipulation of the wrist for management of lateral epicondylitis: a randomized pilot study. Phys Ther 2003;83(7):608-16.
33. Fernandez-Camero J, Cleland J, La Touche Arbizu R. Examination of motor and hypoalgesic effects of cervical vs thoracic spine manipulation in patients with lateral epicondylalgia: a clinical trial. J Manipulative Physiol Ther 2011;11(34):432-440.
34. Abbott JH, Patla CE, Jensen RH. The initial effects of an elbow mobilization with movement technique on grip strength in subjects with lateral epicondylalgia. Man Ther 2001;6(3):163-9.
35. Brosseau L, Casimiro L, Milne S, Robinson V, Shea B, Tugwell P, Wells G. Deep transverse friction massage for treating tendinitis. Cochrane Database Syst Rev 2002(4):CD003528.
36. Stratford PW, Norman GR, McIntosh JM. Generalizability of grip strength measurements in patients with tennis elbow. Phys Ther 1989;69(4):276-81.
37. Verhaar JA, Walenkamp GH, van Mameren H, Kester AD, van der Linden AJ. Local corticosteroid injection versus Cyriax-type physiotherapy for tennis elbow. J Bone Joint Surg Br 1996;78(1):128-32.
38. Brooks CP, Woodruff LD, Wright LL, Donatelli R. The immediate effects of manual massage on power-grip performance after maximal exercise in healthy adults. J Altern Complement Med 2005;11(6):1093-101.
39. Tyler TF, Thomas GC, Nicholas SJ, McHugh MP. Addition of isolated wrist extensor eccentric exercise to standard treatment for chronic lateral epicondylosis: a prospective randomized trial. J Shoulder Elbow Surg 2010;19(6):917-22.
40. Nagrale AV, Herd CR, Ganvir S, Ramteke G. Cyriax physiotherapy versus phonophoresis with supervised exercise in subjects with lateral epicondylalgia: a randomized clinical trial. J Man Manip Ther 2009;17(3):171-8.
41. Luginbuhl R, Brunner F, Schneeberger AG. No effect of forearm band and extensor strengthening exercises for the treatment of tennis elbow: a prospective randomised study. Chir Organi Mov 2008;91(1):35-40.

42. Croisier JL, Foidart-Dessalle M, Tinant F, Crielaard JM, Forthomme B. An isokinetic eccentric programme for the management of chronic lateral epicondylar tendinopathy. Br J Sports Med 2007;41(4):269-75.
43. Stergioulas A. Effects of low-level laser and plyometric exercises in the treatment of lateral epicondylitis. Photomed Laser Surg 2007;25(3):205-13.
44. Bjordal JM, Lopes-Martins RA, Joensen J, Couppe C, Ljunggren AE, Stergioulas A, Johnson MI. A systematic review with procedural assessments and meta-analysis of low level laser therapy in lateral elbow tendinopathy (tennis elbow). BMC Musculoskelet Disord 2008;9:75.
45. Barr S, Cerisola F, Blanchard V. Effectiveness of corticosteroid injections compared with physiotherapeutic intervention for lateral epicondylitis: a systematic review. Physiotherapy 2009;95:251-265.
46. Gaujoux-viala C, Dougados M, Gossec L. Efficacy and safety of steroid injections for should and elbow tendonitis: a meta-analysis of randomised controlled trials. Ann Rheum Dis 2009;68:1843-1849.
47. Bisset L, Beller E, Jull G, Brooks P, Darnell R, Vicenzino B. Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. BMJ 2006:1-6.
48. Newcomer K, Laskowski E, Idank D, McLean T, Egan K. Corticosteroid injection in early treatment of lateral epicondylitis. Clinical Journal of Sport Medicine 2001;11:214-222.
49. Lin Y, Tu Y, Chen S, Chen S, Lin I, Guo H. Comparison between botulinum toxin and corticosteroid injection in the treatment of acute and subacute tennis elbow. Am J Phys Med Rehabil 2010;89(8):653-659.
50. Placzek R, Drescher W, Deuretzbacher G, Hempfing A, Meiss A. Treatment of chronic radial epicondylitis with botulinum toxin A. JBJS 2007;89-A(2):255-260.
51. Keizer S, Rutten H, Pilot P, Morre H, Os J, Verburg A. Botulinum toxin injection versus surgical treatment for tennis elbow. Clincal Orthopedics and Related Research 2002(201):125-131.
52. Kazemi M, Azma K, Tavana B, Rezaiee Moghaddam F, Panahi A. Autologous blood versus corticosteroid local injection in the short-term treatment of lateral elbow tendinopathy: a randomized clinical trial of efficacy. Am J Phys Med Rehabil 2010;89(8):660-7.
53. Ozturan KE, Yucel I, Cakici H, Guven M, Sungur I. Autologous blood and corticosteroid injection and extracoporeal shock wave therapy in the treatment of lateral epicondylitis. Orthopedics 2010;33(2):84-91.
54. Peerbooms J, Sluimer J, Bruijn D, Gosens T. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial: platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. Am J of Sports Med 2010;38(2):255-262.
55. Edwards SG, Calandruccio JH. Autologous blood injections for refractory lateral epicondylitis. J Hand Surg Am 2003;28(2):272-8.
56. Paoloni JA, Murrell GA, Burch RM, Ang RY. Randomised, double-blind, placebo-controlled clinical trial of a new topical glyceryl trinitrate patch for chronic lateral epicondylosis. Br J Sports Med 2009;43(4):299-302.
57. McCallum SD, Paoloni JA, Murrell GA. Five-year prospective comparison study of topical glyceryl trinitrate treatment of chronic lateral epicondylosis at the elbow. Br J Sports Med 2011;45(5):416-20.
58. Green S, Buchbinder R, Barnsley L, Hall S, White M, Smidt N, Assendelft W. Acupuncture for lateral elbow pain. Cochrane database of systematic reviews 2008:Art.No.:CD003527. DOI: 10.1002/14651858.CD003527.
59. Greene BL, DeJoy DM, Olejnik S. Effects of an active ergonomics training program on risk exposure, worker beliefs, and symptoms in computer users. Work 2005;24(1):41-52.