International Centre for Allied Health Evidence

University of South Australia

International Centre for Allied Health Evidence

A member of the Sansom Institute

Systematic Review of the Literature

The effectiveness of injection of steroid to the elbow (medial or lateral epicondyles) as a form of interventional pain management

Prepared for:
Amanda Bowens,
Information Specialist
The Accident Compensation Corporation
PO Box 242
Wellington 6011
New Zealand

Prepared by:
International Centre for Allied Health Evidence
University of South Australia
Adelaide
SA 5000
Australia

RESEARCH CENTRE RESPONSIBLE FOR THE PROJECT

International Centre for Allied Health Evidence
School of Health Sciences
City East Campus
University of South Australia
Adelaide
South Australia 5000
Website: www.unisa.edu.au/cahe

Review team
Steve Milanese
Karen Grimmer
Ashley Fulton
Holly Bowen
Heath Pillen

Centre Director
Professor Karen Grimmer
Phone: (08) 8302 2769
Fax: (08) 8302 2766
Email: karen.grimmer@unisa.edu.au

Project administrator
Ms. Madeleine Mallee
Business Services Officer
Business Development Unit
Division of Health Sciences
University of South Australia
Phone: (08) 8302 2121
Fax: (08) 8302 1472
Email: madeleine.mallee@unisa.edu.au

Citation details
The International Centre for Allied Health Evidence (2016) Systematic Review of Literature: The Effectiveness of injection of Steroid with or without Local Anaesthetic to the Elbow (Medial or Lateral Epicondyle) as a form of Interventional Pain Management: Technical Report. Prepared for the Accident Compensation Corporation, New Zealand.

Table of Contents

Contents

Abbreviations

The following abbreviations are used in this report and are collated here for readers' convenience

Abbreviation		Abbreviation	
AB	Autologous blood	**PPT**	**Pressure pain threshold**
CI	Confidence Interval	**PRP**	Platelet rich plasma
CSI	Corticosteroid injections	**PRTEE**	Patient-related tennis elbow evaluation
DASH	Disabilities of the Arm, Shoulder, and Hand (DASH),	**RCT**	Randomised Controlled trial
ESWT	Extracorporeal Shock Wave Therapy	**ROM**	Range Of Movement
LE	Lateral Epicondylitis	**RR**	Risk Ratio /Relative Risk
MA	Meta-analysis	**SIGN**	Scottish Intercollegiate Guidelines Network
MET	Muscle Energy Techniques	**SMD**	Standard Mean difference
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs	**SR**	Systematic Review
NRS	Numerical Rating Scale	**US**	Ultrasound
PICO	Population, Intervention, Comparator, Outcome	**VAS**	Visual Analogue Scale
PLA2	Phospholipase A2		
	Quality Ratings		
AQ	Acceptable Quality	**LQ**	Low Quality
CS	Can't say	**NA**	Not Applicable
HQ	High Quality	**R**	Reject (Unacceptable Quality)
QS	Quality of Study		

EXECUTIVE SUMMARY

Objective of the Review	The objective of this systematic review is to synthesise the evidence related to the effectiveness of injection of steroid to the elbow (medial and lateral epicondyle) as a form of interventional pain management. In order to review the evidence this review aims to answer the following research questions 1. What is the evidence for the effectiveness of steroid injections into the elbow (medial and lateral epicondyle) in relieving pain and/or in improving functional outcomes in patients with pain? 2. What is the evidence for the safety of steroid injections into the elbow (medial and lateral epicondyle)?
Evidence sourced	The search yielded 1674 articles. After scrutiny, 1637 articles were excluded as duplicates or failing to meet the inclusion criteria (shown in Figure 1), leaving 37 studies for inclusion in this review including 19 systematic reviews (SRs) and 18 randomised controlled trials (RCTs).
What is the evidence for the effectiveness of steroid injections into the elbow (medial and lateral epicondyles) in relieving pain and/or in improving functional outcomes in patients with pain?	• **The evidence indicates that steroid injections are effective in the short term (< 6 weeks) for reducing pain and improving function in patients with lateral epicondylitis** (Level A Recommendation). • **The evidence indicates that steroid injections are not effective in the intermediate and longer term (> 6 weeks) for reducing pain and improving function in patients with lateral epicondylitis** (Level A Recommendation). • **The evidence indicates that physiotherapy interventions including general active physiotherapy, exercises and iontophoresis are more effective than steroid injections in the intermediate to long term** (Level A Recommendation based on 1x HQ SR, 1x AQ SR and 2x AQ RCT). • **The evidence indicates that autologous blood product injections are more effective than steroid injections, particularly in the long term** (Level A Recommendation based on 1x HQ SR, 1x AQ SR). • **The evidence indicates that platelet-rich plasma (PRP) appears to provide better longer term pain relief than steroid injections** (Level C Recommendation based on 2 x AQ RCT RCT (AQ+)). • **The evidence indicates that steroid injections are effective in the short term (< 8 weeks) for reducing pain and improving function in patients with medial epicondylitis** (Level C Recommendation based on 2 x AQ RCT RCT (AQ+)).
What is the evidence for the safety of steroid injections into the elbow	• **Minor complications associated with steroid injections into the elbow are not uncommon but rarely require significant medical attention. Prevalence rates of minor complications associated with steroid injections appear no different than those following placebo injections**. (Level A Recommendation based on 2 x SRs).

What is the evidence for differences in effectiveness if imaging is used?	• **This review could find no evidence regarding the relative effectiveness of imaging for steroid injections into the elbow (medial or lateral epicondyle) for pain and/or improving functional outcomes in patients with pain.**
Does the evidence report any information about cost effectiveness?	• **The evidence suggests that steroid injections present a much smaller portion of direct medical spending related to treatment of lateral epicondylitis than physiotherapy, GP visits and specialist visits** (Level D Recommendation based on 1 cohort study).
Comparison to 2005 recommendations	• **The recommendations from this review do not significantly change the findings from the previous 2005 review.**

1. Background

1.1 Objective of this Review

The objective of this review is to synthesise the evidence related to the effectiveness of injection of steroid to the elbow (medial or lateral epicondyle) as a form of interventional pain management. This review will carry out a systematic review of the best available research evidence.

This review aims to answer the following research questions:

a) What is the evidence for the effectiveness of steroid injections in patients with elbow pain (medial or lateral epicondyle)?
b) What is the evidence for the effectiveness of steroid injections in improving functional outcomes in patients with elbow pain (medial or lateral epicondyle)?
c) What is the evidence for the safety of steroid injections with or without local anaesthetic in patients with elbow pain (medial or lateral epicondyle)?

1.2 Description of the Intervention

Lateral Epicondylitis

Lateral epicondylitis (LE) or tennis elbow is the most common condition affecting the elbow clinically and can be a source of significant pain and disability (Samagh et al. 2016). The prevalence has been estimated to range from 1 to 3% of the population (Verhaar 1994), with minimal gender variation. The typical age of onset is between 35 and 54 years (Mark et al. 2015).

Although given the name "tennis elbow", only about 10% of those with lateral epicondylitis describe this as an associated activity (De Smedt et al. 2007). It most commonly occurs after minor and often unrecognized trauma of the extensor muscles of the forearm. Work-related movements and risk factors which have been linked with this condition include repetitive and forceful elbow flexion and extension, repetitive wrist extension and pronation/supination, non-neutral position of hands and arms during work and the use of heavy hand tools (Walker-Bone et al. 2012, De Smedt et al. 2007, Haahr and Andersen 2003). As the wrist extensors play an important role in stabilising the wrist in extension, an activity important for carrying out the activities of daily living, in this disorder the activities of daily living are adversely affected (Barr et al. 2009).

The clinical manifestation of lateral epicondylitis involves pain over the lateral humeral epicondyle which may radiate to the forearm, provoked during excessive, quick, repetitive activities involving the hand in gripping or manipulating an object (Samagh et al. 2016). Pain and decreased function are the main complaints which affect activities of daily living (holding tools, shaking hands, lifting a cup of coffee, dressing and desk or household work, hitting a backhand stroke in tennis etc).

The insertion of the extensor carpi radialis brevis (ECRB) has been identified as the primary anatomical site of lateral epicondylitis, although degenerative changes in the extensor digitorum communis (EDC) is present in approximately 50% of cases and occasionally pathological changes are seen on the undersurface of the extensor carpi

radialis longus (ECRL) (Nirschl and Ashman 2003, Mark et al. 2015). Research indicates repetitive contractures of the extensor mechanism lead to microscopic tears and eventually degenerative tendinosis (Kraushaar and Nirschl 1999). The tendinosis is theorized to be caused by a failed response of tissue to repetitive micro tears as well as hypovascular tissue of the tendon origin. The pathological process appears less inflammatory and more representative of a degenerative tendinosis. However although the presence of active inflammatory cells has not been demonstrated histologically, the role of a neurogenic inflammatory response in patients with lateral epicondylitis has been investigated. The up-regulation of NK-1 receptors in patients with chronic pain has been seen on PET scan when identifying radioligand NK-1 receptors. Substance P, a primary agonist for these pain receptors, has also been found in increased amount in tissues samples of patients with lateral epicondylitis (Bales et al. 2007, Ljung et al. 2004).

The described histology of this "angiofibroblastic hyperplasia", as termed by Nirschl and Ashman (2003), consist of disorderly tendon fibres in combination with fibroblasts and atypical vascular granulation-like tissue, focal hyaline degeneration and calcific debris surrounded by hypercellular and degenerative tissues, although additional molecular studies have shown that fibro cartilage may be a "normal" histological feature of aging tendons (Faro and Wolf 2007).

Medial Epicondylitis

Often termed 'golfers' elbow', medial epicondylitis (ME) represents 9.8% to 20% of all cases of epicondylitis, affecting 0.4 - 1.3% of the population (Mark et al. 2015). The average age of patents at onset is between 40 and 50 years, although there is a subset of younger patients usually secondary to overhead throwing activities. Smoking, obesity, repetitive movements and forceful activities show significant associations with ME (Koot 2016). ME is associated with pathology at the common flexor tendon insertion at the medial epicondyle, with the muscles involved including the pronator teres, the flexor carpi radialis, the flexor digitorum superficialis, and the flexor carpi ulnaris. The histopathology is the same as described previously for LE.

Terminology

There has been some debate in the literature about the terminology used for these conditions with some authors recommending that the correct diagnostic label is 'epicondylalgia', as the traditional inflammatory model was both flawed and simplistic (Waugh 2005). Whilst the term epicondylalgia has been recommended, as it reinforces the concept that this is a complex condition with potentially several pathophysiological mechanisms and underlying causes of pain, for this review the term 'epicondylitis' has been used as it reflects the term most commonly used in the research literature.

Use of Steroid Injections

How steroid injections work in the management of epicondylitis remains controversial (Coombes et al. 2009, Elmajee and Pillai 2016). Steroids have an anti-inflammatory effect, inhibiting fibroblast proliferation, angiogenesis, and formation of granulation tissue. They also interfere with collagen precursor ground substance sulfation and collagen repair (Nichols 2005). However, the lack of significant inflammatory markers in histopathological studies of chronic epicondylitis makes the concept of an anti-inflammatory effect less likely (Elmajee and Pillai 2016). It could be argued that the histopathological studies have involved recalcitrant/chronic cases of epicondylitis, so the documented histological features may represent the end stage of a process. The developing appreciation of the role of a neurogenic inflammatory response in patients with epicondylitis suggests a potential anti-inflammatory role for steroids. Some authors have explained the analgesic actions of steroids by the effects on the calcitonin gene-related peptide, neuropeptides, and substance P, which are increased in tendinopathy (Fredberg and Stengaard-Pedersen 2008). In addition, some argue that steroid injections are associated with strong placebo effects (Coombes et al. 2009)

2. Methodology

2.1 Review question

What is the effectiveness of injection of steroid in patients with elbow pain (medial or lateral epicondyle)?

2.2 Methods

A systematic review of published research literature was undertaken to provide a synthesis of the currently available research evidence related to the effectiveness of steroid injections with or without local anaesthetic in patients with elbow pain (medial or lateral epicondyle) as a form of interventional pain management. A systematic and rigorous search strategy was developed to locate all published and accessible research evidence. The evidence base for this review included research evidence from existing systematic reviews, meta-analyses and high-level primary research (randomised controlled trials, prospective cohort studies). Where no systematic reviews, randomised controlled trials or prospective cohort studies were located, then other primary study designs (excluding commentary /expert opinion) were considered.

2.3 Search strategy

The search was developed using a standard PICO structure (shown in Table 1). Only English articles published, using human participants, which were accessible in full text, were included.

Table 1: Criteria for considering studies in the review

Population	Humans
Intervention	Steroid injection with or without local anaesthetic for patients with elbow pain (medial or lateral epicondyle) as a form of interventional pain management
Comparator	Any active treatment or placebo.
Outcomes	• Pain-related primary outcome; • Functional outcomes (range of motion, reduction of disability, return to work, quality of life) • Safety and risk • Relationship to imaging • Best practice recommendations • Cost effectiveness

A combination of search terms (shown in Table 2) were used to identify and retrieve articles in the following databases:

- OVID
  - EMBASE,
  - MEDLINE,
  - AMED,
- ICONDA,
- CINAHL,
- PubMed,
- Pre-Medline,
- The Cochrane Library,
- Scopus,
- TRIP database

Table 2: Search terms for the review

Search term 1	Search terms 2	Search terms 3	Search terms 4
• Pain	• Injection	• Elbow Joint* • Tennis Elbow • Periarthritis • Golf* elbow • elbow* • epicondyl* periarthrit* • flexor retinaculum Radiohumeral • Humeroulnar	• Steroid • Betamethasone • Dexamethasone • Fluocortolone • Methylprednisolone • Paramethasone • Prednisolone • Prednisone • Triamcinolone • Hydrocortisone • Cortisone • Methandrostenolone • Stanozolol • Methenolone • Oxymetholone • Oxandrolone • Nandrolone • Diflucortolone • Fluprednisolone

The titles and abstracts identified from the above search strategy were assessed for eligibility by the *i*CAHE researchers. Full-text copies of eligible articles were retrieved for full examination. Reference lists of included full-text articles were searched for relevant literature not located through database searching.

2.4 Study Selection

Inclusion Criteria

- Study types: systematic reviews (SRs), all primary research designs - randomised controlled trials (RCTs), cohort studies (prospective or retrospective), case studies or case series.
- Participants: patients with elbow pain (medial or lateral epicondyle).
- Intervention: steroid injections with or without local anaesthetic.
- Controls: any active treatment or placebo, or no intervention control.
- Outcomes: pain relief (primary) functional outcomes, safety, and risk (secondary).
- Publication criteria: English language, full text available, in peer reviewed journal.

Exclusion criteria

- Studies only available in abstract form, e.g. conference presentations.
- Grey literature and non-English language material.
- Studies involving healthy volunteers or experimentally induced pain.

2.5 Critical Appraisal	Scottish Intercollegiate Guidelines Network (SIGN) checklists specific to the study design of the included studies were used to assess their methodological quality. The SIGN checklists ask a number of questions with yes, no, can't say or not applicable as responses. The appraiser then gives an overall rating of quality, based on these responses, of either high quality (++), acceptable quality (+), low quality (-) or unacceptable. As there is no SIGN checklist for case studies, these study designs will not be quality scored. Appendix 1 contains a copy of the SIGN checklists utilized in this review.
2.6 Data Extraction	Data were extracted from the identified publications using a data extraction tool which was specifically developed for this review. The following information was extracted from individual studies: • Evidence source (author, date, country) • Level of evidence • Characteristics of participants • Interventions • Outcome measures • Results For this review the studies that met the inclusion criteria were assessed for internal validity using the SIGN checklist for the relevant study design. Each study was then graded for overall methodological quality using the SIGN levels of evidence model.

2.7 Data Synthesis

As described, for this review each study was graded for overall methodological quality using the SIGN checklist specific to the study design of the included studies.

Recommendations from the literature were made and scored according to a modification of the SIGN Evidence Grading Matrix (see Table 3). The modification was to add levels 1 and 2 to differentiate between the 1+ and 1-, 2+ and 2- levels of evidence.

Table 3: Modified SIGN Evidence Grading Matrix

Levels of scientific evidence	
1++	High-quality meta-analyses, high-quality systematic reviews of clinical trials with very little risk of bias
1+	Well-conducted meta-analyses, systematic review of clinical trials or well-conducted clinical trials with low risk of bias
1	Meta-analyses, systematic review of clinical trials or clinical trials with a moderate (acceptable) level risk of bias.
1-	Meta-analyses, systematic reviews of clinical trials or clinical trials with high risk of bias.
2++	High-quality systematic reviews of cohort or case and control studies; cohort or case and control studies with very low risk of bias and high probability of establishing a causal relationship
2+	Well-conducted cohort or case and control studies with low risk of bias and moderate probability of establishing a causal relationship
2	Cohort or case and control studies with moderate risk of bias and potential risk that the relationship is not causal.
2-	Cohort or case and control studies with high risk of bias and significant risk that the relationship is not causal.
3	Non-analytical studies, such as case reports and case series.
4	Expert opinion.

To standardise strengths of recommendations from the extensive literature used for this review, a structured system was developed to incorporate a number of quality measures. Four measures were selected as important variables for the assessment of recommendation strength from the primary and secondary research sources. These were:

a) Combination of data via meta-analysis

b) Quality of systematic review/trials

c) Number of RCTs

d) Consistency of the evidence

A scoring system was developed, based on a 0 and 1 score for each of these variables:

1. Combination of data via meta-analysis: Yes = 1, No = 0
2. Quality of systematic review: HQ/Acc (+) =1, LQ(0)/R = 0
3. Number of RCTs: ≥ 5RCTs = 1, < 5=0
4. Consistency: ≥ 75% agreement = 1, < 75% agreement = 0

2.8 Grades of Recommendation

This allowed for a maximum potential score of 4 and a minimum score of 0, which reflected a measure of the evidence strength across a range of studies. The resultant score was transferred to the SIGN Evidence Grading matrix

Total Score	SIGN Evidence Grading matrix score
4	1++
3	1+
2	1
1/0	1-

Final recommendations were graded according to SIGN Grades of Recommendations (Table 4).

Table 4: Scottish Intercollegiate Guidelines network (SIGN) Grades of Recommendations

Grades of Recommendations	
A	At least one meta-analysis, systematic review or clinical trial classified as 1++ and directly applicable to the target population of the guideline, or a volume of scientific evidence comprising studies classified as 1+ and which are highly consistent with each other.
B	A body of scientific evidence comprising studies classified as 2++, directly applicable to the target population of the guideline and highly consistent with each other, or scientific evidence extrapolated from studies classified as 1++ or 1+.
C	A body of scientific evidence comprising studies classified as 2+, directly applicable to the target population of the guideline and highly consistent with each other, or scientific evidence extrapolated from studies classified as 2++.
D	Level 3 or 4 scientific evidence, or scientific evidence extrapolated from studies classified as 2+

3. Results

3.1 Evidence Sources

The search yielded 1674 articles; following removal of duplicates, 683 articles were identified for screening of title and abstract. After scrutiny, 954 articles were excluded for failing to meet the inclusion criteria (shown in Figure 1), leaving 34 studies for inclusion in this review. Figure 1 illustrates the process involved in study selection.

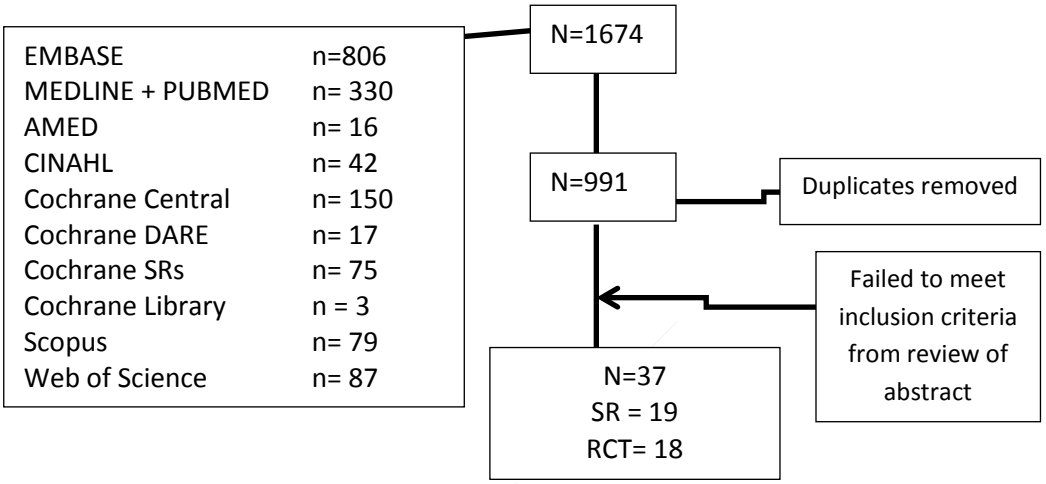

Figure 1: Flow chart of search results

3.2 Quality of the Evidence

The overall quality of the studies included in this review ranged from high to low.

	N=	HQ(++)	AQ(+)	LQ(-)	R(0)
Systematic reviews	19	11	4	3	1
RCTs	18	2	9	7	0

Appendices 2 and 5 present the critical appraisal scores for the systematic reviews (SRs) and randomised controlled trials (RCTs) included in this review. Common design flaws identified in the included studies are listed below.

Systematic reviews

A) Studies did not address the potential for publication bias in reporting their reviews.

B) Excluded studies were not listed.

C) Reviews often failed to differentiate between primary and secondary outcomes when synthesising their findings. Most systematic reviews used pain as a primary outcome and functional disability etc. as secondary outcomes, but failed to differentiate between the two when synthesising study findings in their reviews.

D) Systematic reviews often failed to define the specific pathology involved. Epicondylitis is often diagnosed through the area of pain (lateral or medial elbow) and results from clinical tests (i.e. Mills, Maudsleys or Cozens) with uncertain diagnostic accuracy for specific pathology.

Randomised controlled trials

A) The studies often failed to ensure that the only difference between the two groups (intervention vs. control) was the treatment under investigation. With the small numbers reported in the RCTs, it was difficult to ensure that the effect of confounders was dealt with. This was particularly important when considering the effect of secondary outcomes. Studies rarely controlled for the patient's involvement in co-interventions such as exercise/medication etc.

B) Subjects and investigators were rarely blinded to the intervention involved.

C) Clinical studies often failed to define the specific pathology involved. Epicondylitis is often diagnosed through the area of pain (lateral or medial elbow) and results from clinical tests (i.e. Mills, Maudsleys or Cozens) with uncertain diagnostic accuracy for specific pathology.

D) Clinical studies often failed to consider the clinical spectrum of presentations to ensure homogeneity of subjects, i.e. acute to chronic, severe to mild.

3.3 Outcome Measures – Pain and Function

Systematic reviews

A total of 18 systematic reviews were found in this review that investigated the effectiveness of steroid injections as a pain management intervention for the elbow. These systematic reviews appraised 66 RCTs. Appendix 3 presents the findings from the systematic reviews included in this review. Appendix 4 presents the studies included in those systematic reviews.

Randomised controlled trials

A total of 18 RCTs that were not included in the 18 systematic reviews were identified in this review. Appendix 6 presents the data extraction from the RCTs included in this review

Lateral Epicondylitis

Systematic Reviews

Pre 2005

Labelle et al. (1992) presented a systematic review into the scientific evidence for methods of treatment for lateral epicondylitis of the elbow, which included cortisone injections. They found 78 papers, including 7 case reports, 53 case series and 18 clinical trials, of which 5 clinical trials focused on steroid injections (Day et al. 1978; Brattberg 1983; Clarke & Woodland 1975; Hughes & Currey 1969; Kivi 1983).

All trials scored low on quality scoring and examined treatment with various local steroid injections. Day et al. (1978) showed a significant therapeutic effect of methylprednisolone solution compared with xylocaine and saline solutions in 95 subjects ($p < 0.001$). Hughes & Currey (1969) and Clarke & Woodland (1975) showed no differences between various preparations of steroid, however all showed some effect. Brattberg (1983) found significantly better ($p < 0.005$, $n = 60$) results with acupuncture than with steroid injection and Kivi (1983), reported similar results when comparing various oral steroids with indomethacin in 80 patients.

The authors concluded that whilst most studies suggested a positive therapeutic effect for steroid injections, the very low quality scores and conflicting results make further investigations mandatory.

Study	QS	Conclusions	Level of Evidence
Labelle et al. (1992)	LQ(-)	• Most studies suggested a positive therapeutic effect for steroid injections, but the very low scores and some conflicting results make further investigations mandatory.	1-

Assendelft et al. (1996) assessed the effectiveness of steroid injections in the treatment of lateral epicondylitis by a systematic review/meta-analysis of RCTs. A total of 12 RCTs were identified. Ten trials compared steroid injections with another (placebo) treatment, whereas two compared different corticosteroid regimens: (Price et al. 1991;

Verhaar 1992; Saartok & Eriksson 1986; Day et al. 1978; Haker & Lundeberg 1993; Murley & Lond 1954; Freeland & Gribble 1954; Halle et al. 1986; Baily & Brock 1957; Kivi 1983; Hughes & Currey 1969).

The authors concluded that the evidence on steroid injections for the treatment of tennis elbow was not conclusive, with many trials conducted in a secondary care setting with serious methodological flaws and heterogeneity among the trials. Steroid injections appeared to be relatively safe and seemed to be effective in the short term (2-6 weeks).

Study	QS	Conclusions	Level of Evidence
Assendelft et al. (1996)	HQ(++)	• Steroid injections appeared to be relatively safe and seemed to be effective in the short term (2-6 weeks).	1+

Smidt et al. (2002) undertook a systematic review of RCTs to evaluate the effectiveness of steroid injections for lateral epicondylitis. They identified 13 RCTs (Bär et al. 1997; Day et al. 1978; Erturk et al. 1997; Freeland & Gribble 1954; Haker & Lundeberg 1993; Halle 1986; Hay et al. 1999; Murley & Lond 1954; Oksenberg et al. 1998; Price et al. 1991; Saartok & Eriksson 1986; Verhaar et al. 1996; Baily & Brock 1957), and explored the effects on pain, global improvement and grip strength.

The authors presented their findings according to:

- ***Short term results:*** All studies except Saartok & Eriksson (1986), who measured and sufficiently reported either pain or global improvement, found statistically significant and clinically relevant short-term results in favour of steroid injections.
- ***Steroid injection compared to placebo injection:*** There was insufficient evidence to support or refute the effectiveness of steroid injection compared to placebo injection.
- ***Steroid injection compared to injection with local anaesthetic:*** Quantitative analysis showed that the pooled estimate for global improvement was statistically significant and clinically relevant (RR (95%CI): 0.18 (0.08, 0.39). There is strong evidence for the effectiveness of steroid injections on global improvement compared to an injection with local anaesthetic. There is insufficient evidence for pain and grip strength
- ***Steroid injection compared to conservative treatment:*** Due to the low number of studies on pain, there was weak evidence for the effectiveness of steroid injections compared to other conservative treatments. The pooled estimate for global effect was statistically significant and clinically relevant (RR (95%CI): 0.50 (0.36, 0.70) in favour of steroid injections (strong evidence). The pooled estimate for grip strength was statistically significant and clinically relevant (SMD (95%CI): 20.70 (21.07, 20.33) in favour of injections.
- ***Intermediate and long term effectiveness:*** Only six studies performed an intermediate (6 weeks - 6 months) or long-term (>6 months) outcome assessment and none of the studies found statistically significant results in favour

of steroid injections.

- ***Effectiveness of different amounts, doses and suspensions of steroid injections:*** There was insufficient evidence for the use of any specific amount, dosage or type of steroid suspension.

The authors concluded that although the available evidence showed superior short-term effects of steroid injections for lateral epicondylitis, it was not possible to draw firm conclusions on the effectiveness of injections due to the lack of high quality studies. No beneficial effects were found for intermediate or long-term follow-up.

Study	QS	Conclusions	Level of Evidence
Smidt et al. (2002)	HQ(++)	• Steroid injections appeared to be effective in the short term (up to 6 weeks).	1+
		• No beneficial effects were found for intermediate or long-term follow-up.	1+

Post 2005

Nimgade et al. (2005) undertook a systematic review of RCTs into the effectiveness of treatments for lateral epicondylosis interventions, including steroid injections. They included 6 RCTs that investigated the effects of steroid injections against other treatments (Price et al. 1991; Hay et al. 1999; Smidt et al. 2002; Newcomer et al. 2001; Murley & Lond 1954; Saartok & Eriksson 1986). The authors included a review of the quality of evidence over time.

The authors concluded that in the short term (<2 to 3 months), active interventions, especially steroid injections, appeared more efficacious than relative rest. In the long term, active physiotherapy outperformed injections, although it does not appear significantly better than relative rest after 1 year. Although patients on relative rest eventually improve, early active interventions such as injections and exercise therapy may help attain functional goals more quickly. They also found no increase in study quality (ascertained by internal validity) over time. A low Pearson product-moment correlation between publication year and quality score of 0.039 (n = 30, P = 0.84) was found. Using partial correlation to adjust for journal quality (2002 ISI journal impact factor), the correlation between publication year and quality score was 0.368, but remained insignificant (df = 14, P = 0.161).

Study	QS	Conclusions	Level of Evidence
Nimgade et al. (2005)	AQ(+)	• Steroid injections appeared to be effective in the short term (up to 3 months).	1
		• In the long term, active physiotherapy outperformed injections	1

Barr et al. (2009) conducted a systematic review of RCTs comparing the effectiveness of steroid injections with physiotherapeutic interventions for the treatment of lateral

epicondylitis. Five studies were included that involved comparison between an injection group and a physiotherapeutic intervention group (Bisset et al. 2003; Smidt et al. 2002; Tonks et al. 2007; Verhaar et al. 1996; Uzunca et al. 2007).

Four of the studies included the measurement of pain-free grip strength. Standardised mean differences (effect sizes) were calculated for this outcome measure and assessor's rating of severity at 3, 6, 12, 26 and 52 weeks for two of the RCTs. Large effect sizes were demonstrated in favour of steroid injections at short-term follow-up. Despite corticosteroid injections being found to be more effective in the short term compared with physiotherapeutic interventions, reported recurrence rates varied from 34% to 74% in three of the included studies. At intermediate- and long-term follow-up, medium-to-large effect sizes were demonstrated in favour of physiotherapeutic interventions compared with steroid injections. However, at long-term follow-up, the research suggests that there is a small benefit of physiotherapeutic interventions compared with a 'wait and see' policy.

Study	QS	Conclusions	Level of Evidence
Barr et al. (2009)	HQ(++)	• steroid injections are favourable to physiotherapeutic interventions at short-term follow-up; however, the recurrence rates have been shown to vary from 34% to 72%	1
		• Physiotherapeutic interventions have been shown to be favourable in the intermediate to longer term.	1

Krogh et al. (2013) completed a systematic review/meta-analysis to assess the comparative effectiveness and safety of injection therapies in patients with lateral epicondylitis. They identified 8 different injectates that were used clinically with this condition. They included 17 trials (n=1381) of which 10 involve glucocorticoid injections (Akermark et al. 1995; Dogramaci et al. 2009; Kazemi et al. 2010; Lin et al. 2010; Lindenhovius et al. 2008; Newcomer et al. 2001; Ozturan et al. 2010; Peerbooms et al. 2010; Price et al. (study 1) 1991; Price et al. (study 2) 1991). Over the 17 trials the risk of bias was high with only 3 studies (18%) presenting with a low risk of bias.

Pooled results (SMD [95% confidence interval]) showed that beyond 8 weeks, glucocorticoid injection was no more effective than placebo (-0.04 [-0.45 to 0.35]), but only 1 trial (which did not include a placebo arm) was at low risk of bias. Autologous blood (-1.43 [-2.15 to -0.71]), platelet-rich plasma (-1.13 [-1.77 to -0.49]), prolotherapy (-2.71 [-4.60 to -0.82]) and hyaluronic acid (-5.58 [-6.35 to -4.82]) were also statistically superior to placebo, whereas polidocanol (0.39 [-0.42 to 1.20]) and glycosaminoglycan (-0.32 [-1.02 to 0.38]) showed no significant effect compared with placebo.

Study	QS	Conclusions	Level of Evidence
Krogh et al. (2013)	HQ(++)	• Steroid injections are no more effective than placebo (SMD -0.04 [-0.45 to 0.35])	1+

Olaussen et al. (2013) presented a systematic review looking at different interventions for lateral epicondylitis including steroid injections and non-electrotherapeutical physiotherapy. Their inclusion criteria involved RCTs only and physiotherapy interventions including stretching, mobilisation, manipulation, massage, exercise or home training, and that did not involve treatments such as splinting, ultrasound, shock wave and other electrotherapeutic modalities. They identified 11 RCTs (n= 1161) including patients of both sexes and all ages (Bisset et al. 2006; Coombes et al. 2013; Hay et al. 1999; Price et al. 1991; Smidt et al. 2002; Toker et al. 2008; Lindenhovius et al. 2008; Newcomer et al. 2001; Martinez-Silvestrini et al. 2005; Peterson et al. 2011; Selvanetti et al. 2003)

Steroid vs no intervention or NSAIDs

Steroid injection gave a short-term reduction in pain versus no intervention or nonsteroidal anti-inflammatory drugs (SMD −1.43, 95% CI−1.64 to −1.23). At intermediate follow-up, the authors found an increase in pain (SMD 0.32, 95% CI 0.13 to 0.51), reduction in grip strength (SMD −0.48, 95% CI −0.73to −0.24) and negative effect on the overall improvement effect (RR 0.66 (0.53 to 0.81)).

Steroid vs anaesthetic

For steroid injection versus lidocaine injection, the evidence was conflicting. At long-term follow-up, there was no difference in overall improvement and grip strength, with conflicting evidence for pain.

Study	QS	Conclusions	Level of Evidence
Olaussen et al. (2013)	HQ (++)	• Steroid injection gave a short-term reduction in pain versus no intervention or NSAID drugs (SMD −1.43, 95% CI −1.64 to −1.23).	1+
		• At intermediate follow-up, there was an increase in pain (SMD 0.32, 95% CI 0.13 to 0.51), reduction in grip strength (SMD −0.48, 95% CI −0.73 to −0.24) and negative effect on the overall improvement effect (RR 0.66 (0.53 to 0.81)).	1+
		• For steroid injection versus lidocaine injection, the evidence was conflicting	1+

Rodriguuez (2014) undertook a review of systematic reviews/RCTs into the effectiveness of steroid injections compared to platelet rich plasma (PRP) injections for lateral epicondylitis. They identified 14 studies of which seven (4 systematic reviews (Coombes, Bisset, & Vicenzino 2010; Krogh et al. 2013; Priteo-Lucena et al. 2012; Sheth et al. 2012) and 3 RCTs (Gosens et al. 2011; Krogh et al. 2012; Peerbooms et al. 2010)) directly compared the two interventions.

The authors concluded that whilst the evidence supported corticosteroid injections as an effective short-term intervention, there was a lack of evidence of an intermediate or long-term effect on pain. Platelet-rich plasma (PRP) was shown to be more effective, providing longer lasting positive results with a lower recurrence rate.

Study	QS	Conclusions	Level of Evidence
Rodriguuez (2014)	LQ(-)	• Corticosteroid injections are an effective short-term intervention for reducing pain and improving function in patients with LE, but lack evidence of intermediate or long term effects	1-
		• Platelet-rich plasma (PRP) was shown to be more effective than steroid injections, providing longer lasting positive results with a lower recurrence rate	1-

Sayegh and Straugh (2015) presented a systematic review/meta-analysis comparing longitudinal outcomes following non-surgical treatment and no treatment for patients with LE. They included studies with a 6 month follow up and included all conservative treatments including injections (steroid, platelet-rich plasma, autologous blood, sodium hyaluronate, or glycosaminoglycan polysulfate), physiotherapy, shock wave therapy, laser, ultrasound, corticosteroid iontophoresis, topical glyceryl trinitrate, or oral naproxen. They identified 22 studies of which 6 compared cortisone injections with non-treatment (Krogh et al. 2013; Coombes et al. 2013; Wolf et al. 2011; Bisset et al. 2003; Runeson & Haker 2002; Smidt et al. 2002; Hay et al. 1999). Unfortunately, this review failed to identify the specific effects of any of the individual treatments, and therefore provided little information for our review.

Study	QS	Conclusions	Level of Evidence
Sayegh & Strauch (2015)	AQ(+)	• Lack of intermediate & long-term benefits to nonsurgical treatment compared with placebo/observation	1-
		• Steroid injections not examined separately; part of nonsurgical treatment group	1-

Arirachakaran et al. (2016) presented a systematic review/meta-analysis comparing the clinical outcomes from platelet-rich plasma (PRP) injections and autologous blood (AB) injections versus steroid injections in LE. They identified 10 RCTs of which 6 included steroid injections (Kazemi et al. 2010; Peerboom et al. 2010; Dojode 2012; Omar et al. 2012; Singh et al. 2013; Krogh et al. 2012).

The authors concluded that PRP injections significantly improved pain and PRTEE score when compared with AB injection and steroid injection, and compared to AB injection, steroid injection had significantly improved disability score (DASH) and significantly improved pressure pain threshold (PPT).

Multiple active treatment comparisons indicated that within 2 months only AB injection showed an improvement of borderline significance (P=0.0056) in pain VAS, but PRP and AB injection showed a significant improvement in pain VAS when compared with steroid injections. AB injection had significantly improved DASH scores and PPT when compared with PRP and steroid injections, but AB injection had a statistically significantly higher risk of adverse effects when compared with PRP and

steroid injections at the last follow-up assessment. The chances of adverse effects from PRP injection and steroid injection were not significantly different

Study	QS	Conclusions	Level of Evidence
Arirachakaran et al. (2016)	HQ(++)	• Platelet-rich plasma (PRP) injections significantly improved pain and PRTEE score when compared with AB injection and steroid injection	1
		• Steroid injection had significantly improved disability score (DASH) and significantly improved pressure pain threshold (PPT) compared to AB injections	1

Claesson et al. (2016) presented a systematic review/meta-analysis that specifically focussed on the effect of steroid injections for enthesopathy of the extensor carpi radialis brevis (ECRB). They focussed on RCTs that used a placebo injection controlled approach with at least 10 subjects, followed patients up for at least 1 month and looked at pain, DASH and/or grip strength. They identified 16 studies but excluded 7 studies with low Jadad scores and two that lacked suitable data comparing the two interventions, leaving 7 RCTs for inclusion in the final analysis (Price et al. 1991; Lindenhovius et al. 2008; Zeisig et al. 2008; Wolf et al. 2011; Mardani-Kivi et al. 2013; Coombes et al. 2013; Krogh et al. 2012).

The authors found no difference between the pain intensity 6 months after injection of steroids or placebo. The pain intensity (as measured by VAS) was slightly, but significantly, lower at 1 month, but not at 3 months, after steroid injection. There were no significant differences in grip strength or Disabilities of the Arm, Shoulder, and Hand (DASH) score at any time point. They concluded that the weight of evidence to date suggests that corticosteroid injections are neither meaningfully palliative nor disease modifying when used to treat ECRB enthesopathy.

Study	QS	Conclusions	Level of Evidence
Claesson et al. (2016)	HQ(++)	• The pain intensity (as measured by VAS) was slightly, but significantly, lower 1 at month, but not at 3 months, after steroid injection compared to placebo	1+
		• There were no significant differences in grip strength or Disabilities of the Arm, Shoulder, and Hand (DASH) score at any time point.	1+

Dong et al. (2016) undertook a systematic review/meta-analysis into the effectiveness of injection therapies for LE (including steroid). Their inclusion criteria included RCTs with at least two injection therapies for LE, including placebo (PLA) or a 'wait and see' strategy, with assessment of pain or functional recovery. They identified 27 studies for inclusion (Price et al. 1991; Akermark et al. 1995; Hay et al. 1999; Newcomer et al. 2001; Smidt et al. 2002; Wong et al. 2005; Bisset et al. 2006; Placzek et al. 2007; Tonks et al. 2007; Lindenhovius et al. 2008; Scarpone et al. 2008; Dogramaci et al. 2009;

Espandar et al. 2010; Kazemi et al. 2010; Lin et al. 2010; Ozturan et al. 2010; Peerbooms et al. 2010; Petrella et al. 2010; Thanasas et al. 2011; Wolf et al. 2011; Omar et al. 2012; Coombes et al. 2013; Jindal et al. 2013; Krogh et al. 2012; Mardani-Kivi et al. 2013; Rabago et al. 2013; Stenhouse et al. 2013).

Compared with placebo interventions, only prolotherapy and hyaluronic acid demonstrated statistically significant results, while steroid injections presented with a marginal weighted mean difference benefit (WMD: 0.12 (95% CI:-0.65 to 0.90)

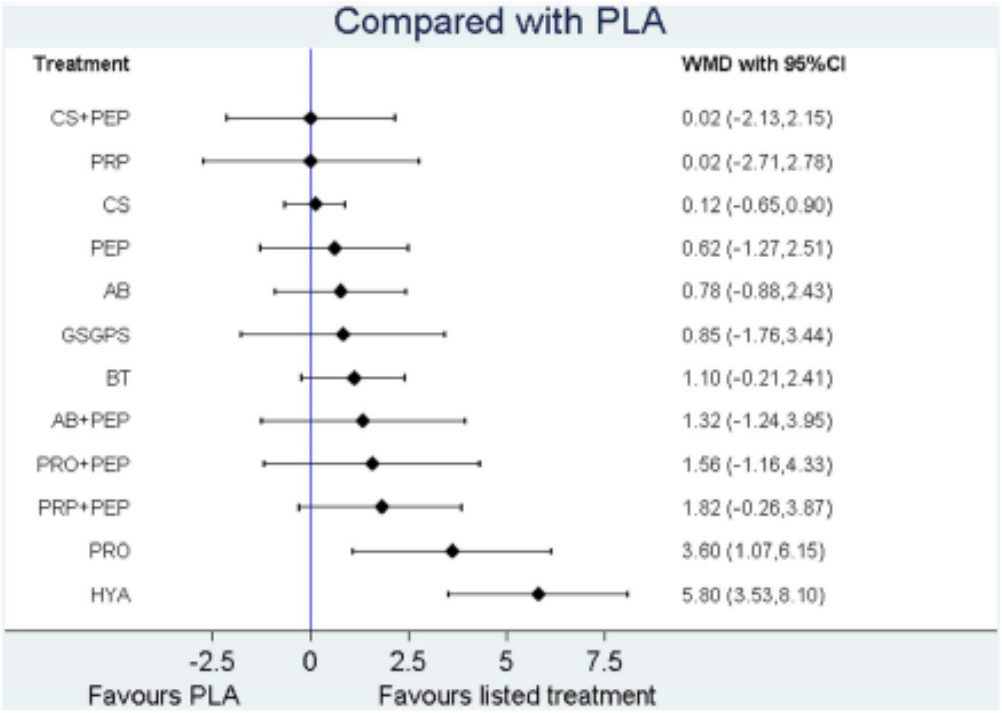

Figure 2: *Forest plot from meta-analysis of injection therapies against placebo for LE (from Dong et al. 2016)*

The authors identified that although steroid injections were the most commonly used injection therapy, their data suggested it was a suboptimal choice whether or not it is combined with peppering. This may have been as the data extracted for this review were the results of the follow-up closest to 6 months (26 weeks), which is usually considered an intermediate term.

Study	QS	Conclusions	Level of Evidence
Dong et al. (2016)	HQ(++)	• Steroid injections cannot be recommended as treatment for LE, as effects over 6 months are not statistically different from placebo	1+

Elmajee et al. (2016) presented a systematic review comparing the efficacy of three common injection treatment modalities (corticosteroid injection (CSI), platelet rich plasma (PRP), and autologous blood injection (ABI)) for chronic LE. They identified 7 RCTs published since 2005, of which three studies concerned the comparison between

PRP and CSI (Gosens et al. 2011; Krogh et al. 2012; Gautam et al. 2015), and one RCT related to the effectiveness of ABI and CSI (Inklebarger & Clarke 2015).

The authors reported that CSIs failed to demonstrate long-lasting significant clinical effects in chronic LE. However, PRP and ABI were shown to have a progressive and increasing effect from 6 months to one year following the injections. PRP and ABI demonstrated comparable effects in terms of pain and function. As the authors identified, the lack of homogeneity between studies in terms of dosage, use of peppering, use of imaging, concentrations and types of steroid, number of injections etc. makes it difficult to directly compare studies.

Study	QS	Conclusions	Level of Evidence
Elmajee et al. (2016)	R(0)	Steroid injections failed to demonstrate long-lasting significant clinical effects in chronic LE.	1-
		PRP and ABI were shown to have a better, more progressive and increasing effect from 6 months to one year following the injections compared to steroids	1-

Qian et al. (2016) presented a systematic review/meta-analysis comparing the efficacy and safety of autologous blood products (ABP) compared with steroid Injections in the treatment of LE. This review included both RCTs and prospective cohort studies and excluded studies that involved patients with tears of the extensor tendon. They identified ten RCTs (n = 509), which were subsequently included in the meta-analysis (Ozturan et al. 2010; Peerbooms et al. 2010; Wolf et al. 2011; Dojode et al. 2012; Krogh et al. 2012; Arik et al. 2014; Kazemi et al. 2010; Omar et al. 2012; Gautam et al. 2015; Jindal et al. 2013).

The pooled analysis showed that steroid injections were more effective than ABPs for pain relief in the short term (SMD = 0.88; 95% CI = 0.31-1.46%; P =.003). However, in the intermediate term, ABPs exhibited a better therapeutic effect for pain relief (SMD = -0.38; 95% CI = -0.70 to -0.07%; P = .02), function (SMD = -0.60; 95% CI = -1.13 to -0.08%; P = .03), disabilities of the arm, shoulder, and hand (MD = -11.04; 95% CI = -21.72 to -0.36%; P = .04) and Nirschl stage (MD = - 0.81; 95% CI = -1.11 to -0.51%; P < .0001). In the long term, ABPs were superior to steroid injections for pain relief (SMD = -0.94; 95% CI = -1.32 to -0.57%; P < .0001) and Nirschl stage (MD = -1.04; 95% CI = -1.66 to -0.42%; P = .001). Moreover, for grip strength recovery, no significant difference was found between the two therapies (P > .05).

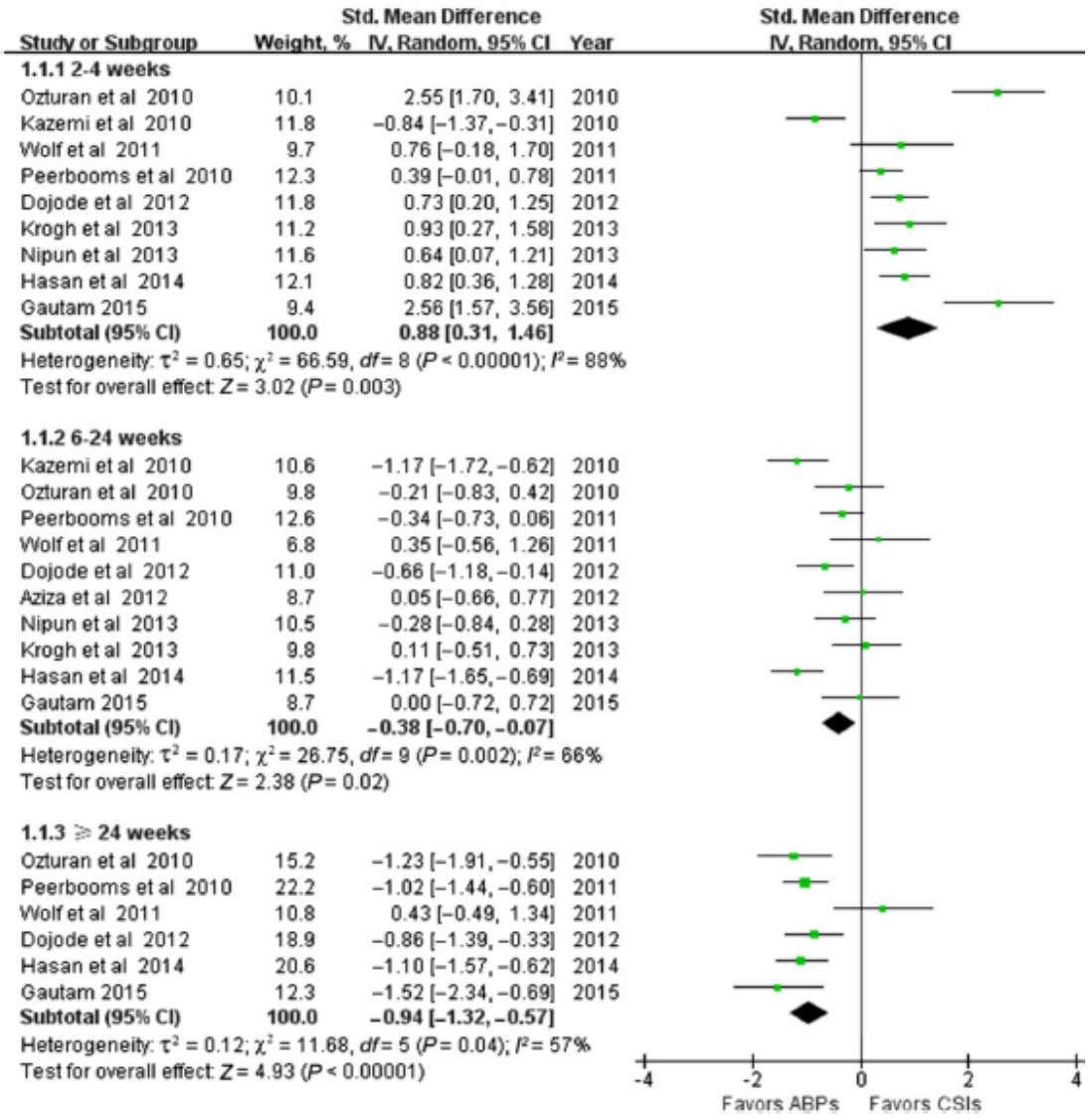

Figure 3: *Forest plots from meta-analyses of efficacy of autologous blood products (ABP) compared with corticosteroid Injections in the treatment of LE (from Qian et al. 2016)*

Study	QS	Conclusions	Level of Evidence
Qian et al. (2016)	HQ(++)	• Steroid injections appear to be superior to autologous blood product injections for pain relief in the short term	1+
		• In the intermediate and long term, autologous blood product injections were better than steroid injections for pain and function	1++

Sirico et al. (2016) presented a systematic review/meta-analysis comparing the effectiveness of local steroid versus autologous blood injections in patients with LE. They identified 4 RCTs (n=218) (Wolf et al. 2011; Kazemi et al. 2010; Arik et al. 2014;

Jindal et al. 2013). Compared to Qian et al. (2016), Sirico et al took a more stringent approach to combining studies in their meta-analysis, requiring exactly the same outcome measures (1-10 VAS scale for pain), hence excluding studies such as Ozturan et al. (2010) which used a 1-100 scale for pain. Despite the stringent focus on clinical homogeneity across the studies, statistical heterogeneity still existed, requiring random effects modelling for the meta-analysis.

The authors identified that at 2 weeks, there was a trend towards a reduction in VAS score in the steroid group (MD = 2.12 (95%CI: 4.38-0.14), p=0.07)). No significant differences were recorded in the medium term (4-12 weeks, MD = 0.85 (95% CI: -0.44 to 2.15)) and long term (24 weeks; MD = 0.63 (95% CI: -2.40 to 3.66), p=0.68).

Study	QS	Conclusions	Level of Evidence
Sirico et al. (2016)	AQ(+)	• Steroid injections resulted in reduced VAS scores in the short term	1
		• No differences between steroid injections & autologous blood injections in the intermediate or long term	1+

Tsikopoulos et al. (2016) undertook a systematic review/meta-analysis to compare the efficacy of autologous whole blood with that of steroid injections on epicondylopathy and plantar fasciopathy. They focussed their review on studies that followed up subjects up to 6 months. They identified 9 RCTs of which 6 related to LE (Arik et al. 2014; Dojode 2012; Jindal et al. 2013; Kazemi et al. 2010; Ozturan et al. 2010; Wolf et al. 2011).

They found that for LE there was a strong trend across the 4 studies included in the meta-analysis that steroid injections had a better effect on pain than autologous whole blood in the short term (up to 6 weeks) (SMD 0.51, 95%CI: -0.04 to 1.06). In the intermediate (8-13 weeks) and long term (24-26 weeks), autologous whole blood had a better effect on pain than steroid injections (intermediate term: SMD -1.10, 95%CI: -1.56 to -0.64) (long term SMD -1.07, 95%CI: -1.38 to -0.75).

Study	QS	Conclusions	Level of Evidence
Tsikopoulos et al. (2016)	HQ(++)	• Steroid better than autologous whole blood for pain relief in short term, i.e. less than 6 weeks (SMD 0.51, 95%CI: -0.04 to 1.06).	1
		• Autologous whole blood better than steroid for pain relief in intermediate and longer term, i.e. greater than 8 weeks	1

Randomised controlled trials

Sixteen (16) RCTs that were not included in the previously reported systematic reviews were identified that investigated the effectiveness of steroid injections for lateral epicondylitis. For this analysis we have reviewed the effectiveness of the steroid injections against a range of other interventions.

Intervention	Comparator	Study	QS	Patients	Result
Steroid vs Physical therapy-type interventions					
Methylprednisolone acetate (20mg) + prilocaine	ESWT	Beyazal & Devrimsel (2015)	LQ(-)	LE > 5/12	• ESWT gave better results across all outcome measures (Pain (VAS, McGill pain Q), Grip strength) than steroid injections up to 12/52
Methylprednisolone acetate 20mg + procaine	Physiotherapy and ESWT	Gunduz (2012)	AQ(+)	LE<3/12	• All treatment improved similarly
Triamcinolone 40mg + lidocaine	Muscle energy techniques	Küçükşen et al. (2013)	AQ(+)	LE >3/12	• Both MET and steroid improved measures of strength, pain, and function compared to baseline, Steroid more effective in the short term (>6wks) while MET better in the long term (<52wks)
Triamcinolone acetonide 10mg + lidocaine	Exercise and ultrasound	Murtezani et al. (2015)	AQ(+)	LE < 3/12	• Exercise group showed significant improvements across all outcome measures (Pain (VAS) PRTEE score, Grip strength) compared to steroid @ 12wks
Depomedrol (40mg)	Saline +/- splinting	Tahririan et al. (2014)	HQ(++)	LE < 6/52	• Steroid significantly decreased pain in short term (4/52) • No benefit in comparison to saline by 24/52 • Splinting gave no added benefit in either group
Triamcinolone 20mg + Lidocaine	Topical and oral NSAID	Ahmed et al. (2012)	LQ(-)	LE < 3/12	• Steroid + topical and oral NSAIDs is superior to the use of topical and oral NSAIDs. • Better results with combination therapy using local steroid injection may be limited to the short term.
Dexamethasone or triamcinolone 10mg	Dexamethasone (10mg) via iontophoresis	Stefanou et al. (2012)	AQ(+)	LE > 2 years)	• By 6 months all groups had equivalent significant results for all measured outcomes (PRTEE score, Grip strength, work status). • Iontophoresis had significant improvement in grip strength, and more likely to get back to work without restriction at 8 weeks.

Steroid had better short term (< 6/52) but not longer term effect on pain & disability compared to:

- Muscle energy techniques (1 x AQ RCT)
- Placebo and splinting (1 x HQ RCT)
- NSAIDs (1 x LQ RCT)

Steroid not as effective as:

- Exercise by 12 weeks (1 x AQ RCT)
- Iontophoresis by 8 weeks (1 x AQ RCT)

Evidence unclear on the effect of steroid compared to:

- ESWT (conflicting results from 1 x LQ and 1 xAQ RCT)

Platelet-rich plasma (PRP)

Dexamethasone 3ml	Platelet-rich plasma (PRP)	Palacio et al. 2016	LQ(-)	LE	• No evidence that one treatment was more effective than another, using DASH and PRTEE by 6 months
Methylprednisolone acetate 2ml + xylocaine 1ml	Platelet-rich plasma (PRP)	Khaliq et al. 2015	LQ(-)	LE	• PRP more effective in reducing pain at 3 weeks than steroid injection.
Methylprednisolone 40mg	Platelet-rich plasma (PRP)	Yadav (2015)	AQ(+)	LE < 6/12	• PRP and CSI both effective for Pain (VAS), Grip Strength, and DASH for LE. • PRP is superior option for longer duration efficacy (3/12).
Betamethasone 10mg + lidocaine	Platelet-rich plasma (PRP)	Lebiedzinski et al. (2015)	LQ(-)	LE <6/52	• PRP better at 12 months in pain and DASH • Steroid has more rapid improvement at 6/52

- PRP appears to provide better longer term pain relief than steroid (1 x AQ RCT and 1 x LQ RCT)

Other injectates

Methylprednisolone acetate 40mg + procaine	Prolotherapy	Carayannopoulos et al. (2011)	AQ(+)	LE <2 yrs	• Both improved from baseline • No significant differences between the groups for VAS or DASH.
Triamcinolone acetonide 40mg	Botox	Guo et al. (2016)	HQ(++)	LE > 6/12	• At 4 weeks steroids were superior to Botox for pain, grip strength and PRTEE • No difference at the 8-, 12-, and 16-week follow-ups.

- Steroid no better than prolotherapy (1 x AQ RCT)
- Steroid better than Botox in short term (< 8 weeks), but no better in longer term (1 x Q RCT)

Dosage parameters

High dose Triamcinolone 10mg + lidocaine	Low dose Triamcinolone 5mg + lidocaine	Weerakul & Galassi (2012)	AQ(+)	LE	No significant difference
Triamcinolone (10mg) + Lidocaine	Peppering vs single injection	Bellapianta et al. (2011)	LQ(-)	LE < 6/12	Single injections performed better than peppering (Pain (VAS), Grip Strength, DASH)

- Higher concentrations of steroid appear no more effective than low dose (1 x AQ RCT)
- Single injection more effective than peppering technique (1 x LQ RCT)

Medial Epicondyle

There were few studies found in this review that specifically focussed on the medial epicondyle. This may reflect the significantly lower prevalence of conditions involving the medial epicondyle compared to the lateral epicondyle.

Systematic Reviews

This review found no systematic reviews that focused on the management of medial epicondylar pain through the use of steroid injections.

Randomised Controlled Trials

This review found only 2 RCTs that specifically focussed on the use of steroids (as intervention or comparator) for subjects with medial epicondylar pain.

Stahl and Kaufman (1997) randomly allocated 58 patients (60 elbows) to a steroid group (who received a single injection of 1% lidocaine with 40mg of methylprednisolone) or a control group (who received a single injection of 1% lidocaine with 40mg of saline solution). Both groups were also allowed to continue with physical therapy and NSAIDs.

Six weeks after the injections, the steroid group had significantly less pain as measured by the Nirschl and Pettrone scale, but not on the VAS scale, than the control group ($p < 0.03$). However, the groups did not differ with regard to pain at three months and at one year. The authors considered that the improvement observed in both groups reflected the natural history of the disorder (both groups had a history of symptoms of at least 12 weeks prior to the interventions) and concluded that the local injection of steroids provided only short-term benefits in the treatment of medial epicondylitis. The Nirschl and Pettrone scale includes a measure of disability rather than just pain intensity, specifying pain related to activity.

Study	QS	Conclusions
Stahl and Kaufman (1997)	AQ(+)	• Steroid injection group had better improvement in pain than saline control group in first 6 weeks
		• Steroid injection no better than saline from 3 months

Bahari et al. (2003) randomly allocated 38 patients to an intervention group (one injection of 40 mg methylprednisolone and 1% lidocaine) and a control group (one injection of normal saline and 1% lidocaine). Both groups were also allowed to continue with physical therapy and NSAIDs. The researchers measured pain severity via the Nirschl and Pettrone scale at baseline, 2 months, 4 months and 12 months.

At 2 months the difference in pain score between the two groups was statistically significant (p = 0.01) with those patients undergoing steroid injections reporting lower pain levels. At 4 months, the mean pain scores in the two groups were similar (p = 0.673) and there were no significant differences between the two groups at 12 months (p = 0.942, Mann-Witney test).

Study	QS	Conclusions
Bahari et al. (2003)	LQ(-)	• Steroid injection had better improvement in pain than saline in first 2 months
		• Steroid injection no better than saline from 4 months

3.4 Outcome Measures – Pain and Function – Recommendations

1. The evidence indicates that steroid injections are effective in the short term (< 6 weeks) for reducing pain and improving function in patients with lateral epicondylitis

Level A

FOR	AGAINST
Level 1++ • Corticosteroid injection gave a short-term reduction in pain versus no intervention or NSAID drugs (SMD −1.43, 95% CI −1.64 to −1.23). (Olaussen et al. 2013; SR (HQ+)).	
Level 1+ • The pooled analysis indicated short-term effectiveness (2-6 weeks): pooled odds ratio (OR) = 0. 15 [95% confidence interval (CI) 0. 10-0.231). At longer term follow-up, no difference could be detected. (Assendelft et al. 1996; SR (HQ+)). • Pain intensity was slightly, but significantly, lower 1 month, but not 3 months, after steroid injection compared to placebo. (Claesson et al. 2016; SR (HQ+)). • Steroid injections appeared to be superior to autologous blood product injections for pain relief in the short term (Qian et al. 2016; SR (HQ+)). • Corticosteroid injections appeared to be effective in the short term (up to 6 weeks) (Smidt et al. 2002; SR (HQ+)).	
Level 1 • Large effect sizes in favour of CSI at short-term (< 6weeks) follow-up (Barr et al. 2009; SR (HQ+)). • Steroid injection had a large effect (defined as SMD>0·8) on reduction of pain compared with no intervention in the short term (SMD 1·44), 95% CI 1·17–1·71, p<0·0001) (Coombes et al. 2010; SR (HQ+)). • Corticosteroid injections appeared to be effective in the short term (up to 3 months). (Nimgade et al. 2005; SR (AQ+)). • Steroid injections resulted in reduced VAS scores in the short term (Sirico et al. 2016; SR (AQ+)). • Steroid better than autologous whole blood for pain relief in the short term, i.e. less than 6 weeks (SMD 0.51, 95%CI: -0.04 to 1.06) (Tsikopoulos et al. 2016; SR (AQ+)).	

2. The evidence indicates that steroid injections are not effective in the intermediate and longer term (> 6 weeks) for reducing pain and improving function in patients with lateral epicondylitis

Level A

FOR	AGAINST
Level 1++ • In the intermediate and long term autologous blood (AB) product injections were better than steroid injections for pain and function (Qian et al., 2016; SR (HQ+)).	
Level 1+ • No difference in pain intensity 6 months after injection of corticosteroids or placebo. (Claesson et al. 2016; SR (HQ+)). • No differences between steroid injections or AB injections in the intermediate or long term (Sirico et al. 2016; SR (AQ+)). • Steroid injections cannot be recommended as treatment for LE, as effects over 6 months are not statistically different from placebo (Dong et al. 2016; SR (HQ++)). • Pooled results (SMD [95% confidence interval]) showed that beyond 8 weeks, glucocorticoid injection was no more effective than placebo (20.04 [20.45 to 0.35]), (Krogh et al. 2013; SR (HQ++)) • At intermediate follow-up, there was an increase in pain (SMD 0.32, 95% CI 0.13 to 0.51), reduction in grip strength (SMD −0.48, 95% CI −0.73 to −0.24) and negative effect on the overall improvement effect (RR 0.66 (0.53 to 0.81)). Long-term follow-up no difference on overall improvement or grip strength, and conflicting evidence for pain (Olaussen et al. 2013; SR (HQ+)). • No beneficial effects were found for intermediate or long-term follow-up (Smidt et al. 2002; SR (HQ++)).	
Level 1 • Autologous whole blood better than steroid for pain relief in intermediate and longer term, i.e. greater than 8 weeks (Tsikopoulos et al. 2016; SR (AQ+)).	

The evidence indicates that physiotherapy interventions were more effective than steroid injections in the intermediate to long term

- Medium-large effect in favour of physiotherapy at intermediate and long-term follow-up. (Barr et al. 2009; SR (HQ++)).
- In the long term, active physiotherapy outperformed injections (Nimgade et al. 2016; SR (AQ+)).
- In the intermediate term (12 weeks) exercise outperformed steroids (Murtezani et al. 2015; RCT (AQ+))
- In the intermediate term (8 weeks) iontophoresis outperformed steroids (Stefanou et al. 2012; RCT (AQ+))

The evidence indicates that autologous blood product injections are more effective than steroid injections, particularly in the long term

- Autologous whole blood better than steroid for pain relief in intermediate and longer term, i.e. greater than 8 weeks (Level 1: Tsikopoulos et al., 2016; SR (AQ+)).
- In the intermediate and long term autologous blood product injections were better than steroid injections for pain and function (Level 1++: Qian et al., 2016; SR (HQ+)).

The evidence indicates that platelet-rich plasma (PRP) appears to provide better longer term pain relief than steroid injections (Yadav 2015; RCT (AQ+) Lebiedzinski et al. 2015; RCT (LQ-))

The evidence indicates that steroid injections are effective in the short term (< 8 weeks) for reducing pain and improving function in patients with medial epicondylitis. (Stahl and Kaufman 1997; Bahari et al. 2003; RCT(AQ))

3.5 Outcome Measures – Safety and Risk

Nichols (2005) presented a systematic review into the complications associated with the use of steroids in the treatment of athletic injuries. They included both intraarticular and periarticular (soft tissue) injections of steroids in their review. They identified 43 studies which they characterised into two main groups. Group 1 examined the usage of steroid injections in the treatment of athletic injuries with secondary mention of complication occurrence (25 studies of which 12 related to lateral epicondylitis (Bär et al. 1997; Day et al. 1978; Ertuk et al. 1997; Haker & Lundeburg 1993; Halle et al. 1986; Hay et al. 1999; Newcomer et al. 2001; Oksenberg et al. 1998; Price et al. 1991; Saartok et al. 1986; Smidt et al. 2002; Verhaar et al. 1996 (n=634)) and one to medial epicondylitis (Stahl and Kaufman 1997). Group 2 were studies that primarily described adverse events associated with steroid injections in the treatment of athletic injuries (18 studies of which 1 related to lateral epicondylitis (Smith et al. 1999) (n=30)).

The authors did not report the complications per area of injection. However, re-analysis of their data showed that of the 635 patients who had LE or ME steroid injections, 128 had complications (20%). Table 5 presents the breakdown

Table 5: Breakdown of side effects from steroid injections

Side effect	Prevalence		Studies
	No	%	
Local warmth	1	0.8%	Bär et al. 1997
Facial flush	6	4.7%	Bär et al. 1997; Smidt et al. 2002; Stahl and Kaufman; 1997
Local erythema	6	4.7%	Bär et al. 1997; Smidt et al. 2002
Local bruising	8	6.2%	Bär et al. 1997; Smidt et al. 2002
Post-injection pain	71	55%	Haker & Lundeberg 1993; Hay et al. 1999; Price et al. 1991; Saartok et al. 1986; Smidt et al. 2002

Skin atrophy	24	18.8%	Price et al. 1991
Other minor reactions	8	6.2%	Smidt et al. 2002
Tendon rupture	1	0.8%	Smith et al. 1999

The authors noted that their review did not identify studies that provided unequivocal evidence that steroid injections did or did not cause damage to human musculoskeletal structures. However, there was evidence that the choice of steroid agent to treat human tendon injuries may affect post treatment tendon strength. Tendons treated with triamcinolone acetonide appeared to develop more frequent mechanical structural defects and a higher tendency to rupture than those treated with methylprednisolone, betamethasone, or hydrocortisone. Further, they reported that the relative doses of corticosteroids administered and injection technique may influence post treatment mechanical tendon properties.

In the Group 2 studies tendon rupture was the predominant complication reported in the athletic subjects, whereas systemic adverse effects occurred more commonly in the nonathletic injury series. This may reflect the systemic nature of the underlying disease process (e.g. rheumatoid arthritis, HLA-B27 arthritis) and the higher number of injections received in the nonathletic injury groups.

Group 1 studies identified the occurrence of relatively few complications, which may reflect the short post-treatment follow-up periods that prevent the discovery of longer-term complications. This suggests that the true incidence of complications is likely underreported due to an underestimation of the numerator (true number of complications). These studies also tended to report mostly minor complications. Alternatively, the Group 2 studies tended to report serious complications, and may actually over-report the true incidence of complications due to an underestimation of the denominator (number of subjects exposed).

Brinks et al. (2010) presented a systematic review into adverse effects of extra-articular steroid injections. This review included 44 case reports, 37 prospective studies and 6 retrospective studies. It identified 9 prospective studies into LE (Lindenhovius et al. 2008; Tonks et al. 2007; Bisset et al. 2006; Wang et al. 2003; Smidt et al. 2002; Jensen et al. 2001; Hay et al. 1999; Verhaar et al. 1996; Price et al. 1991) and one on ME (Stahl et al. 1997).

The authors divided the adverse events into major (defined as those needing intervention or not disappearing) and minor ones (transient, not requiring intervention). After extra-articular injection, the incidence of major adverse events ranged from 0-5.8% and that of minor adverse events from 0-81%.

Table 6: Prevalence of side effects

Studies	Prevalence		Side Effect
	Subject number	Follow up	
Lindenhovius et al. 2008	64	12 months	• Discoloration of skin (3.2%) • Increased elbow pain (3.2%)

Tonks et al. 2007	48	7 weeks	• Skin depigmentation and atrophy in 4%
Bisset et al. 2006	198	4.7%	• Local pain (18.5%). • Loss of skin pigment (3%), • Atrophy of subcutaneous tissue (1.5%)
Wang et al. 2003	94	5 days	• Increased post injection pain during 1.2 days (50%)
Smidt et al. 2002	185	12 months	• Facial flush (3%), • Skin irritation (5%), • Red swollen elbow (3%), • Change of skin colour (11%), • Other not specified side-effects (13%)
Jensen et al. 2001	91	6 weeks	• Pain increase after injection (81%)
Hay et al. 1999	164	6.2%	• Local skin atrophy (1.9%)
Verhaar et al. 1995	106	12 month	• Nil
Price et al. 1991	145	24 weeks	• Post-injection pain (11%-58%). • Skin atrophy (17%-40%)
Stahl et al. 1997	58	12 months	• Facial flushing (0.5%)

Arirachakaran et al. (2016) undertook a systematic review and network meta-analysis comparing adverse events related to the use of platelet- rich plasma (PRP), autologous blood (AB) and steroid injection in lateral epicondylitis. Compared to AB injection, PRP and steroid injection had lower risks of having complications (RR = 0.004; 95 % CI 0.0002, 0.09) and (RR = 0.53; 95 % CI 0.27, 1.05), respectively. PRP injection had an approximately 10 % (RR = 0.90; 95 % CI0.36, 1.27) lower risk than steroid injection.

Assendelft et al. (1996) in their systematic review collected the evidence on adverse events related to steroid injections for LE. They identified 6 of the 12 RCTs that reported adverse events. Baily & Brock (1957) described a worsening of the pain 24-48 h after the injection in 25% of the patients, which was the same proportion as those patients who had a local anaesthetic injection only. Haker & Lundeberg (1993) reported worsening of the pain after injection in two of the 19 patients injected. Price et al. (1991) provided the most extensive report on adverse effects with post-injection pain reported by 50% of the 116 patients injected with a corticosteroid plus local anaesthetic, compared with 31% of the 29 patients injected with a local anaesthetic alone. Skin atrophy was reported in 27% of the 116 patients treated with a corticosteroid injection compared with 17% of the 29 patients injected with a local anaesthetic only. For the various corticosteroid compositions, the prevalence of skin atrophy was 21% for hydrocortisone 25 mg, 30% for triamcinolone acetate (TCA) 10mg and 20% for TCA 20mg.

Claesson et al. (2016) in their systematic review and meta-analysis identified that whilst 5 of 7 studies described adverse events, including rash, fat atrophy, and hypopigmentation at the injection site (Lindenhovius et al. 2008; Coombes et al. 2013; Krogh et al. 2012; Price et al. 1991; Zeisig et al. 2008), the risk was not significantly different from placebo injections.

Coombes et al. (2010) in their systematic review identified that only 23 (82%) of the 28 trials involving steroid injections reported adverse events. This review indicated that

there may be a site specific risk, as by comparison with placebo injection, steroid injection had a significant RR of atrophy for Achilles and patellar tendons, but not elbow tendons. Contrary to Claesson et al. (2016) this review concluded that post-injection pain was reported more frequently after steroid injection than it was after placebo. Gastrointestinal disorders, vertigo, and rash were more common after placebo injection combined with oral NSAIDs than they were after corticosteroid injection.

The authors noted a low frequency of serious adverse events after steroid injection, suggesting an acceptable risk. However, they cautioned that rigorous reporting of adverse events for all trials was needed to confirm the safety of steroid injections. Minor complications such as post-injection pain, subcutaneous atrophy, and skin depigmentation were common, and moderate evidence of harmful effects of repeated steroid injections was noted. However, the optimum number of doses and interval between injections remained unknown.

Krogh et al. (2013) in a systematic review and meta-analysis assessing the comparative effectiveness and safety of injection therapies in patients with lateral epicondylitis identified that the most common side effect across all trials was transient pain after injection, reported in 12 of 17 trials. Of the 8 different injection therapies examined, only glucocorticoid and botulinum toxin were associated with drug-specific adverse effects. Skin atrophy or loss of pigment was reported to occur in a minority of patients in 4 of 9 trials after glucocorticoid injection.

Qian et al. (2016) presented a systematic review comparing autologous blood products with steroid injections for LE. They also reported on adverse events and identified that these events included:

- Temporary post-injection pain in most subjects that subsided within 2 days (Ozturan et al. 2010)
- Discoloration at the injection site in one subject (Ozturan et al. 2010)
- A high rate of post-injection pain at the injection site in the ABPs group (60%) versus the CSI group (26%), with some even lasting for several days (Dojode et al. 2012)
- Local skin atrophy in two subjects (6.6%) (Dojode et al. 2012).
- One subject experienced a minor rash, 3 had skin atrophy, and 1 had discoloration (Krogh et al. 2012)

Smidt et al. (2002) in their SR of the effectiveness of steroid injections for LE identified 8 studies that reported on the adverse effects of steroid injections, such as facial flushes, post injection pain and local skin atrophy (Bär et al. 1997; Baily & Brock 1957; Haker & Lundeberg 1993; Hay et al. 1999; Saartok & Eriksson 1986; Price et al. 1991; Murley & Lond 1954; Verhaar et al. 1996). Post injection pain (11–58%) and local skin atrophy (17–40%) were reported in four studies, but irrespective of whether patients had received a corticosteroid injection or control treatment (Price et al. 1991; Haker & Lundeberg 1993; Hay et al. 1999; Saartok & Eriksson 1986). Occurrence of facial flushes as a side-effect of steroid injections was mentioned by only one study (Bär et al. 1997).

3.6 Economic analysis

Our review found only one study that investigated the economic cost associated with steroid injections for epicondylitis (Sanders et al. 2016). This was a population-based study looking at the health utilisation and direct medical costs associated with the treatment of LE. The study population consisted of 3,166 patients with a mean age of 47 ± 11 years of which 58% were female. Most patients had only 1 encounter for lateral epicondylitis (n = 2,235, 71%). 33 patients underwent surgery within the first year of their diagnosis.

The relative proportion of direct medical costs associated with treating tennis elbow was estimated in a hypothetical cohort of 100 patients based on utilisation patterns and represented patients with 2 or more physician visits for tennis elbow. The estimated annual direct medical cost of treating this group was $80,144. In this cohort, only 4 patients would be treated surgically, but would account for 20% of medical spending ($16,000). However, the largest expense would be office visits ($25,800) and specialty visits ($13,632), as nearly three-quarters of all patients would have seen a specialist twice. Physiotherapy would account for 23% of spending ($18,600), as nearly two-thirds of patients would be seen 3 times by a therapist. Radiographic ($2,832) and injection ($3,280) costs accounted for a much smaller portion of direct medical spending.

4. Recommendations

Summary of Recommendations

- **The evidence indicates that steroid injections are effective in the short term (< 6 weeks) for reducing pain and improving function in patients with lateral epicondylitis** (Level A Recommendation).
- **The evidence indicates that steroid injections are not effective in the intermediate and longer term (> 6 weeks) for reducing pain and improving function in patients with lateral epicondylitis** (Level A Recommendation).
- **The evidence indicates that physiotherapy interventions including general active physiotherapy, exercises and iontophoresis were more effective than steroid injections in the intermediate to long term** (Level A Recommendation based on 1x HQ SR, 1x AQ SR and 2x AQ RCT)
- **The evidence indicates that autologous blood product injections are more effective than steroid injections, particularly in the long term** (Level A Recommendation based on 1x HQ SR, 1x AQ SR
- **The evidence indicates that platelet-rich plasma (PRP) appears to provide better longer term pain relief than steroid injections** (Level C Recommendation based on 2 x AQ RCT (AQ+))
- **The evidence indicates that steroid injections are effective in the short term (< 8 weeks) for reducing pain and improving function in patients with medial epicondylitis**. (Level C Recommendation based on 2 x AQ RCT (AQ+))
- **Minor complications associated with steroid injections into the elbow are not uncommon but rarely require significant medical attention. Prevalence rates of minor complications associated with steroid injections appeared no different than following placebo injections**. (Level A Recommendation based on 2 x SRs)
- **The evidence suggests that steroid injections present a much smaller portion of direct medical spending related to treatment of lateral epicondylitis than physiotherapy, GP visits and specialist visits** (Level D Recommendation based on 1 cohort study)

5. References

Ahmed, GS, Ali, M & Trago, IA 2012, 'Tennis elbow: role of local steroid injection', *Journal of Ayub Medical College, Abbottabad : JAMC,* vol. 24, no. 2, 2012, pp. 84-86.

Akermark, C, Crone, H, Elsasser, U & Forsskahl, B 1995, 'Glycosaminoglycan polysulfate injections in lateral humeral epicondylalgia: A placebo-controlled double-blind trial', *International Journal of Sports Medicine,* vol. 16, no. 3, pp. 196-200.

Arik, HO, Kose, O, Guler, F, Deniz, G, Egerci, OF & Ucar, M 2014, 'Injection of autologous blood versus corticosteroid for lateral epicondylitis: a randomised controlled study', *Journal of Orthopaedic Surgery,* vol. 22, no. 3, Dec, pp. 333-337.

Arirachakaran, A, Sukthuayat, A, Sisayanarane, T, Laoratanavoraphong, S, Kanchanatawan, W & Kongtharvonskul, J 2016, 'Platelet-rich plasma versus autologous blood versus steroid injection in lateral epicondylitis: systematic review and network meta-analysis', *Journal of Orthopaedics and Traumatology,* vol. 17, no. 2, 01 Jun, pp. 101-112.

Assendelft, WJ, Hay, EM, Adshead, R & Bouter, LM 1996, 'Corticosteroid injections for lateral epicondylitis: a systematic overview (Structured abstract)', *British Journal of General Practice,* vol. 46, no. 2,<http://onlinelibrary.wiley.com/o/cochrane/cldare/articles/DARE-11996008185/frame.html>.

Bahari, M, Gharehdaghi, M & Rahimi, H 2003, 'Injection of methylprednisolone and lidocaine in the treatment of medial epicondylitis: A randomized clinical trial', *Archives of Iranian Medicine,* vol. 6, no. 3, July, pp. 196-199.

Baily, R & Brock, B 1957, 'Hydrocortisone in Tennis Elbow—A Controlled Series [Abridged]', *Proceedings of the Royal Society of Medicine,* vol. 50, no. 6, p. 389.

Bales, CP, Placzek, JD, Malone, KJ, Vaupel, Z & Arnoczky, SP 2007, 'Microvascular supply of the lateral epicondyle and common extensor origin', *Journal of Shoulder and Elbow Surgery,* vol. 16, no. 4, pp. 497-501.

Bär, C, Bias, P & Rose, P 1988, 'Dexamethasonpalmitat bei akuter Epikondylitis humeri radialis', *Sports Med,* vol. 16, pp. 378-382.

Barr, S, Cerisola, FL & Blanchard, V 2009, 'Effectiveness of corticosteroid injections compared with physiotherapeutic interventions for lateral epicondylitis: A systematic review', *Physiotherapy,* vol. 95, no. 4, December, pp. 251-265.

Bellapianta, J, Swartz, F, Lisella, J, Czajka, J, Neff, R & Uhl, R 2011, 'Randomized prospective evaluation of injection techniques for the treatment of lateral epicondylitis', *Orthopedics,* vol. 34, no. 11, Nov, pp. e708-712.

Beyazal, MS & Devrimsel, G 2015, 'Comparison of the effectiveness of local corticosteroid injection and extracorporeal shock wave therapy in patients with lateral epicondylitis', *Journal of Physical Therapy Science,* vol. 27, no. 12, Dec, pp.

3755-3758.

Bisset, L, Paungmali, A, Vicenzino, B & Beller, E 2005, 'A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia', *British journal of sports medicine,* vol. 39, no. 7, pp. 411-422.

Bisset, L, Beller, E, Jull, G, Brooks, P, Darnell, R & Vicenzino, B 2006, 'Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial', *Bmj,* vol. 333, no. 7575, p. 939.

Brattberg, G 1983, 'Acupuncture therapy for tennis elbow', *Pain,* vol. 16, no. 3, pp. 285-288.

Brinks, A, Koes, BW, Volkers, ACW, Verhaar, JAN & Bierma-Zeinstra, SMA 2010, 'Adverse effects of extra-articular corticosteroid injections: a systematic review', *BMC musculoskeletal disorders,* vol. 11, Sep, p. 11.

Carayannopoulos, A, Borg-Stein, J, Sokolof, J, Meleger, A & Rosenberg, D 2011, 'Prolotherapy versus corticosteroid injections for the treatment of lateral epicondylosis: a randomized controlled trial', *Pm & R,* vol. 3, no. 8, Aug, pp. 706-715.

Claessen, FM, Heesters, BA, Chan, JJ, Kachooei, AR & Ring, D 2016, 'A Meta-Analysis of the Effect of Corticosteroid Injection for Enthesopathy of the Extensor Carpi Radialis Brevis Origin', *The Journal of Hand Surgery,* vol. 41, no. 10, pp. 988-998. e982.

Clarke, A & Woodland, J 1975, 'Comparison of two steroid preparations used to treat tennis elbow, using the hypospray', *Rheumatology,* vol. 14, no. 1, pp. 47-49.

Coombes, BK, Bisset, L, Connelly, LB, Brooks, P & Vicenzino, B 2009, 'Optimising corticosteroid injection for lateral epicondylalgia with the addition of physiotherapy: a protocol for a randomised control trial with placebo comparison', *BMC musculoskeletal disorders,* vol. 10, no. 1, p. 1.

Coombes, B, Bisset, L & Vicenzino, B 2010, 'Efficacy and safety of corticosteroid injections and other injections for management of tendinopathy: a systematic review of randomised controlled trials (Structured abstract)', *Lancet,* vol. 376, no. 9754,<http://onlinelibrary.wiley.com/o/cochrane/cldare/articles/DARE-12010007121/frame.html>.

Coombes, BK, Bisset, L, Brooks, P, Khan, A & Vicenzino, B 2013, 'Effect of corticosteroid injection, physiotherapy, or both on clinical outcomes in patients with unilateral lateral epicondylalgia: a randomized controlled trial', *Jama,* vol. 309, no. 5, pp. 461-469.

Day, B, Govindasamy, N & Patnaik, R 1978, 'Corticosteroid injections in the treatment of tennis elbow', *The Practitioner,* vol. 220, no. 1317, p. 459.

De Smedt, T, de Jong, A, Van Leemput, W, Lieven, D & Van Glabbeek, F 2007, 'Lateral epicondylitis in tennis: update on aetiology, biomechanics and treatment', *British*

journal of sports medicine, vol. 41, no. 11, pp. 816-819.

Dogramaci, Y, Kalaci, A, Savas, N, Duman, IG & Yanat, AN 2009, 'Treatment of lateral epicondilitis using three different local injection modalities: a randomized prospective clinical trial', *Archives of Orthopaedic & Trauma Surgery,* vol. 129, no. 10, Oct, pp. 1409-1414.

Dojode, C 2012, 'A randomised control trial to evaluate the efficacy of autologous blood injection versus local corticosteroid injection for treatment of lateral epicondylitis', *Bone and Joint Research,* vol. 1, no. 8, pp. 192-197.

Dong, W, Goost, H, Lin, X-B, Burger, C, Paul, C, Wang, Z-L, Kong, F-L, Welle, K, Jiang, Z-C & Kabir, K 2015, 'Injection therapies for lateral epicondylalgia: a systematic review and Bayesian network meta-analysis', *British journal of sports medicine*, pp. bjsports-2014-094387.

Elmajee, M, Gaskell, L, Watts, A, Khan, M, Elmajee, M & Raslan, H 2016, 'A Systematic Review to Compare Three Injection Modalities in the Management of Pain and Function for Patients with Chronic Lateral Epicondylalgia', *Orthopedic & Muscular System: Current Research,* vol. 5, no. 2.

Elmajee, M & Pillai, A 2016, 'Review Article of Corticosteroid Injections Use in Acute and Chronic Lateral Epicondylgia. An Update of the Currently Available Literature', *Orthopedic & Muscular System: Current Research,* vol. 2016.

Ertuerk, H, Celiker, R, Sivri, A, Cetin, A & Cindas, A 1997, 'The efficacy of different treatment regimens that are commonly used in tennis elbow', *ROMATOLOJI VE TIBBI REHABILITASYON DERGISI,* vol. 8, pp. 298-301.

Espandar, R, Heidari, P, Rasouli, MR, Saadat, S, Farzan, M, Rostami, M, Yazdanian, S & Mortazavi, SJ 2010, 'Use of anatomic measurement to guide injection of botulinum toxin for the management of chronic lateral epicondylitis: a randomized controlled trial', *Canadian Medical Association Journal,* vol. 182, no. 8, pp. 768-773.

Faro, F & Wolf, JM 2007, 'Lateral epicondylitis: review and current concepts', *The Journal of Hand Surgery,* vol. 32, no. 8, pp. 1271-1279.

Fredberg, U & Stengaard-Pedersen, K 2008, 'Chronic tendinopathy tissue pathology, pain mechanisms, and etiology with a special focus on inflammation', *Scandinavian journal of medicine & science in sports,* vol. 18, no. 1, pp. 3-15.

Freeland, D & Gribble, MD 1954, 'Hydrocortisone in tennis-elbow', *The Lancet,* vol. 264, no. 6831, p. 225.

Gautam, V, Verma, S, Batra, S, Bhatnagar, N & Arora, S 2015, 'Platelet-rich plasma versus corticosteroid injection for recalcitrant lateral epicondylitis: clinical and ultrasonographic evaluation', *Journal of orthopaedic surgery (Hong Kong),* vol. 23, no. 1,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/293/CN-01101293/frame.html>.

Gosens, T, Peerbooms, JC, van Laar, W & den Oudsten, BL 2011, 'Ongoing positive effect of platelet-rich plasma versus corticosteroid injection in lateral epicondylitis:

a double-blind randomized controlled trial with 2-year follow-up', *The American journal of sports medicine,* vol. 39, no. 6, Jun, pp. 1200-1208.

Gunduz, R, Malas, FU, Borman, P, Kocaoglu, S & Ozcakar, L 2012, 'Physical therapy, corticosteroid injection, and extracorporeal shock wave treatment in lateral epicondylitis: Clinical and ultrasonographical comparison', *Clinical Rheumatology,* vol. 31, no. 5, May, pp. 807-812.

Guo, Y-H, Kuan, T-S, Chen, K-L, Lien, W-C, Hsieh, P-C, Hsieh, I-C, Chiu, S-H & Lin, Y-C 2016, 'Comparison Between Steroid and 2 Different Sites of Botulinum Toxin Injection in the Treatment of Lateral Epicondylalgia: A Randomized, Double-Blind, Active Drug-Controlled Pilot Study', *Archives of Physical Medicine and Rehabilitation*.

Haahr, J & Andersen, J 2003, 'Prognostic factors in lateral epicondylitis: a randomized trial with one-year follow-up in 266 new cases treated with minimal occupational intervention or the usual approach in general practice', *Rheumatology,* vol. 42, no. 10, pp. 1216-1225.

Haker, E & Lundeberg, T 1993, 'Elbow-band, splintage and steroids in lateral epicondylalgia (tennis elbow)', *Pain Clinic,* vol. 6, no. 2, pp. 103-112.

Halle, JS, Franklin, RJ & Karalfa, BL 1986, 'Comparison of four treatment approaches for lateral epicondylitis of the elbow', *Journal of Orthopaedic & Sports Physical Therapy,* vol. 8, no. 2, pp. 62-69.

Hay, EM, Paterson, SM, Lewis, M, Hosie, G & Croft, P 1999, 'Pragmatic randomised controlled trial of local corticosteroid injection and naproxen for treatment of lateral epicondylitis of elbow in primary care', *British Medical Journal,* vol. 319, no. 7215, 09 Oct, pp. 964-968.

Hughes, GRV & Currey, HL 1969, 'Hypospray treatment of tennis elbow', *Ann.Rheum.Dis,* vol. 28, no. 1, pp. 58-62.

Inklebarger, J & Clarke, T 2015, 'Corticosteroid injections for tennis elbow–A hard habit to break', *International Musculoskeletal Medicine*.

Jensen, B, Bliddal, H & Danneskiold-Samsoe, B 2001, 'Comparison of two different treatments for lateral epicondylitis. [Danish]', *Ugeskrift for Laeger,* vol. 163, no. 10, 05 Mar, pp. 1427-1431.

Jindal, N, Gaury, Y, Banshiwal, R, Lamoria, R & Bachhal, V 2013, 'Comparison of short term results of single injection of autologous blood and steroid injection in tennis elbow: a prospective study', *Journal of orthopaedic surgery and research,* vol. 8, 10.1186/1749-799X-8-10,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/504/CN-00960504/frame.html>.

Kazemi, M, Azma, K, Tavana, B, Rezaiee, MF & Panahi, A 2010, 'Autologous blood versus corticosteroid local injection in the short-term treatment of lateral elbow tendinopathy: a randomized clinical trial of efficacy', *American journal of physical*

medicine & rehabilitation / Association of Academic Physiatrists, vol. 89, no. 8, 10.1097/PHM.0b013e3181ddcb31,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/504/CN-00748504/frame.html>.

Khaliq, A, Khan, I, Inam, M, Saeed, M, Khan, H & Iqbal, MJ 2015, 'Effectiveness of platelets rich plasma versus corticosteroids in lateral epicondylitis', *JPMA. The Journal of the Pakistan Medical Association,* vol. 65, no. 11 Suppl 3, pp. S100-104.

Kivi, P 1983, 'The etiology and conservative treatment of humeral epicondylitis', *Scandinavian journal of rehabilitation medicine,* vol. 15, no. 1, pp. 37-41.

Koot, W, The, B & Eygendaal, D 2016, 'Lateral and medial non-articular elbow pain', *Orthopaedics and Trauma*.

Kraushaar, BS & Nirschl, RP 1999, 'Tendinosis of the elbow (tennis elbow): clinical features and findings of histological, immunohistochemical, and electron microscopy studies', *Journal of bone and joint surgery,* vol. 81, no. 2, p. 259.

Krogh, T, Fredberg, U, Stengaard-Pedersen, K, Christensen, R & Ellingsen, T 2012, 'Treatment of lateral epicondylitis with injection of platelet-rich plasma or corticosteroid versus saline: A randomized, double-blind, placebo-controlled trial', *Annals of the Rheumatic Disease. Conference: Annual European Congress of Rheumatology of the European League Against Rheumatism, EULAR,* vol. 71, no. no pagination.

Krogh, TP, Bartels, EM, Ellingsen, T, Stengaard-Pedersen, K, Buchbinder, R, Fredberg, U, Bliddal, H & Christensen, R 2013, 'Comparative effectiveness of injection therapies in lateral epicondylitis: a systematic review and network meta-analysis of randomized controlled trials', *The American journal of sports medicine,* vol. 41, no. 6, Jun, pp. 1435-1446.

Küçükşen, S, Yilmaz, H, Sallı, A & Uğurlu, H 2013, 'Muscle energy technique versus corticosteroid injection for management of chronic lateral epicondylitis: randomized controlled trial with 1-year follow-up', *Archives of Physical Medicine and Rehabilitation,* vol. 94, no. 11, pp. 2068-2074.

Labelle, H, Guibert, R, Joncas, J, Newman, N, Fallaha, M & Rivard, C 1992, 'Lack of scientific evidence for the treatment of lateral epicondylitis of the elbow. An attempted meta-analysis', *Bone & Joint Journal,* vol. 74, no. 5, pp. 646-651.

Lebiedzinski, R, Synder, M, Buchcic, P, Polguj, M, Grzegorzewski, A & Sibinski, M 2015, 'A randomized study of autologous conditioned plasma and steroid injections in the treatment of lateral epicondylitis', *International Orthopaedics,* vol. 39, no. 11, 30 Jul, pp. 2199-2203.

Lin, Y, Tu, Y, Chen, S, Lin, I, Chen, S & Guo, H 2010, 'Comparison between botulinum toxin and corticosteroid injection in the treatment of acute and subacute tennis elbow: a prospective, randomized, double-blind, active drug-controlled pilot study', *American journal of physical medicine & rehabilitation / Association of Academic Physiatrists,* vol. 89, no. 8,

10.1097/PHM.0b013e3181cf564d,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/157/CN-00750157/frame.html>.

Lindenhovius, A, Henket, M, Gilligan, B, Lozano-Calderon, S, Jupiter, J & Ring, D 2008, 'Injection of dexamethasone versus placebo for lateral elbow pain: a prospective, double-blind, randomized clinical trial', *The Journal of Hand Surgery,* vol. 33, no. 6, 10.1016/j.jhsa.2008.02.004,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/021/CN-00650021/frame.html>.

Lindenhovius, A, Henket, M, Gilligan, BP, Lozano-Calderon, S, Jupiter, JB & Ring, D 2008, 'Injection of dexamethasone versus placebo for lateral elbow pain: a prospective, double-blind, randomized clinical trial', *The Journal of Hand Surgery,* vol. 33, no. 6, pp. 909-919.

Ljung, BO, Alfredson, H & Forsgren, S 2004, 'Neurokinin 1-receptors and sensory neuropeptides in tendon insertions at the medial and lateral epicondyles of the humerus Studies on tennis elbow and medial epicondylalgia', *Journal of orthopaedic research,* vol. 22, no. 2, pp. 321-327.

Mardani-Kivi, M, Karimi-Mobarakeh, M, Karimi, A, Akhoondzadeh, N, Saheb-Ekhtiari, K, Hashemi-Motlagh, K & Bahrami, F 2013, 'The effects of corticosteroid injection versus local anesthetic injection in the treatment of lateral epicondylitis: A randomized single-blinded clinical trial', *Archives of Orthopaedic and Trauma Surgery,* vol. 133, no. 6, June, pp. 757-763.

Mark, Y, Kate, H, Adam, T & Srinath, K 2015, 'Lateral and Medial Epicondylitis', *MOJ Orthop Rheumatol,* vol. 3, no. 2, p. 00090.

Martinez-Silvestrini, JA, Newcomer, KL, Gay, RE, Schaefer, MP, Kortebein, P & Arendt, KW 2005, 'Chronic lateral epicondylitis: comparative effectiveness of a home exercise program including stretching alone versus stretching supplemented with eccentric or concentric strengthening', *Journal of Hand Therapy,* vol. 18, no. 4, pp. 411-420.

Murley, A & Lond, M 1954, 'Tennis-elbow treated with hydrocortisone acetate', *The Lancet,* vol. 264, no. 6831, pp. 223-225.

Murtezani, A, Ibraimi, Z, Vllasolli, TO, Sllamniku, S, Krasniqi, S & Vokrri, L 2015, 'Exercise and Therapeutic Ultrasound Compared with Corticosteroid Injection for Chronic Lateral Epicondylitis: A Randomized Controlled Trial', *Ortopedia Traumatologia Rehabilitacja,* vol. 17, no. 4, Jul-Aug, pp. 351-357.

Newcomer, K, Laskowski, E, Idank, D, McLean, T & Egan, K 2001, 'Corticosteroid injection in early treatment of lateral epicondylitis', *Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine,* vol. 11, no. 4,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/461/CN-00376461/frame.html>.

Nichols, AW 2005, 'Complications associated with the use of corticosteroids in the treatment of athletic injuries', *Clinical Journal of Sport Medicine,* vol. 15, no. 5, Sep,

pp. 370-375.

Nimgade, A, Sullivan, M & Goldman, R 2005, 'Physiotherapy, steroid injections, or rest for lateral epicondylosis: what the evidence suggests (Structured abstract)', *Pain Practice,* vol. 5, no. 3,<http://onlinelibrary.wiley.com/o/cochrane/cldare/articles/DARE-12006000090/frame.html>.

Nirschl, RP, Rodin, DM, Ochiai, DH, Maartmann-Moe, C & Grp, D-A-S 2003, 'Iontophoretic administration of dexamethasone sodium phosphate for acute epicondylitis - A randomized, double-blinded, placebo-controlled study', *American Journal of Sports Medicine,* vol. 31, no. 2, Mar-Apr, pp. 189-195.

Oksenberg, D, Cuchacovich, M, Alamo, M, Goecke, A, Contreras, L, Catalan, J, Saavedra, I, Gaete, L & Gatica, H 1998, 'Comparative effects of intra articular injections of two betametasone preparations in patients with osteoarthritis or epicondylitis', *Revista Medica De Chile,* vol. 126, no. 6, Jun, pp. 623-628.

Olaussen, M, Holmedal, O, Lindbaek, M, Brage, S & Solvang, H 2013, 'Treating lateral epicondylitis with corticosteroid injections or non-electrotherapeutical physiotherapy: A systematic review', *BMJ Open,* vol. 3 (10) (no pagination), no. e003564.

Omar, A, Ibrahim, M, Ahmed, A & Said, M 2012, 'Local injection of autologous platelet rich plasma and corticosteroid in treatment of lateral epicondylitis and plantar fasciitis: Randomized clinical trial', *Egyptian Rheumatologist,* vol. 34, no. 2, 10.1016/j.ejr.2011.12.001,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/010/CN-00896010/frame.html>.

Ozturan, KE, Yucel, I, Cakici, H, Guven, M & Sungur, I 2010, 'Autologous blood and corticosteroid injection and extracoporeal shock wave therapy in the treatment of lateral epicondylitis', *Orthopedics,* vol. 33, no. 2.

Palacio, EP, Schiavetti, RR, Kanematsu, M, Ikeda, TM, Mizobuchi, RR & Galbiatti, JA 2016, 'Effects of platelet-rich plasma on lateral epicondylitis of the elbow: prospective randomized controlled trial', *Revista Brasileira de Ortopedia (English Edition),* vol. 51, no. 1, pp. 90-95.

Peerbooms, JC, Sluimer, J, Bruijn, DJ & Gosens, T 2010, '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', *The American journal of sports medicine,* vol. 38, no. 2, Feb, pp. 255-262.

Peterson, C & Hodler, J 2011, 'Evidence-based radiology (part 2): Is there sufficient research to support the use of therapeutic injections into the peripheral joints?', *Skeletal Radiology,* vol. 39, no. 1, pp. 11-18.

Petrella, RJ, Cogliano, A, Decaria, J, Mohamed, N & Lee, R 2010, 'Management of tennis elbow with sodium hyaluronate periarticular injections', *BMC Sports Science,*

Medicine and Rehabilitation, vol. 2, no. 1, p. 1.

Placzek, R, Deuretzbacher, G & Meiss, AL 2007, 'Treatment of chronic plantar fasciitis with Botulinum toxin A: Preliminary clinical results', *Clinical Journal of Pain,* vol. 22, no. 2, February, pp. 190-192.

Price, R, Sinclair, H, Heinrich, I & Gibson, T 1991, 'Local injection treatment of tennis elbow--hydrocortisone, triamcinolone and lignocaine compared', *British Journal of Rheumatology,* vol. 30, no. 1, Feb, pp. 39-44.

Prieto-Lucena, J, González-Carmona, O, Pons-Sarazibar, Y, Vázquez-Sousa, C, Bravo-Paniagua, M & Pastor-Mañosa, C 2012, 'Infiltraciones de sangre autóloga y plasma enriquecido en plaquetas en el tratamiento de la epicondilitis. Una revisión sistemática', *Rehabilitación,* vol. 46, no. 2, pp. 157-163.

Qian, X, Lin, Q, Wei, K, Hu, B, Jing, P & Wang, J 2016, 'Efficacy and Safety of Autologous Blood Products Compared With Corticosteroid Injections in the Treatment of Lateral Epicondylitis: A Meta-Analysis of Randomized Controlled Trials', *PM and R.,* vol. 19.

Rabago, D, Lee, KS, Ryan, M, Chourasia, AO, Sesto, ME, Zgierska, A, Kijowski, R, Grettie, J, Wilson, J & Miller, D 2013, 'Hypertonic dextrose and morrhuate sodium injections (prolotherapy) for lateral epicondylosis (tennis elbow): Results of a single-blind, pilot-level randomized controlled trial', *American journal of physical medicine & rehabilitation/Association of Academic Physiatrists,* vol. 92, no. 7, p. 587.

Rodriguez, JA 2014, 'Corticosteroid versus platelet-rich plasma injection in epicondylitis', *Orthopedic nursing,* vol. 33, no. 5, 01 Sep, pp. 257-265; quiz 266-257.

Runeson, L & Haker, E 2002, 'Iontophoresis with cortisone in the treatment of lateral epicondylalgia (tennis elbow)--a double-blind study', *Scandinavian journal of medicine & science in sports,* vol. 12, no. 3, Jun, pp. 136-142.

Saartok, T & Eriksson, E 1986, 'Randomized trial of oral naproxen or local injection of betamethasone in lateral epicondylitis of the humerus', *Orthopedics,* vol. 9, no. 2, Feb, pp. 191-194.

Samagh, P, Sudhakar, K & Jindal, R 2016, 'Lateral Epicondylitis: Impact on Demographic Variables', *Journal of Ergonomics*, pp. 1-6.

Sayegh, ET & Strauch, RJ 2015, 'Does Nonsurgical Treatment Improve Longitudinal Outcomes of Lateral Epicondylitis Over No Treatment? A Meta-analysis', *Clinical Orthopaedics and Related Research,* vol. 473, no. 3, pp. 1093-1107.

Scarpone, M, Rabago, D, Zgierska, A, Arbogest, J & Snell, E 2008, 'The efficacy of prolotherapy for lateral epicondylosis: a pilot study', *Clinical journal of sport medicine: official journal of the Canadian Academy of Sport Medicine,* vol. 18, no. 3, p. 248.

Selvanetti, A, Barrucci, A, Antonaci, A, Martinez, P, Marra, S & Necozione, S 2003, 'Role of the eccentric exercise in the functional reeducation of lateral epicondylitis: a randomised controlled clinical trial', *Medicina dello Sport,* vol. 56, no. 2, pp. 103-

113.

Sheth, U, Simunovic, N, Klein, G, Fu, F, Einhorn, TA, Schemitsch, E, Ayeni, OR & Bhandari, M 2012, 'Efficacy of autologous platelet-rich plasma use for orthopaedic indications: a meta-analysis', *J Bone Joint Surg Am,* vol. 94, no. 4, pp. 298-307.

Singh, JA 2013, 'Use of botulinum toxin in musculoskeletal pain', *F1000Research,* vol. 2 (1) (no pagination), no. 52, 24 Jul.

Sirico, F, Ricca, F, DI Meglio, F, Nurzynska, D, Castaldo, C, Spera, R & Montagnani, S 2016, 'Local corticosteroid versus autologous blood injections in lateral epicondylitis: meta-analysis of randomized controlled trials', *European journal of physical and rehabilitation medicine*.

Smidt, N, Assendelft, WJJ, Van der Windt, DAWM, Hay, EM, Buchbinder, R & Bouter, LM 2002, 'Corticosteroid injections for lateral epicondylitis: A systematic review', *Pain,* vol. 96, no. 1-2, pp. 23-40.

Smidt, N, Van Der Windt, DAWM, Assendelft, WJJ, Deville, WLJM, Korthals-de Bos, IBC & Bouter, LM 2002, 'Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: A randomised controlled trial', *Lancet,* vol. 359, no. 9307, 23 Feb, pp. 657-662.

Stahl, S & Kaufman, T 1997, 'The efficacy of an injection of steroids for medial epicondylitis. A prospective study of sixty elbows', *Journal of Bone & Joint Surgery - American Volume,* vol. 79, no. 11, Nov, pp. 1648-1652.

Stahl, S & Kaufman, T 1997, 'Ulnar nerve injury at the elbow after steroid injection for medial epicondylitis', *Journal of Hand Surgery - British Volume,* vol. 22, no. 1, Feb, pp. 69-70.

Stefanou, A, Marshall, N, Holdan, W & Siddiqui, A 2012, 'A randomized study comparing corticosteroid injection to corticosteroid iontophoresis for lateral epicondylitis', *Journal of Hand Surgery,* vol. 37, no. 1, January, pp. 104-109.

Stenhouse, G, Sookur, P & Watson, M 2013, 'Do blood growth factors offer additional benefit in refractory lateral epicondylitis? A prospective, randomized pilot trial of dry needling as a stand-alone procedure versus dry needling and autologous conditioned plasma', *Skeletal Radiology,* vol. 42, no. 11, pp. 1515-1520.

Tahririan, MA, Moayednia, A, Momeni, A, Yousefi, A & Vahdatpour, B 2014, 'A randomized clinical trial on comparison of corticosteroid injection with or without splinting versus saline injection with or without splinting in patients with lateral epicondylitis', *Journal of Research in Medical Sciences,* vol. 19, no. 9, Sep, pp. 813-818.

Thanasas, C, Papadimitriou, G, Charalambidis, C, Paraskevopoulos, I & Papanikolaou, A 2011, 'Platelet-rich plasma versus autologous whole blood for the treatment of chronic lateral elbow epicondylitis a randomized controlled clinical trial', *The American journal of sports medicine,* vol. 39, no. 10, pp. 2130-2134.

Toker, S, Kilincoglu, V, Aksakalli, E, Gulcan, E & Ozkan, K 2008, 'Short-term results of

treatment of tennis elbow with anti-inflammatory drugs alone or in combination with local injection of a corticosteroid and anesthetic mixture. [Turkish]', *Acta orthopaedica et traumatologica turcica,* vol. 42, no. 3, 2008, pp. 184-187.

Tonks, J, Pai, S & Murali, S 2007, 'Steroid injection therapy is the best conservative treatment for lateral epicondylitis: a prospective randomised controlled trial', *International journal of clinical practice,* vol. 61, no. 2, 10.1111/j.1742-1241.2006.01140.x,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/283/CN-00577283/frame.html>.

Tsikopoulos, K, Tsikopoulos, A & Natsis, K 2016, 'Autologous whole blood or corticosteroid injections for the treatment of epicondylopathy and plantar fasciopathy? A systematic review and meta-analysis of randomized controlled trials', *Physical Therapy in Sport.,* vol. 10.

Uzunca, K, Birtane, M & Tastekin, N 2007, 'Effectiveness of pulsed electromagnetic field therapy in lateral epicondylitis', *Clinical Rheumatology,* vol. 26, no. 1, Jan, pp. 69-74.

Verhaar, JAN 1992, 'Tennis elbow [thesis]', *Maastricht: State University Maastricht*.

Verhaar, JAN 1994, 'Tennis Elbow: Anatomical, epidemiological and therapeutic aspects', *International Orthopaedics,* vol. 18, no. 5, pp. 263-267.

Verhaar, JAN, Walenkamp, GH, van Mameren, H, Kester, AD & van der Linden, AJ 1996, 'Local corticosteroid injection versus Cyriax-type physiotherapy for tennis elbow', *Journal of Bone & Joint Surgery - British Volume,* vol. 78, no. 1, Jan, pp. 128-132.

Walker-Bone, K, Palmer, KT, Reading, I, Coggon, D & Cooper, C 2012, 'Occupation and epicondylitis: a population-based study', *Rheumatology,* vol. 51, no. 2, pp. 305-310.

Wang, AA, Whitaker, E, Hutchinson, DT & Coleman, DA 2003, 'Pain levels after injection of corticosteroid to hand and elbow', *American journal of orthopedics (Belle Mead, N.J.),* vol. 32, no. 8, Aug, pp. 383-385.

Waugh, E.J., 2005. Lateral epicondylalgia or epicondylitis: what's in a name?. Journal of Orthopaedic & Sports Physical Therapy, vol.35, no.4, pp.200-202.

Weerakul, S & Galassi, M 2012, 'Randomized controlled trial local injection for treatment of lateral epicondylitis, 5 and 10 mg triamcinolone compared', *Journal of the Medical Association of Thailand,* vol. 95 Suppl 10, Oct, pp. S184-188.

Wolf, J, Ozer, K, Scott, F, Gordon, M & Williams, A 2011, 'Comparison of autologous blood, corticosteroid, and saline injection in the treatment of lateral epicondylitis: a prospective, randomized, controlled multicenter study', *The Journal of Hand Surgery,* vol. 36, no. 8, 10.1016/j.jhsa.2011.05.014,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/086/CN-00811086/frame.html>.

Wong, SM, Hui, AC, Tong, P-Y, Poon, DW, Yu, E & Wong, LK 2005, 'Treatment of lateral epicondylitis with botulinum toxin: a randomized, double-blind, placebo-controlled

trial', *Annals of internal medicine,* vol. 143, no. 11, pp. 793-797.

Yadav, R, Kothari, S & Borah, D 2015, 'Comparison of local injection of platelet rich plasma and corticosteroids in the treatment of lateral epicondylitis of humerus', *Journal of Clinical and Diagnostic Research,* vol. 9, no. 7, 10.7860/JCDR/2015/14087.6213,<http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/238/CN-01103238/frame.html>.

Zeisig, E, Fahlström, M, Öhberg, L & Alfredson, H 2008, 'Pain relief after intratendinous injections in patients with tennis elbow: results of a randomised study', *British journal of sports medicine,* vol. 42, no. 4, pp. 267-271.

6. Appendices

Appendix 1: Sign Checklists Used in this Review

SIGN Critical Appraisal Tool for Systematic Reviews and Meta-analyses

SIGN

Methodology Checklist 1: Systematic Reviews and Meta-analyses

SIGN gratefully acknowledges the permission received from the authors of the AMSTAR tool to base this checklist on their work: *Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C,. et al.. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Medical Research Methodology 2007, **7**:10 doi:10.1186/1471-2288-7-10. Available from http://www.biomedcentral.com/1471-2288/7/10 [cited 10 Sep 2012]*

Study identification (*Include author, title, year of publication, journal title, pages*)	
Guideline topic:	Key Question No:
Before completing this checklist, consider: Is the paper relevant to key question? Analyse using PICO (Patient or Population Intervention Comparison Outcome). IF NO reject. IF YES complete the checklist.	
Checklist completed by:	

Section 1: Internal validity

In a well conducted systematic review:		***Does this study do it?***	
1.1	The research question is clearly defined and the inclusion/ exclusion criteria must be listed in the paper.	Yes □ **If no reject**	No □
1.2	A comprehensive literature search is carried out.	Yes □ Not applicable □ **If no reject**	No □
1.3	At least two people should have selected studies.	Yes □	No □ Can't say □
1.4	At least two people should have extracted data.	Yes □	No □ Can't say □
1.5	The status of publication was not used as an inclusion criterion.	Yes □	No □
1.6	The excluded studies are listed.	Yes □	No □
1.7	The relevant characteristics of the included studies are provided.	Yes □	No □
1.8	The scientific quality of the included studies was assessed and reported.	Yes □	No □
1.9	Was the scientific quality of the included studies used appropriately?	Yes □	No □
1.10	Appropriate methods are used to combine the individual study findings.	Yes □ Can't say □	No □ Not applicable □

1.11	The likelihood of publication bias was assessed appropriately.	Yes □ No □ Not applicable □
1.12	Conflicts of interest are declared.	Yes □ No □
SECTION 2: OVERALL ASSESSMENT OF THE STUDY		
2.1	What is your overall assessment of the methodological quality of this review?	High quality (++) □ Acceptable (+) □ Low quality (-)□ Unacceptable – reject 0 □
2.2	Are the results of this study directly applicable to the patient group targeted by this guideline?	Yes □ No □
2.3	**Notes:**	

SIGN Critical Appraisal Tool for Controlled trials

SIGN

Methodology Checklist 2: Controlled Trials

Study identification (*Include author, title, year of publication, journal title, pages*)

Guideline topic:	Key Question No:	Reviewer:

Before completing this checklist, consider:

1. Is the paper a **randomised controlled trial** or a **controlled clinical trial**? If in doubt, check the study design algorithm available from SIGN and make sure you have the correct checklist. If it is a **controlled clinical trial** questions 1.2, 1.3, and 1.4 are not relevant, and the study cannot be rated higher than 1+
2. Is the paper relevant to key question? Analyse using PICO (Patient or Population Intervention Comparison Outcome). IF NO REJECT (give reason below). IF YES complete the checklist.

Reason for rejection: 1. Paper not relevant to key question ☐ 2. Other reason ☐ (please specify):

SECTION 1: INTERNAL VALIDITY

In a well conducted RCT study…		***Does this study do it?***
1.1	The study addresses an appropriate and clearly focused question.	Yes ☐ No ☐ Can't say ☐
1.2	The assignment of subjects to treatment groups is randomised.	Yes ☐ No ☐ Can't say ☐
1.3	An adequate concealment method is used.	Yes ☐ No ☐ Can't say ☐
1.4	The design keeps subjects and investigators 'blind' about treatment allocation.	Yes ☐ No ☐ Can't say ☐
1.5	The treatment and control groups are similar at the start of the trial.	Yes ☐ No ☐ Can't say ☐
1.6	The only difference between groups is the treatment under investigation.	Yes ☐ No ☐ Can't say ☐
1.7	All relevant outcomes are measured in a standard, valid and reliable way.	Yes ☐ No ☐ Can't say ☐
1.8	What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?	
1.9	All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).	Yes ☐ No ☐ Can't say ☐ Does not apply ☐
1.10	Where the study is carried out at more than one site, results are comparable for all sites.	Yes ☐ No ☐ Can't say ☐ Does not apply ☐

SECTION 2: OVERALL ASSESSMENT OF THE STUDY

2.1	How well was the study done to minimise bias?	High quality (++)☐

	Code as follows:	Acceptable (+)☐ Low quality (-)☐ Unacceptable – reject 0 ☐
2.2	Taking into account clinical considerations, your evaluation of the methodology used, and the statistical power of the study, are you certain that the overall effect is due to the study intervention?	
2.3	Are the results of this study directly applicable to the patient group targeted by this guideline?	
2.4	**Notes.** Summarise the authors' conclusions. Add any comments on your own assessment of the study, and the extent to which it answers your question and mention any areas of uncertainty raised above.	

Appendix 2: Quality scores for systematic reviews used in this review

Reference (author, year)		Question													
Study	**Year**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**1.10**	**1.11**	**1.12**	**2.1**	**2.2**
Arirachakaran et al.	2016	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	HQ(++)	Y
Assendelft et al.	1996	Y	Y	CS	Y	Y	Y	Y	Y	Y	Y	N	N	HQ(++)	Y
Barr et al.	2009	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	HQ(++)	Y
Brinks et al.	2010	Y	Y	Y	Y	Y	N	Y	N	N	NA	N	Y	AQ(+)	Y
Claesson et al.	2016	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	HQ(++)	Y
Coombes et al.	2010	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	HQ(++)	Y
Dong et al.	2016	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	HQ(++)	Y
Elmajee et al.	2016	Y	Y	N	N	N	N	N	CS	CS	CS	N	N	R(0)	Y
Krogh et al.	2013	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	HQ(++)	Y
Labelle et al.	1992	Y	Y	Y	CS	N	N	N	Y	Y	N	N	Y	LQ(-)	Y
Nichols et al.	2005	Y	Y	CS	CS	Y	N	Y	N	N	NA	N	N	LQ(-)	Y
Nimgade et al.	2005	Y	Y	Y	N	N	N	Y	Y	Y	N	N	N	AQ(+)	Y
Olaussen et al.	2013	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	HQ(++)	Y
Qian et al.	2016	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	HQ(++)	Y
Rodriguez	2014	Y	Y	CS	CS	N	N	N	Y	Y	N	N	N	LQ(-)	Y
Sayegh & Strauch	2014	Y	Y	CS	CS	Y	N	Y	Y	Y	Y	Y	Y	AQ(+)	Y
Sirico et al.	2016	Y	Y	Y	CS	N	Y	Y	Y	Y	Y	N	Y	AQ(+)	Y
Smidt et al.	2002	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	HQ(++)	Y
Tsikopoulos et al.	2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	HQ(++)	Y

Appendix 3: Data extraction for systematic reviews included in this review

Author and year	SIGN Score	Approach	Studies (patient No)	Outcome	Conclusions	Evidence				Grade
						1	2	3	4	
Arirachakaran et al. (2016)	HQ(++)	Steroid injection	6 RCTs; (n=NS)	Pain, Disability, Functional movement	Autologous blood injection (ABI) sig. better than CSI for all outcomes (Pain, DASH, PRTEE, PPT)	1	1	0	0	1
					Platelet-rich plasma (PRP) sig. better than CSI for pain and disability (DASH).	1	1	0	0	1
					AB injection has a higher risk of adverse effects, with a relative risk of 1.78 (1.00, 3.17), when compared to CS.	1	1	0	0	1
Assendelft et al. (1996)	HQ(++)	Steroid injection	12 RCTs (n=NS)	Treatment success	The pooled analysis indicated short-term effectiveness (2-6 weeks): pooled odds ratio (OR) = 0. 15 [95% confidence interval (CI) 0. 10-0.231). At longer term follow-up, no difference could be detected.	1	1	1	0	1+
Barr et al. (2009)	HQ(++)	Steroid injection vs Physiotherapy	5 RCTs; (n = 597)	Pain-free grip strength	Large effect sizes in favour of CSI at short-term (< 6weeks) follow-up	1	1	0	0	1
					Medium-large effect in favour of physiotherapy at intermediate and long-term follow-up.	1	1	0	0	1
Brinks et al. (2010)	AQ(+)	Steroid injections (general)	9 RCTs, 1 Prospective trial; (n=1092)	Adverse Events	Difficult to accurately quantify the incidence of adverse effects after extra-articular corticosteroid injection. The minor adverse events effects ranged from skin rash to flushing and disturbed menstrual pattern. Increased pain or steroid flare after injection was reported in 19 studies. After extra-articular injection, the incidence of major adverse events ranged from 0-5.8% and that of minor adverse events from 0-81%.	0	1	1	0	1
Claesson et al. (2016)	HQ(++)	Steroid injections	7 RCTs (n=530)	Pain, DASH, Grip strength	Pain intensity was slightly, but significantly, lower 1 month, but not 3 months, after steroid injection compared to placebo. There were no significant differences in grip strength or Disabilities of the Arm, Shoulder, and Hand score at any time point.	1	1	1	0	1+
					No difference in pain intensity 6 months after injection of corticosteroids or placebo.	1	1	1	0	1+
Coombes et al. (2010)	HQ(++)	Steroid injection	12 RCTs; (n= NS)	Pain, function, overall improvement, adverse events	Steroid injection had a large effect (defined as SMD>0·8) on reduction of pain compared with no intervention in the short term (SMD 1·44, 95% CI 1·17–1·71, p<0·0001)	1	1	0	0	1
					No intervention was favoured at intermediate term (–0·40, –0·67 to –0·14, p<0·003) and long term (–0·31, –0·61 to –0·01, p=0·05).	1	1	0		1

Author and year	SIGN Score	Approach	Studies (patient No)	Outcome	Conclusions	Evidence				Grade
						1	2	3	4	
Dong et al. (2016)	HQ(++)	Injection therapies	27 RCTs	Pain	Steroid injections cannot be recommended as treatment for LE, as effects over 6 months are not statistically different from placebo	1	1	1	0	1+
Elmajee et al. (2016)	R(0)	Injection therapies	7 RCTs (n=504)	Pain	Corticosteroid injections failed to demonstrate long-lasting significant clinical effects in chronic LE.	0	0	1	0	1-
					PRP and ABI were shown to have a better, more progressive and increasing effect from 6 months to one year following the injections compared to steroids	0	0	1	0	1-
Krogh et al. (2013)	HQ(++)	Injection therapies	9 RCTs; (n= 301)	Pain, adverse events	Pooled results (SMD [95% confidence interval]) showed that beyond 8 weeks, glucocorticoid injection was no more effective than placebo (20.04 [20.45 to 0.35]), .	1	1	1	0	1+
Labelle et al. (1992)	LQ(-)	Treatment of LE	5 RCTs (n=335)	Pain	Most studies suggested a positive therapeutic effect for steroid injections, the very low scores and some conflicting results make further investigations mandatory.	0	0	1	0	1-
Nichols et al. (2005)	LQ(-)	Steroid injection; majority lateral epicondylitis	12 RCTs, 1 Case report; (n= 635)	Complications and adverse events	18.74% (119/635 patients) of Elbow CSI experienced complications. Only minor treatment complications reported.	0	0	1	0	1-
Nimgade et al. (2005)	AQ(+)	Steroid injection vs physio vs rest	11 RCTs; (n= 930)	Overall patient improvement	Corticosteroid injections appeared to be effective in the short term (up to 3 months).	0	1	1	1	1+
					In the long term, active physiotherapy outperformed injections	0	1	0	0	1-
Olaussen et al. (2013)	HQ(++)	Steroid injection vs physio	8 RCTs; (n= 925)	Overall improvement, pain, grip strength	Corticosteroid injection gave a short-term reduction in pain versus no intervention or NSAID drugs (SMD −1.43, 95% CI −1.64 to −1.23).	1	1	1	1	1++
					At intermediate follow-up, there was an increase in pain (SMD 0.32, 95% CI 0.13 to 0.51), reduction in grip strength (SMD −0.48, 95% CI −0.73 to −0.24) and negative effect on the overall improvement effect (RR 0.66 (0.53 to 0.81)).	1	1	1	0	1+
					Long-term follow-up no difference on overall improvement or grip strength, and conflicting evidence for pain	1	1	0	1	1+

Author and year	SIGN Score	Approach	Studies (patient No)	Outcome	Conclusions	Evidence				Grade
						1	2	3	4	
Qian et al. (2016)	HQ(++)	Steroid injection vs. autologous blood products	10 RCTs; (n= 509)	Pain, grip strength, function, ROM, disability	Steroid injections appear to be superior to autologous blood product injections for pain relief in the short term	1	1	1	0	1+
					In the intermediate and long term autologous blood product injections were better than steroid injections for pain and function	1	1	1	1	1++
Rodriguez (2014)	LQ(-)	Steroid injection vs. platelet rich plasma injection	5 SRs, 6 RCTs; (n= NS)	Pain, Function	Corticosteroid injections are an effective short-term intervention for reducing pain and improving function in patients with LE, but lack evidence of intermediate or long term effects	0	0	1	0	1-
					Platelet-rich plasma (PRP) was been shown to be more effective than steroid injections, providing longer positive results with a lower recurrence rate.	0	0	1	0	1-
Sayegh & Strauch (2015)	AQ(+)	Steroid injection	7 RCTs; N = 316	Pain, Function, Disability, Grip Strength, Escape treatment	Lack of intermediate & long-term benefits to nonsurgical treatment compared with placebo/observation	0	0	0	0	1-
					CSIs not examined separately; part of nonsurgical treatment group	0	0	0	0	1-
Sirico et al. (2016)	AQ(+)	Steroid injection vs. autologous blood products	4 RCTs (n=218)	Pain	Steroid injections resulted in reduced VAS scores in the short term	1	1	0	0	1
					No differences between steroid injections or ABS in the intermediate or long term	1	1	1	0	1+
Smidt et al. (2002)	HQ (++)	Steroid injection	13 RCTs; N =	Pain, global improvement, function, grip strength, return to work	Corticosteroid injections appeared to be effective in the short term (up to 6 weeks).	0	1	1	1	1+
					No beneficial effects were found for intermediate or long-term follow-up.	0	1	1	1	1+
Tsikopoulos et al. (2016)	HQ(++)	Steroid injection vs Autologous Whole Blood	6 RCTs; N = NS	Pain, assessment of composite outcomes	Steroid better than autologous whole blood for pain relief in short term, ie less than 6 weeks (SMD 0.51, 95%CI: -0.04 to 1.06).	1	1	0	0	1
					Autologous whole blood better than steroid for pain relief in intermediate and longer term, ie greater than 8 weeks	1	1	0	0	1

Appendix 4: RCTs within the systematic reviews used in this study

RCTs	Labelle et al. (1992)	Assendelft et al. (1996)	Smidt et al. (2002)	Nimgade et al. (2005)	Barr et al. (2009)	Krogh et al. (2013)	Olaussen et al. (2013)	Rodriguez (2014)	Sayegh and Straugh (2015)	Arirachakaran et al. (2016)	Claesson et al. (2016)	Dong et al. (2016)	Elmajee et al. (2016)	Qian et al. (2016)	Sirico et al. (2016)	Tsikopoulos et al. (2016)	Nichols 2005	Brinks et al. (2010)	Total References
Baily & Brock 1957		x	x																2
Murley & Lond 1954		x	x	x															3
Freeland & Gribble 1954		x	x																2
Hughes and Currey 1969	x	x																	2
Clarke and Woodland 1975	x																		1
Day et al. 1978	x	x	x														x		4
Brattberg 1983	x																		1
Kivi 1983	x	x																	2
Saartok & Eriksson 1986		x	x	x													x		4
Halle et al. 1986			x														x		2
Price et al. 1991		x	x	x		x	x				x	X					x	x	9
Verhaar 1992		x																	1
Haker & Lundeberg 1993		x	x														x		3
Akermark et al. 1995						x						X							2
Verhaar et al. 1996			x		x												x	x	4
Bär et al. 1997			x														x		2
Erturk et al. 1997			x														x		2
Stahl and Kaufman 1997																	x		1
Oksenberg et al. 1998			x														x		2
Hay et al. 1999			x	x			x		x			X					x	x	7
Jensen 2001																		x	1
Newcomer et al. 2001				x		x	x					X					x		5
Smidt et al. 2002				x	x		x					X					x	x	6
Runeson & Haker 2002									x										1
Wang 2003																		x	1
Bisset et al. 2003,					x														1
Selvanetti et al. 2003							x												1
Martinez -Silvestrini et al. 2005							x												1
Wong et al. 2005												X							1
Bisset et al. 2006							x		x			X						x	4
Uzunca et al. 2007					x														1
Placzek et al. 2007												X							1
Stahl 1997																		x	1
Tonks et al. 2007					x							X						x	3
Lindenhovius et al. 2008						x	x				x	X						x	5
Scarpone et al. 2008												X							1
Zeisig 2008											x								1
Toker et al. 2008							x												1
Dogramaci et al. 2009						x						X							2
Espandar et al. 2010												X							1
Kazemi et al. 2010						x				x		X		x	x	x			6
Lin et al. 2010						x						X							2
Ozturan et al. 2010						x						X		x		x			4
Peerbooms et al. 2010						x		x		x		X		x					5
Coombes,et al. 2010								x	x										2
Petrella et al. 2010												X							1
Gosens et al. 2011								x					x						2
Thanasas et al. 2011												X							1
Peterson et al. 2011							x												1
Wolf et al. 2011									x		x	X		x	x	x			6
Priteo-Lucena et al. 2012																			0
Sheth et al. 2012								x											1
Dojode 2012										x				x		x			3
Omar et al. 2012										x		X		x					3
Coombes et al. 2013							x				x	X							3
Jindal et al. 2013												X		x	x	x			4
Krogh et al. 2012								x	x	x	x	X	x	x					7
Singh et al. 2013																			0
Mardani-Kivi et al. 2013											x	X							2
Rabago et al. 2013												X							1
Stenhouse et al. 2013												X							1
Arik et al. 2014														x	x	x			3
Gautam et al. 2015													x	x					2
Inklebarger and Clarke 2015													x						1
Total References	5	10	13	6	5	9	11	6	6	5	7	27	4	10	4	6	13	10	157

Appendix 5: Quality scores for randomised controlled trials used in this review

Reference (author, year)		Questions												
Study	**Year**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**1.10**	**2.1**	**2.2**	**2.3**
Bellapianta et al.	2011	Y	CS	N	N	CS	Y	Y	38.7%	N	NA	LQ(-)	Y	Y
2.4	No studies have directly compared the peppered-injection technique to the single injection technique. Our results suggest that patient outcome is improved with the single injection													
Beyazal & Devrimsel	2015	Y	CS	N	N	N	Y	Y	NR	N	NA	LQ(-)	Y	Y
2.4	Both the extracorporeal shock wave therapy and steroid injection were safe and effective in the treatment of lateral epicondylitis. However, extracorporeal shock wave therapy demonstrated better outcomes than steroid injection at the long-term follow-up.													
Carayannopoulos et al.	2011	Y	Y	Y	Y	N	Y	Y	29.2%	N	NA	AQ(+)	Y	Y
2.4	Both prolotherapy and corticosteroid therapy were generally well tolerated and appeared to provide benefit of long duration, although the study lacked sufficient power to draw conclusions.													
Gunduz	2012	Y	Y	Y	Y	Y	N	Y	NR	N	NA	AQ(+)	Y	Y
2.4	Our results have shown that pain and grip strength of LE patients improved after physical therapy, injection, and ESWT; however, those changes were not reflected to ultrasonographic findings													
Küçükşen et al.	2013	Y	Y	Y	Y	Y	CS	Y	6.09%	N	NA	AQ(+)	Y	Y
2.4	Both MET and CSI improved measures of strength, pain, and function compared to baseline, however CSI was more effective in the short term (>6wks) while MET scored more highly for the long term (<52wks)													
Lebiedzinski et al.	2015	Y	Y	Y	N	N	CS	Y	NR	N	NA	LQ(-)	Y	Y
2.4	ACP better at 12 months; CSI has more rapid improvement. Therapeutic effect is longer lasting in ACP group.													
Murtezani et al.	2015	Y	Y	Y	Y	Y	N	Y	18.3%	N	NA	AQ(+)	Y	Y
2.4	Our results suggest that ultrasound therapy and exercise are beneficial in the treatment of tennis elbow													
Stefanou et al.	2012	Y	CS	CS	N	Y	Y	Y	18.8%	N	NA	AQ(+)	Y	Y
2.4	Dexamethasone via iontophoresis produced sig. short-term benefits for grip strength and RTW. This study suggests that this iontophoresis technique for delivery of corticosteroid may be considered a treatment option for patients with lateral epicondylitis													
Tahririan et al.	2014	Y	Y	Y	Y	Y	CS	Y	1.26%	N	NA	HQ(++)	Y	Y
2.4	CSI sig. pain reduction in short term, no benefit in comparison to control by 24th week													
Weerakul & Galassi	2012	Y	CS	CS	N	Y	Y	Y	7.14%	N	NA	AQ(+)	Y	Y

Reference (author, year)		Questions												
Study	**Year**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**1.10**	**2.1**	**2.2**	**2.3**
2.4	The use of 5 mg triamcinolone was comparable to 10 mg triamcinolone injected locally to treatment of lateral epicondylitis.													
Yadav	2015	Y	CS	CS	N	Y	Y	Y	7.69%	N	NA	AQ(+)	Y	Y
2.4	PRP and CSI both are effective in the treatment of lateral epicondylitis. However, PRP is a superior treatment option for longer duration efficacy.													
Guo et al.	2016	Y	Y	Y	Y	Y	Y	Y	16.12	N	NA	HQ(++)	Y	Y
2.4	Injections with the Botox and with steroid effectively reduced pain and improved upper limb function in patients with lateral epicondylalgia for at least 16 weeks. The onset of effect was earlier in the Steroid and Botox-Epic groups than in the Botox-Tend group.													
Khaliq et al.	2015	Y	Y	CS	CS	Y	CS	Y	NR	N	NA	LQ(-)	Y	Y
2.4	PRP is an effective alternate to corticosteroid in the treatment of lateral epicondylitis (tennis elbow).													
Palacio et al.	2016	Y	Y	Y	Y	CS	CS	Y	NR	N	NA	LQ(-)	Y	Y
2.4	At a significance level of 5%, there was no evidence that PRP was more effective than CSI, or vice-versa, when assessed using the DASH and PRTEE questionnaires													
Bahari et al.	2003	Y	CS	CS	N	Y	Y	Y	NR	N	NA	LQ(-)	Y	Y
2.4	CSI had short-term benefits; not recommended for medial epicondylitis. Control (NSAIDS, splinting, physiotherapy) provides best conservative approach. SI near a sensitive nerve (ulnar nerve) is not justified.													
Stahl & Kaufman	1997	Y	Y	Y	Y	Y	CS	Y	0.00%	NA	NA	AQ(+)	Y	Y
2.4	The local injection of steroids provides only short-term benefits in the treatment of medial epicondylitis.													
Ahmed et al.	2012	Y	Y	N	Y	CS	N	Y	NR	N	NA	LQ(-)	Y	Y
2.4	In patients with tennis elbow, the use of local steroid injection in combination with topical and oral NSAIDs is superior to the use of combination of topical and oral NSAIDs. Better results with combination therapy using local steroid injection may be limited to the short term.													

Appendix 6: Data extraction for randomised controlled trials used in this review

Study	Subjects			Intervention	Comparator	Outcome measures	Time	Results
	N=	Age	Diagnosis					
Bellapianta et al. (2011)	19	NR	Acute symptomatic lateral epicondylitis (<6 months);	Triamcinolone (10mg) + Lidocaine	Peppering vs single injection	Pain (VAS), Grip Strength, DASH	Baseline and 10 wks	Single injections performed better than peppering
Beyazal & Devrimsel (2015)	64	26-57	Lateral epicondylitis	Methylprednisolone acetate (20mg) + prilocaine	ESWT	Pain (VAS, McGill pain Q), Grip strength	Baseline, 4 & 12 wks	• ESWT better results across all outcome measures than steroid injections
Carayannopoulos et al. (2011)	24	18-75	Lateral epicondiliitis (3/12 to 2 years)	Methylprednisolone acetate 40mg + procaine	Prolotherapy	Pain (VAS), Grip Strength, DASH	Baseline, 1, 3, 6 mths;	• No significant differences between the prolotherapy and the corticosteroid group for change in VAS, QVAS, or DASH. Both improved from baseline
Gunduz (2012)	59	43-46	Pain lateral elbow < 3 months	Methylprednisolone acetate 20mg + procaine	Physiotherapy and ESWT	Pain (VAS), Grip Strength,	Baseline, 1, 3, 6 mths	• All treatment improved similarly
Küçükşen et al. (2013)	82	18-72	Pain lateral elbow > 3 months	Triamcinolone 40mg + lidocaine	Muscle energy technique	Pain (VAS), Grip Strength, DASH	Baseline, 6, 26, 52 wks	• Both MET and CSI improved measures of strength, pain, and function compared to baseline, however CSI was more effective in the short term (>6wks) while MET scored more highly for the long term (<52wks)
Lebiedzinski et al. (2015)	120	21-96	Acute symptomatic lateral epicondylitis (<6 weeks);	Betamethasone 10mg + lidocaine	autologous conditioned plasma	Pain, DASH	baseline, 6wks, 6 & 12 mths	• ACP better at 12 months; CSI has more rapid improvement. Therapeutic effect is longer lasting in ACP group.
Murtezani et al. (2015)	60	>18yrs	Lateral epicondylitis (<3/12)	Triamcinolone acetonide 10mg + lidocaine	Exercise and Ultrasound	Pain (VAS) PRTEE score, Grip strength	Baseline, 6wk, 12 wk	• Exercise group sig. improvements across all outcome measures compared to CSI @ 12wks
Stefanou et al. (2012)	101	18-71	Lateral epicondylitis (> 2 years)	Dexamethasone or triamcinolone 10mg	Dexamethasone (10mg)via iontophoresis	PRTEE score, Grip strength, work status	Baseline, 8 weeks, 6 months	• By 6-month all groups had equivalent significant results for all measured outcomes.

								• The iontophoresis patients had statistically significant improvement in grip strength at 8 weeks. They were also more likely to get back to work without restriction at 8 weeks.
Tahririan et al. (2014)	78	32-65	Acute symptomatic lateral epicondylitis (<6 weeks);	Depomedrol (40mg)	control +/- splinting	Pain (VAS), Oxford Elbow Scal	Baseline, 2, 4, & 24 wks	• CSI sig. pain reduction in short term, • No benefit in comparison to control by 24th week
Weerakul & Galassi (2012)	112	46	Lateral epicondylitis	High dose Triamcinolone 10mg + lidocaine	Low dose Triamcinolone 5mg + lidocaine	Pain (VAS) grip strength	Baseline & 12 wks	• *There were no statistically significant in terms of patient satisfaction, pain score, tenderness at lateral epicondyle, grip strength and adverse effect rate*
Yadav (2015)	65	21-60	Lateral epicondiliitis (<6/12)	Methylprednisolone 40mg	Platelet-rich plasma	Pain (VAS), Grip Strength, DASH	Baseline, 15 days, 1 & 3 mths	• PRP and CSI both are effective in the treatment of lateral epicondylitis. However, PRP is a superior treatment option for longer duration efficacy.
Ahmed et al. (2012)	60	>18	Lateral epicondiliitis (<3/12)	Triamcinolone 20mg + Lidocaine	Topical and oral NSAID	Pain (VAS)	Baseline 6/52, 12/52	• In patients with LE, the use of local steroid injection in combination with topical and oral NSAIDs is superior to the use of combination of topical and oral NSAIDs. Better results with combination therapy using local steroid injection may be limited to the short term.
Guo et al. (2016)	26	Ave 51yrs	Lateral epicondiliitis (>6/12)	triamcinolone acetonide 40mg	Botox	Pain (VAS), Grip Strength, PRTEE	Baseline, 4, 8, 12, and 16 weeks	• At 4 weeks Steroids were superior to the Botox injection at the tender point in improvement on the visual analogue scale (p=0.006), grip strength (p=0.03) and Patient-Rated Tennis Elbow Evaluation (p=0.02). • However, these differences were not observed at the 8-, 12-, and 16-week follow-ups. • There was no significant difference between the Steroid and Botox to the enthesis groups.

Palacio et al. (2016)	60	22-85	Lateral epicondylitis	Dexamethasone 3ml	platelet-rich plasma (PRP)	DASH, PRTEE	Baseline, 3 months, 6 months	• At a significance level of 5%, there was no evidence that one treatment was more effective than another, when assessed using the DASH and PRTEE questionnaires.
Khaliq et al. (2015)	102		Lateral epicondylitis	methylprednisolone acetate 2ml + xylocaine 1ml	platelet-rich plasma (PRP)	Pain (VAS)	Baseline, 3 weeks	• PRP more effective in reducing pain at 3 weeks than steroid injection.
Bahari et al. (2003)	38	mean 42.55 & 42.7	Medial epicondylitis	Methylprednisolone, 40mg + 1ml Lidocaine	Saline + 1ml Lidocaine	Nirschl and Pettrone grading 0 - 4 severity of pain	Baseline, 2, 4, & 12 months	• The severity of pain in both groups was same before the treatment and there was no significant difference between the two groups. The difference in pain score between the two groups at 2 months was statistically significant (p = 0.01). At 4 months, the mean pain scores in the two groups were similar (p = 0.673) and there were no significant differences between the two groups at 12 months (p = 0.942, Mann-Witney test)
Stahl & Kaufman (1997)	58	43(1.22) years	Medial epicondylitis	Methylprednisolone, 40mg+ 1ml Lidocaine	platelet-rich plasma (PRP)	Nirschl and Pettrone grading 0 - 4 severity of pain; VAS	Baseline, 6 week, 3 & 12 months	• Experimental group sig. less pain than control group at 6 wks on Nirschl & Pettrone, but groups did not differ at 3 & 12 mths. No difference on VAS for any time point.