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Surgical management of lateral epicondylitis: a scoping review of published literature

Duncan Muir, MRCS[a,*], Helena Blakeway, MBChB[a], Richard Morris, MRCS[a], Ali A. Narvani, FRCS[a], Ahmed Elgebaly, MD[b], Mohamed A. Imam, FRCS[a,b]

[a]Rowley Bristow Orthopaedic Unit, Chertsey, UK
[b]Smart Health Unit, University of East London, London, UK

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Background: Surgical intervention for lateral epicondylitis remains a controversial topic, with its purpose being debated. Recent guidelines have concluded no benefit from surgery when compared to conservative management.
Methods: An electronic database search of Ovid Medline via PubMed, EMBASE, and the Web of Science was performed to understand the published literature further.
Results: 35 studies incorporating 1564 patients were included. This included 12 trials and 23 observational studies. Most studies reported the benefits of surgery in pain and function despite the majority of studies using a variety of outcome measures.
Conclusion: Surgery is reported to treat lateral epicondylitis successfully. However, multicenter studies have yet to be published, and the low number of included patients means that further evidence is required to conclude management.

Lateral epicondylitis or tennis elbow, presents as one of the most common causes of lateral elbow pain, quoted as having an overall prevalence of 1%-3% and notably affecting 50% of all-level tennis player.[17] It is characterized by pain near the lateral epicondyle, pain on resisted wrist extension, and pain when gripping objects, resulting in reduced grip strength.[16] The mechanism of injury is not fully understood; however, the most commonly accepted cause is microtearing at the point of insertion of the common extensor tendon, usually the extensor carpi radialis brevis (ECRB) on the lateral humeral epicondyle.[38] This results in a healing process with minimal inflammation; thus, the term tendinosis is commonly used. Furthermore, symptoms are widely aggravated by repetitive use, normally occupational or sports-related.[29]

Due to the high prevalence of this condition, the socioeconomic impact can be significant.[48] Thus, it is imperative to form appropriate management plans for lateral epicondylitis. The majority of cases use a variety of conservative measures. In the first stage (preprimary care), patients can attempt stretching exercises and simple over-the-counter analgesia.[3] These can also include counterforce bracing, activity-modification, and physiotherapy, which have found to be of particular benefit in the younger population.[36] If symptoms persist, general practitioners can refer for physical therapy, further analgesics, and request orthopedic input where measures, such as corticosteroid injections and plasma-rich platelet infusions, are considered. In the case of persistent symptoms, surgery has been a further possible treatment for lateral epicondylitis for over 20 years.[10] As there are several different management options for this common condition, there has been a requirement for up-to-date guidelines recommending the most suitable evidence-based practice. In the United Kingdom, the British Elbow and Shoulder Society (BESS) produced recommendations for treating lateral epicondylitis alongside a thorough rating of the quality of available evidence.[39] The authors concluded numerous factors in the treatment of lateral epicondylitis. They concluded the evidence quality to be inferior, with few studies comparing surgery to conservative management, and the methodological quality was deemed poor. Thus, they concluded that surgery offers no benefit to conservative management of lateral epicondylitis. Furthermore, they noted no difference in outcome between open or arthroscopic techniques.

The high prevalence of lateral epicondylitis, alongside the publication of novel guidelines questioning the benefit of surgery in this condition, highlights the requirement for a deeper understanding of published literature. This scoping review aimed to review all randomized trials and observational studies investigating

Institutional review board approval was not required for this systematic review.

*Corresponding author: Duncan Muir, MBChB, MRCS, Surrey and Sussex Hospitals NHS Trust, Trauma and Orthopaedics, East Surrey Hospital, Redhill, UK RH1 5RH.
E-mail address: duncan.muir@nhs.net (D. Muir).

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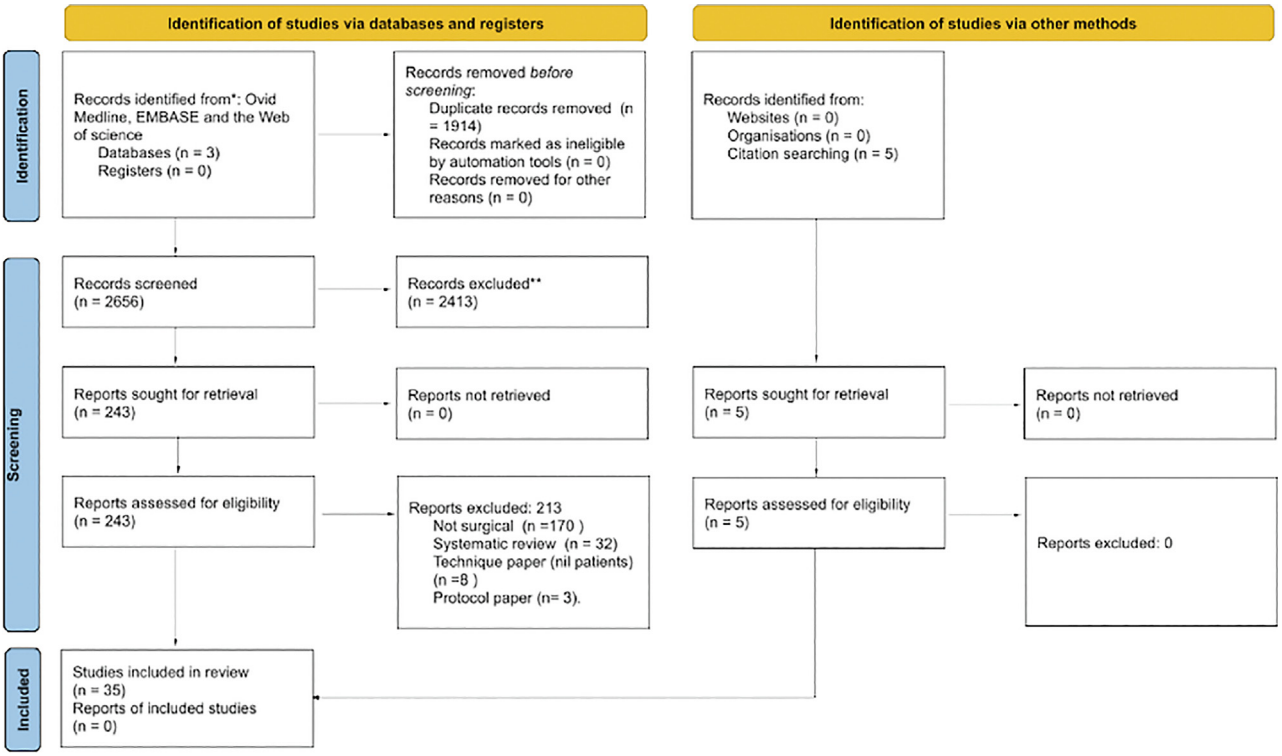

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-analyses for Scoping Reviews guided flow diagram of study selection for inclusion in this scoping review.

surgical management, namely the characteristics of the studies included and where potential areas of improvement in research can be identified.

Methods

A scoping review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses for Scoping Reviews model.[45] The primary questions addressed were:

- How long is conservative management being trialled before surgery is offered to patients?
- What surgical options are being utilized for lateral epicondylitis?
- Which study designs have been published on this topic?
- Which outcomes are being investigated, and how are these being calculated?

Eligibility criteria

Published reports were deemed eligible if they investigated adult patients undergoing surgery for treatment of lateral epicondylitis. This included all open, arthroscopic, and percutaneous procedures. We excluded studies published in languages other than English, with no full-text, abstracts, case reports, thesis, and preprints. Systematic reviews and protocol papers were also excluded. We included the report with the longest follow-up time in the case of multiple publications of the same dataset.

Bibliographic search and screening

The electronic search was conducted using Ovid Medline via PubMed, EMBASE, and the Web of Science from inception until August 2023. Two authors (DM and HB) searched the literature using the terms 'tennis elbow' OR 'lateral epicondylitis' AND 'outcome' OR 'outcomes' AND 'management'. References from related papers were also screened and included if they were deemed to have fulfilled the inclusion criteria. Retrieved records were screened in two stages: title and abstract screening, followed by full texts screening of potentially eligible records. Two authors (DM and HB) conducted the screening process, and any discrepancies in study selection were resolved by consensus or a third author (RM). The study selection process can be visualized in Figure 1.

Data extraction

Data extraction was performed independently by two authors (DM and HB). Variables extracted included the study's first author, country of publication, year of publication, study design, patient number, management investigated (open, arthroscopic or percutaneous), and overall findings. If there were any discrepancies, these were first discussed, and if required, a third author (RM) was consulted. Due to this manuscript being a scoping review to gain an overall understanding of surgical options for lateral epicondylitis, risk of bias and quality assessment analysis were not performed. Studies were not grouped for evidence synthesis because heterogeneity hinders the quantitative pooling of the study's outcomes.

Results

The initial search resulted in 2656 citations (after duplicates were removed). After initial title screening, 243 full-text articles were reviewed by two authors (DM and HB), resulting in 35 studies being included in the final review (Fig. 1).

The most common reason for study exclusion was that the study did not investigate surgery in lateral epicondylitis (n = 170, 70%), followed by studies not analyzing individual patients (n = 43, 18%).

Table I
Demographics of included studies.

Author	Country	Year	Study design	Patient number (elbows)
Clark[7]	Canada	2018	RCT	75
Monto[30]	USA	2014	RCT	60
Meknas[28]	Norway	2008	RCT	48
Chandran[5]	India	2021	RCT	30
Kroslak[21]	Australia	2018	RCT	26
Watts[47]	UK	2020	RCT	52
Dunkow[11]	England	2004	RCT	45 (47)
Kiezer[18]	Netherlands	2002	RCT	40
Khashaba[19]	Wales	2001	RCT	18 (23)
Leppilahti[23]	Finland	2001	RCT	28
Radwan[32]	Egypt	2008	RCT	56
Goyal[14]	India	2022	non-RCT	50
Bigorre[4]	France	2011	Retrospective cohort	28 (30)
Coleman[8]	New Zealand	2010	Retrospective cohort	158 (171)
Koh[20]	Singapore	2013	Retrospective cohort	20
Kaleli[16]	Belgium	2004	Retrospective cohort	26
Longacre[24]	USA	2000	Retrospective cohort	42 (44)
Dunn[12]	USA	2008	Retrospective cohort	130 (139)
Thornton[43]	USA	2005	Retrospective cohort	20 (22)
Cummins[9]	USA	2006	Prospective cohort	18
Wahegaonkar[46]	India	2019	Retrospective cohort	14
Shim[37]	Korea	2018	Retrospective cohort	15
Soeur[40]	France	2016	Retrospective cohort	35
Choudhury[6]	India	2023	Retrospective cohort	47
Paksoy[31]	Turkey	2021	Retrospective cohort	38
Stiefel[41]	USA	2014	Retrospective cohort	198
Lukjanov[26]	Finland	2020	Retrospective cohort	5 (6)
Glanzmann[13]	Switzerland	2019	Retrospective cohort/technique	20
Maaty[27]	Egypt	2018	Retrospective cohort	25
Thurston[44]	New Zealand	1998	Retrospective cohort	169 (78 surgery)
Sawyer[34]	USA	2011	Retrospective cohort	14
Latterman[22]	USA	2010	retrospective cohort	36
Amrodi[1]	Iran	2016	retrospective cohort	24
Babaqi[2]	Egypt	2014	retrospective cohort	31
Rocchi[33]	Italy	2019	Retrospective cohort	14

RCT, randomised controlled trial.

Study design and characteristics

Thirty-five articles were included in this review for analysis, with their characteristics being presented in Table I. Furthermore, the surgeries have been detailed in Table II as well as their variables assessed and outcomes. Twelve of these were clinical trials (11 randomized,[5,7,8,11,18,19,21,23,28,30,32,47] one nonrandomised,[14] with the remaining studies being cohort (one prospective[9] and 22 retrospective [1,2,4,6,9,11-15,18-22,24,26,27,31-34,37,40,41,43-45,47]). Studies were published from 1998 to 2023, and almost all were based in developed countries. All studies were single-center, with no studies investigating patients from more than one center included. The total patient number was 1564 (1600 elbows), which included 457 (29%) male and 445 (28%) female patients, with the remaining 662 (43%) of patients' sex not reported. Seven studies (two cohorts[7,10] and five trials[14,19,21,32,47]) performed a sample size calculation and stated that their studies were adequately powered.

Thirty-four (97%) included studies diagnosed lateral epicondylitis with a clinical examination performed by an orthopedic surgeon as a minimum,[1,2,4,6-9,11-15,18-22,24,26-28,30-34,37,40,41,43,44,46,47] with 11 studies also obtaining preoperative imaging or confirmation (e.g., response to local anesthetic).[4,9,12-14,20,26,30,31,37,43] One study did not specify their method of diagnosing the condition.[5]

Nonoperative management

All included studies investigated patients who had undergone surgical intervention for lateral epicondylitis. Within this, all patients had been trialled on conservative management. In all studies, this was stated as a combination of simple analgesics, physiotherapy, and often steroid injections. The median time of minimum conservative management before surgery was six months (IQR 6 months), with two studies not commenting on this.

Surgical management

All studies investigated surgical management in treating lateral epicondylitis and the specific form of intervention is shown in Table I. Open surgery was performed purely in 19 studies,[1,4,5,8,9,12-14,19-21,23,26,32,33,37,43,45] of which the most commonly performed procedure was the ECRB release. Other studies commonly performed a variation on this technique. Six of these studies were clinical trials, comparing open surgical techniques in four, one to botox[18] and one to sham surgery.[21] Overall results suggest that surgery is beneficial in improving patient symptoms, including pain and function, as well as overall satisfaction. A trial that compared open surgery to sham surgery found no improvement in function when surgery was performed.[28]

One clinical trial investigated open surgery with either arthroscopic[7] or percutaneous surgery.[11] This found no difference in investigated outcomes, with the arthroscopic approach requiring a longer operating time.

Arthroscopic surgery alone was investigated in 11 studies[2,6,14,22,24,30,31,34,37,40,41,47] and investigated compared to platelet-rich plasma in one study.[47] In the pure arthroscopic studies, two trials were included, with one comparing differing methods of arthroscopic surgery[30] and one comparing conservative management.[14] Compared to conservative management, this trial

Table II
Surgery performed with overall findings.

Author	Management type	Overall findings
Clark[7]	Open versus arthroscopic débridement of the pathologic ECRB origin	No difference in VAS/DASH, arthroscopy longer op time
Monto[30]	Arthroscopy with ECRB débridement and decortication with combined elbow arthroscopy, ECRB débridement, anchor repair and decortication	Suture anchor repair resulted in improved short and long term outcomes
Meknas[28]	Extensor tendon release and repair, and microtenotomy	Microtenotomy offered quicker improvement in VAS and improved grip strength
Chandran[5]	Active release vs myofascial release	Myofascial release technique was slightly more effective in improving grip strength, reducing pain, & disability when compared to active release technique
Kroslak[21]	Open release vs sham surgery	No benefits from surgery
Watts[47]	Arthroscopic release vs PRP	L-PRP and surgery produce equivalent functional outcome but surgery may result in lower pain scores at 12 months
Dunkow[11]	Open (Nirschl) release vs percutaneous tenotomy.	Perc. patients return to work earlier than open, improved sporting activites and DASH score
Kiezer[18]	Botox vs Hohmann open operative	No differences at 2 years.
Khashaba[19]	Nirschl, with/without drilling	Drilling offers no benefit but causes more stiffness
Leppilahti[23]	Decompression of PIN vs lengthening of ECRB	Nil benefit between the two, success in 60% of all patients
Radwan[32]	Perc tenotomy vs shock therapy	Similar benefits
Goyal[14]	Arthroscopic release vs conservative management	Improved pain at 6 moths in surgery. No difference in grip strength
Bigorre[4]	ECRB fasciotomy, deep branch radial nerve decompression	Surgery resulted in favourable improvement, with no difference if occupational disease or not
Coleman[8]	Modified Nirschl	Majority of patients described as satisfactory
Koh[20]	Fasciotomy and surgical tenotomy	Well tolerated in 19/20 patients
Kaleli[16]	Percutaneous release of common extensor	Good results in 25/26 for pain, satisfaction and function
Longacre[24]	Arthroscopic release of ECRB tendon	Surgery resulted in lower pain and earlier return to work
Dunn[12]	Mini-open Nirschl surgical technique	Mini-Open Nirschl surgical technique with accurate resection of the tendinosis tissue remains highly successful in the long term.
Thornton[43]	suture anchor repair of the extensor carpi radialis brevis to the lateral epicondyle	Improved VAS and DASH
Cummins[9]	arthroscopic débridement of the extensor tendon's common origin and open assessment of the arthroscopic procedure	Significant residual tendinopathy present. Symptoms worse in those patients
Wahegaonkar[46]	Novel technique of rhomboid excision over ECRB tendon	Improved VAS and Mayo
Shim[37]	Open débridement and LCL recon	Simultaneous surgical treatment including open débridement and ligament reconstruction provides satisfactory pain relief and functional improvement in patients with LE and LCL insufficiency.
Soeur[40]	Arthroscopic release	Surgery improved symptoms but was not related to duration of preoperative symptoms
Choudhury[6]	Arthroscopic release and lateral epicondyle decortication	Earlier return to work in surgery, otherwise nil differences
Paksoy[31]	arthroscopic lateral capsule resection with or without ECRB tendon débridement	No difference with/without débridement
Stiefel[41]	Arthroscopic bayonet technique	Effective but no specific numbers quoted
Lukjanov[26]	Free fat grafting	Improvement in VAS, small bump left on elbow
Glanzmann[13]	Knotless suture anchor repair	Improved in all symptoms and grp strength
Maaty[27]	Drilling humerus alongside PRP	Drilling improved symptoms compared to PRP injection alone
Thurston[44]	Open excision of common extensor origin	Surgery good outcomes, long lasting
Sawyer[34]	Arthroscopic combined medial and lateral epicondylar débridement	Safe technique with improved DASH scores
Latterman[22]	Arthroscopic release ECRB	Arthroscopic release of the ECRB is a viable option for recalcitrant lateral epicondylitis.
Amrodi[1]	Minimal incision technique	High patient satisfaction, low complication
Babaqi[2]	Arthroscopic resection of a capsular fringe complex was done beside débridement of the undersurface of Extensor Carpi Radialis Brevis	Marked improvement in function
Rocchi[33]	Semicircumfrential and partial detachment of the entire extensor apparatus enthesis.	Improvement in VAS and DASH

DASH, disabilities of the arm, shoulder and hand; *ECRB*, extensor carpi radialis brevis; *L-PRP*, leucocyte and platlet-rich plasma; *LCL*, lateral collateral ligament; *LE*, lateral epicondylitis; *PIN*, posterior interosseus nerve; *VAS*, visual analogue scale; *PRP*, platlet-rich plasma.

found similar outcomes between the two methods; however, arthroscopic surgery resulted in lower pain at six months. When compared to PRP, surgery was found to have similar functional outcomes but reduced postoperative pain. When reviewing all arthroscopic papers, there were primarily beneficial outcomes regarding pain and function in surgically treated patients.

The remaining studies investigated percutaneous tenotomy. One study investigated this method compared to shock therapy, finding similar benefits.[32] A further study looked at open surgery comparison and found that percutaneous patients return to work earlier and have improved function than the open equivalent.[11] The last study found significant improvement in patients whose extensor origin was released percutaneously.[15]

Outcomes

All included studies investigated a variety of pain and function. Pain was assessed in 32/35 (91%) of papers. The most common measuring tool for pain was the visual analog scale (VAS) used in 22 studies (69%). Other methods of assessing pain were the Grundberg and Dobson scale (two studies), and differing methods of measuring pain were used in the remaining eight studies. Function was measured in 32/35 studies (91%). The two most commonly used methods of measuring this were the disabilities of the arm, shoulder and hand (DASH) questionnaire and the Mayo classification. DASH was used in 13 (40%) studies, and Mayo was used in eight studies (25%). Various measures were used in the remaining 14 studies (44%).

Discussion

This scoping review provides the most up-to-date review of the surgical management of lateral epicondylitis. Compared to a previous review on surgical management in clinical trials only,[3] we have included an additional 1000 patients from published studies, allowing for further understanding of surgery in lateral epicondylitis as well as characteristics of these studies. All included studies investigated outcomes in adults (both male and female) who had undergone surgery after failing conservative management for lateral epicondylitis, with all studies investigating either pain, function or both outcomes. Due to this manuscript being a scoping review instead of a systematic review or meta-analysis, quality or risk of bias assessments were not performed.

There were roughly twice as many observational studies (all cohorts) than clinical trials. The most common study type within observational studies was the retrospective cohort, comprising 22/35 of all studies analyzed. This study type is quick and easy to conduct compared to prospective studies, thus allowing for higher case analysis. Still, it does have a risk of reporting bias as a surgeon may alter their technique/cases, including those who show preferential outcomes. Thus, given that the majority of studies investigating lateral epicondylitis surgery are retrospective, it is recommended that further studies are required to analyze cases prospectively.[42]

Twelve trials are included in this review. Five of these trials included sample size calculations and were deemed to have adequate powering. Where there is limited information on a research topic, authors must calculate this if they aim to contribute to understanding the topic.[35] One trial specifically looked at open surgery compared to sham surgery,[21] with a finding of no difference between the two groups. This highlights a main point of this review, in determining if there is any benefit in surgery in general for tennis elbow. As per the recent BESS guidelines,[38] it was stated that there is no strong evidence for the use of surgery compared to placebo in lateral epicondylitis management. However, in this review's findings, when surgery has been used there has been an overall improvement in symptoms, for example pain. Due to the lack of literature comparing surgery to nonoperative management, it is not possible to ascertain that the improvement in these patients would not be matched with conservative measures. Therefore from the literature reviewed, the role of surgery in this condition is not fully determined.

Despite other trials concluding no benefit in function from surgery, there was a repeated finding of improved pain at 6-month intervals in surgical intervention. This was found to be the case in all surgical techniques studies, including ECRB release, fasciotomies and débridement with no difference found in additional options such as drilling. Due to the low number of included patients, drawing strong conclusions from any included studies is challenging. Furthermore, for any conclusions to be drawn on one surgical technique compared to another is not possible with the lack of data allowing comprehensive analysis. Thus, there is a requirement for more extensive, more methodologically rigorous trials investigating surgery compared to placebo or conservative management. There is a lack of arthroscopic data within the literature, and therefore to draw conclusions on this method is not possible. Regarding future studies investigating this, the likely next-step will be that of prospectively collected and retrospectively analyzed data. This will add to the literature on the potential benefits of this surgical modality.

Seven more studies were included looking at purely open surgery compared to arthroscopic, likely due to arthroscopic surgery being relatively new compared to open surgery. Studies showed specifically improved VAS and DASH scores in arthroscopic surgery, however, did comment on the longer operative time of the minimally invasive technique. This in turn can increase morbidity and potential complications can result. However, this will likely change as the learning curve for arthroscopic surgery levels out, and it is more commonly taught to surgical trainees. Both open and arthroscopic techniques found improvement in patient outcomes for pain and function; however, when comparing studies at a narrative level there are no consistent differences between the two modalities. Most studies investigated ECRB release or a variation on this, with several studies publishing their technique and outcomes. For this review, we only included technique papers where patients could be analyzed, as this allowed an element of understanding of the potential benefits of the technique being investigated. As shown in Table II, there are several differing techniques, with no agreed method for the optimum surgical approach for lateral epicondylitis. This makes analysis of surgery challenging, as most studies are publishing their own particular techniques. Despite promising outcomes from the majority of these, due to the current uncertainty of surgery as a whole in lateral epicondylitis management, further research from multiple centers on one agreed operation would add to the argument in favor of surgery.

Furthermore, as all studies included are single-center, the evidence is weak in choosing the optimal surgery and whether there is a role at all for it. To counter this, there is a requirement for multicenter studies and surgeon collaboration. By centers linking data and operative techniques, there will be a stronger evidence base for particular operations alongside a higher included patient number. Published research of this caliber would aid in the production of guidelines for the potential benefit and role of surgery in epicondylitis.

When analyzing how a diagnosis of lateral epicondylitis is made, this review found that all studies were using a clinical diagnosis (often with the addition of radiology; however, this was not vital for a diagnosis itself). In addition, there was general agreement between studies that conservative management should be trialled for six months before surgery was offered to patients. In the UK, the most recent BESS guidelines have concluded that no imaging is required for a diagnosis (as most studies in this review are in keeping with), and that a referral to orthopedics should be made within 3-6 months of primary care treatment. This is also in keeping with most of the included studies in this review.[39]

Despite all studies investigating similar outcomes, there was a wide variety in the specific tools used to measure these. The VAS and DASH scoring methods are commonly used for pain and function; however, most studies are not using these. This can make study comparison challenging, especially when meta-analysis is attempted. Other surgical specialties have produced internationally accepted guidelines on complication definitions and have found that this reduces heterogeneity and allows for efficient study comparison.[25] A similar outcome could be achieved with lateral epicondylitis outcome measurement, as all studies using the same scales could allow for larger meta-analyses with potentially significant differences. Despite the variety in measurements, however, most of the included studies did report a benefit in measured outcomes postsurgery.

The main limitation of this review is the varying quality of studies included. Previous reviews analyzing randomised controlled trials on this topic did show a high risk of bias in studies they included, which are also included in this review. Furthermore, due to not calculating observational study quality, there is no possible way to filter out poor-quality studies from this paper. However, due to the purpose of this paper being a scoping review, this limitation is acceptable. Further limitations include not including grey literature or conference abstracts. Due to the limited

number of available studies on the subject with low patient numbers, this would possibly aid in identifying further gaps in the literature on this topic. Only studies written in English were analyzed as well, again reducing the volume of overall data included in this review. As mentioned previously, these limitations can be accepted in scoping reviews, as this study type aims to give an overall understanding rather than specific data comparisons and analysis.

Conclusion

The optimum management for lateral epicondylitis remains a controversial topic, with the role of any surgery still frequently debated. This scoping review has highlighted that despite several published studies investigating this, there remains a low patient number included across the board, with no multicenter studies being performed and varying study quality. With new UK guidelines stating that there is weak evidence on the role of surgery, it is recommended that further studies use collaboration between centers and validated outcome measures. This would allow for increased study synthesis and comparison.

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