British Society for Surgery of the Hand Evidence for Surgical Treatment (BEST)

Topic: *Evidence based management of adults with acute ulnar collateral ligament (UCL) of the thumb injuries*

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Sally Hopewell: Systematic review expertise

Neal Thurley: Research librarian and carried out literature searches

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Collaborating organisations

This guideline has been reviewed and endorsed by the Councils of the British Society of Skeletal Radiologists *(BSSR), the British Association of Hand Therapists (BAHT) and the Royal College of Emergency Medicine (RCEM).*

Conflicts of interest

There are no conflicts of interest of relevance for any of the GDG members or document authors.

Disclaimer

This document reflects a consensus view of the British Society for Surgery of the Hand Research Committee and Council, based on a systematic and transparent review of evidence. All users of this document must ensure that they consider the entirety of the document when using it, that the recommendations within this guideline are not mandatory, and that clinical judgement and that patient-centred decision making for all individual patients is the highest priority. Users are reminded of their individual duties and responsibilities, professional or otherwise, to use this guideline responsibly and that no content within this guideline overrides these duties and responsibilities.

Process

This document has been produced by systematic reviews, with the interpretation and development of recommendations achieved by consensus of the GDG members.

Overall Objective

The overall objective is to describe the management of adult patients with acute ulnar collateral ligament (UCL) injuries of the thumb metacarpophalangeal joint (MCPJ) in the United Kingdom.

Anticipated Users

The anticipated users are health care professionals treating patients with acute UCL injuries, those commissioning care for patients, and possibly patients and carers of patients with acute UCL injuries.

Target Population

Adults with acute UCL injuries of the thumb MCPJ.

Questions discussed in this BEST

1. How should patients with suspected UCL injuries be initially assessed, investigated and managed?
2. Which patients should be referred to specialist services and when should they be seen?
3. How should patients be further assessed and investigated by specialist services?
4. What treatments should be offered to which patients and when?
5. Which treatments are superior to other treatments?
6. Which treatments are more cost-effective than other treatments?
7. What outcomes can be expected from specific treatments?
8. What future quality improvement work and/or research might be beneficial in this area?

Questions not discussed in this BEST

1. Questions relating to non-acute (chronic) UCL injuries

Inclusion & exclusion criteria

Patients 18 years and older (adults) with acute injuries (3 or less weeks from injury) to the ulnar collateral of the thumb MCPJ were included. Paediatric UCL injuries were not considered as part of this systematic review.

Plain Language Summary

Sprains and tears of the thumb ligaments are a relatively common injury. The ulnar collateral ligament (UCL) is the ligament closest to the webspace of the thumb's metacarpophalangeal joint (MCPJ- this is the joint which makes up the largest 'knuckle' of the thumb). The UCL is frequently injured, resulting in pain and difficulty using the thumb, particularly when pinching. Patients with these injuries mostly go to Emergency Departments (EDs) and Minor Injuries Units (MIUs), and they are then often referred onto hospital services (secondary care) for further treatment. Patients may be treated with non-surgical treatments such as splints and plaster casts to keep the thumb MCPJ still, or with surgery to repair or reconstruct the ligament. We searched for all studies that assessed the diagnosis of UCL injuries and that assessed the treatment of UCL injuries. A group that included two patients, a radiologist, a commissioner, an emergency medicine doctor, hand therapists and surgeons then formally discussed the studies in order to agree upon recommendations of how to diagnose and treat UCL injuries.

The group's recommendations are that patients with acute UCL injuries should be assessed with a history, clinical examination, and x-rays. Patients without significant joint laxity can be treated non-surgically. Patients with significant joint laxity on clinical examination may be treated with non-surgical joint immobilisation or surgical repair and should reach a shared decision with their clinician about the definitive treatment within 2 weeks of presentation.

Introduction

Acute complete ruptures of the ulnar collateral ligament (UCL) of the thumb metacarpophalangeal joint (MCPJ) are common injuries, accounting for around 50 in 100,000 presentations to Emergency Departments (EDs)(1)*. These injuries frequently result in pain and dysfunction, which can be persistent in a minority of cases. More minor 'sprains' without joint instability on clinical examination are generally treated with early movement as pain allows, while there is more controversy as to how best to manage complete UCL ruptures which typically manifest with joint instability on clinical examination.*

Understanding the anatomy of the region and the variation in severity of the injury is of clinical importance. Clinical examination requires an appreciation of the pathophysiology of the adductor muscle aponeurosis, proper UCL, accessory UCL and palmar plate. The MCPJ is typically examined by applying a valgus force in extension and in a degree of MCPJ flexion to relax the palmar plate, the latter thought to be isolating the UCL proper. The clinical investigations for UCL injuries include simple x-rays, x-rays while applying a force to the MCPJ (stress x-rays), Ultrasound (USS) and Magnetic Resonance Imaging (MRI). The term 'Stener lesion' is used to describe when the ligament is completely torn and is retracted, allowing the adductor aponeurosis to become interposed between the torn ligament and its site of bony insertion. There is some controversy as regards the 'Stener lesion' relating to its true frequency, how best to diagnose its presence and how best to treat it.

Our aim was to perform two systematic reviews. The first 'diagnostic' review aimed to assess the strength of evidence relating to the diagnosis of acute UCL injuries. The second 'therapeutic' review aimed to assess the strength of evidence relating to non-surgical and surgical interventions for acute UCL injuries.

Methods

Both systematic reviews are carried out according to PRISMA guidance with a pre-registered protocol, searches carried out by the research librarian, and two reviewers performing the screening and data output.

Diagnostic:

The inclusion was any study relating to acute UCL injuries in adults (aged ≥18). Exclusion criteria included age <18 years, chronic injuries (presentation>3weeks from injury), injuries with a significant bony avulsion fragment, open injuries, and non-isolated UCL injuries. Review articles, studies not published as a full article (conference abstracts), studies not involving patients and case studies were also excluded. The intervention was patients undergoing any form of diagnostic test relating to acute suspected UCL injuries. This included any retrospective and prospective cohort/case control studies, and randomised controlled trials (all types of randomised trials were included). The initial search yielded 1579 articles. After screening by title, abstract and removing duplicate and non-English studies, 88 studies were selected for further full text assessment of eligibility by the authors. Following this, 24 studies were finally selected as being relevant to the research question (Appendix 1 – Figure 1). Six studies assessed clinical examination, 12 US, six MRI and two stress arthrography. One study assessed both ultrasound and MRI as index tests and another both clinical stress testing and ultrasound. The reference tests used were surgery, MRI and clinical follow-up. The study quality was assessed using the QUADAS-2 tool(2)*. Levels of evidence were grade from 1 to 4 based on The Oxford Centre for Evidence-based Medicine - Levels of Evidence.*

Therapeutic:

The inclusion was any study relating to acute UCL injuries in adults (aged ≥18). Exclusion criteria included age <18 years, chronic injuries (presentation>3weeks from injury), injuries with a significant bony avulsion fragment, open injuries, and non-isolated UCL injuries. Review articles, studies not published as a full article (conference abstracts), studies not involving patients and case studies were also excluded. The intervention was patients undergoing any form of therapeutic (surgical or non-surgical) intervention and the comparator was any therapeutic intervention

(including, but not be restricted to, e.g. active monitoring, usual care, non-surgical interventions such as early mobilisation or splinting or cast treatment, surgical interventions or similar). The study design had to include an intervention and a comparator. This included any retrospective and prospective cohort/case control studies, and randomised controlled trials (all types of randomised trials were included). A total of 1161 records were identified through database searching (Appendix 1 – Figure 2). After removal of duplicate entries, 761 titles and abstracts were screened, 11 full articles were assessed and six met the inclusion criteria. Shortlisted studies were assessed using SIGN50 methodology.

Systematic review results

Diagnostic

Clinical examination:

Of the six studies which reviewed clinical examination techniques, two were of level 2 evidence and four of level 3 (Appendix 2 -Table 1)(3–8)*. The level 2 studies tested cohorts of 23 and 30 patients respectively and both stated a positive clinical diagnosis of a valgus deformity of > 35º on stress testing However, Heyman et al. tested patients under local anaesthetic block with the MCPJ in 30º flexion and palpated for a mass, and Mahajan et al. clinically assessed with the MCPJ in 30º flexion and extension whilst noting a fixed end-point with no mention of local anaesthesia*(6,8)*. Heyman et al. used surgery as the reference standard and documented displaced ligaments alone, with the results giving a sensitivity of 0.94 (95% CI 0.70 to 1.00) and specificity of 0.57 (95% CI 0.18 to 0.90). In comparison, Mahajan et al. used MRI as the reference standard and assessed both displaced and ruptured undisplaced ligaments. Their results gave a sensitivity of 0.92 (95% CI 0.64 to 1.00) and specificity of 0.41 (95% CI 0.18 to 0.67) for the detection of displaced ligaments, and a sensitivity of 0.91 (95% CI 0.71 to 0.99) and specificity of and 0.75 (95% CI 0.35 to 0.97) for ruptured undisplaced ligaments.*

The remaining four level 3 studies used differing criteria for a positive diagnosis of injury. These included the presence of a palpable 'tender tumor', valgus stress instability testing with no specified threshold angle or degree of thumb flexion, a laxity of >15º compared to the contralateral thumb and Cooper et al. compared examination either with or without local anaesthesia (3–5,9)*. Louis et al. compared two protocols of examination from having no specified angle of laxity for the first 20 patients to >35º with the thumb in full flexion for the later 20 patients. The reference standards also varied with one study using stress radiography alone, one using surgery only and two using a combination of surgery and clinical follow-up. Two studies were considered to have an unclear risk of bias and the remaining four a high risk of bias for the reference standard (Appendix 3). Further statistical analysis was not carried out due to the heterogeneity of studies in regards the differing examination techniques and inconsistent reference tests.*

Ultrasound:

The search identified 12 studies which assessed the use of ultrasound in the diagnosis of UCL injuries. Of these, two were level 1 studies, four level 2 studies and six level 3 studies (Appendix 2 -Table 2). The publication dates of the studies ranged from 1993 to 2018. Of the two level 1 studies, Shekarchi et al. compared the accuracy of diagnosing complete UCL rupture in 20 patients on ultrasound with a 12MHz probe with the findings confirmed on MRI, giving a sensitivity of 0.71 (95% CI 0.29 to 0.96) and specificity of 0.85 (95% CI 0.55 to 0.98)(10)*. In contrast, Susic et al. did not report the specifications of the ultrasound used to assess a completely torn and displaced UCL in 14 patients with clinical signs of injury and confirmed findings at surgical exploration*(11)*. This study gave figures reporting a sensitivity of 0.40 (95% CI 0.05 to 0.85), specificity of 0.78 (95% CI 0.40 to 0.97) and accuracy of 0.64 (95% CI 0.35 to 0.87) for a completely torn and displaced ligament.*

In the four level 2 studies, the ultrasound transducer frequency was not reported in one, 7.5 MHz in two and a range of 10 to 17 MHz in the other(12–14)*. All four studies compared findings using surgery as the reference standard although one of the Hergan et al. studies also reviewed the use of MRI. Chuter et al. tested the diagnosis of all complete ruptures, whereas the two studies by Hergan et al. and Melville et al. assessed the diagnosis of displaced ligaments. The six remaining trials of level 3 evidence used as their reference standards both surgery and clinical follow-up, meaning no comparable values for sensitivity or specificity could effectively be described* (5,15–19)*. Comparing the results of the four studies which assessed the effectiveness of ultrasound in diagnosing completely torn and displaced ligaments using surgery as the reference standard, gives a range of test sensitivity from 0.4 to 1.00, specificity from 0.78 to 1.00 and accuracy from 0.64 to 1.00 from a total of 96 participants.*

The studies were reviewed for their individual risk of bias and applicability. All were scored as having low concerns of applicability for the patient selection, index test, and all but one for reference test. However, 33% were considered to have a high risk of bias and 50% an unclear risk of bias for the reference standard. When flow and timing was considered, 42% of studies had a high risk of bias and 50% an unclear risk of bias (Appendix 3).

MRI:

Six trials were identified pertaining to the use of MRI (Appendix 2 -Table 3). Of these, one had an evidence level of 2 and the rest were level 3. The level 2 trial additionally considered the use of ultrasound and adopted surgery as the reference standard (13)*. All five of the level 3 trials compared both surgery and clinical follow-up as the reference standards. Only the level 2 trial provided sufficient data for a statistical test result, reporting a sensitivity of 1.00 (95% CI 0.54 to 1.00) and specificity of 1.00 (95% CI 0.72 to 1.00) for displaced and non-displaced tears in a sample of 17 patients.*

In the five level 3 trials a total of 83 patients underwent MRI and 14 MR arthrography (20–24)*. Of these, 49 (51%) were confirmed with surgery and the rest were treated conservatively with clinical follow-up. Out of all the studies there was one reported instance of confirmed incorrect diagnosis with MRI, whereby a UCL diagnosed as moderately displaced was found to have a partial tear at surgery*(24)*.*

When the risk of bias and applicability concerns are considered, none of the studies were found to have a low risk of bias for the reference test or flow and timing domains. This was either because the patient sample outcome was assessed with two distinct reference tests or the details of how the reference test was carried out and whether the assessors were blinded was not reported. Adequate detail was given for the conduct of MRI in 50% of the studies. However, there were problematic or unclear patient selection methods in five of the six studies (Appendix 3).

Therapeutic

The results are summarised in Tables 4, 5 and 6. The study by Sollerman et al compared a functional splint with plaster cast treatment in patients with complete UCL ruptures(25)*; patients were managed both surgically and non-surgically. The authors reported no difference in MCPJ range of movement (ROM), grip strength and sick leave taken; however, the data provided were insufficient for any further analysis, such as a forest plot. The RCT by Rocchi et al. compared the outcomes of operated patients treated with either a traditional standard thumb spica which immobilized the MCPJ or a new modified thumb spica which allowed early MCP motion*(26)*. At 12 months the new spica group had increased MCPJ ROM (standardized mean difference (SMD), −3.69; 95% confidence interval (CI), −2.46–−4.92, P<0.0001), a better Dreiser index (SMD, 1.65; 95%CI, 0.81–2.50; P=0.0001) and reduced pain VAS (SMD, 1.53; 95% CI, 0.70–2.35; P=0.0003). There was no statistically significant difference between groups in tip pinch strength at any time point. The RCT by Crowley et al. compared outcomes between patients treated with*

early active mobilization or plaster immobilization after being treated surgically with Mitek anchor repair(27)*. The outcome data was not provided, meaning that any further analysis was not possible. The retrospective comparative case series by Saetta et al. demonstrated a higher chance of an excellent functional result with suture repair versus steel wire, but this was not statistically significant (risk ratio, 1.19; 95% CI, 0.82–1.71); the other outcome data was incomplete and thus precluded further analysis*(28)*. The retrospective case series by Lane demonstrated no statistically significant difference in the chances of a full versus partial recovery in ROM of the MCPJ, of a full versus partial recovery in strength and of a full versus partial functional recovery*(29)*. The study by Katolik et al. did not provide adequate data with which to conduct any further analysis*(30)*.*

Rocchi et al. demonstrated no statistically significant difference in complication rate between treatment with the standard spica and the new spica (risk ratio, 1.5; 95% CI, 0.29–7.73); the complications consisted of three cases of temporary dysaesthesia and two cases of inflammatory scars. The complication rate was identical in both the early active mobilization and plaster cast groups in the study by Crowley et al. (Risk ratio: 1.0, 95% CI: 0.32, 3.10); all six complications in this study were that of scar tethering, with all resolving with ultrasound therapy and massage. The studies by Saetta et al. and Sollerman et al. did not make any mention of specific complications. Lane et al demonstrated no statistically significant difference in the complication rate between the older method of pull out suture plus K-wire fixation and the new method of suture repair (risk ratio, 3.57; 95% CI, 0.25–50.15); there was one complication with the traditional method (broken pull-out suture at 2 weeks) and one with the new method (re-rupture at 9 months) The study by Katolik et al demonstrated a higher complication rate with pull-out suture versus bone anchor repair, but this was not statistically significant (risk ratio, 4.00; 95% CI, 0.92–17.30); all the ten complications were soft-tissue-related (five were persistent wound erythema consistent with wound infection and five were paraesthesiae, which resolved over time).

Overall, all studies were deemed to be at a high risk of bias, particularly in terms of blinding of outcome assessment and selecting reporting. There is a lack of high quality prospective studies using reliable and valid patient reported outcome measures (PROMs). Only the study by Rocchi used a validated PROM, and none of the other studies used validated PROMS

Other studies (not included in the systematic review):

There are no randomised controlled trials in the English literature on other aspects of diagnosis or management which fit the inclusion criteria of this systematic review. However, there are some cohort studies which are worth mentioning:

Pichora et al(31)
This cohort study followed up 32 patients who had been investigated with stress radiography, arthrography and clinical examination. All patients were treated with a removable custom splint. In the 32 patients available for follow-up, mean relative instability improved from 17 degrees after injury to 2.3 degrees at follow up. Functional and subjective outcomes were good or satisfactory in more than 90% of patients, pinch strength recovered to 89% of the contralateral thumb at approximately 1 year following injury*. Outcomes for all patients with Stener lesions were satisfactory, although joint stability was less than in the whole group. The three failures involved persistent symptoms, that defied subsequent surgery and which were not related to joint instability.*

Landsman et al(32)
This cohort study assessed the outcomes in 39 patients with 40 UCL ruptures. All patients were assessed clinically and deemed to have significant laxity of the UCL. All patients were treated with splint immobilisation for a minimum of 8 weeks and six patients (15%) were treated with delayed surgery as a result of no firm endpoint on stressing the UCL. In the 34 patients who did not require delayed surgery there was a recovery of pinch strength to 92% of the contralateral thumb at beyond 1 year. Also 28 patients of 34 had no pain on daily activities, while the remaining 6 patients reported an occasional ache on strenuous activities.

Systematic review overview discussion:

Diagnostic

The six clinical assessment studies reported sensitivities between 0.91 and 0.94 and specificities between 0.41 and 0.75. Twelve ultrasound studies stated sensitivities between 0.4 and 1.0 and specificities between 0.78 and 1.0. From six MRI studies, one stated a sensitivity of 1.0 and specificity of 1.0. However, when the studies were assessed using the QUADAS-2 tool, most were determined to be of low to moderate quality with significant heterogeneity in design. Despite the term 'Stener lesion' being widely used, no study has demonstrated that it can be reliably diagnosed by any form of clinical examination or investigation. Overall, these results support the use of clinical examination given its high sensitivity for the detection of displaced ligaments; however the role of ultrasound and MRI remains unclear. In summary significant laxity on clinical examination is defined as any of the following: 1) No firm end point to stressing of the UCL in full extension or 30 degrees of flexion of the MCPJ; 2) >20 degrees more laxity than the contralateral thumb in full extension or 30 degrees of flexion of the MCPJ; 3) >30 degrees laxity in full extension of the MCPJ or 30 degrees of flexion of MCPJ.

Therapeutic

There is some low quality evidence which supports early mobilisation for surgically treated patients. The studies by Crowley et al and Rocchi et al have demonstrated some early functional benefits to early mobilisation after surgery. Therefore, there is sufficient evidence to support early mobilisation after surgery when it is felt to be safe to do so.

The natural history of complete ruptures is uncertain as the rate of failure of non-surgical treatment is highly variable. Pichora et al reported only 3 failures (7%) of non-surgical treatment in 42 patients, and all these failures were not associated with joint instability(31). *Landsman et al reported 6 failures (15%) out of 40 patients which were all associated with joint instability*(32). *While Milner et al reported a very low rate of failure for ruptures with less than 3mm displacement on MRI and a 90% failure rate for ruptures with >3mm displacement*(23).

There is a lack of evidence comparing surgery to non-surgical treatment, and no prospective study has compared surgery to non-surgical treatment. Non-surgical immobilisation can be either with a cast or a customised splint, however there is no evidence to demonstrate the superiority of a specific type of immobilisation.

There is also a high level of uncertainty relating to the outcomes for both non-surgical and surgical treatments due to the lack of high quality evidence. There is a lack of high quality prospective studies using reliable and valid patient reported outcome measures (PROMS). Of note only one of all the included therapeutic studies used a validated PROM.

Clinical practice recommendations:

*Based on the current available evidence, clinical examination is recommended to assess for significant laxity of the UCL (**low evidence**). There is insufficient evidence to mandate the routine use of ultrasound (USS) or magnetic resonance imaging (MRI).*

*Patients without significant joint laxity should be treated non-surgically. It is reasonable to offer early surgery or non-surgical immobilisation of the MCPJ to patients with significant joint laxity on clinical examination (**very low evidence**).*

Good practice points:

It is considered good practice that:

- *Patients are assessed by history, clinical examination and x-rays in two orthogonal planes. This initial clinical examination should be performed by an appropriately trained healthcare professional*
- *There is a local pathway for the management of suspected UCL injuries which involves specialist musculoskeletal (MSK) services and access to definitive surgical care when deemed necessary*
- *Patients with pain but preserved function AND no clinical evidence of significant joint laxity AND normal x-rays may be discharged with safety net advice*
- *Patients who do not meet the above criteria for early discharge should be referred on to specialist MSK services*
- *A shared decision about definitive management should be reached within 2 weeks of a patient's referral to specialist MSK services (the specialist MSK services should be capable of providing surgery when needed)*
- *Non-surgical immobilisation for patients with significant joint laxity should be with a rigid orthosis such as a cast or thermoplastic splint*

Clinical audit indicators:

It is considered that the following could be used as clinical audit indicators:

- *Suitable validated patient reported outcome measures (PROMs)*
- *Pinch strength*
- *Persistent joint instability*

Resource Implications:

It is believed that the clinical practice recommendations and good practice points align with existing NHS practice. Therefore, the resource implication of implementing this guideline is considered minimal.

Facilitators and barriers to implementation:

If clinical staff are not competent in assessing UCL injuries, then training may be required. Such training is not believed to be complex, expensive or onerous to deliver. No other significant barriers to implementation have been identified. It is suggested that using the quick reference as a standalone reference may be facilitator. For example, users may wish to make the quick reference guide could be made available in clinical areas.

Future research recommendations:

Areas for future research into the management of UCL injuries include:

- *High quality prospective cohort studies to better understand the natural history of UCL injuries*
- *High quality diagnostic studies to assess the reliability and validity of modern imaging techniques, as well as how these relate to clinical prognosis*

- *High quality RCTs to investigate the clinical and cost effectiveness of surgery versus non-surgical joint immobilization*
- *High quality RCTs to assess the clinical and cost effectiveness of different rehabilitation regimes after surgery*

(It should be noted that PROMs should be an integral part of any future research studies and that a diagnostic study could potentially be embedded within a future RCT)

Stakeholders invited to provide external review:

The British Orthopaedic Association

The British Association of Plastic, Reconstructive and Aesthetic Surgeons

The British Association of Hand Therapists

The Royal College of Emergency Medicine

The Royal College of Radiologists

Timeline of guideline:

Date topic identified:
Date GDG lead appointed:
Date draft supplied by GDG authors:
Date Internal review completed:
Dates of public consultation:
Date external review completed:
Date published:

Appendix 1: PRISMA flow charts for systematic review

Figure 1: Diagnostic review flow chart

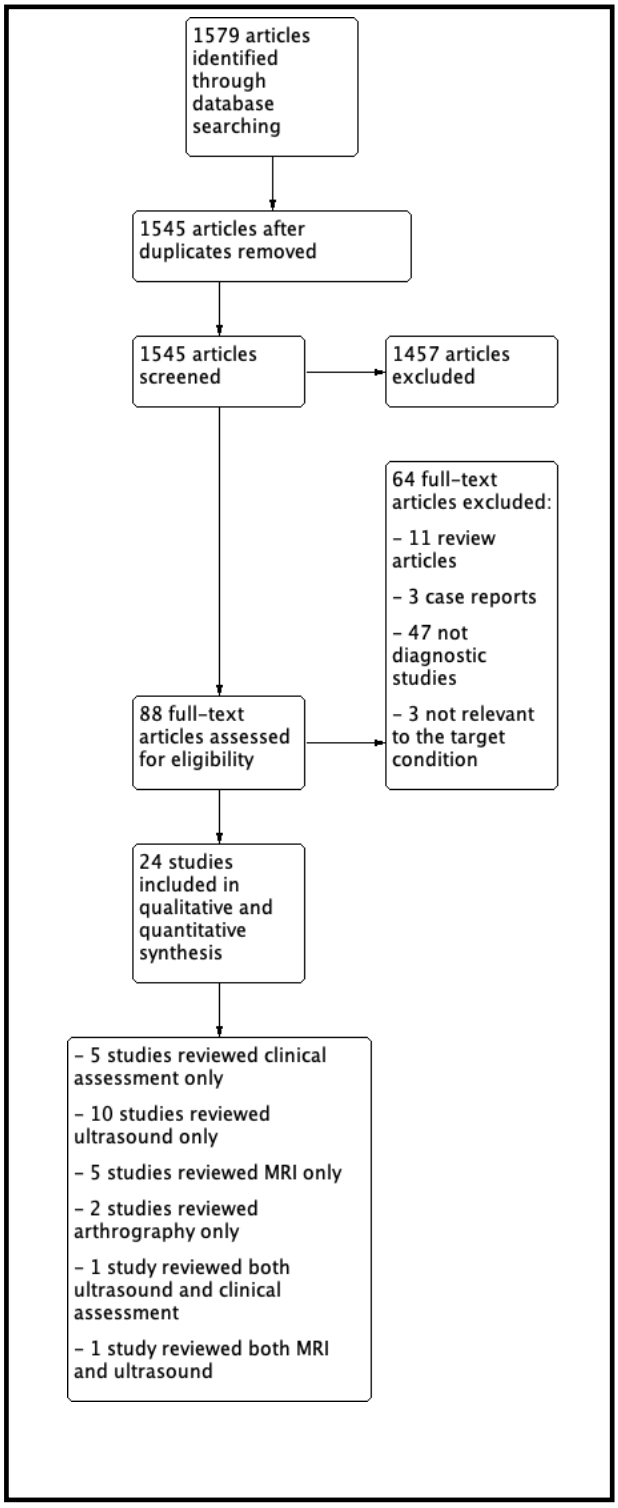
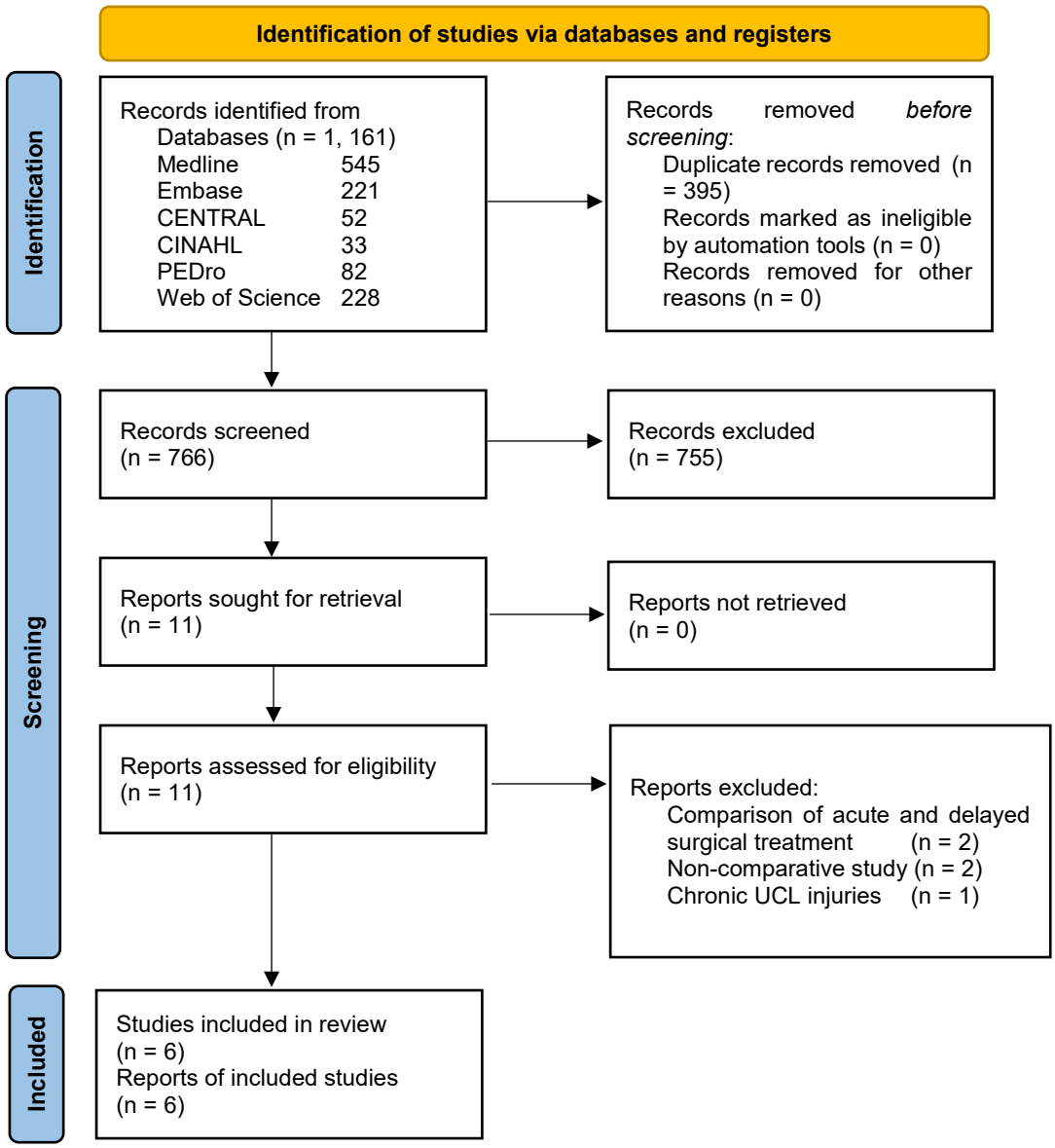


Figure 2: Therapeutic review flow chart



Appendix 2: Review tables including study characteristics and evidence

Table 1: Characteristics of included studies- Clinical Examination

Study (Year)	Country of Origin	Level of Evidence	Number of patients	Mean age (range)	Index Test(s)	Reference Test(s)	Outcome summary	Sensitivity	Specificity
Abrahamsson et al. (1990)	Sweden	3	24	27 (15-49)	'Palpable' lump at MCPJ	Surgery (8) / 1-year clinical stability (16)	7 of 8 patients with a lump had displaced UCL at surgery. 15 of 16 patients with no lump treated conservatively had a stable MCPJ.	n/a	n/a
Cooper et al. (2005)	UK	3	47	32.4 (14-73)	Clinical stress test under local anaesthetic (LA)	Stress radiography	39 patients had negative stress tests for both index and reference assessment. 7 had positive assessments for both. 1 patient had a negative test under LA but positive stress radiogram.	87.5% (laxity)	100% (laxity)
Heyman et al. (1993)	US	2	23	Not reported	Clinical stress test	Surgery	Valgus >35° in 30° flexion and full extension had a completely torn and displaced ligament in 15 of 17 patients.	94% (dislocation)	57% (dislocation)

Louis et al. (1986)	US	3	2 types of examination techniques: 20+20	22.5 (14-29)	Clinical stress tests at- 1. Extension and varying degrees of flexion 2. >35° laxity with MCPJ in full flexion	Surgery	Technique 1: of positive patients 20% of ligaments were displaced at surgery. Technique 2: of positive patients 70% of ligaments were displaced at surgery.	n/a	n/a
Mahajan et al. (2016)	Netherlands	2	30	Not reported	Clinical stress test	MRI	MCPJ valgus >35° in extension and >20° in 30° flexion and/or no fixed endpoint. - 15 patients had positive stress tests. 13 had complete UCL rupture and 9 completely torn and displaced on MRI. - 7 patients had no end-point. All had complete rupture with 3 completely torn/displaced on MRI. - 8 patients had 'inconclusive results'. 2 were ruptured, 1 completely torn and displaced, 3 partial tear, 3 intact.	91% (complete rupture) 92% (dislocation)	75% (complete rupture) 41% (dislocation)

Murphey et al. (1997)	US	3	25	Not reported	Clinical Stress Test / Stress Ultrasound	Surgery (14) / Clinical Follow-Up (11)	MCPJ valgus >30° +/- palpable 'Stener' lesion: - Identified 'correct grade' in 24 of 25 (96%) patients and UCL dislocations in 5 of 8 (62%) patients.	n/a	n/a

Table 2: Characteristics of included studies- Ultrasound Assessment

Study (Year)	Country of Origin	Level of Evidence	Number of patients	Mean age (range)	Index Test(s)	Reference Test(s)	Outcome summary	Sensitivity	Specificity
Chuter et al. (2009)	UK	2	79	40 (12-81)	Ultrasound	Surgery	127 patients had surgery, of which 79 had prior ultrasound. Of these, 1 was false positive diagnosis and 6 were false negative. PPV was 99%.	92% (complete rupture)	n/a
Hergen et al. (1995a)	Austria	2	39	37.2 (16-61)	Ultrasound	Surgery	36 of 39 patients had a correct preoperative diagnosis. 5 had no rupture, 15 complete rupture and 16 dislocation. Of the 3 misdiagnosed patients one was delayed, one had a technical error and the other had a misinterpretation of the image.	89% (dislocation) 88% (undisplaced rupture)	95% (dislocation) 94% (undisplaced rupture)
Hergen et al. (1995b)	Austria	2	17	37 (14-70)	Ultrasound / MRI	Surgery	Ultrasound correctly diagnosed 15 of 17 patients. Of these, 5 of 6 displaced tears and 10 of 11 undisplaced tears were confirmed at surgery.	83% (dislocation) 91% (undisplaced rupture)	91% (dislocation) 83% (undisplaced rupture)

Hoglund et al. (1995)	Sweden	3	64	35 (10-81)	Ultrasound	Surgery (39) / Clinical Follow-Up (25)	Ultrasound correctly diagnosed 32 of 39 patients who received surgery. Of these 13 of 17 undisplaced tears and 13 of 16 completely torn and displaced tears were confirmed at surgery.	n/a	n/a
Jones et al. (2000)	UK	3	60	34 (11-79)	Ultrasound	Surgery (19) / Clinical Follow-Up (41)	For complete UCL rupture, 17 were diagnosed clinically and 11 of these were confirmed with both US and surgery. 4 of these had a completely torn and displaced ligament confirmed with US and surgery. Of the other 6 diagnosed as intact on US, 3 had non-displaced ruptures at surgery.	n/a	n/a
Kohut et al. (1993)	Switzerland	3	21	27 (16-63)	Ultrasound	Surgery (7) / Clinical Follow-Up (14)	7 of 21 patients had surgery. Of these, the ultrasound findings of a completely torn and displaced ligament matched the surgical exploration in 4 patients. 2 patients had a false positive result, and 0 patients false negative.	n/a	n/a
Melville et al. (2013)	US	2	26	40 (19-75)	Ultrasound	Surgery	26 patients had 17 completely torn and displaced ligaments, 7 undisplaced ruptures and 2 partial-thickness tears at surgery.	100% (dislocation)	100% (dislocation)
Murphey et al. (1997)	US	3	25	Not reported	Clinical Stress Test / Stress Ultrasound	Surgery (14) / Clinical Follow-Up (11)	Ultrasound: - Identified 'correct grade' in 25 of 25 patients (100%) and UCL dislocations in 6 of 8 (75%) of patients.	n/a	n/a

Noszian et al. (1995a)	Austria	3	69	44.5 (14-75)	Ultrasound	Surgery (43) / Clinical Follow-Up (26)	37 of the 43 patients who had surgery had findings in agreement with those on ultrasound. Of these, 6 of 39 patients were incorrectly diagnosed as having displaced ligaments: 5 had intact ligaments and 1 a rupture 'in-situ'. /the remaining 4 patients had non-displaced ligaments correctly diagnosed.	n/a	n/a
Schnur et al. (2002)	US	3	16	(17-66)	Ultrasound	Surgery (10)/ Clinical Follow-Up (6)	10 patients had an ultrasound diagnosis of a complete rupture. Of these, 7 of 8 had this confirmed at surgery. 1 other patient was diagnosed with a complete rupture at repeat ultrasound but found to have an attenuated ligament at surgery needing repair. Another patient diagnosed with an intact UCL on ultrasound was found to have a giant cell tumour at surgery. 6 patients were treated conservatively.	n/a	n/a
Shekarci et al. (2018)	Iran	1	20	38.6 (16-64)	Ultrasound	MRI	7 patients had complete UCL rupture diagnosed on ultrasound of which 5 were confirmed with MRI. 13 patients were diagnosed with an intact UCL of which 11 were confirmed with MRI.	71.4% (complete rupture)	84.6% (complete rupture)
Susic et al. (1999)	Denmark	1	14	Not reported	Ultrasound	Surgery	All 14 patients had ruptured ligaments at surgery. Ultrasound correctly diagnosed 2 of 5 completely torn and displaced ligaments and 7 of 9 undisplaced ligaments. 2 patients diagnosed with displaced	40% (dislocation)	78% (dislocation)

							ligaments with ultrasound were found to be undisplaced.		

Table 3: Characteristics of included studies- MRI Assessment

Study (Year)	Country of Origin	Level of Evidence	Number of patients	Mean age (range)	Index Test(s)	Reference Test(s)	Outcome summary	Sensitivity	Specificity
Harper et al. (1996)	US	3	19	21.5 (21-46)	MRI / MR arthrography / stress radiography (SR)	Surgery (8) / Clinical Follow-Up (11)	5 patients underwent MRI of which 2 had a diagnosis of UCL dislocation confirmed at surgery. The remaining 3 had no signs of dislocation were treated successfully conservatively. 14 patients underwent both MRa and SR. 6 had diagnoses confirmed at surgery, 8 were treated successfully conservatively.	n/a	n/a
Hergen et al. (1995b)	Austria	2	17	37 (14-70)	Ultrasound / MRI	Surgery	MRI correctly diagnosed 11 undisplaced ruptures and 6 completely torn and displaced UCLs of which all were confirmed at surgery.	100% (undisplaced and completely torn/displaced ligaments)	100% (undisplaced and completely torn/displaced ligaments)

Hinke et al. (1994)	US	3	11	Not reported	MRI	Surgery (5) / Clinical Follow-Up (6)	All 11 patients were diagnosed with complete UCL rupture on MRI. Of these, 5 were confirmed at surgery. 6 were managed successfully with clinical follow-up. 2 of 3 UCL dislocations were correctly diagnosed on MRI prospectively.	n/a	n/a
Louis et al. (1989)	US	3	3	20 (19-21)	MRI	Surgery (2) / Clinical Follow-Up (1)	2 patients had completely torn/displaced UCLs diagnosed on MRI and confirmed at surgery. The last had a ligamentous strain diagnosed on MRI and was successfully manged conservatively.	n/a	n/a
Milner et al. (2015)	US	3	43	39 (16-69)	MRI	Surgery (24) / Clinical Follow-Up (19)	14 patients had a completely torn/displaced UCL diagnosed on MRI and treated successfully with surgery. 10 patients had a complete rupture with >3mm separation on MRI. These were initially treated conservatively but 9 required surgical repair. 1 of 5 patients with a complete rupture and <3mm separation required surgery.	n/a	n/a
Romano et al. (2003)	Canada	3	21	(14-62)	MRI	Surgery (10) / Clinical Follow-Up (11)	In the 10 patients who underwent surgery, 7 were correctly diagnosed by MRI as having a completely completely torn/displaced ligament and 2 a moderately displaced tear. The 1 misdiagnosed moderately displaced UCL had a partial tear at surgery.	n/a	n/a

							Of the 11 treated conservatively there were 2 partial tears, 4 minimally displaced tears, 1 completely torn/displaced tear, 1 moderately displaced tear and 3 non-displaced tears diagnosed on MRI.		

Table 4 Study characteristics

Author	Year	Journal	Setting	Type of study	Population	Intervention	Comparator	Primary outcome	Outcomes	Time points
Crowley et al.	2013	Techniques in Hand & Upper Extremity Surgery	Single centre, Department of Plastic Surgery	RCT	Acute complete UCL ruptures repaired with Mitek anchors	Early active mobilisation using a custom-made thermoplastic splint	Immobilisation in a plaster-of-Paris thumb spica for 4-weeks	None specified	Range of motion, return to normal hand function and work, complications	Weekly first 4 weeks,1, 3 and 6 months
Katolik et al.	2008	Plastic & Reconstructive Surgery	Single centre, Hand Centre	Retrospective cohort study	Acute complete UCL ruptures treated surgically	Intraosseous suture anchor and early mobilisation	Pull-out suture tied over a button and cast immobilisation	None specified	Range of motion, grip strength, pinch strength, patient satisfaction, complication	Endpoint only, mean 29 (range 14 to 45) months

Lane, L.B	1991	American Journal of Sports Medicine	Single centre Orthopaedic Surgery Department	Retrospective cohort study	Acute complete UCL ruptures treated surgically	Suture of UCL to tendinous insertion of the adductor pollicis - 'New' method.	Pull-out suture with K-wire fixation MCPJ - 'Traditional' method	None specified	Range of motion (full or partial, strength (full or partial), overall outcome (excellent, good or poor), stability, pain, ability to return to previous level of competition, complications	Endpoint only, mean 3.9 (range 2.0 to 8.5) years
Rocchi et al.	2014	European journal of physical & rehabilitation medicine	Single centre, Orthopaedic and Hand Surgery Department	RCT	Acute complete UCL ruptures treated surgically	Modified splint post-operatively, allowing flexion-extension of the MCPJ	Immobilisation in a hand-based thermoplastic spica splint post-operatively, that immobilised the MCPJ	None specified	Pain (VAS), Dreiser's functional hand index, range of motion, pinch strength, time off work, residual symptoms, incidence of recurrence, number of physiotherapy sessions, complications	1, 2, 6 and 12 months
Saetta et al.	1992	Journal of Hand Surgery -	Single centre, Accident	Retrospective cohort study	Acute complete UCL ruptures	Repair using pre-fashioned pull-out steel suture	Repair using non-absorbable suture	None specified	Pain (VAS), overall function (excellent, good,	Endpoint only, mean 19 (range 6 to 36) months

		British Volume	& Emergency Department		treated surgically				fair or poor), pinch, key and grasp grip strength, degrees of movement on radial stress of the MCPJ, sensation in the distribution of the superficial radial nerve to pin-prick and light touch.	
Sollerman et al.	1991	Acta Orthopaedica Scandinavica	Single centre, Hand Surgery Department	RCT	Acute UCL ruptures treated surgically or non surgically	Immobilisation in a functional splint that allows flexion and extension of the MCPJ but prevents ulnar and radial deviation of the thumb.	Plaster cast immobilisation.	None specified	Range of motion, stability, pinch grip strength, stability, length of sick leave	Endpoint only, mean 15 (range 11 to 41) months

MCPJ – Metacarpophalangeal joint. RCT – Randomised controlled trial. UCL – Ulnar collateral ligament. VAS – Visual analogue scale

Table 5 Details of study participants, demographics and eligibility criteria.

Author	Year	Inclusion criteria	Exclusion criteria	Number of participants	Mean age of participants	Sex of participants	Data comments
Crowley et al.	2013	All adult patients who underwent Mitek bone anchor repair for a ruptured UCL.	None specified	12	Median 42 (range 20 to 72) years	8 males 4 females	
Katolik et al.	2008	Complete rupture of the UCL, within 4 weeks of injury. Diagnosis established clinically by manual stress testing of the thumb metacarpophalangeal in 30º of flexion. Diagnosis was confirmed if there is absolute laxity of > 30º, or laxity of 10º greater than the contralateral side, without evidence of a firm endpoint.	Avulsion fractures that comprised more than 10% of the articular surface.	73	32 years	Not reported	
Lane, L.B	1991	Acute grade III UCL injuries in athletes, diagnosed as laxity in excess of 35° and/or 15 more than the contralateral thumb with the metacarpophalangeal joint in 30° of flexion.	None specified	32	30 (range 16 to 76) years	20 males 16 females	Characteristics not individually reported for the intervention groups.
Rocchi et al.	2014	Acute, within 0-7 days, complete tear of UCL of the thumb. Complete UCL tear diagnosed by clinical examination when there was no solid	Partial suspected tear of UCL. Cases with associated injuries of the skin, tendons, nerves, vessels or bony fractures.	30	39 (range 16 to 64) years	24 males 6 females	Characteristics not individually reported for the intervention groups

		endpoint at valgus stress, with more than 30º stressed radial deviation and more than 20º difference compared to the uninjured side.					
Saetta et al.	1992	Presence of a clinically unstable thumb MCPJ on radial stress following a recent injury.	None specified.	25	41.4 (range 18 to 60) years	Not reported	Characteristics not individually reported for the intervention groups
Sollerman et al.	1991	Acute rupture of UCL, thought to require surgical treatment following clinical and radiographic examination by experienced orthopaedic specialists.	None specified	62	32 (range 11 to 62) years	43 males, 19 females	Some characteristics were not individually reported for the intervention groups, such as age, length of follow-up and losses to follow-up.

UCL – Ulnar collateral ligament. Reported results are mean (range) unless otherwise indicated.

Table 6 Details of study outcomes, time points and a summary of results.

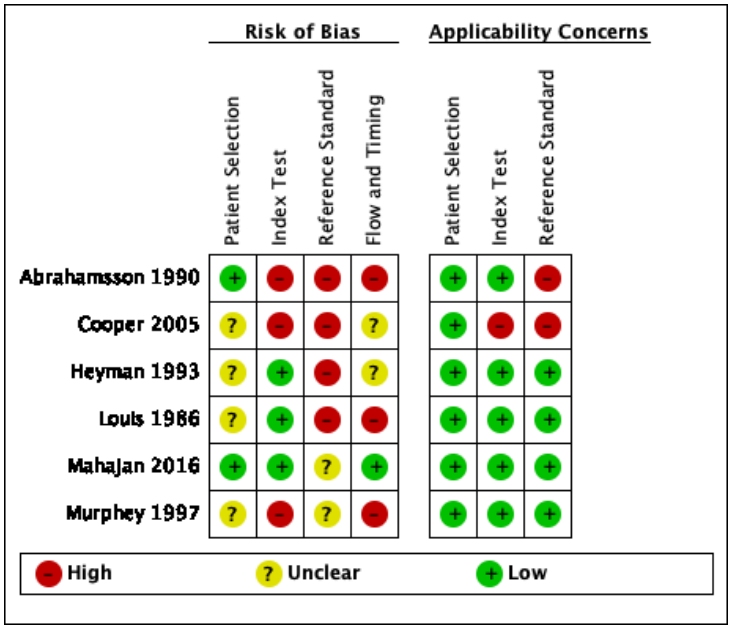
Author	Year	Outcomes (primary in bold if present)	Time points	Summary of results and adverse events
Lane, L.B	1991	Range of motion (full or partial, strength (full or partial), overall outcome (excellent, good or poor), stability, pain, ability to return to previous level of competition, complications	Endpoint only, mean 3.9 (range 2.0 to 8.5) years	Patients treated using the new surgical fixation method returned to sports sooner. There were no differences in pain, stability, range of motion and strength between the groups, though ROM was restored more rapidly in the 'new' fixation group. There were 2 complications, one re-rupture following a fall after 9 months and one incidence of broken pullout suture.
Crowley et al.	2013	Range of movement at MCPJ, time to return to normal function and work, complications.	Weekly, then 1, 3 and 6 months	No significant difference in the final range of motion achieved either at the IPJ of MCPJ in both groups but maximum ROM was achieved earlier by the early active mobilisation group. Three patients in each group suffered from scar tethering, which resolved with ultrasound therapy and massage in all cases.
Katolik et al.	2008	Range of motion at MCPJ and IPJ, grip strength, pinch strength, soft tissue complications, patient satisfaction.	Endpoint only, mean 29 (range 14 to 45) months	Improved range of motion, reduced tourniquet time (which was used as a proxy for surgical time and thus cost) and fewer soft tissue complications were noted in the anchor group. There were no differences in grip strength. The authors report savings of approximately $140-per-patient with the suture anchor technique.
Saetta et al.	1992	Pain (VAS), overall function (excellent, good, fair or poor), pinch, key and grasp grip strength, degrees of movement on radial stress of the MCPJ, sensation in the distribution of the superficial radial nerve to pin-prick and light touch.	Endpoint only, mean 19 (range 6 to 36) months	Outcomes were similar across the two groups, suggesting that both methods of repair are equally effective.
Rocchi et al.	2014	Pain (VAS), Dreiser's functional hand index, range of motion, pinch strength, time off work, residual symptoms, incidence of recurrence, number of physiotherapy sessions, complications.	1, 2, 6 and 12 months	Faster and better functional results were noted in the modified splint and immediate post-operative immobilisation group. There were three cases of temporary dysesthesia of the dorsal-ulnar region of the thumb in the modified splint group and two in the standard splint group, all resolved spontaneously. Two cases of inflammatory scar (one in each group) were noted which resolved with anti-inflammatories and skin massage.

Sollerman et al.	1991	Range of motion, stability, pinch grip strength, stability, length of sick leave	Endpoint only, mean 15 (range 11 to 41) months	There was no difference with regards stability, range of motion, strength of the injured thumb, and length of sick leave. However, the patients found the splint more comfortable than plaster cast immobilization.

MCPJ – Metacarpophalangeal joint. IPJ – Interphalangeal joint. VAS – Visual Analogue Scale. ROM – Range of motion.

Appendix 3: Quality assessments

Figure 3: Table and graph summary of methodological quality of clinical assessment trials



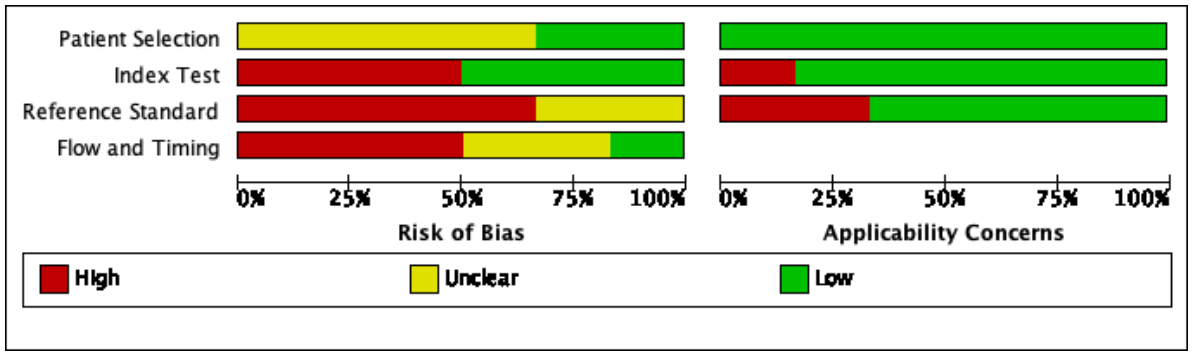


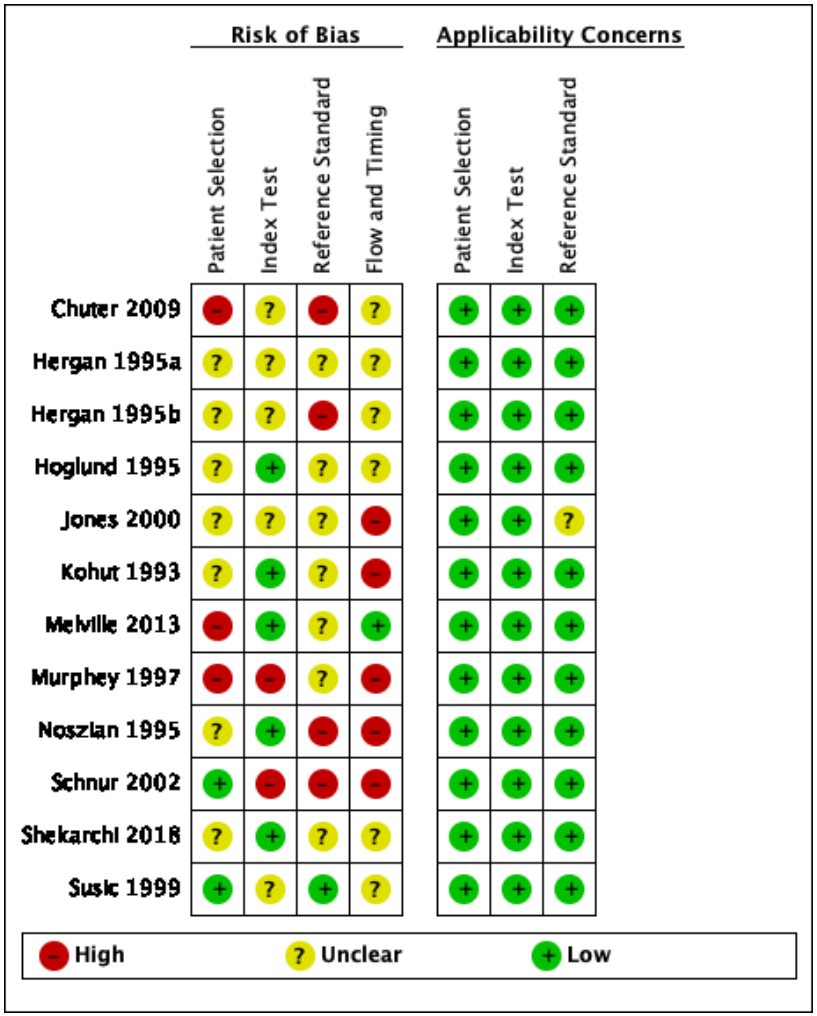
Table 7 - Consolidated summary of risk of bias in included studies using the Cochrane risk of bias tool for randomised controlled trials or the appropriate SIGN checklist

Study	Bias domain	Risk of bias	Overall assessment of risk of bias	Justification of risk
Randomised controlled trials				
Crowley et al., 2013	Randomisation Deviations from the intended interventions - effect of assignment to intervention) - effect of adhering to intervention) Missing outcome data Bias in measurement of the outcome Bias in selection of the reported result	Some concerns Low Low Low High Some concerns	High risk	The small sample size, inadequate randomisation method and limited description of outcome assessments limits the strength of their findings. In addition, no primary outcome measure was identified and there is no information regarding a prior sample size calculation to estimate the number of participants required in order to reach meaningful conclusions.
Rocchi et al., 2014	Randomisation Deviations from the intended interventions - effect of assignment to intervention) - effect of adhering to intervention) Missing outcome data Bias in measurement of the outcome Bias in selection of the reported result	Low Some concerns Low Low Low Some concerns	Some concerns	A variety of outcomes were measured, with no one specified primary outcome measure. Though the two groups were equal in size, group characteristics are not reported and parameters such as age, gender and hand dominance are not reported separately each group.

Sollerman et al., 1991	Randomisation Deviations from the intended interventions - effect of assignment to intervention) - effect of adhering to intervention) Missing outcome data Bias in measurement of the outcome Bias in selection of the reported result	Low High High Low High Some concerns	High	The method of randomisation is not clearly described. There was variable follow-up with outcomes assessed at differing time points. No information is provided regarding the validity or reliability of the method used for assessing comfort in performing functional tasks. Little detail is provided regarding the standardisation of outcome assessments, blinding of assessors or participants, statistical analyses or a prior sample size calculations to inform number of participants required to detect statistical or clinically significant changes.
Retrospective studies				
Katolik et al., 2008	Selection Confounding Performance bias Attrition bias/missing data Detection bias Statistical analysis	Low Low Low High Low Low	Acceptable (Some concerns)	A sound methodology was applied, and the authors attempted to address the potential impact of confounding. However, it is limited by the sample size, retrospective nature and limited reporting of results, measures of uncertainty, data distribution and details about between-group characteristics.
Lane, L.B, 1991	Selection Confounding Performance bias Attrition bias/missing data Detection bias Statistical analysis	No information High No information No information No information No information	Low quality (high risk of bias)	There were differential numbers of participants per group, with only seven in the traditional repair group. Follow-up was variable between the groups, which may have an impact on outcomes, as they were assessed at differing times post intervention. There is no information provided about characteristics of the two groups, and therefore it is not possible to compare the groups.

Saetta et al., 1992	Selection Confounding Performance bias Attrition bias/missing data Detection bias Statistical analysis	No information No information No information High High No information	Low quality (high risk of bias)	Inadequate information is provided about how confounding has been addressed or acknowledged. No information is provided about patient characteristics or between group differences. Though outcome assessment was consistent across the groups, they were performed at differing timepoints both within individuals and across groups.

Figure 4: Table and graph summary of methodological quality of ultrasound assessment trials



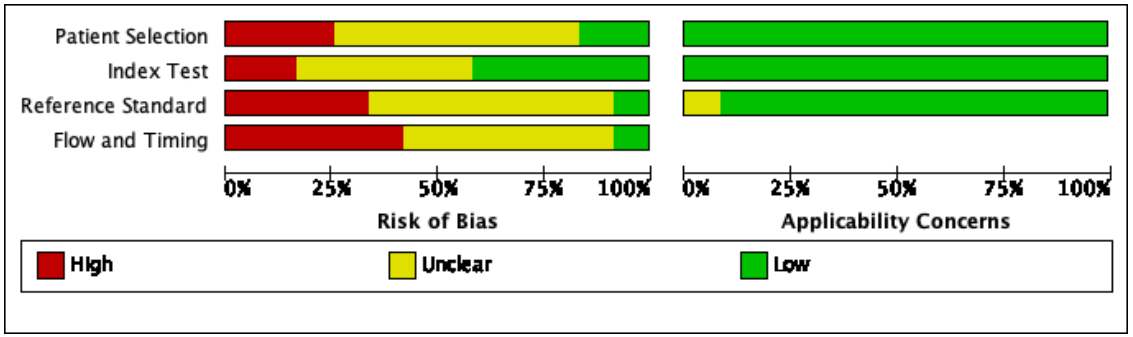
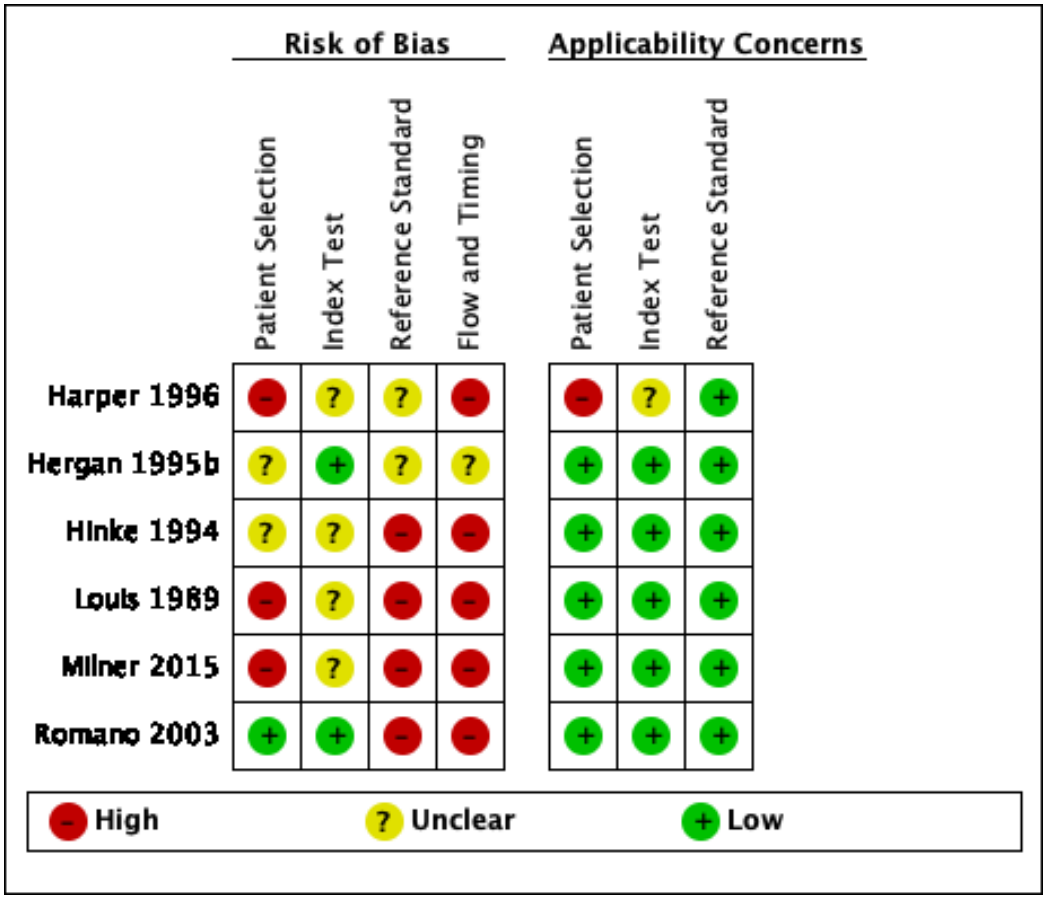
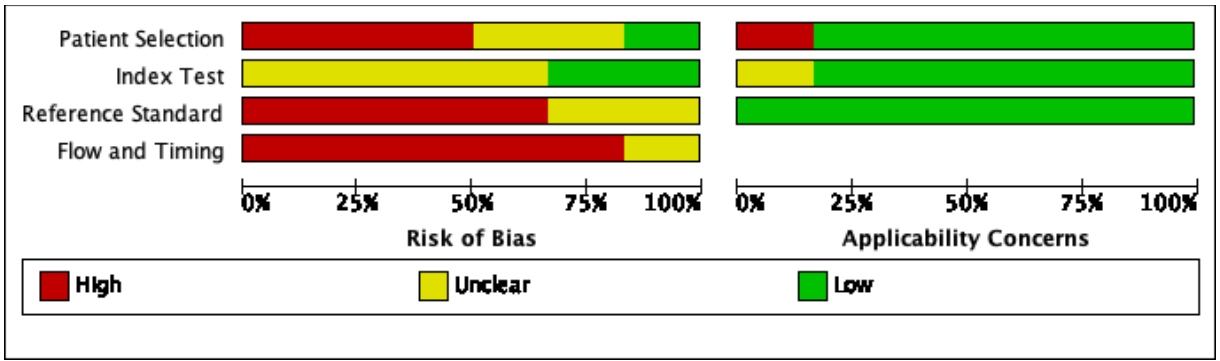

Patient Selection
Index Test
Reference Standard
Flow and Timing
0%
25%
50%
75%
100%
Risk of Bias
Applicability Concerns
High
Unclear
Low

Figure 5: Table and graph summary of methodological quality of MRI assessment trials

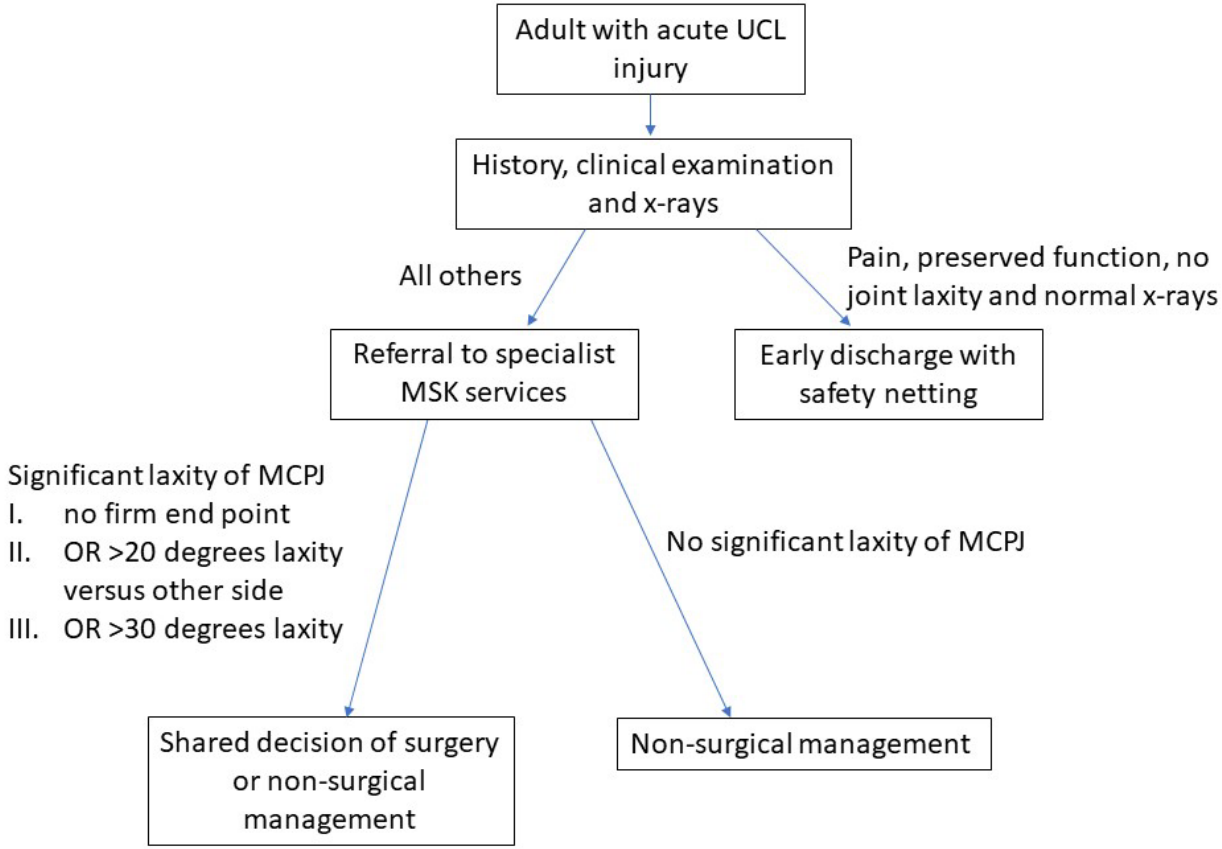




Appendix 4: Key clinical practice recommendations

1. *Clinical examination is recommended to assess for significant laxity of the UCL (**low evidence**).*
2. *X-rays in orthogonal planes should be obtained to check for fractures and joint subluxation.*
3. *There is insufficient evidence to mandate the routine use of ultrasound (USS) or magnetic resonance imaging (MRI).*
4. *Patients without significant joint laxity should be treated non-surgically.*
5. *It is reasonable to offer early surgery or non-surgical immobilisation of the MCPJ to patients with significant joint laxity on clinical examination (**very low evidence**).*

Appendix 5: Patient flow algorithm



Appendix 6: Support Tool: Quick reference guide

BSSH Evidence for Surgical Treatment (BEST): Evidence based management of acute ulnar collateral ligament of the thumb injuries

Key clinical practice recommendations:

1. *Clinical examination is recommended to assess for significant laxity of the UCL (**low evidence**)*
2. *X-rays in orthogonal planes should be obtained to check for fractures and joint subluxation.*
3. *There is insufficient evidence to mandate the routine use of ultrasound (USS) or magnetic resonance imaging (MRI)*
4. *Patients without significant joint laxity should be treated non-surgically*
5. *It is reasonable to offer early surgery or non-surgical immobilisation of the MCPJ to patients with significant joint laxity on clinical examination (**very low evidence**)*

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