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

Topic: Evidence-based Management of Thumb Base Osteoarthritis

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Contents

Authors 4
Guideline Development Group 4
Acknowledgements 4
Funding sources used 5
Collaborating organisations 5
Conflicts of interest 5
Disclaimer 5
Process 5
Overall aim 6
Anticipated users 6
Target population 6
Questions discussed in this BEST 6
Questions not discussed in this BEST 6
Inclusion and exclusion criteria 6
Plain language summary 7
Introduction 9
Methods 10
Database search results 12
Systematic review results 12
Systematic review discussion 24
Clinical practice recommendations 30
Good practice points 31
Clinical audit indicators 34
Resource implications 34
Facilitators and barriers to implementation 35
Future research recommendations 35
Stakeholders invited to provide external review 36
Timeline of guideline 36
Appendix 1: PRISMA flow chart for systematic review 37
Appendix 2: Evidence summary tables and Characteristics of included studies 38

Appendix 3: Key clinical practice recommendations 91
Appendix 4: Patient flow algorithm 92
Appendix 5: Support Tool: quick reference guide 93
Appendix 6: Quality of evidence assessment of included studies (Risk of bias tables).....94
Appendix 7: Included study references.....99
Appendix 8: Excluded study references 104
Appendix 9: Reference List 116

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Conflicts of interest

Victoria Jansen was a principal investigator for the OTTER II study (Adams 2020) at Derby, and corresponding author for the Davenport study; both of which are included in this review. There are no other 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 consider the entire document when using it, that the recommendations within this guideline are not mandatory, and that clinical judgement and that patient-centered 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 aim

The overall aim is to provide an overview of the best evidence for non-surgical and surgical management of adult patients with thumb base osteoarthritis in the United Kingdom and to suggest a pathway for the management of this condition.

Thumb base osteoarthritis (TBOA), as used in these guidelines, refers to trapeziometacarpal (first carpometacarpal) osteoarthritis (OA), with or without concomitant scaphotrapeziotrapezoid (STT) osteoarthritis, unless specifically stated otherwise.

Anticipated users

The anticipated users are health care professionals treating patients with thumb base osteoarthritis, those commissioning care for patients with thumb base osteoarthritis, and possibly patients and carers of patients with thumb base osteoarthritis.

Target population

Adults with a diagnosis of thumb base osteoarthritis.

Questions discussed in this BEST

What is the effectiveness of commonly used non-surgical and surgical treatments for thumb base osteoarthritis?

This broad question is sub-divided into three sections to discuss the current evidence:

1. Are non-invasive treatments, such as education, exercise, and splints, effective in treating TBOA?
2. Are steroid injections effective in treating TBOA?
3. Are surgical treatments effective for TBOA?

Questions not discussed in this BEST

Other pharmacological treatment options such as oral, topical or transdermal medications. These are included in the NICE guideline [NG226] Published: 19 October 2022. https://www.nice.org.uk/guidance/ng226/chapter/Recommendations - Section 1.4

Inclusion and exclusion criteria

Adult population (18 years of age and above) with pain and/or limitation of function because of osteoarthritis affecting the base of the thumb. Both sexes, all ethnic backgrounds included.

Rheumatoid or other forms of inflammatory arthritis and post-traumatic arthritis were excluded.

Plain language summary

Thumb base osteoarthritis (TBOA) is a common condition that causes pain in the joint at the base of thumb. The pain (increases with use of the thumb, especially for activities such as gripping and pinching, thereby limiting function. Symptoms can vary from occasional pain with heavier use to constant pain that affects activities of daily living. Diagnosis is confirmed by an experienced healthcare practitioner, mainly through clinical examination, sometimes supported by an x-ray.

Non-surgical treatment consists of learning about the condition, changing the way certain painful activities are performed, doing specific exercises and other measures to provide pain relief. A splint is sometimes prescribed to improve pain and function.

Injection of a steroid drug into the joint at the base of the thumb can be effective in providing short term relief of pain and improvement in function.

Surgery can be offered to treat patients with thumb base osteoarthritis. The most performed operation involves removing a small bone (trapezium) at the base of the thumb. This operation is called a trapeziectomy. Simply removing the affected bone is known to improve pain and function but it can also be combined with other additional procedures to support the base of the thumb following removal of the affected bone. These include creation of a new ligament or a sling to support the bone at the base of the thumb or inserting natural or artificial material into the space left behind by the removed bone. Other operations such as stiffening the joint to prevent movement (joint fusion) or replacing the worn out joint with an artificial joint (joint replacement) are alternatives.

We formed a group involving surgeons and hand therapists to look at studies comparing the different treatment options for thumb base osteoarthritis. We formally discussed the studies at length to come up with recommendations for treating thumb base osteoarthritis and discussed these recommendations further with GP and patient representatives before finalising the guidance.

The group recommends that the treatment of thumb base osteoarthritis should follow a step-wise approach, starting with simple treatments, with low risk of harm, before progressing to more complex invasive treatments, if pain and dysfunction continues.

We suggest that all patients with a diagnosis of thumb base osteoarthritis should be offered non-surgical treatment to start with. Non-surgical treatment consists of supported self-management, with the aim of guiding and eventually enabling patients to manage their thumb base osteoarthritis by themselves. All patients should be sign-posted to high quality sources of information at the outset with a view to enabling them to manage their own condition. Some

patients will need additional support from trained healthcare professionals to successfully adopt these measures.

Splints may be considered in some patients who have not responded to supported self-management alone but we do not recommend that splints are used on their own as a treatment for thumb base osteoarthritis, without the other aspects of self-management described above.

The group suggests that it is reasonable to offer steroid injections in those patients where self-management, with or without additional use of splints, fails to provide sufficient improvements in pain and function.

When non-surgical treatment fails to provide adequate benefit, removal of the bone at the base of the thumb (trapeziectomy) can be performed with the expectation of good to excellent results in most patients suffering from this condition. Recently, replacement of the joint at the base of the thumb is showing promising results and but more research is needed and is underway to compare this with trapeziectomy.

Introduction

Thumb base osteoarthritis (TBOA) is a common problem.(1). The prevalence of radiographic OA (osteoarthritis) increases with age but clinical experience suggest that symptoms do not always correlate well with radiological severity (2). Symptoms of TBOA include pain at the base of the thumb, stiffness and reduced movement, weakness of pinch and grip and instability that can vary in severity and duration. Function is affected variably in different individuals and can range from constant pain and disability to an occasional inconvenience with certain activities. Activities involving repetitive or strong gripping or pinching actions tend to worsen symptoms of TBOA.

Irrespective of radiological findings (3), treatment is based on symptom severity. It is universally agreed by healthcare professionals that the initial management of TBOA should be non-surgical. The aim of treatment is to reduce pain and improve function.

Non-surgical treatment centers on understanding the cause of pain and building strategies to minimise it. This involves use of patient education, activity modification, hand exercises, oral and topical analgesia, heat, ice, and splints. If these measures fail to improve the symptoms, injection of a therapeutic substance (commonly corticosteroid) into the joint space may provide pain relief and improve function. Despite these non-surgical measures, if symptoms remain disabling, surgery is considered.

Trapeziectomy, the first surgical treatment for TBOA, was described more than 70 years ago and although many other procedures have been proposed, trapeziectomy is still commonly performed (4). There have been concerns that excision would result in proximal migration of the metacarpal with resultant loss of length of the thumb and weakness and eventually abutment on the scaphoid and secondary scapho-metacarpal OA. To avoid these complications, a variety of modifications have been described. These include interposition of a natural or synthetic material in the space created by excising part or whole of the trapezium such as interposition of tendon (5–10), Artelon (11), polypropylene (12) or pyrocarbon (13). Others have described ligament reconstruction (creation of a ligament between the bases of the first and second metacarpals) to prevent instability (3), or a combination of ligament reconstruction and tendon interposition (LRTI) (14). An alternative method of “suspending” the thumb metacarpal base with a tendon sling (15,16) to prevent proximal migration has also been used.

Trapeziometacarpal fusion is an alternative to trapeziectomy, particularly in younger higher demand individuals, to preserve stability and strength (17). However, there are concerns about progression of OA in the more proximal scapho-trapezio-trapezoid (STT) joint and compensatory thumb metacarpophalangeal (MCP) joint hyper-extension (18).

Prosthetic replacement of the trapeziometacarpal joint is proposed to preserve more physiological movement and stability at the base of the thumb with an early recovery time. A variety of prostheses have been reported (19–28). However, these are associated with a risk of loosening, instability, and subsidence with some reporting a high revision rate (21,22,24,26–

28), although more recent implants show improvements in outcomes including longer term survival (19,20,23,25).

Excision of a wedge of bone from the metacarpal (metacarpal osteotomy) (29) is a less common procedure that is reported to improve pain and correct adduction contracture (30).

More recently, minimally invasive and trapezium preserving procedures, such as arthroscopic procedures (31,32) and denervation (33) have been described with case-series reporting favourable short-term outcomes.

Methods

The aim of these guidelines was to provide an evidence-based pathway for managing TBOA from primary care, through to secondary care. We divided the management into three main categories – non-invasive treatment, joint injection, and surgery. The non-invasive categories were further subdivided into patient education, exercise, and splinting.

Included studies were randomised controlled trials and systematic reviews of randomised controlled trials of treatment options for TBOA in adults over 18 years of age. Studies of post-traumatic arthritis or inflammatory arthritis were excluded.

Database search strategy

Our initial search criteria were broad to identify the widest range of available evidence for treating TBOA. The databases searched were Cochrane Library, Pubmed, Embase and Medline. The main search was conducted on 1 December 2018 and later updated using the same criteria on 20 March 2021.

Broad search criteria included the following terms:

Thumb OR thumbs OR thenar OR pollex OR pollicis) AND (base OR basal OR basilar OR trapeziometacarpal OR trapezio-metacarpal OR "trapezio metacarpal" OR TMC OR TMCJ OR carpometacarpal OR carpo-metacarpal OR "carpo metacarpal" OR CMC OR CMCJ OR scaphotrapeziotrapezoid OR scaphotrapeziotrapezoidal OR triscaphe OR triscaphoid OR (STT AND joint[TW]) OR (STT AND joints[TW])) AND osteoarthritis OR oa OR osteo-arthritis OR arthritis OR arthritic OR arthrosis OR osteoarthrosis OR osteoarthritic OR osteo-arthritic)) OR TMOA OR "TM OA" OR rhizarthrosis

This was further refined by adding additional terms as follows:

Education/exercise

AND exercise OR exercises OR exercising OR therapy OR therapist OR physiotherapy OR physiotherapist OR "physical training" OR "strength training" OR strengthening OR mobilisation OR mobilization OR "passive movement" OR "active movement")

Splinting

AND splint OR splints OR splintage OR splinting OR orthosis OR orthoses OR orthotic OR support OR supports OR brace OR braces OR bracing OR "assistive device" OR "assistive devices")

Joint injections

AND adrenal cortex hormones OR steroid OR steroids OR corticosteroid OR corticosteroids OR hyaluronic OR hyaluronate OR hylan OR injection OR injections OR intraarticular OR intra-articular)

Surgical treatment

AND surgery OR surgical OR operation OR operations OR operative OR excision OR excisions OR trapeziectomy OR trapeziectomies OR trapezial OR "ligament reconstruction" OR "ligament reconstructions" OR "tendon interposition" OR "tendon interpositions" OR LRTI OR arthroplasty OR arthroplasties OR excision OR spacer OR spacers OR "joint replacement" OR "joint replacements" OR swanson OR "joint resurfacing" OR artelon OR implant OR implants OR arthrodesis OR fusion OR fusions OR osteotomy OR osteotomies OR denervation OR denervations OR arthroscopy OR arthroscopic)

Database search results

Using the widest search criteria, we found 5618 papers in total. The titles were screened to exclude duplicates and papers that were clearly not relevant to our review. The remaining 893 papers were screened using the abstracts to identify the papers that dealt with the treatment options relevant to our review. We excluded 712 (non-invasive 47, injections 19, surgery 646) papers at this stage.

Full texts of 181 (non-invasive 80, injections 31, surgery 70) papers were evaluated. After excluding 132 papers [wrong study design (retrospective, cohort comparison, non-randomised), review, letter/author correspondence] a final 47 papers were included in our review as follows:

Non-invasive - 22

Injections - 12

Surgery - 15

The eligible papers were assessed in accordance with the SIGN50 methodology (34).

Systematic review results

Non-surgical treatment

Twenty-two studies met the eligibility criteria. These included six systematic reviews, 11 RCTs, one pilot RCT and four randomised crossover trials. The total number of participants included in the trials were 1229. Eight trials used combined clinical and radiographic diagnosis, four used clinical alone and four used radiological diagnosis alone. All radiographic grades of TBOA were included. Participants mean ages ranged from 51-82 years and they were predominantly female (63-99%).

According to SIGN criteria, one systematic review was assessed as low quality (35), five systematic reviews were assessed as moderate (36–40)and one assessed as high quality (41). One trial was assessed as high quality (42), four as moderate quality (43–46), and eleven as low quality (47–57). Most of the included trials had a high risk of performance and detection bias due to issues of blinding. Outcomes for non-surgical treatment were reported predominantly in the short term (less than three months) and adverse events were not often reported. All grades of TBOA were included across the different studies making the results more generalizable. Most studies excluded patients with co-existing hand conditions.

For non-invasive management as a whole Ahern et al. (36) (moderate quality systematic review of RCTs with low risk of bias) compared treatment versus usual care/sham or placebo. Ahern et.al concluded that both splints and multimodal treatments (involving exercise and manual

therapy) provide clinically worthwhile improvements in pain and function. However, the numbers of patients in the meta-analyses were small. Three other moderate quality systematic reviews included a greater number of studies and participants by including comparisons against other interventions, including those with hand OA, and by not excluding low quality RCTs (38–40). We only extracted the results for TBOA from these studies, which are included in the summaries below. The following is a summary of the evidence for specific non-invasive interventions.

Exercise vs no exercise

Villafane et al. (46) (moderate quality) combined manual therapy and exercise versus sham ultrasound and found the former showed significant improvements in pain at two months, but no differences in function or strength (n=60). This study excluded patients with anxiety and depression, which might reduce the generalizability. Two moderate quality systematic reviews (36,40) that included the above study, also reported on the effect of manual therapy and exercise. The pooled analysis from Ahern et al. (36) showed that multimodal treatment, which included exercise, reduced pain intensity by an estimated 2.9 points (95% CI 2.8 to 3.0; on 0 to 10 pain scale) compared with placebo treatments. Bertozzi et al. (40) conducted a meta-analysis on three studies (n=117), which used manual therapy techniques with exercise. They found moderate evidence that the interventions significantly reduced pain within the short follow up times (two weeks to two months). This review included studies on hand OA, which were excluded from this guideline review.

General hand exercise vs specific thumb exercise

Davenport et al. (53) (low quality pilot study) assessed this question in isolation. The data suggested improvements with exercises but potentially no difference between the groups. Another underpowered study (58) assessed thumb abduction exercises with a thermoplastic thumb strap splint versus pinch exercises with a thermoplastic short opponens splint and found both groups achieved the same level of pain relief and small clinically relevant increases in strength over six weeks.

Splint vs no splint

All studies included in the systematic reviews (39,41,59) and a more recently published low-quality study (56) suggest pain relief with splints is clinically significant when compared with usual care. These results are at risk of bias with no details on the “usual care” or “no treatment group” used for comparison. It is notable that splints are often prescribed to be used during painful activities, yet pain during function whilst wearing a splint was only measured in one moderate quality study and found to be reduced (45).

Rannou et al. (43) (moderate quality study) found using a splint at night only (45) demonstrated no change versus usual care over one month but over a longer period (12 months) significant reductions in pain and disability were demonstrated. Additionally, Rannou et al (43)looked at

radiographic disease progression and found no difference between splint and no splint at 12 months. There is a suggestion that optimal mood and adaptive strategies are important to maximise function and that the therapist should focus on coaching patients, rather than the biomechanics of splint choice (50).

When compared with other interventions, two studies (42,44), assessed as moderate and high quality respectively) found no difference between splint vs exercise.

A recent high-quality placebo-controlled splint study found that on average there was no additional benefit of splinting (true or placebo) to an optimal package of self-management (42). This package of care included the core interventions recommended by NICE (60). Engagement with clinicians who delivered the study in the NHS has highlighted the necessity to equip professionals to provide this self-management package.

Rigid vs soft splint

Rivilin et al. (35) (moderate quality systematic review) concluded that there is no difference between the different splints except for reduced disability with prefabricated splints (35). However, all these studies used short length crossover designs (between 6- 10 weeks in total). The comparisons between splints may not be valid due to inadequate washout periods. Buhler et al. (43) (high quality systematic review) excluded studies with a high risk of bias (41)and also reported no difference between splints for improvements in pain or function.

Splint includes wrist/metacarpophalangeal (MCP) joint vs does not include wrist/MCP joint

Kroon et al. (59) (moderate quality systematic review) favoured splints that immobilised both the MCP joint and the trapeziometacarpal joints over the trapeziometacarpal joint alone for pain relief (3 studies, n=185). However, only Cantero-Tellez et al. (51) in this systematic review compared a splint that truly included or excluded the MCPJ. The other two studies compared splints that immobilized the MCPJ versus those that allowed limited motion and prevented hyperextension at the MCPJ. A further high-quality systematic review (41) concluded that there was no difference in outcome between splints with MCPJ included and without (6 studies, n=436).

Splint at night vs day/during activities

There were no studies that compared the use of a splint in the day versus night. Rannou et al. (43) (moderate quality) compared night splinting versus no splint and showed a significant reduction in pain at 12 months but less improvement at one month, which is the point of comparison for the other included studies investigating the use of splints. Most of the studies in this review advised wearing splints in the daytime for aggravating activities. Three low quality studies advised splint wearing during the day and specified additional night use (54,56,61),

while three other low-quality studies allowed the freedom to choose to use at night if use helped with sleep and pain (50–52). From the studies included in this review we cannot determine an optimum splint wearing schedule.

Education delivered by a therapist vs patient leaflet

There were no studies that compared modes of delivery of education.

Injections

Twelve studies met the inclusion criteria. Of these, seven were randomised controlled trials and the remaining five were systematic reviews. The following is a summary of the available evidence for the use of injections in the treatment of TBOA, including specific comparisons.

Steroid versus placebo

Six studies addressed the question of relative performance of steroids versus placebo. A seventh examined the performance of steroid injection versus dextrose prolotherapy. Dextrose prolotherapy injections are not typically used in the UK for the treatment of osteoarthritis, and despite some mixed evidence exploring its use in musculoskeletal conditions, it is currently considered alternative medicine. While the mechanism and efficacy of this treatment remains investigational, this randomised controlled trial (62) is considered under this heading for the purpose of this review.

Meenagh et al. (63) (moderate quality RCT) compared placebo (0.25 mL 0.9% saline) against steroid injections. Forty participants were included in this double-blinded study. Participants underwent assessment at 4, 12 and 24 weeks. There was no significant difference in pain (VAS) between groups. Significant improvements in physician and patient global assessment evaluations were noted in both steroid and placebo groups from the first 4-week follow-up with the placebo group maintaining its benefit through to the final 24-week follow-up, whilst the steroid group returned to baseline at this stage. This paper is notable for its inclusion of power calculations, though unfortunately fewer than half the required numbers could be recruited.

Heyworth et al. (64) compared the effects of corticosteroid against hyaluronic acid (HA) and placebo in another moderate quality RCT. Sixty participants were randomised to receive either corticosteroid (1 ml placebo 0.9% sodium chloride at week 0 and 1 ml sodium betamethasone at week 1), HA (two injections of 1 ml Hylan G-F 20 at weeks 0 and 1) or placebo (two injections of 1 ml 0.9% NaCl at weeks 0 and 1). Participants underwent assessment at 2, 4, 12 and 26 weeks. All groups show an initial decrease in pain with no significant differences in pain (VAS) between groups. DASH score, range of motion, grip strength, key pinch and tip pinch was similar between groups.

Jahangiri et al. (62) assessed performance of steroid injections versus dextrose prolotherapy in a moderate quality double-blind RCT. A single dose of steroid was preceded by two doses of a 0.9% saline placebo to replicate the three-injection schedule of 20% dextrose prolotherapy treatment. Sixty patients were included in the study and results were obtained at 1,2 and 6 months. Both forms of treatment improved pain (VAS), lateral pinch and hand function (measured by HAQ-DI questionnaire) at 6 months. However, treatment with dextrose prolotherapy was more sustained and reported to be better than steroid for pain and hand function.

Trellu et al. (65) performed a moderate quality systematic review with a metanalysis using standardised response means (SRM) to compensate for the heterogeneity in the available

studies. This review included three studies to compare steroid vs placebo - Meenagh et al. (63), Heyworth et al. (64), both of which are included in this guideline review and additionally, an unpublished study (conference abstract- not included in this review) by Mandl et al. (66) Interestingly their use of the SRM led them to establish that the steroid group in Meenagh et al. (63) demonstrated efficacy with large effect size, despite the original authors noting no significant difference. The overall conclusion was that there was no significant superiority of one treatment group over the other.

Fowler et al performed a moderate quality systematic review looking at intra-articular steroid injections in TBOA (67). This study included four randomized controlled trials also included in this guideline review and five other case series. They provided a narrative synthesis of their results and arrived at the conclusion that there are potentially significant short-term benefits to be gained from steroid injections that can lead to improved pain and function in the first 1 to 3 months. They suggested that steroid injections were a low-risk procedure that could delay or avoid surgery. The authors also highlighted the limited quality of evidence available from the current literature, which we echo.

Kroon et al. performed a moderate quality systematic review looking at the safety and efficacy of pharmacological, non-pharmacological and surgical treatment for hand osteoarthritis (59). Within their review, they included a meta-analysis of two studies (63,66) comparing pain relief with steroid vs placebo and showed no differences between the groups at 26 weeks.

Riley et al. (68) performed a high-quality systematic review and metanalysis of injection therapy for TBOA. They included nine randomised controlled trials with 504 patients. The injection-based interventions consisted of HA, corticosteroid, placebo and dextrose. They could perform only a limited meta-analysis due to heterogeneous and incomplete data. Within their review, they examined the previously mentioned studies by Meenagh et al. (63) and Heyworth et al. (64) but reported that due to incomplete data provided in the original papers they were unable to include the question of steroids vs. placebo in their metanalysis.

Steroid versus hyaluronic acid (HA)

Bahadir et al. performed a low quality RCT comparing the effects of corticosteroid injections against HA (69). Forty female patients were included in this study. The treatment arms had different treatment protocols as those receiving HA received three injections of 5 mg sodium hyaluronate (Ostenil) at weekly intervals, whereas those receiving steroid only had a single injection of 20 mg triamcinolone acetonide. This could influence blinding and introduce bias upon the results. Participants were evaluated at 1,3,6 and 12 months. Pain (VAS) was better in the corticosteroid group at months 1 and 6 after treatment in comparison with HA. Corticosteroids also had a more sustained improvement in pain (12 months) compared to HA (6 months). Grip strength improvement was more sustained in the HA group (6 months) compared with corticosteroid (3 months), although there was no significant difference in grip

strength. Hand function as a measure of Duruoz Hand Index was more sustained with cortiscosteroids (6 months). The authors concluded that corticosteroid injections provided a more effective and sustained improvement in pain and function compared to HA.

Stahl et al. (70) conducted a low quality RCT involving 52 participants receiving a single dose of methylprednisolone 40mg (n=25) versus sodium hyaluronate 15mg (n=27) for the treatment of early (Stage 2) TBOA. Participants were evaluated at 1, 3 and 6 month intervals. Both groups had improvement in pain from baseline with no significant differences between them. Both groups had improvement in grip strength, with an earlier improvement in the steroid group compared to HA. The authors did not comment on whether there were differences between groups for grip strength.

Fuchs et al. (71) compared the effects of corticosteroid injections against HA in a moderate quality RCT involving 56 participants, randomised to receive either three injections of corticosteroid (10 mg triamcinolone acetonide) or three injections of HA (Ostenil mini containing 10 mg sodium hyaluronate)(72). Corticosteroids provided earlier and better pain relief in comparison with HA, with its maximum effect at weeks 2 – 3 after injection. Pain relief from HA was found to be more moderate and reached a maximum effect after 26 weeks. There was no statistically significant difference in pain (VAS) between groups. Function by means of key pinch was better with HA at 6 months but all other measures were not statistically significant between groups. They showed that 79% of those in the corticosteroid group and 88% of those in the HA group maintained improvement in pain after 26 weeks.

Monfort et al. (72) randomised 88 patients in a moderate quality RCT to receive a course of either three injections of HA (n=48) or corticosteroid (betamethasone) (n=40). Participants were evaluated at 1, 3 and 6 month intervals. There was no significant difference in pain (VAS) between groups. Subset analysis of those with more symptomatic arthritis measured by FIHOA (a composite pain and functional scoring system) and VAS, showed that improvement in FIHOA and VAS was superior in the HA group for this subset of patients.

Heyworth et al. (64) compared the effects of corticosteroid against HA and placebo as described previously. There was a statistically significant difference in tip pinch at week 12 with the HA group having greater pinch strength than the corticosteroid group. However, there were no significant differences in pain (VAS) between groups. All groups show an initial decrease in pain. Key pinch, grip strength, range of motion and DASH scores was similar between groups.

Trellu et al. (65) performed a metanalysis using standardised response means (SRM) and included 5 studies to compare corticosteroid vs HA, of which 4 of the published studies are also included in this guideline review. The metanalysis did not demonstrate a significant difference between HA and corticosteroid groups in early follow-up. At medium term follow-up, the HA group had an advantage for pulp-pinch force (at 24-weeks), whilst the steroid group had an advantage for pain scores. They noted that this improvement in pain at 24-weeks for the

steroid group appeared to be driven by the trial by Bahadir et al. (69), whilst the other included trials did not detect a difference.

Riley et al. (68) performed a meta-analysis of two studies (70,72) comparing the effect of corticosteroid against HA on pain at rest and demonstrated no difference. A further meta-analysis (69,70) compared the effect of corticosteroid against HA on pain with activity demonstrated an improvement in the medium term in favour of the corticosteroid group but not at other time points. This meta-analysis (of (69,70) also demonstrated no differences in tip pinch and grip strength.

Single injection versus multiple injections

There were no studies or reviews comparing single injections against multiple injections at the time of our study.

Landmark technique versus image guided injections

There were no studies or reviews comparing landmark technique against image guided injections at the time of this review.

Surgical treatment

The review identified 15 eligible studies. All compared one surgical technique with another. No study compared surgery with no surgery or a placebo.

A high quality systematic review (73) comprised 11 studies compared different types of surgery. Pain improved post operatively without differences between groups. The authors were unable to find conclusive evidence that one technique conferred a benefit over another technique for pain relief and physical function. They commented that the available studies were of insufficient quality to provide conclusive evidence.

Wajon et al. conducted an analysis of pooled data for pain relief using the VAS scale comparing trapeziectomy with trapeziectomy and ligament reconstruction and tendon interposition (LRTI) (74–76). They reported that the pain relief provided by trapeziectomy and LRTI was 3 mm lower on a 0 – 100 VAS scale compared with trapeziectomy alone. They concluded that there was low quality evidence that trapeziectomy and LRTI did not provide any additional benefit to pain relief when compared to trapeziectomy alone.

Wajon et al. conducted an analysis of pooled data for physical function using the DASH score [3 studies – (74,76,77)] comparing trapeziectomy with trapeziectomy+LRTI. They reported that DASH for trapeziectomy+LRTI was 0.03 points higher on a 0 – 100 point scale compared with trapeziectomy alone. They concluded that there was low quality evidence that trapeziectomy+LRTI did not provide any additional benefit to physical function when compared to trapeziectomy alone.

The current review includes an additional four studies published since, that met our inclusion criteria. We agree with Wajon et al that the overall quality of the published studies are low to moderate (assessed using SIGN methodology). We assessed the studies by Field and Buchanan, Brennan et al., Gangopadhyay et al., Salem and Davis and Thorkildsen and Rokkum (75,77–80)as moderate quality while the remaining studies had greater risk of bias and were assessed as low quality.

The following is a summary of the results from studies comparing different surgical procedures.

Trapeziectomy versus trapeziectomy with ligament reconstruction and tendon interposition (LRTI)

Six studies were identified (74–79) of which five were also reviewed by Wajon et al (73) and an additional recent long term follow up of the study by Field et.al (78).

Belcher and Nicholl (74) used an abductor pollicis longus (APL) sling. Surgery improved the patients' perception of hand function ($P<0.001$) and pain levels ($P<0.001$). There was no

difference between groups at 13 (7 – 29) months and the study concluded there was no benefit of LRTI (n= 23) over trapeziectomy (n= 19).

De Smet et al. (76) used the whole of flexor carpi radialis (FCR), while Gangopadhyay et al. (79), Salem and Davis (77) and Field and Buchanan (81) used half of the tendon.

De Smet et al. (76) reported no significant difference in pain relief, patient satisfaction, mobility, key or grip strength. The mean DASH score was 33 (range 0-77, SD 22.79) for trapeziectomy in 22 patients and 27 (range 0-94, SD 22.79) for LRTI in 34 patients (P>0.05).

Field and Buchanan (75) compared 32 trapeziectomies with 33 LRTIs. At 12 months, the authors found no difference in VAS pain scores, physical function, range of movement or strength between the groups. Brennan et al. (78) reported the long term follow up results (mean 17.5 years) in the same cohort of patients. Pain scores were decreased in both groups compared with baseline. Pain score (VAS) was 3.25 (range 0–8, SD: 2.33) for trapeziectomy and 2.4 (range 0–7, SD: 2.05) for LRTI. The difference was not significant. There was no difference in Quick DASH scores: trapeziectomy 5 (0 – 23) and 9 (5 – 21) for LRTI (p=0.23). The follow up study by Brennan et al. (78) had a high loss to follow up and the authors were able to review 34 (trapeziectomy 14, LRTI 20) of the 65 thumbs (52%) in Field and Buchanan's study. Reasons for loss to follow up were given and there were no significant differences in the characteristics of the patients who were followed up.

Salem and Davis (77) reported the six (4.2 - 8.1) year results in 114 thumbs (59 trapeziectomy and 55 trapeziectomy+LRTI). The authors found a significant improvement in both DASH: trapeziectomy 31(26–42): LRTI 30 (22–35) and Patient Evaluation Measure: trapeziectomy 35(29–41) and LRTI mean 34(27–39). These were significantly improved from baseline but no intergroup difference, as was also the case for subjective pain assessment.

Gangopadhyay et al. (79) presented the 5 to 18 years follow up in 174 patients who underwent trapeziectomy alone (n= 53) or with tendon interposition (n= 46) or with LRTI (n= 54). The one-year outcomes were previously reported by Davis et al (82). At a median follow up of 6 years, there was a significant improvement in pain from baseline to final assessment but no difference between groups (p=0.383). Functional outcomes and subjective restriction of activity were not different between groups. There was no difference in grip or pinch strength or ability to oppose the thumbs between the groups.

Wajon et al (73) performed a pooled comparison between trapeziectomy vs trapeziectomy with LRTI (4 studies – Belcher and Nicholl, Field and Buchanan, Gangopadhyay et al., Salem and Davis) with regards to complications. There was no significant difference in adverse events between the two operations in individual studies. In the aggregate analysis, there was an absolute risk increase in adverse events by 9% in LRTI compared to trapeziectomy alone.

Trapeziectomy with LRTI versus trapeziectomy with ligament reconstruction (LR) alone

Two RCTs made this comparison (83,84) using hemi FCR. Gerwin et al. (83), in a study of 20 patients (LRTI 9, LR 11), reported no differences in physical function, range of movement or overall satisfaction. Kriegs-Au et al. (84) reported the results in 31 patients (LRTI 16, LR 15) with no statistical difference in Buck-Gramcko Score with regards to pain and physical function. The authors reported an overall superiority of LR versus LRTI due to better scores for thumb abduction, willingness to undergo the operation again and cosmesis.

Trapeziectomy versus trapeziectomy and tendon interposition

Gangopadhyay et al. (79) included the comparison between trapeziectomy alone and trapeziectomy with palmaris longus interposition and reported no difference in pain, function, strength or adverse event between groups at 5 to 18 years follow up.

Corain et al. (85) compared 64 trapeziectomies and APL interpositions with 56 trapeziectomies and distraction with Kirschner wire insertion. After a mean follow up of 6.8 (3 - 10) years, there was no difference in DASH score [trapeziectomy + APL mean (SD) - 18.2 (1.2) versus trapeziectomy with K-wire - 17 (1.9)], range of motion or strength between the groups. The authors reported better pain relief (VAS score) in the K-wire group ($p<0.05$).

Trapeziectomy with LRTI versus trapeziectomy and tendon interposition

Gangopadhyay et al (79) reported a significant improvement in subjective pain scores with both procedures but no difference between groups at 5 to 18 years after surgery. Grip, key and tip pinch strength were similar, as were thumb opposition and metacarpophalangeal hyperextension.

Trapeziectomy with LRTI/tendon interposition versus implant arthroplasty

Thorkildsen and Røkkum (80) compared 20 trapeziectomies and LRTI, using hemi-FCR, with 20 Elektra joint replacements. The authors reported no difference in the primary outcome (QDASH) at two years. In the Elektra group, early results of strength and motion were better but there were notably more complications with six patients needing at least one more operation during the two-year follow up period.

Tagil et al (86) compared the Swanson silicone implant (n = 15) with trapeziectomy and tendon interposition using a slip of APL (n=13). At 43 months (2 – 5 yrs), there was no difference in pain (VAS scores), satisfaction score, range of movement or strength between the groups. Two of

the 13 implants dislocated early after the procedure and 5 others showed subluxation on dynamic radiographs but these did not need further surgery.

Trapeziectomy with LRTI versus trapeziectomy with allograft

Marks et al (87) compared 29 trapeziectomies with FCR LRTI with 31 trapeziectomies with allograft ligament reconstruction and tendon interposition at 12 months. The total baseline MHQ score increased from 51 (95% CI, 46-56) to 83 (95% CI, 78-87) in the FCR group (P 0.05) and from 53 (95% CI, 47-58) to 76 (95% CI, 69-84) for the allograft group at the final follow-up (P0.05). There was no difference between groups. This finding was mirrored by the DASH, SF-12 physical health score and grip strength. The complication rate in the allograft group was high at 26% and the authors concluded the use of the allograft should be reserved for revisions needing a large amount of material for interposition.

Trapeziectomy with LRTI versus arthrodesis

Hart et al (88) compared trapeziectomy and hemi FCR LRTI in 20 patients with first carpometacarpal joint arthrodesis using cross K-wires in 20 patients. The arthrodesis group had a statistically better Buck-Gramcko score at 6 months (42.6 versus 35.3; $p<0.05$) but no difference at final review at 6.8 (2 – 10) years.

Vermeulen et al. (89) performed a similar study comparing trapeziectomy and LRTI using a third of FCR in 21 patients with arthrodesis using plates and screws in 17 patients. Both groups showed similar improvements in pain and function (DASH and PRWHE scores) at 3 and 12 months but the trial was stopped early owing to the higher complication rate in the arthrodesis group (71% vs 29%). At 12 months, 86% would have trapeziectomy and LRTI again versus 53% for arthrodesis.

Trapeziectomy with tendon interposition versus partial trapeziectomy and spacer

Nilsson (90) compared trapeziectomy and tendon interposition (APL, ECRL or FCR) in 37 patients with partial trapeziectomy and Artelon CMC spacer in 72 patients at 12 months. Statistically significant pain relief (VAS score) was obtained in both groups with no difference in the DASH score, range of motion or pinch and grip strengths. The Artelon group had a revision rate of 10% during the first year. The interposition group had better pain relief in the intention to treat analysis and the authors were unable to show superiority of the spacer.

Systematic review discussion

Non-invasive treatment

There is consistency in available evidence that non-surgical treatment for TBOA provides clinically worthwhile improvements in pain and function. Evidence concurs from a systematic review of a limited number of RCTs with low risk of bias comparing treatment vs usual care/ sham or placebo (36), and from two other systematic reviews which included comparison against other interventions (38,40).

Looking at the individual components of a treatment package, there is moderate quality evidence to support exercise over no exercise (46), with large benefits in pain seen in the exercise group. Low quality evidence suggests there is no difference in outcome when using different types of exercise (53,57). Included studies provided set exercise regimes which varied in their choice of exercises and in the frequency and repetitions prescribed. There is no evidence to suggest one type of exercise is superior to another. Exercises that were included in the trials (38,40) were active exercises to increase or maintain range of motion, particularly the first webspace, exercises to improve control of a healthy thumb posture with function (proprioception or neuromuscular exercises) and strengthening exercises for the thenar muscles for grip and pinch. Also used in one study were therapist applied neural gliding exercises and passive mobilisation techniques.

In conclusion, evidence suggests that exercise is beneficial as an active strategy for long term management but may not be required daily to make gains and three times per week (42) may suffice. The exercise prescription should be tailored to the individual patient's presentation and their ability to perform the exercise correctly.

Majority of the splint studies in this review have either compared different splints or compared splints with usual care. There is low to moderate quality evidence to support splinting when compared with usual care. However usual care is frequently not well described. All studies, Rannou et al. (43) excepted, used splints during the day, with some specifying or giving the option to use at night. Splint wearing schedule and duration may be important, e.g., moderate quality evidence suggests rigid splints may provide benefit versus usual care when used overnight to rest the joint and maintain the first web space (43). However, no study provides clear criteria for splint choice, and low to moderate quality evidence suggests that when splints are fabricated and fitted by a therapist, specific designs did not make a difference to changes in pain or function. (e.g., including MCPJ or not, wrist based or soft versus hard).

A more recent high-quality placebo-controlled splint study (42), found that on average there was no additional benefit of splinting (true or placebo) to an optimal package of self-management. Self-management consists of a multimodal approach that includes education about the condition, exercise, task modification, pacing, forming healthy habits, pain

management (including identification of pain triggers) and splinting. None of the included studies (RCTs) investigated all elements of a self-management programme, although packages of care have been assessed in cohort studies, excluded from this review. For example, a study describing the role of exercise aimed at restoring the dynamic stability of the trapeziometacarpal joint, in conjunction with education and splints demonstrated improved pain and function after 6 weeks (91). Another cohort study demonstrated that greater reductions in pain were achieved when exercises were used in addition to splints (92).

In the absence of clear evidence regarding choice and schedule for splints, where splints are indicated they should be prescribed to fit to a person's lifestyle and requirements (activities of daily living, job, hobbies).

Patient education has only been investigated in a limited number of hand OA trials, which included patients with TBOA (93,94). Both trials showed superiority of therapist delivered education. Since completion of the searches for this review a 'high quality' randomised controlled trial was published, reporting on the efficacy of multimodal intervention (splint, exercise and topical NSAIDs) versus education alone (95). They demonstrated that education alone provided significant pain relief, however hand function and mental health were enhanced by the addition of the multimodal therapies. Interestingly by 6 months patients did not tend to continue with all the components (splint and NSAIDs were used by less than 25%, 40-60% continued to use exercise), other than ergonomic adjustments (70%) but they maintained their improvements.

Injections

The studies investigated the effects of corticosteroid, placebo (normal saline) and hyaluronic acid (HA) injections in TBOA.

There was low to moderate quality evidence that corticosteroid injections were effective in improving pain and function in patients with TBOA. The evidence from three moderate quality RCTs comparing steroid with placebo and five low to moderate quality RCTs comparing steroid with HA concurred that pain (VAS score) improved with steroid injections over 2 weeks to 6 months. Hand function, assessed using a variety of scoring systems also improved in the short term.

In addition to the individual trials, there were three moderate quality systematic reviews and a further high quality systematic review that addressed the use of injections in TBOA. These studies also reported short term improvements in pain and function following injections but failed to demonstrate superiority of one injectable over another. In summary, when compared with each other, there was moderate quality evidence suggesting no difference in the pain relief provided by steroids compared to placebo (saline injection) and low to moderate quality

evidence that both steroids and HA provided similar pain relief. There was no agreement as to which treatment provided more sustained benefit.

It is important to note that HA (hyaluronic acid) is not currently approved by the National Institute of Clinical Excellence for intraarticular injection in the treatment of osteoarthritis (NICE guideline NG 226: https://www.nice.org.uk/guidance/ng226). This is based on studies in large joint (hip and knee) osteoarthritis that demonstrate no consistent benefit in terms of pain relief, improved function or quality of life and potential harm (hip osteoarthritis).

There were no studies that compared injection to no injection or placebo injection without injection of a substance. It is uncertain whether the volume of the substance injected has an effect through mechanical distension of the joint.

Within the included studies, there were no comparisons of the landmark technique against image guided injections. Some authors argue that there is low accuracy in entering the thumb base joints without image guidance. In a study conducted by Hunter et al., surgeons of different levels of experience performed intra-articular injections using a landmark technique. This was then immediately assessed using fluoroscopy. Accuracy of injections to the trapeziometacarpal joint was 64% (96). A similar method of assessment by Helm et al. found an accuracy rate of 58% by landmark technique into the trapeziometacarpal joint (97). Cadaveric injection of the thumb base with the utilization of blue dye showed that landmark technique achieves intraarticular injection 50% of the time (98). However, it remains unclear whether image guidance for an accurate injection into the intraarticular space is important in achieving clinical benefit. In larger joints with rheumatological disorders, despite greater accuracy with ultrasound guidance, usage of ultrasound image guidance for injections in itself did not offer any additional benefit over landmark technique (99) in the short term. In a database study comparing landmark technique against image guided injections with ultrasound, there was no difference in the interval between treatment or time to surgery for 62333 patients with TBOA (100). A more recent prospective study comparing intra and extra-articular injections of corticosteroid in 102 trapeziometacarpal joints (101) reported equal benefits in the short term with both techniques but better pain relief and functional improvement with intra-articular injections at 3 months, with some intra-articular injections maintaining their benefit at 6 months. However, these studies did not consider any concomitant treatment such as analgesia, splints or exercises that may have influenced the outcome in either group.

Complications after steroid injections are uncommon. Fat necrosis and skin depigmentation are possibilities, but more serious complications are exceedingly rare. A recent review of HES data including over 19000 steroid injections concluded that serious complications, namely septic arthritis, neurovascular injury, need for wound debridement or tendon repair after a primary steroid injection in secondary care was 0.04% within 90 days (102). The study also reported that half of these patients needed further treatment for their TBOA, with one in five progressing to surgery.

The available evidence suggests that steroid injections are effective in the short term (1 to 6 months) in providing pain relief and improving function and the associated risks are extremely low. A steroid injection performed under image guidance costs £513. The cost effectiveness of multiple injections is unclear and there is no published consensus on the frequency or maximum number of injections for treating TBOA and further research is needed. A steroid injection is significantly less expensive compared to a trapeziectomy (£3430) and given its low risks, should be considered as a treatment modality and a component of non-surgical management for TBOA in selected individuals.

Surgery

There is moderate evidence that surgery can provide an improvement in pain and function from the pre-operative state.

Trapeziectomy was the most commonly performed surgical procedure that was compared with other procedures. Most studies compared trapeziectomy with various forms of ligament reconstructions and/or soft tissue interposition with each other or with trapeziectomy alone. Few additional studies compared trapeziectomy and LRTI with implant arthrpoplasty or arthrodesis.

Based on our review and considering the overall low quality of available evidence, we were unable to find any one surgical procedure that was better than another for providing pain relief or improving function. Trapeziectomy with LRTI was most compared with other procedures. When compared with trapeziectomy alone, we found low to moderate evidence that LRTI does not provide any additional benefit to trapeziectomy.

Pain was reported using different methods in the included studies. These were VAS scores (7 studies), a subjective scale (pain at rest and with various grades of activity – 3 studies), as part of a physical function score (Buck-Gramko, PEM, DASH, Quick DASH, PRWHE and MHQ – 9 studies). All studies consistently reported good to excellent pain relief (VAS 20 to 30/100 or 80% with no or mild pain). When compared to pre-operative values, this improvement was significant but not all studies reported a comparison with pre-operative values. It is uncertain if pre-operative pain levels influenced the post-operative results or the threshold of pain at which surgery was offered. Overall, there is low quality evidence that suggests no difference in the pain relief provided by the various operations being compared.

Physical function was also reported using different methods in the included studies. These were a subjective scale (ability to perform various activities/ADLs – 4 studies) or as part of a physical function score (Buck-Gramko, PEM, DASH, Quick DASH, PRWHE and MHQ – 13 studies). All studies reported improvement in physical function and when compared to pre-operative values, this improvement was significant but not all studies reported a comparison with pre-

operative values. Overall, there is low quality evidence that suggests no difference in the improvement in physical function between the various operations.

There is insufficient evidence to determine if any surgical procedure affects the ROM differently than another or whether it improves compared to pre-operative values. Field and Buchanan reported significantly more radial abduction with LRTI compared to trapeziectomy alone, maintained in the long term (75,78). Similarly, there is insufficient evidence to comment on whether any surgical procedure affects the strength differently than another or whether it improves compared to pre-operative values. Quality of life and global assessment were not reported in most of the studies and as such, we are unable to comment if any of the surgical procedures affect these parameters.

There were no studies comparing surgery with placebo/sham procedure or no surgery.

All but three (78,85,90) of the included studies reported complications following surgery (76,83,88). These can be grouped into the following broad categories:

- Scar tenderness
- Tendon related - rupture/tendonitis/adhesions
- Neurological – sensory loss/paraesthesia/neuroma
- Complex regional pain syndrome (CRPS)
- Revision surgery

Individual studies comparing trapeziectomy, trapeziectomy with LRTI and trapeziectomy with tendon interposition did not report any difference in adverse events between the procedures compared. Two studies (88,89) comparing trapeziectomy and LRTI with arthrodesis reported increased complications in the latter, resulting in stopping the study in one. Studies comparing trapeziectomy and LRTI with implant arthroplasty have reported increased complications with the latter (80,86). However, the reporting of complications in these studies are of sufficiently low quality such that conclusions about adverse events cannot be drawn from them.

A recent systematic review and network metanalysis of randomised controlled trials comparing surgical interventions for TBOA (103) reached the same conclusion as our review, stating that there was evidence of moderate certainty that trapeziectomy with LRTI did not appear to be associated with any long term benefits when compared with trapeziectomy alone. The authors also concluded that there was some increase in the frequency of minor complications with LRTI compared with trapeziectomy alone, while arthrodesis and joint replacement arthroplasty had the highest incidence of major complications. They recommended that trapeziectomy alone should be the preferred surgical treatment for TBOA until further high quality evidence was available to suggest otherwise.

Currently, there is insufficient evidence to recommend joint replacement arthroplasty over trapeziectomy as the primary surgical treatment of TBOA. However, there has been increased interest due to reports of rapid rehabilitation, improved pain and function, together with longer

implant survival with the more recent uncemented prosthetic designs (19,20,23,25). As a result of these encouraging results, implant arthroplasty is gaining an increasing role in selected patients, although higher quality Level 1 studies are required to provide further evidence to guide this practice. The National Institute of Health and Care Research (NIHR) has recently approved a multi-centre randomised controlled trial [Surgery versus Conservative OsteOarthritis of Thumb Trial (SCOOTT)] to determine the clinical and cost effectiveness of treating arthritis of the base of the thumb, with or without surgery, and to determine the clinical and cost effectiveness of trapeziectomy versus base of thumb joint replacement. The results of this or similar trials, when available will help further guide surgical and non-surgical treatment of TBOA in the future.

Clinical practice recommendations

The treatment of thumb base osteoarthritis should follow a step-wise approach, starting with non-surgical measures with low risk of harm before progressing to more invasive and complex treatments if pain and dysfunction continues. We were unable to find evidence to support the suggested sequence of treatment recommendations but the group and most clinicians agree that the treatment of TBOA should follow a step-wise treatment escalation ladder.

We recommend that non-surgical treatment should be offered to all patients presenting with symptomatic TBOA (high evidence). Non-invasive treatment consists of a comprehensive package of self-management. A comprehensive self-management programme consists of a multimodal therapy approach that includes the following components: education about the condition; exercise; task modification; pacing; forming healthy habits; pain management (including identification of pain triggers). Patients should understand the principles of self-management as a priority and actively engage in self-management strategies.

Splints should be considered as an option in the treatment ladder for those who have not responded to a self-management package of treatment (low to moderate evidence). This may be particularly important for those who are unable to engage actively in their treatment, or who have restrictions in their ability to modify aggravating tasks.

Intra-articular corticosteroid injection is a low-risk procedure (high evidence) that provides short-term pain relief (low to moderate evidence) and should be considered in those who have not responded to a comprehensive self-management programme +/- splint.

If symptoms fail to resolve with self-management +/- splint +/- steroid injection, surgery should be considered in patients with TBOA (moderate evidence). When surgery is indicated, additional procedures do not appear to confer any benefit over excision of the trapezium alone (low evidence).

Good practice points

- Healthcare professionals should support the patient in a self-management programme to optimise outcome. They should direct the patients to high quality resources and educational material. Although multiple sources of information exist (see Appendix 4 - Patient flow algorithm), the group found the information provided by the OTTER II study to be one of the most comprehensively developed sources of publicly available educational material. The information was developed involving patients and research with clinicians (Delphi Study) and can be found in the published study protocol (104).

  The Osteoarthritis Thumb Therapy (OTTER) II Trial: a study protocol

- Where facilities exist, referral to the local hand therapy service or MSK service with hand therapy expertise should be considered. To improve outcome, it is recommended that self-management should be individualised to patients to ensure the relevance of the information and treatment, for example exercises tailored to the clinical assessment, task modification tailored to the aggravating activities (see figure 1 for suggested considerations for an exercise prescription, as used by the therapists in the guideline development group). Psychologically informed delivery may be important in optimising patient engagement e.g., goal setting, identifying barriers and facilitators to engagement, assessing confidence and signing contracts (42) .

- In the absence of clear evidence regarding choice and wearing schedule for splints, where splints are indicated they should be prescribed to fit to a person's lifestyle and requirements (activities of daily living, job, hobbies) to ensure compliance and improve outcome (see figure 2 for suggested considerations for splint prescription, as used by the therapists in the guideline development group). Splints should not be the first and only non-invasive treatment prescribed.

- Where corticosteroid injections are indicated, consider performing this in the out-patient setting using landmark technique where expertise is available. Image guidance improves accuracy of injections and may provide longer pain relief but currently there is no evidence to support one technique over another.

- Steroid injections are known to provide short term pain relief (commonly 3 months and up to 6 months). The cost-effectiveness of repeated injections is unclear but the group

consider it reasonable to repeat injections if the patient does not wish to have surgery and the benefit has lasted for 6 months or more.

- Surgery should only be offered after a reasonable trial of non-surgical management. The group consider it reasonable to offer surgery if symptoms fail to resolve after 6 months of non-surgical management consisting of supported self-management +/- splint +/- corticosteroid injection(s).

- Patients treated with surgery should be added to the UK National Hand Registry to allow assessment and analyses of outcomes.

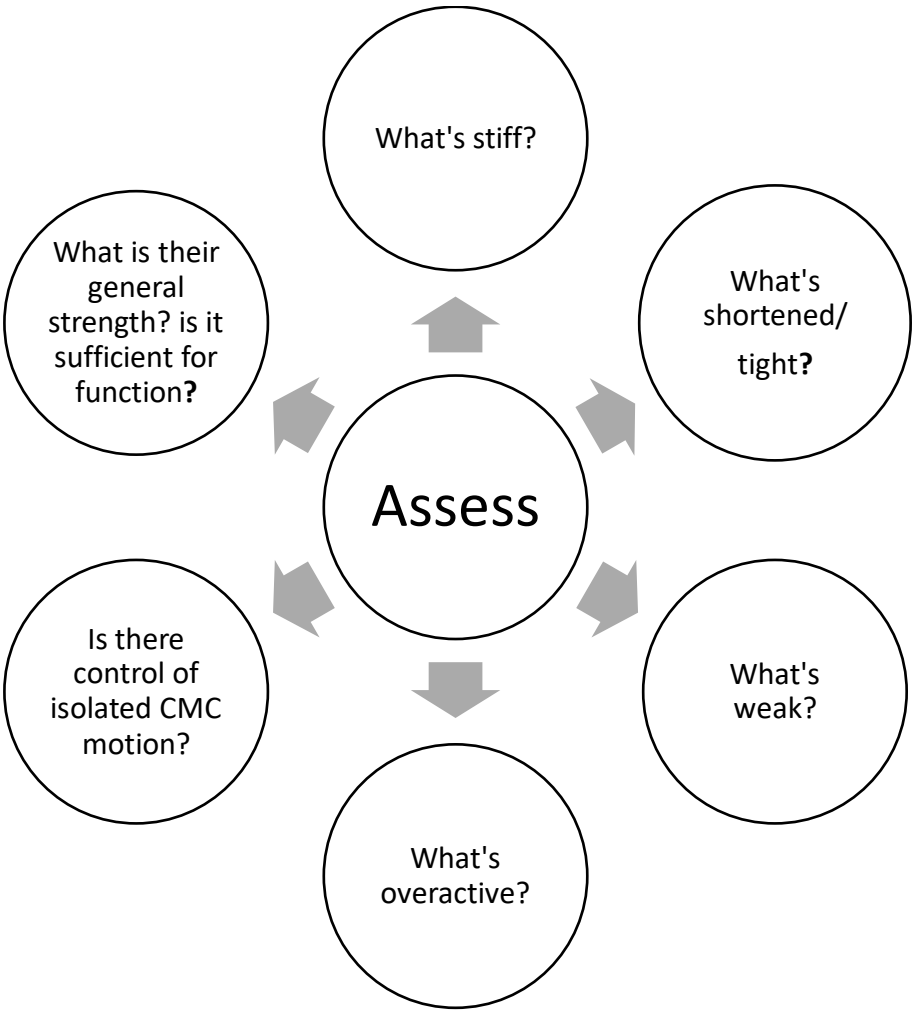


Figure 1: *Suggested considerations for exercise prescription*

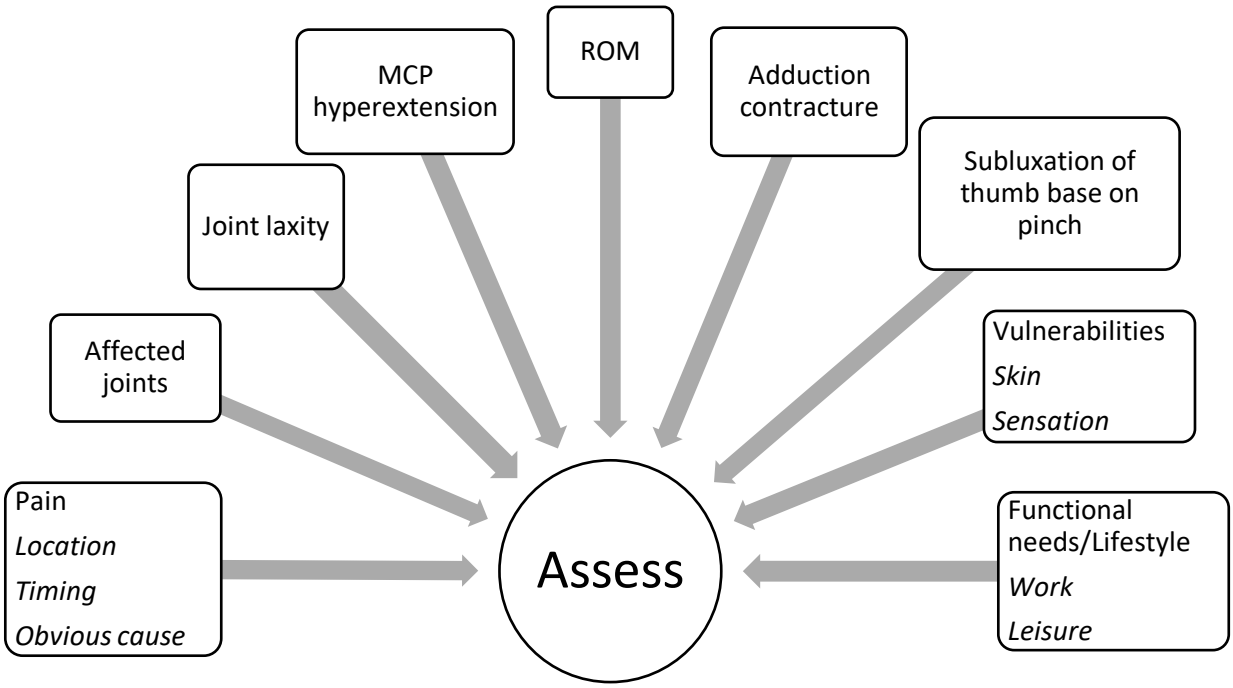


Figure 2: *Suggested splint assessment principles*

Clinical audit indicators

Provision of pre-hospital supported self-management before referral to secondary care.

Rate of steroid injections after supported self-management.

Rate of conversion to surgery following supported self-management.

Submission of data to the UK Hand Registry for all surgical procedures.

Resource implications

The recommendations and good practice points are largely in-line with current NHS practice and there are no major resource implications to implementing the guidelines. There is some variation across the country with regards to the provision and delivery of non-invasive treatment for TBOA. Non-invasive treatment is significantly less expensive compared to any form of surgery and as the recommended initial management, it has the potential for reducing overall cost.

In most NHS settings, hand therapy/MSK services already exist and hence the delivery of such treatment through these services needs no additional resource. Where this service is not available, training of personnel to deliver non-invasive care will be beneficial. While supported self-management provides best outcomes, healthcare professionals can sign-post self-motivated patients to the appropriate material as the first step in the treatment ladder and this needs no additional resource. Healthcare professionals may however, need education regarding the availability of the resources and educational materials that they can direct their patients to use for self-management.

Using splints only where necessary is resource saving.

Injections are commonly performed for TBOA and is in-line with current NHS practice. Performing injections using the land-mark technique in the out-patient setting will reduce cost compared to image-guided injections where these are done in the operating suite. Healthcare professionals performing the injections are currently doing so with their existing training and no additional training needs are identified. Performing injections only after a trial of non-invasive treatment has the potential to reduce overall numbers of injections performed.

Trapeziectomy alone after a trial of non-surgical treatment and performed only if non-surgical treatment fails to resolve the symptoms is the least expensive surgical option and is in line with current UK practice.

Facilitators and barriers to implementation

Where current practice consists of referral to secondary care without a trial of non-invasive treatment, education of healthcare professionals regarding the recommended management pathway will be required. A quick-reference guide with a patient flow pathway can be provided as a reminder of the guideline recommendations to first-contact healthcare professionals. Working with commissioning groups to incorporate the guidelines into local health-pathways will establish the use of the recommendations in primary care.

It is envisaged that BSSH/BAHT will develop self-management resources that will be made freely available for healthcare professionals and patients to use in due course.

Future research recommendations

Is night splinting and supported self-management more effective at reducing pain, compared with supported self-management alone, in patients with thumb base osteoarthritis?

What are the long-term outcomes (changes in pain and hand function) of conservative management (supported self-management, including splints and steroid injections) of thumb base osteoarthritis?

Does early intervention with supported self-management and task modification alter disease course in thumb base osteoarthritis?

Is an accurate joint injection with image guidance necessary for symptoms relief in thumb base osteoarthritis?

What is the clinical and cost-effectiveness of repeated corticosteroid injections?

Threshold for surgical treatment – is it possible to identify the need for surgery based on a functional or objective scoring system?

Surgery versus non-surgical treatment (supported self-management) – long term outcomes.

Trapeziectomy versus implant arthroplasty using newer generation e.g. dual mobility implants.

Stakeholders invited to provide external review

British Orthopaedic Association

British Association of Plastic, Reconstructive and Aesthetic Surgeons

British Association of Hand Therapists

Royal College of General Practitioners

British Society for Rheumatology

Timeline of guideline

Date topic identified: 9 March 2018

Date GDG lead appointed: 9 March 2018

Date draft supplied by GDG authors: 4 July 2023

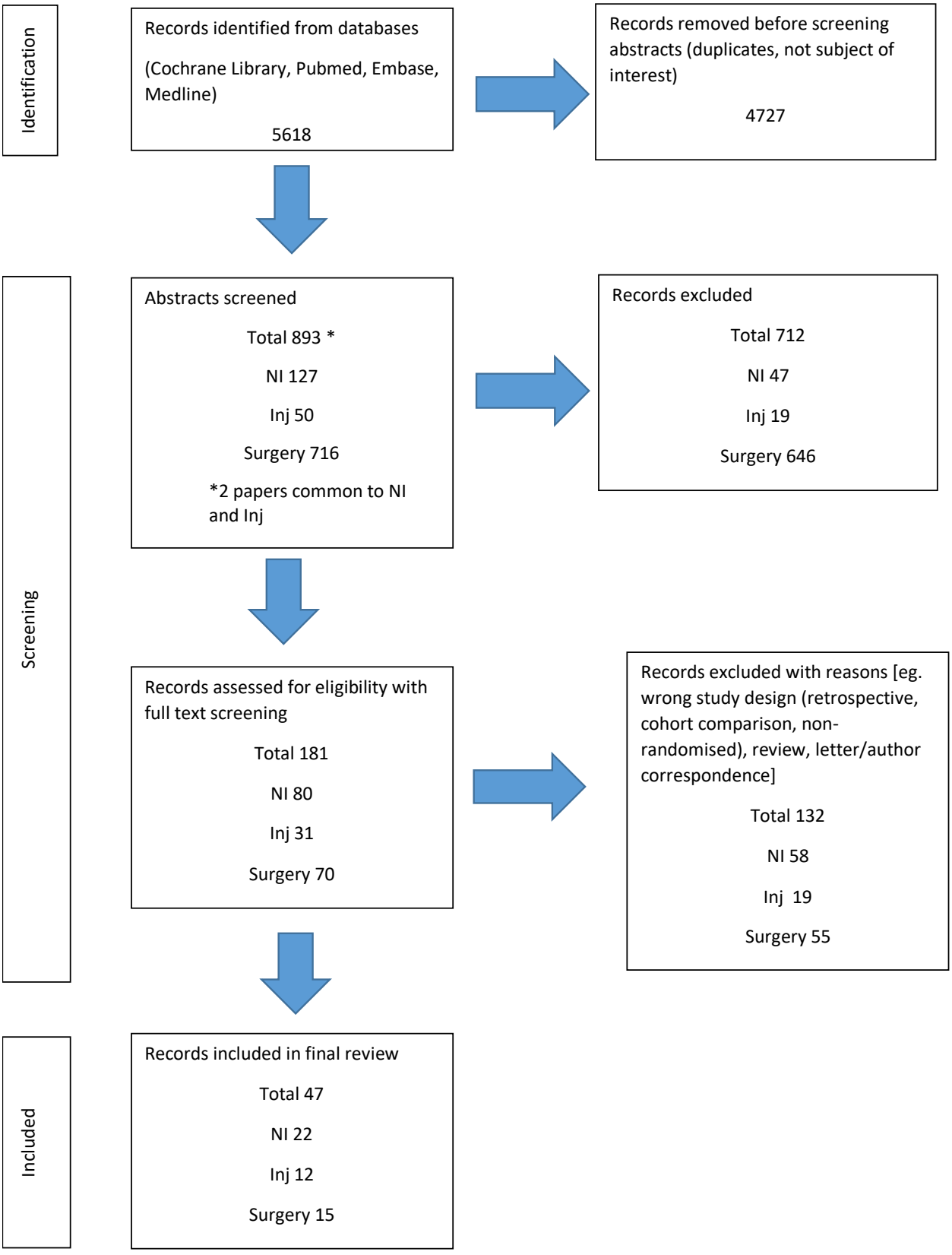
Date Internal review completed: 19 October 2023

Dates of public consultation: 19 October 2023 to 3 Dec 2023

Date external review completed: 27 November 2023

Date published: 11 December 2023

Appendix 1: PRISMA flow chart for systematic review



Appendix 2: Evidence summary tables and Characteristics of included studies

Appendix 2.1: Evidence summary tables: Key Question 1: Is non-invasive treatment (exercise, education and splints) effective in treating thumb base OA?

<table>
<tr><td colspan="2">Study complete reference:</td><td colspan="2">Study type / Evidence level:</td></tr>
<tr><td colspan="2">Ahern M, Skyllas J, Wajon A, Hush J. The effectiveness of physical therapies for patients with base of thumb osteoarthritis: Systematic review and meta-analysis. Musculoskelet Sci Pract. 6AD;35:46–54.</td><td colspan="2">Systematic review of Randomised Controlled Trials
Moderate (+) Quality</td></tr>
<tr><td>Study details:</td><td>Patient characteristics:</td><td colspan="2">Interventions / Comparators:</td></tr>
<tr><td>Country: Australia SR, data international.
Centres:
Setting:
Funding Sources: nil
Dropouts:</td><td>n: 198 in 5 studies
Mean age (years): 55-84
Gender (M:F): 66-100% female
Incl. Criteria: CMCJOA clinical/ radiological, trial of physical therapy intervention. RCTs with low risk of bias.
Excl. Criteria: no serious co-morbid hand conditions
Stage TBOA: I-IV individual studies did specify.</td><td colspan="2">Multimodal – neurodynamic, exercise, Passive accessory joint mobilisations
(12 sessions 4 weeks)
Exercise, heat & splints vs. cream (2 sessions 4 weeks)

Uni modal –
Passive accessory joint mobilisations (PA) vs sham ultrasound treatments (4 sessions 2 weeks)
Splint vs. no splint (3 sessions 26 weeks)
Custom thermoplastic splint vs. Prefabricated neoprene splint vs. no splint (? Sessions 4 weeks)</td></tr>
<tr><td>Outcome measures / Results:</td><td>Time points:
Pain:

Physical Function:
Global assessment:
ROM:

Strength:

Others:
Imaging:
Adverse Effects:</td><td colspan="2">1-26 weeks (most <13 weeks). Closest data to 4 weeks used for extraction. (mean differences and 95% CI)
Pain at rest (1-10): 3.13 [2.46, 3.80] (n=86) favours (unimodal) interventions, (reduced by)
Pain on pinch (1-10). 2.89 [2.76, 3.02] (n=95) favours (multimodal) interventions
(0-100). 6.81 [1.68, 11.95] (n=85) favours (unimodal) interventions
-
-
Pinch (kg): 0.10 [0.00, 0.20] (n=95) favours (multimodal) intervention, 1.29 [0.97, 1.62] (n=113) favours (unimodal) interventions
Grip (kg): 0.88 [-0.13, 1.88] (n=113) favours (unimodal) interventions
PPT pain pressure threshold. Upper limb dexterity. Data not presented nor meta-analysis performed as only in single studies
-
Not presented in tables or mentioned in discussions.</td></tr>
<tr><td>Authors Conclusions:</td><td colspan="3">High quality evidence shows unimodal and multimodal physical therapy treatments can result in clinically worthwhile improvements in pain and function for patients with base of thumb OA.</td></tr>
<tr><td>Notes:</td><td colspan="3">Unable to judge search bias no list of excluded studies, however we cannot find any placebo/ inactive controlled RCTs missing. Therapy studies tended to score high risk of bias for performance and detection bias due to issues with blinding. Publication bias was not assessed. Short term data the most common time points for assessment were close to 4 weeks, so this was chosen for meta-analysis – longer term data is needed. No adverse effects mentioned.</td></tr>
</table>

Study complete reference:		**Study type / Evidence level:**
Arazpour, M,et al,. The effect of thumb splinting on thenar muscles atrophy, pain and function in subjects with thumb carpometacarpal osteoarthritis. Prosthetics & Orthotics International (2016) 1-8.		Randomised Control Trial Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Iran **Centres:** Single **Setting:** University **Funding Sources:** Nil **Dropouts:** Nil	***n:*** 25 **Mean age (years):** 50.18 **Gender (M:F):** 87% Female **Incl. Criteria:** CMCJOA clinical & radiological **Excl. Criteria:** no other deformities in the thumb IPJ, no comorbid hand conditions, no previous splint/ steroid **Stage TBOA:** I & II	Splint versus no intervention: 1. **Group 1**: Custom made *thermoplastic splint, during ADLs (Thermoplastic, wrist & MCPJ free) 2. **Group 2**: No detail, no intervention

Outcome measures / Results:

Time points:		**Baseline** *Mean (SD)*	**4-Weeks** *Mean (SD)*	**Effect Size**
Pain: (VAS 0-10)	**Group 1**	5 (1.5)	4 (1.3)	1.71 s **(*p*=<0.001)**
	Group 2	3.6 (1.2)	3.4 (0.5)	
Physical Function: (MHQ 0-100 higher scores worse function)	**Group 1**	55.4 (1.5)	56.3 (13.5)	0.773 (*p*=0.05)
	Group 2	64.2 (15.32)	60.1 (9.4)	
Global assessment:	-			
ROM:	-			
Strength:	-			
Others:	CSA thenar muscles no significant differences			
Imaging:	-			
Adverse Effects:	None mentioned			

Authors Conclusions:	Large and significant changes with splinting on perceived pain and function, but not on muscle cross-sectional area.
Notes:	Control group lacks detail, no blinding information, unequal groups in size and baseline pain and no statistical calculations for sample size. No references about what might be a significant change in muscle diameter in 4 weeks, in small muscles – all measures trended to reduced. Uncertain regarding data analysis, reports groups being equal yet baseline scores show large differences. Issues with statistical bias, assessor and performance bias, and no measures of strength when muscle bulk was a priority.

Study complete reference:	Study type / Evidence level:
Kroon F, Kloppenburg M, Schoones J, Carmona L. Systematic literature review (SLR) for the 2018 update of the EULAR management recommendations for hand osteoarthritis (OA). Annals of the rheumatic diseases. 2018;77 (Supplement 2):1133.	Systematic Review Moderate (+) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Review Europe, studies included worldwide **Centres:** Multiple **Setting:** **Funding Sources:** Not stated, EULAR assumed **Dropouts:** Nil	***n:*** 853 in 16 studies **Mean age (years):** Range 50.2-83 **Gender (M:F):** Range 67-100% female **Incl. Criteria:** all interventions for hand OA, comparators usual care, placebo or other intervention **Excl. Criteria:** studies without a comparator, n<20, studies with premature termination. **Stage TBOA:** I-III but also clinical diagnosis included.	1. Splint, exercise, education vs. Placebo splint, exercise, education 2. Splint vs no treatment 3. Splint vs. usual care (Rheumatologist/ GP) 4. Custom thermoplastic or neoprene splint vs. prefabricated splint 5. Splint incl. MCPJ vs excl. MCPJ 6. Splint + exercise vs. Exercise alone 7. Splint incl. wrist vs. excl. wrist 8. Splint + pinch exercise vs. different splint + abduction exercises 9. Group education exercise + splint vs. group education 10. Manual therapy + exercise vs. sham US

Outcome measures / Results:	Time points:		2 - 12 weeks	4 - 8 weeks	13 - 52 weeks
	Pain: (0-100 VAS)	**Splint vs. usual care/ no Ix** (*Effect estimates mean difference & 95% CI)*	-	−2.9 (−12.2 to 6.5); *n*=221 4 studies	−17.4 (−25.6 to −9.2) n=137 2 studies in favour of intervention group
		Long CMCJ & MCPJ vs. short splint CMCJ only (*Effect estimates mean difference & 95% CI)*	−0.85 (−5.1 to 3.4) *n*=185 3 studies all favour of long splint	-	-
	Physical Function:	**Splint vs. no Ix / Usual care** (*Effect estimates mean difference & 95% CI)*	-	SMD 0.24 (−0.11 to 0.60), *n*=144 3 studies in favour of control (4 weeks)	-6.3 (-10.9- -1.7) 0/90 Cochin HFS (N=126), *n*=112 1 study; In favour of splint (52 weeks)
		Long CMCJ & MCPJ vs. short splint CMCJ only (*Effect estimates mean difference & 95% CI)*	1.7 (−0.94 to 4.3) in favour of short splint (9-12 weeks)	-	-
	Global assessment:	-			
	ROM:	-			
	Strength:	**Grip Strength: Splint vs. no Ix / Usual care** (*Effect estimates mean difference & 95% CI)*	-	SMD 0.39 (−0.35 to 1.1), *n*=95 2 studies (6-8 weeks)	SMD 0.8 (−3.1 to 4.7) *n*= 40 in 1 study, all in favour of splints (13 weeks)
	Others:	-			
	Imaging:	-			
	Adverse Effects:	-			
Authors Conclusions:	Thumb base splinting shows long term benefit in pain relief, splint studies all had high risk of bias				
Notes:	No assessment of publication bias & only a single reviewer. Results were combined with hand OA for education and exercise interventions, so data could not be extracted. Data is presented for 15 studies on splinting in CMCJOA.				

Study complete reference:		**Study type / Evidence level:**
Bani, M. A. et al; Comparison of custom-made and prefabricated neoprene splinting in patients with the first carpometacarpal joint osteoarthritis. Disabil 2013;8(3):232-7.		Randomised cross over study Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Iran **Centres:** Single **Setting:** University **Funding Sources:** University **Dropouts:** Nil	***n:*** 35 **Mean age (years):** 55.66 **Gender (M:F):** 71.5% Female **Incl. Criteria:** Radiological & clinical diagnosis CMCJOA. **Excl. Criteria:** Deformities of the affected hand/ thumb, DIPJ, splint/ injection previous 6 months, other disease affecting the thumb or wrist (e.g. carpal tunnel syndrome, De Quervain's tendonitis, Dupuytren's, cervical spine pathology. **Stage TBOA:** I & II	Three study groups: two types of splints and a control group: 1. Control **(C)** – unclear, but no splints. 2. Group 1 Prefabricated neoprene thumb splint **(S1)** 3. Group 2 Custom made thermoplastic thumb splint; hand based **(S2)** Four-weeks splint (S1 or S2) during aggravating activities, followed by 2 weeks 'washout period' without splint. Subsequent crossover between Groups S1 and S2 for a further 4-weeks of splintage.

Outcome measures / Results:

Time points: Four-weeks splint (S1 or S2) during aggravating activities, followed by 2 weeks 'washout period' without splint. Subsequent crossover between Groups S1 and S2 for a further 4-weeks of splintage. Outcome data was measured at Baseline, at 4-weeks. After a 2-week washout period baseline data was again collected and repeated after 4-weeks.

		Study Group	Baseline	4/52 Follow-up	Versus Control Group (C)	S1 versus S2
Pain:	VAS, mean (SD)	C	6.5 (1)	7 (1)	-	-
		S1	6.6 (2)	3.8 (2)	*p* = 0.062	*p* = 0.878
		S2	6.7 (2)	3 (1)	***p* = 0.049**	
Physical Function:	DASH, mean (SD)	C	60.1 (13)	56.8 (12)	-	-
		S1	61.2 (5)	66.6 (5)	*p* = 0.060	*p* = 0.884
		S2	58 (12)	62 (8)	***p* = 0.026**	
Global assessment:	-					
ROM:	-					
Strength:	Grip in kg, mean (SD)	C	7.5 (1)	7.4 (1)	-	-
		S1	7.4 (2)	8 (2)	*p* = 0.664	*p* = 0.130
		S2	7.3 (3)	8 (3)	*p* = 0.590	
	Pinch in kg, mean *(SD)*	C	4.1 (0.3)	4.1 (0.2)	-	-
		S1	5.4 (1)	6.2 (1)	***p* = <0.001**	*p* = 0.418
		S2	4.6 (1)	5.7 (1)	***p* = <0.001**	
Others:	-					
Imaging:	-					
Adverse Effects:	None mentioned					

Authors Conclusions:	Both splints reduced pain, there were no significant differences between the splints for all parameters – authors suggest custom made splint is superior for pain relief at 10 weeks.
Notes:	Concerns: assessor is unblinded, control group poorly described, small numbers and no power calculation. The differences in pain were large so it is possible the sample was sufficient but no confidence intervals are given. Washout period not proven possible carry over effect from previous splints – we have chosen to display results from the first period (4 weeks) rather than 6 & 10 weeks. We disagree with the authors that a custom-made splint is superior, as in tables the difference between the splints did not reach significance level.

Study complete reference:	Study type / Evidence level:
Becker, S. J. et al.; A prospective randomised comparison of neoprene vs thermoplastic hand-based thumb spica splinting for trapeziometacarpal arthrosis. Osteoarthritis Cartilage 2013;21(5):668-75, 2013	Randomised Control Trial Low (-) Quality

Study details / Limitations:	Patient characteristics:	Interventions / Comparators:
Country: USA **Centres:** Single **Setting:** Hospital **Funding Sources:**	***n:*** 119 (62 analysed at 9 ±9wks) **Dropouts:** 43% in over 5-15 weeks **Mean age (years):** 63 (57 non completers) **Gender (M:F):** 14:48 non completers 13:38 **Incl. Criteria:** clinical diagnosis CMCJOA **Excl. Criteria:** any surgery **Stage CMCJOA:** not staged as radiographic diagnosis not required.	Two types of splints **Neoprene** splints Thermoplastic **(TP)** splint Both hand-based splints included MCPJ Wearing schedule: as needed for pain relief day and/or night.

Outcome measures / Results:

Time points: Baseline observations and +10 weeks

Pain:

Physical Function:

	Group	Mean change (SD)	95% CI	Significance between groups
VAS 0-10	Neoprene	4.3 (2)	(0-8)	NS
	TP	4.2 (2)	(1-9)	
DASH	Neoprene	2.5 (17)	(-33-57)	NS
	TP	3.8 (13)	(-28-40)	

Global assessment: -

ROM: -

Strength:

Grip (% of unaffected or least involved side)	Neoprene	85(23)	(42-161)	NS
	TP	92 (30)	(50-217)	
Pinch (% of unaffected or least involved side)	Neoprene	92 (20)	(41-133)	NS
	TP	90 (19)	(49-127)	

Others:

Splint comfort (VAS 0-10)	Neoprene	6.8 (3)	(0-10)	$p = 0.048$ (neoprene significantly more comfortable)
	TP	5.3 (3)	(0-10)	

Imaging: -

Adverse Effects: None mentioned.

Authors Conclusions:

Neoprene splints are on average less expensive, more comfortable and as effective as TP splints.

Suggests that surgeons and therapists spend more time coaching patients on adaptive and palliative measures to reduce symptoms and maintain function, rather than focus on splint biomechanics/choice.

Notes:

Concerns: Patients were not prohibited from other treatments which included splints, splint wearing schedules were not recorded.

Sample size calculations required 60 participants in each group, high dropout left only 30 per group.

At high risk of bias, but results concur with other studies which suggest one type of splint is not superior to another.

Study complete reference:	Study type / Evidence level:
Bertozzi, L.; et al.; Investigation of the effect of conservative interventions in thumb carpometacarpal osteoarthritis: systematic review and meta-analysis. Disabil Rehabil 2015;37(22):2025-43	Systematic Review Moderate (+) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Review Italy/ USA, studies Europe, USA, Asia, South America. **Centres:** Universities **Setting:** **Funding Sources:** **Dropouts:**	***n:*** 16 RCTs n=1145 **Mean age (years):** 56.5-82 **Gender (M:F):** not documented **Incl. Criteria:** RCTs published on conservative interventions for symptomatic CMCJOA, with a control group. **Excl. Criteria:** Quasi and non randomised trials. **Stage CMCJOA:** II-IV	Though other joints were included in the trials within this review, only TBOA was include in the meta-analysis. The following categories were examined: 1. Laser vs. sham 2. Thermoplastic splint vs. no splint 3. Night splint vs. usual care 4. **Manual therapy (MT) & ex** vs. sham US 5. **Manual therapy vs sham US**

Outcome measures / Results:]

Time points: Results were considered for improvements over the short-term (defined as <45 days), medium-term (>45 days but <3 months) or long-term (>3 months).

	Comparison:	Follow-up:	Effect Size (SD):	Significance Level:	Notes:
Pain:	Manual therapy vs. Control: Pain	Short Term	-1.86 (-3.7 to -0.02)	p=0.04	n=139, 4 studies, favors MT
	Manual therapy & Exercises: Pain	Medium Term	-11.23 (-13.30 to - 9.16)	p= 0.00	n=60, 1 study (excluded from this BSSH review)
Physical Function:	Splint vs. Control: Function	Long term	-1.54 (-3.54 to 0.46)	p=0.11	n=201
Global assessment:	-				
ROM:	-				
Strength:	**Grip strength**				
	Manual therapy vs. Control:	Short Term	0.35 (-0.83 to 0.13)	p=0.14	Favours manual therapy
	Manual therapy & Exercise	Medium Term	-0.54 (-1.05 to -0.03)	p=0.03	
	Pinch strength				
	Manual therapy vs control	Short Term	-0.76 (-1.79 to 0.28)	p=0.15	Favours manual therapy
	Manual therapy & Exercise	Medium Term	0.00 (-1.43 to 1.43)	p=1.00	*Studies excluded in BSSH review*
Others:	-				
Imaging:	-				
Adverse Effects:	Eight studies reported no adverse events. A further eight studies did not report on adverse events. One study, examining laser therapy, reported adverse events in 4 patients (these were not classified as major or minor)				

Authors Conclusions:	Moderate quality evidence that manual therapy and exercise improve pain, and splints improve function & pinch strength.
Notes:	One author in the review authored 4 of the studies reviewed, these make up all the meta-analyses results for TBOA presented above. Which means the results have not been replicated by other practitioners, important as they are manual therapy techniques operator dependent and requiring frequent attendance. Publication bias as only published studies, half the studies included hand OA (n=663 N=7)

Study complete reference:	**Study type / Evidence level:**
Cantero-Tellez, R; et al.; Effect of immobilisation of metacarpophalangeal joint in thumb carpometacarpal osteoarthritis on pain and function. A quasi-experimental trial. J Hand Ther 2018;31(1):68-73	Randomised Control Trial Low (-) Quality

Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Spain **Centres:** **Setting:** hand rehabilitation clinic. **Funding Sources:** **Dropouts:** 0	***n:*** 84 **Mean age (years):** 60 **Gender (M:F):** 92% female **Incl. Criteria:** radiographically confirmed CMCJOA, women(?), pain >4/10 with ADLs **Excl. Criteria:** injury, Duputrens, DeQuervain's, previous treatment CMCJOA 6mo, **Stage CMCJOA:** Not specified	Two types of splints Thermoplastic (TP) hand based (HB) splint **(Ballena)** TP hand-based splint MCPJ free **(Colditz)** Both used at night and 3-4 hours per day, for 3 months

Outcome measures / Results:

Time points: Baseline scores and 3 months post-intervention.

Pain:

VAS 0-100	**Change from baseline score, *within* groups at 3 month follow-up**		**Difference *between* groups at 3 month follow-up**	
	Mean (SD)	*Significance*	*Mean (SD)*	*Significance*
Ballena	-25.7 (1.7)	Not significant	-8.9 (-12.1 to –4.3)	Not significant
Colditz	-25 (1.8)			

Physical Function:

DASH 0-100	**Change from baseline score, *within* groups at 3 month follow-up**		**Difference *between* groups at 3 month follow-up**	
	Mean (SD)	*Significance*	*Mean (SD)*	*Significance*
Ballena	-10.3 (1.0)	Significant	-6.7 (11.3 to -6.2)	Not significant
Colditz	-12.0 (1.0)			

Global assessment: -

ROM: -

Strength: -

Others: -

Imaging: -

Adverse Effects: None.

Authors Conclusions: A clinically significant reduction in pain intensity and functional difficulties was achieved with both splints.

Notes: Quasi- randomization is the main weakness of this study, along with no non splint group. Improved pain relief with both splints (statistically and clinically significant) - no statistical difference between designs, effects could be due to the non-specific effects of attending therapy, better function with MCP free, discussion reports groups didn't have MCP hyper extension so possibly lack of splint control at MCP had less clinical impact.

Study complete reference:	Study type / Evidence level:
Davenport, B. J.; et al Pilot randomised controlled trial comparing specific dynamic stability exercises with general exercises for thumb carpometacarpal joint osteoarthritis, Hand Therapy 2012;17(3):60-67	Randomised Control Trial Pilot Low (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: UK **Centres:** single **Setting:** secondary care **Funding Sources:** local charity	***n:*** 39 **Dropouts:** 41% **Mean age (years):** 59.5 **Gender (M:F):** 82% female **Incl. Criteria:** clinical & radiological CMCJOA, allowed to have had/ have other interventions prior to/ during study. **Excl. Criteria:** inflammatory joint disease, co-existing hand conditions. **Stage CMCJOA:** I-IV accepted but not specified	Two types of exercise: 1. **Specific**: Dynamic stability exercises 2. **General**: general exercise including pinch

Outcome measures / Results:	Time points:			Baseline	3 Months	6 Months	Significance
	Pain:	VAS 0-100 Mean (SD)	Specific	1.9 (1-3)	2.5 (2-4)	2 (1-3)	P<0.005
			General	1.8 (0-3)	1.1 (0-3)	0.3 (0-3)	
	Physical Function:	DASH Reduction from baseline (median IQR)	Specific	3.7 (±20)	6.6 (±20)	-	Not significant
			General	11(±13)	9.1 (±18)	-	
	Global assessment:	-					
	ROM:	-					
	Strength:	Pinch in Kg Mean (SD)	Specific	2.4 (2-3)	2.5 (2-3)	2.7 (2-3)	
			General	4 (2-5)	4 (3-7)	4 (3-7)	
	Others:	APL Moment (Nm) Mean (SD)	Specific	1 (1-1.7)	1 (0.6-1.2)	0.9 (0.7-1.6)	
			General	2 (0.5-2.5)	2 (1-2.5)	2 (1.5-2.7)	
	Imaging:	-					
	Adverse Effects:	-					

Authors Conclusions:	Pilot study results can be used to power a future study. Improved APL strength at baseline was associated with better outcomes in both groups.
Notes:	Underpowered pilot study, groups not equal at baseline "General" exercise group had greater baseline strength. High rate of loss to follow up. Those lost to follow up had higher baseline VAS for pain. Pragmatic; other interventions allowed.

Study complete reference:	**Study type / Evidence level:**
Gomes Carreira, A. C.; et al. Assessment of the effectiveness of a functional splint for osteoarthritis of the trapeziometacarpal joint on the dominant hand: a randomised controlled study. J Rehabil Med 2010;42(5):469-74	Randomised Control Trial Moderate (+) Quality

Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Brazil **Centres:** single **Setting:** outpatient clinic hospital. **Funding Sources:** local foundation funding source – does not appear to be commercial	***n:*** 40 **Dropouts:** 0 **Mean age (years):** 64 **Gender (M:F):** 1/20 95% female **Incl. Criteria:** clinical & radiological CMCJOA, dominant hand affected, pain VAS > 3/10VAS **Excl. Criteria:** able to pinch/ grip, IPJ deformity, scheduled surgery, recent Rx, other hand pathologies. **Stage CMCJOA:** II/III	Two study groups: 1. Group 1 splint (TP MCPJ included) 6mo **(SG)** 2. Group 2 no treatment 3mo but splint for assessments, splint 3-6 months. Splints used during aggravating activities. **(CG)**

Outcome measures / Results:

Time points:			**Baseline** *Mean (SD)*	**3 Months** *Mean (SD), Significance*		**6 Months** *Mean (SD), Significance*	
Pain:	VAS (0-10), without splint	CG	5.1 (1.4)	5.2 (2)	p= 0.003	4.4 (2.5)	p=0.009
		SG	5.1 (1.1)	2.9 (2.2)		2.5 (2.6)	
Physical Function:	DASH Score. Scores given for Q1,2,3 separately, no totals, no significant differences from baseline to 6mo between either group, unable to judge if clinically significant changes within groups.						
Global assessment:	-						
ROM:	-						
Strength:	Grip (Kg)	CG	18.7 (6.8)	20.1 (6.2)	p=0.311	20.1 (5.2)	p=0.207
		SG	20.5 (7.7)	20.9 (6.4)		20.8 (5.3)	
	Pinch (Kg) T-Tip	CG	3.3 (1.2)	3.7 (1.1)	p=0.322	4.1 (0.9)	P=0.118
		SG	3.1 (0.9)	3.7 (1.2)		4.4 (1.3)	
Others:	Upper Limb Dexterity (O'Connor), in seconds	CG	357 (76)	341 (117)	p=0.255	322 (68)	P=0.316
		SG	359 (82)	310 (89)		296 (81)	
Imaging:	-						
Adverse Effects:	-						

Authors Conclusions:	This study concluded that the use of a thumb orthosis to the dominant hand during the performance of ADLs reduces pain experienced with Grade II–III TBOA. The clinical implications of this study are that, despite no change in functional measures, pain is decreased in the dominant hand of individuals wearing a CMC thumb stabilization orthosis. Not only did pain decrease in the study group, pain was also found to improve in the control group once the orthosis was applied for ADL performance. Splint has no impact on strength or dexterity but reduces key pinch strength when worn (NB. As the splint is molded into abduction opposition not adduction.
Notes:	Concerns: blinding of participants, no measure of splint adherence. Results apply to females, compliant with 4 attendances, using a rigid thermoplastic splint for symptomatic TBOA of grade II/ III, severe deformity which precluded grip or pinch were not included.

Study complete reference:		**Study type / Evidence level:**
Cantero-Tellez, R., et al. (2018). "Necessity of Immobilizing the Metacarpophalangeal Joint in Carpometacarpal Osteoarthritis: Short-term Effect." HAND **13**(4): 412-417.		Randomised Control Trial Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Spain **Centres:** single **Setting:** outpatient clinic **Funding Sources:** None	***n:*** 66 **Dropouts:** 5 **Mean age (years):** 64 **Gender (M:F):** 6:27, 5:28 **Incl. Criteria:** Radiologic and symptomatic TBOA VAS >4/10 **Excl. Criteria:** Any hand/ neuro condition, previous Rx in last 6 months, previous IA cortisone, MCPJ HE, anxiety & depression. **Stage CMCJOA:** 2/3	Two types of splint, each worn at night and for 3-4 hours per day. **Splint 1:** TP thumb spica ***including*** MCPJ **Splint 2:** TP thumb spica ***excluding*** MCPJ

Outcome measures / Results:	**Time points:**			Baseline	1 week	
	Pain	*VAS (0-100)*	Splint 1 (Inc. MCPJ)	77	46	NS between groups. Significant change from baseline.
			Splint 2 (Exc. MCPJ)	77	48	
	Physical Function:	*Quick DASH*	Splint 1 (Inc. MCPJ)	40	36	
			Splint 2 (Exc. MCPJ	42	36	
	Global assessment:	-				
	ROM:	-				
	Strength:					
	Others:	-				
	Imaging:	-				
	Adverse Effects:	-				
Authors Conclusions:	Both orthoses reduced pain and improved function in the short term.					
Notes:	Concerns: Excluded patients with MCPJ hyperextension and anxiety and depression, so Internally valid but limited generalisability. Unclear about concealment, allocation and blinding and drop outs. Changes in function did not meet clinical significance, high risk of performance, assessment, statistical bias (no sample size calculation), and no control group. Data in baseline table for groups was switched for table of analysis leading to concern over accuracy – the differences between groups was the same so it may not have affected the results but is a factor of concern.					

Study complete reference:	Study type / Evidence level:
Buhler M, Chapple CM, Stebbings S, Sangelaji B, Baxter GD. Effectiveness of splinting for pain and function in people with thumb carpometacarpal osteoarthritis: a systematic review with meta-analysis. Osteoarthritis Cartilage. 2018;11:11.	Systematic Review High (++) Quality

Study details:	Study / Patient characteristics:	Interventions / Comparators:
Country: New Zealand **Centres:** - **Setting:** - **Funding Sources:** Doctoral scholarship **Dropouts:** -	***n:*** 12 studies (1353) analysed **Mean age (years):** ranged 51-71 **Gender (M:F):** 77-100% female **Incl. Criteria:** all studies which investigate effectiveness of splinting for TBOA on pain, function/ Health Related QoL **Excl. Criteria:** Feasibility studies or post-surgery studies, those with high risk of selection bias. **Stage TBOA:** I-IV	Splint vs no splint Different splint types

Outcome measures / Results:	Time points:	0 – 3 months (SD, Mean difference & 95% CI)			3 – 12 months (SD, Mean difference & 95% CI)		
		Splint vs no splint N=221 4 studies	*Soft vs rigid N=224 3 studies*	*MCPJ vs no MCPJ N=422 6 studies*	*Splint vs no splint N=137 2 studies*	*Soft vs rigid N=224 3 studies*	*MCPJ vs no MCPJ N=84 1 study*
	Pain:	-0.24 (-0.6,0.12) NS	0.03 (-0.04,0.46) NS	-0.16 (-0.58, 0.25) NS	-0.7 (-1.04, -0.35) **p= 0.000** Favours splint	0.03 (-0.04,0.46) NS	-0.34 (-0.77, 0.09) NS
	Physical Function:	0.12 (-0.15,0.38) NS	0.05 (-0.21,0.32) NS	0.48 (-0.13,1.09) NS	-0.42 (-0.77, -0.08) **p= 0.02** Favours splint	0.05 (-0.21,0.32) NS	1.68 (1.18, 2.19) **p< 0.0001** Favours splint, not including MCPJ
	Global assessment:	-					
	ROM:	-					
	Strength:	-					
	Others:	-					
	Imaging:	-					
	Adverse Effects:	No major adverse events, one report of skin irritation.					

Authors Conclusions:	The current review supports the conclusion that splinting has medium to large effects for pain and small to medium effects for function in the medium-term, and further supports the conditional recommendation of international guidelines that splinting is an effective intervention for TBOA. Current evidence, however, derives from a small number of studies with small sample sizes and short periods of follow up. Thus, the overall quality of the existing evidence is low, and it is not possible to draw firm conclusions as to the effectiveness of splinting as an intervention.
Notes:	Good methodology for assessing risk of bias and then doing a sensitivity analysis and with those with greater risk of bias. Studies included: McKee 2006, Weiss 2000 & 2004, Canterro Tellez 2017 & 2018, Arazpour 2017, Rannou 2009, Hermann 2014, Van der Vegt 2017, Sillem 2011, Gomes & Carreira 2010, Becker 2013.

Study complete reference:		Study type / Evidence level:
Rivlin, M.; Beredjiklian, P. Comparison of custom-made versus prefabricated thumb splinting for carpometacarpal arthrosis: A Systematic Review and Meta-analysis. *Archives of Bone and Joint Surgery* 2018;6(6):478-485		Systematic review Moderate (+) Quality
Study details:	**Patient / Study characteristics:**	**Interventions / Comparators:**
Country: Iran **Centres:** - **Setting:** - **Funding Sources:** - **Dropouts:** -	***n:*** 230 (5 studies) **Mean age (years):** 61 (4 studies not identified in Weiss) **Gender (M:F):** 49/181 **Incl. Criteria:** Prospective, RCT's, patients over 18-years of age and with follow up times of > 1 month. There were no limitations for time period & language. **Excl. Criteria:** All other study types **Stage CMCJOA:** **Bani 2013** Grade 1& 2- Clinical & radiological + pain at base of thumb **Weiss 2004** Grade 1-2 Clinical & radiological **Silem 2011** No grading clinical diagnosis- No grade detail **Becker 2013** Clinical diagnosis –No grade details **Vegt 2017** Clinical and diagnosis. Grades 1-2stratified into 1 group 3-4 another	The included studies considered the following comparisons: • Comfort cool versus custom (MCP & IP free) *C/Over* • Comfort cool versus hybrid (Neoprene covered with Orfit MCP & IP free) *C/over* • Comfort cool versus custom (HB TP MCP included IP free) • Comfort cool versus custom TP Orfit 1.6 lined with plastazote (? MCP & IP free) similar to hybrid design *C/Over* • Custom thumb spica (MCP included) vs. push splint (Not a soft material) • Overall: Custom vs. prefabricated

Outcome measures / Results:		
	Time points:	Mean follow up 8.1 weeks
	Pain:	Standard diff in mean (95% CI) level of significance Meta-analysis: 4 studies n=205 No difference between the two splints -0.711 (-1.484, 0.062) p=0.425
	Physical Function:	DASH, AUSCAN, Functional Hand Index for OA In favour of prefabricated splints –0.3 (-0.53, -0.08) p= 0.008
	Global assessment:	-
	ROM:	-
	Strength:	Among five studies that reported pinch strength, one was excluded by leave-one-out cross-validation technique. **Pinch strength**: No significant difference between the two groups -0.37 (-0.86,0.13) (P=0.15) **Grip strength:** No significant difference between the two groups –0.09 (-0.3, 0.1) (P=0.42)
	Others:	-
	Imaging:	-
	Adverse Effects:	-
Authors Conclusions:	The results of the pooled data demonstrated only a statistically significant difference in disability scores among splints in favour of the prefabricated splints. The rest of the outcome measures consisting of pain, grip strength, and pinch strength were not statistically different	
Notes:	Reinforced view that splints in general reduce pain, improve pinch power, grip strength and function in BTOA in short to medium follow up. Splint design and material of custom splints varied, with one of these being a hybrid design. Low quality - as the study types available were not ideal to answer the question. With 4/5 as cross over studies with short time scales (mean 8.1 weeks) we cannot be certain that the results were due to a particular splint type, to meta-analyse these as 2 distinct groups seems at high risk of bias for anything other than immediate effects of splint use. Generally prefab splints less costly but not all i.e., PUSH splint.	

Study complete reference:	Study type / Evidence level:
Sillem, H.; Backman, C. L.; Miller, W. C.; Li, L. C. Comparison of two carpometacarpal stabilizing splints for individuals with thumb osteoarthritis. *J Hand Ther 2011;24(3):216-25; quiz 126; discussion 227-30*	Randomised trial with crossover Low (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Canada **Centres:** 3 **Setting:** Outpatient **Funding Sources:** - **Dropouts:** 2	***n:*** 56 **Mean age (years):** 64 (45-84) **Gender (M:F):** 5:51 **Incl. Criteria:** English speaking, 45+ years Clinical diagnosis CMCJOA **Excl. Criteria:** Previous thumb surgery, concomitant neurological diagnosis, OA wrist. **Stage CMCJOA:**	Two types of splints: **Comfort cool** prefabricated neoprene vs. Custom made **"Hybrid"** splint Splints to be worn heavy tasks, when symptomatic and at night as required The patients received the first splint on their initial (baseline) visit. At 4 weeks, the first splint was returned, followed by a one-week washout period. The second splint was received at the 5-week visit. At 9 weeks (Baseline + 4/52 for the second splint), the patient was allowed both splints and a telephone review was conducted at 12-weeks.

Outcome measures / Results:

Time points:		Baseline	4-week Review	*Mean Difference*	*95% Confidence Interval, Significance*
Pain:	***AUSCAN***				
	Comfort Cool	27.84	25.78	2.05 (9.54)	(-0.53, 4.63), 0.12
	Hybrid	27.67	21.98	5.69 (11.08)	(2.66, 8.71), <0.001
Physical Function:	***AUSCAN***				
	Comfort Cool	53.09	50.40	2.69 (16.33)	(-1.7,7.1), 0.23
	Hybrid	52.67	47.13	5.54(17.37)	(0.8, 10.28), 0.02
Global assessment:	-				
ROM:	-				
Strength:	***Grip (Kg)***				
	Comfort Cool	18.7	18.54	-0.37 (4.14)	(-1.5, 0.76), 0.51
	Hybrid	18.43	19.25	-0.83 (3.80)	(-1.88, 0.22), 0.12
	Lateral Pinch (Kg)				
	Comfort Cool	4.40	4.72	-0.33 (1.84)	(-0.83,0.18), 0.20
	Hybrid	4.40	4.60	-0.21 **(**1.14)	(-0.52, 0.10), 0.19
Others:	Patient satisfaction: 63% preferred comfort cool pre-fabricated splint				
Imaging:	-				
Adverse Effects:	-				

Authors Conclusions:	Hybrid and comfort cool had equivalent effect on hand function and grip strength and lateral pinch, Hybrid greater at decreasing pain, 63% preferred prefabricated.
Notes:	This study has a short follow-up of just 4 weeks, during which time neither splint demonstrated an improvement greater than the minimally clinically important difference of 7.46 points on the AUSCAN. Subgroup analysis reveals greater improvements in those with affected dominant hand, with 10.62 points on AUSCAN, therefore clinically relevant. Absence of a control group without splint. At 3 months, 40 of 44 patients (91%) continued to use their splints, suggesting perceived patient benefit. 1/52 washout period not proven too short as likely carry over effect from one splint to another. Variables during treatment not monitored i.e., Medication 25/45 used medication for symptoms, little detail on who assessed eligibility and randomised. Therapists not blinded to splints or outcome measure.

Study complete reference:	Study type / Evidence level:
Van Der Vegt, A. E.; Grond, R.; Gruschke, J. S.; Boomsma, M. F.; Emmelot, C. H.; Dijkstra, P. U.; Van Der Sluis, C. K. The effect of two different orthoses on pain, hand function, patient satisfaction and preference in patients with thumb carpometacarpal osteoarthritis a multicentre, crossover, randomised controlled trial. Bone and Joint Journal 2017;99-B(2):237-244 2017	Crossover Randomised Controlled Trial Low (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Holland **Centres:** 1. 3 Centres: 2. Isala Hospital, Zwolle, 3. University Medical Center Groningen 4. Medical Center Leeuwarden **Setting:** 3 Hospitals 14 hand therapists **Funding Sources:** Push splints provided by NEA (no involvement in trial) **Dropouts:** 4/63	***n:*** 63 **Mean age (years):** 61.1 **Gender (M:F):** 44/63 **Hand Dominance:** Right 55, Left 5, Both 3 **Incl. Criteria:** 18yrs+ Clinical diagnosis CMCOA by Clinical history, Examination radiograph. Mild STT but symptomatic TM OA **Excl. Criteria:** Secondary CMCOA, previous surgery CMCOA or steroid inj. preceding 6/12, RA, CTS, Radiocarpal OA, STT OA (primary), severe cognitive disorders, previous use of orthoses designs used in trial or an inability to understand Dutch. **Stage TBOA:** Eaton & Glickel grades 1-4. Subdivided into Stages 1 or 2 (*Group 1)* and Stages 3 or 4 (*Group 2).* • **Group 1:** *n=* 27 *[Stage 1 n=6; Stage 2, n=21]. 1 Dropout.* *First splint PB=14, First splint CM n=13* • **Group 2:** *n=* 36 *[Stage 3 n=25; Stage 4, n=11]. 3 Dropouts.* *First splint PB n=19, First splint CM=17*	Two types of splints: Off the shelf "Push brace" (**PB)** and Custom-made thumb spica **(CM)**. Each worn for two weeks with 2/52 washout then swap design for further 2/52: - **Baseline:** Splint provided and initial assessment and scores. - **2/52** Follow-up assessment and returning of splint for washout period. - **4/52** Provision of 2nd splint and assessment - **6/52** Assessment

Outcome measures / Results:

Time points: ***Results shown for 2/52 before crossover***

		Baseline Pre-Push Brace	Post Push Brace	Baseline Pre-Custom	Post Custom	Significance *(p=)*
Pain:	**VAS (0 – 10)**	3.5 (2.0)	3.2 (2.0)	3.9 (2.1)	3.6 (2.1)	0.573
Physical Function:	**FIHOA**	9.7 (5.9)	8.8 (5.9)	9.6 (6.2)	9.6 (5.9)	0.184
Global assessment:				-		
ROM:	-					
Strength:	**Key grip (Kg), no orthosis**	6.2 (3)	6.0 (2.7)	6 (2.8)	6.2 (2.8)	0.134
	Key grip (Kg), with orthosis	5.9 (2.8)	6 (2.7)	5.2 (2.3)	5.3 (2.3)	
	Key pinch reduced when wearing splint. Mean difference 0.6kg p<0.001 Greater with custom splint (0.9kg) than PB (0.4kg)					

Others: **Splint satisfaction (D-Quest):** 8-40 pts (40=Maximum satisfaction): Greater satisfaction with PB than CM: 68% preferred PB, 13% CM and 19% either (mean difference 7 points p<0.001). PB worn 1.9 hours longer than CM (p<0.001). Ninety percent indicated that they would continue to use a splint following completion of the study.

Patients with CM felt more impaired in daily activities than those with the PB (4.7 versus 2.8 points). Impairments more pronounced at beginning of wearing period then reduced for the CM whilst impairment with PB remained fairly stable over time

Imaging: Radiographic stage considered: No significant difference found between patients with Eton-Glickel Stage 1 or 2, and Stage 3 or 4 except for analysis of splint wear diaries. Orthosis wear in patients with Stage 1 or 2 decreased from 7.3 to 6.6 hours by completion of follow-up, whilst patients with Stage 3 or 4 increased their average wear hours from 8.8 to 9.7 hours (p=0.008).

Adverse Effects: One patient suffered temporary skin reaction due to thermoplastic material of CM splint, which resolved on cessation of splint.

Authors Conclusions:

In general patients were satisfied with the splints, and both splints provide a minor reduction in pain.

Though most patients may prefer the Push splint, recorded differences for dexterity and key grip strength in favour of the push splint were small and probably not clinically relevant.

Notes:

Pain reduction minimal using an orthoses with no difference between the two selected splints. Only design difference in splints was MCP included in one and not in the other, both are rigid. Short splinting and washout period, no control group. Therapy effects mentioned but no details to what the therapy was included. Selection bias raised as a possible concern, as no information provided on patients who refused to participate . Study not sufficiently powered to detect small differences. Unclear if PIs who were the assessors and unblinded to allocation were also those delivering the intervention and whether they had access to other data e.g. OA grade, pain levels etc.

Study complete reference:	**Study type / Evidence level:**
Villafane, J. H.; Cleland, J. A.; Fernandez-de-Las-Penas, C. The effectiveness of a manual therapy and exercise protocol in patients with thumb carpometacarpal osteoarthritis: a randomised controlled trial. *J Orthop Sports Phys Ther 2013;43(4):204-13*	Double-Blind Randomised Control Trial Moderate (+) Quality

Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Italy **Centres:** Department of Physical Therapy. Residenza Sanitaria Assistenziale "A. Maritano," Sangano, Italy; Department of Physical Therapy. **Setting:** Private practice **Funding Sources:** **Dropouts:**	***n:*** 60 **Mean age (years):** 82 **Gender (M:F):** 3/37 **Incl. Criteria:** A history of repetitive use of their dominant hand (eg, former factory worker) Diagnosis of stage III or IV secondary CMC joint OA in the dominant hand, according to the Eaton-Littler-Burton classification system based on radiographic findings. **Excl. Criteria:** Greater than 4 points on the Beck Depression Inventory55 or greater than 30 points on the State-Trait Anxiety Inventory.1 Patients with a medical history of carpal tunnel syndrome, surgical interventions to the first CMC joint, De Quervain tenosynovitis, bilateral symptoms, or degenerative or non -degenerative neurological conditions in which pain perception was altered were excluded. No previous Rx for CMC OA. **Stage TBOA: -**	Two groups receiving 12 sessions over 4 Weeks: 1. **Experimental group (30)** Multi-modal Rx: • joint mobilisation, • neural mobilisation, • exercise including grip (Rogers & Wilder) 2. **Placebo group (30):** same number of treatment sessions and of similar duration, but only received inactive doses of pulsed ultrasound

Outcome measures / Results:

Time points: Baseline, 4-weeks, 8-weeks.

Pain:

VAS on Key Grip (0-10)	**Pre**	**Post**	**4-Weeks**	**8-Weeks**
Experimental Group	5.0 ± 0.3	1.9 ± 0.3 p<0.05	1.5 ± 0.2 p<0.05	1.5 ± 0.2 p<0.05
Placebo Group	5.0 ± 0.2	4.9 ± 0.2	4.4 ± 0.3	4.4 ± 0.3
Between group difference	0.0 **(–0.1, 0.2)**	3.0 **(2.6, 3.8**)	2.9 **(2.2, 3.7)**	2.9 **(2.3, 3.8)**

Between-group differences for pain improvements and the lower bound estimate of the 95% CI exceeded the reported minimal clinically important difference of 20mm.

Physical Function: -

Global assessment: -

ROM: -

Strength: The treatment approach did not produce clinically meaningful change in pinch and grip strength

Others: PPT (Pressure pain thresholds) - No difference between groups for PPT.

Imaging: -

Adverse Effects: -

Authors Conclusions: The application of a multimodal manual therapy intervention of joint mobilisation, neural mobilisation, and exercise is beneficial to reduce pain in patients with CMC joint OA. No changes in PPT and motor function were observed

Notes:

Short follow up only.
No functional outcomes assessed.
Provides evidence that multimodal intervention consisting of joint mobilisation, neural mobilisation, and exercise is beneficial to reduce pain in patients with TBOA.
The treatment approach did not produce clinically meaningful change in PPTs or pinch and grip strength.
Higher scoring patients for pain and depression scores excluded (Select group of patients with no other significant co-morbidities).

Study complete reference:	Study type / Evidence level:
Weiss, S.; Lastayo, P.; Mills, A.; Bramlet, D. Splinting the degenerative basal joint: custom-made or prefabricated neoprene? J Hand Ther 2004;17(4):401-6	Randomised crossover trial. Not blinded. Low (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: USA **Centres:** **Setting:** Hand Centre **Funding Sources:** Grant from AAHS **Dropouts:** None reported.	***n:*** 25 **Mean age (years):** Not reported. **Gender (M:F):** 4:21 **Incl. Criteria:** Stage1/2 Eaton Littler **Excl. Criteria:** No concomitant hand diagnoses e.g., CTS, DeQuervain's, STT arthritis) **Stage CMCJOA:** Stage 1 (*n*=15), Stage 2 (*n*=10).	A custom made thermoplastic short opponens splint (CMT) B prefabricated neoprene splint (PFN)

Outcome measures / Results:

Time points: Three Visits: Baseline, 1-Week follow-up with assessment and splint swap 2-Week assessment.

Pain:

	Baseline whole group	1 week CMT	1 week PFN
Pain at rest (VAS)	5.42 (0.48)	3.59 (0.44) p<0.05	2.29 (0.33) p<0.05
Pain during pinch with splint (VAS)	3.46 (0.57)	2.84 (0.49)	1.88 (0.32) p<0.05

Physical Function:

Activities of Daily Living (%)	***Less Difficult***	***No Difference***	***More Difficult***
CMT	26%	41%	33%
PFN	48%	40%	12%

Global assessment: -

ROM: -

Strength:

	Baseline whole group	1 week CMT	1 week PFN
Pinch Strength, with splint (Kg)	3.40 (0.36)	3.10 (0.34)	3.70 (0.36)

Others:

Splint Satisfaction Rating (VAS)	-	4.9 (0.43)	7.5 (0.45)

Splint Preference: 24% Custom Made Thermoplastic (CMT); 72% Prefabricated Neoprene (PFN)

Reasons given: Support – 35%; Pain relief – 29%; Ease of application – 22%; Appearance – 14% ; No preference – 8%

Imaging: -

Adverse Effects: -

Authors Conclusions:

Splinting continues to be an effective treatment technique for relieving pain, controlling subluxation forces, and improving (or at least not inhibiting) activities of daily living for patients with stage 1 and 2 TBOA. Although both short opponens splints seem to be effective, a simple PFN splint can be used with confidence because CMCJ-OA patients prefer the CMC and MPJ soft neoprene splint to the hard CMT CMC splint.

Neither splint improved pinch strength when not wearing splint

Notes:

Small sample numbers and no sample size calculation suggests this study is likely to be underpowered. Short time periods of 1 week splint wear 1 week washout- cannot assume the first splint did not influence pain relief provided by the second. No placebo group; cannot assume pain relief is not to attention and being part of a study. Physical function assessment does not make use of a validated tool. Does not state if patients having any other treatments that may have influenced pain response etc. (therapy or medication). No blinded assessors, insufficient details on assessments e.g. detail of protocols for strength testing.

Study complete reference:	Study type / Evidence level:
Wajon A, Ada L. No difference between two splint and exercise regimens for people with osteoarthritis of the thumb: A randomised controlled trial. Aust J Physiother. 2005;51:245–9.	Randomised Control Trial Low (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Australia **Centres:** Hand therapy at Hornsby/School of Physiotherapy University of Sydney **Setting:** Hand Therapy practice **Funding Sources:** -	***n:*** 40 **Dropouts:** 6 **Mean age (years):** Experimental Group = 59.7 Control Group = 61.2 **Gender (M:F):** Experimental Group = 5:14. Control Group = 4:17 **Incl. Criteria:** Pain at base of thumb and grades I-III TMCOA. If no Radiographic images diagnosed clinically with palpation and grind test **Excl. Criteria:** Additional diagnoses of DeQuervain's, CTS, Scapholunate instability or trigger thumb, or treatment with steroid injection in preceding 6/52 or previous surgery for TMCOA. **Stage CMCJOA:** thumb and grade I-III	Two different splint and exercise regimes: **Control group:** TP Opponens thumb splint +pinch exercises - Weeks 0-2: Opponens thumb splint including MCP. Full time wear – removable for hygiene purposes only - Weeks 2: Continue splint + start pinch exercise regimen - Week 4: Splint + exercises checked - Week 6: Patients are discharged with advice on joint protection, splint regimen and exercise performance **Study group:** TP Thumb strap + Abduction exercises - Weeks 0-2: Wore thumb strap full time - Weeks 2-6: Continued with splint removing for palmar abduction exercises - Week 4: Splint + exercises checked - Week 6: Discharged with joint protection advice to wear splint aggravating activities and continue exercising

Outcome measures / Results:

Time points*:		Baseline		Week 6		
		Study Group (*n*=19) *Mean (SD)*	Control (*n*=21) *Mean (SD)*	Study Group (*n*=18) *Mean (SD)*	Control (*n*=16) *Mean (SD)*	Mean difference, (95% CI)
Pain:	**Pain VAS (0-10)**	3 (1.9)	2.9 (2.2)	1.3 (2.2)	0.9 (1.2)	0.5 (-1.1, 2)
Physical Function:	**Dexterity: Sollerman (/80)**	67.9 (6.5)	69.7 (3.9)	74.8 (6.1)	75.6 (3.3)	0.7 (-3.6, 5)
Global assessment:	-					
ROM:	-					
Strength:	**Pinch: tip to tip (kg)**	4 (1.8)	3.5 (1.4)	4.7 (2.2)	4 (1.7)	0.1 (-0.8, 0.9)
Others:	-					
Imaging:	-					
Adverse Effects:	-					

Authors Conclusions:

No greater effect of experimental intervention on decrease in pain, increase in strength or function by 6-week follow-up.

Although there was no difference between groups both improved by 6 weeks in all parameters, When both groups considered together pain decreased by mean of 2.1cm on VAS (95% CI -2.8to -1.3, *p=<0.01).* Strength increased by mean of 0.6 kg of tip pinch strength (95% CI 0.2 to 1.0,*p*<0.01). Sollerman scores improved by a mean of 6.5 points (95% CI 4.4 to 8.6, *p*=<0.01)

Notes:

Key issues are statistical re sample size (Under powered no sample size calculation) loss to follow up and no ITT analysis. Randomization not detailed although states done by independent assessor. No patient rated outcomes of function in their life or measures of quality of life. Changes were small, follow up short (6 weeks). Differences were achieved but they size of effect was not clinically significant; the confidence intervals were wide for the size of change observed.

**For clarity only baseline and 6-weeks visits are demonstrated here. Two- and Four-Week visits omitted.*

Study complete reference:	Study type / Evidence level:
Hermann, M.; Nilsen, T.; Eriksen, C. S.; Slatkowsky-Christensen, B.; Haugen, I. K.; Kjeken, I. Effects of a soft prefabricated thumb orthosis in carpometacarpal osteoarthritis. Scand J Occup Ther 2014;21(1):31-9	Randomised Control Trial Moderate (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Norway **Centres:** Single Centre **Setting:** Hospital **Funding Sources:** **Dropouts:** 4 (3 due to other significant medical problem)	***n:*** (55 analysed**)** **Mean age (years):** 70.5 **Gender (M:F):** 1:58 **Incl. Criteria:** HOA diagnosed by a physician ACR criteria, thumb pain on palpation, and ability to communicate well in Norwegian. **Excl. Criteria:** previous thumb surgery, cortisone injection during the last two weeks before inclusion, other diseases that could have an impact on hand function, and cognitive deficits. **Stage TBOA:** Mean 15.2 years disease duration – over 30% KL grade 3 or more Presence of subluxation: Right 16 (34.8%), Left 28 (59.6%)	Two study groups: - Group 1: Control group (*n*=29): Hand exercises - Group 2: Intervention/orthosis Group (*n*=30): Splint (Hand based soft fabric wrap) + exercises Exercise Regime: 4x Exercises twice daily.

Outcome measures / Results:

Time points: Baseline and 8/52 Follow-up.

Pain:

	Orthosis group *Mean change, 95% CI & p-value (n=28)*	Control group *Mean change, 95% CI & p-value (n=27)*	Adjusted mean difference between groups **(95% CI)**
Pain during grip right hand (NRS 0-10)	-0.08 (-0.9, 0.8) *p*=0.85	0.4 (-0.8, 0.6) *p*=0.53	0.08 (-1.2, 1.4)
Pain during grip left hand	0.5 (-1.4, 0.5) *p*=0.31	-0.4 (-1.7,0.8) *p*=0.47	0.17 (-1.2, 1.6)
Pain during pinch right hand	-0.3 (–1.2, 0.7) *p*=0.54	-0.2 (–1.4, 0.96) *p*=0.73	0.09 (–1.2, 1.4)
Pain during pinch left hand	0.3 (–1.5, 0.9) *p*= 0.6	0.3 (–1.5, 0.9) *p*=0.82	–0.3 (–1.7, 1.2)

Physical Function: -

Global assessment: Qualitative data on when patients felt splints useful or not: 17 were satisfied with the orthosis design, while 11 reported that they would prefer an orthosis which gave more support.

ROM: -

Strength:

Grip strength right hand (kg)	2.8 (–11.1,16.7) *p*=0.68	1.4 (–15.7,18.6) *p*=0.86	1.0 (–21.8,19.8)
Grip strength left hand (kg)	1.5 (–13.2, 16.2) *p*=0.83	5.9 (–11.7, 23.6) *p*=0.49	–4.4 (–27.5, 18.6)
Pinch strength right hand (kg)	–0.7 (–3.8, 2.5) *p*=0.66	–0.8 (–4.9, 3.4) *p*=0.71	–0.9 (–5.9, 4.1)
Pinch strength left hand (kg)	–0.7 (–3.8, 2.5) *p*=0.66	–0.8 (–4.9, 3.4) *p*=0.71	–0.9 (–5.9, 4.1)

Others: -

Imaging: -

Adverse Effects: -

Authors Conclusions: A soft prefabricated orthosis seems to have an immediate pain-relieving effect during use, but no effects in terms of less hand pain, or improved strength or activity performance when not worn.

Notes: Pragmatic study of soft splint without trying to add any other specific treatment regimen, a significant proportion of patients would have preferred greater support and TP maybe preferable for activities in which the hand would get wet. No formal recording of splint use. Qualitative data gathered retrospectively and not via a daily diary potentially inaccurate. Analgesia not monitored, possible impact of steroids administered prior to trial, as only 2/52 exclusion. Therapists and patients not blinded (may reduce accuracy of information). Pain scores at rest are not reported.

Study complete reference:		Study type / Evidence level:
Meireles, S. M.; Jones, A.; Natour, J. Orthosis for Rhizarthrosis: A systematic review and meta-analysis. Semin Arthritis Rheum 2018;31():31		Systematic review of RCTs and crossover RCT Moderate (+) Quality
Study details:	**Study inclusion criteria:**	**Interventions / Comparators:**
Country: Brazil **Centres:** **Setting:** **Funding Sources:**	Randomised controlled trials involving subjects with rhizarthrosis classified using clinical and radiological criteria, in which orthosis was used for treatment, compared with individuals without orthosis or other rehabilitation interventions, as well as studies that compared different types of orthosis. Fourteen studies were analysed (combined n=668) and were included in the qualitative synthesis, with 3 studies deemed sufficiently homogenous to form the basis for a qualitative synthesis (meta-analysis) with inclusion of a total of 222 patients (between 141 and 203 per subgroup).	This systematic review identified studies with significant heterogeneity amongst the investigated orthosis types. Included comparisons were: - OT care along with a biomechanically active splint vs. OT care with a biomechanically inactive (placebo) splint - Custom made thermoplastic thumb splint vs. Control group: no intervention - Custom made thumb splint / Prefabricated thumb splint vs. control group: No intervention - Prefabricated neoprene thumb TMC restriction splint vs. Customized thermoplastic hand-based thumb spica splint - Technical accessories plus semi-stable textile splint vs. technical accessories plus non- stabilizing leather splint - Thermoplastic polyethylene semi-rigid thumb splint vs. Firm elastic material thumb splint vs. Supple elastic material thumb splint - Soft, elastic fabri-foam covering the wrist, the CMC joint, and the MCP joint of the thumb, reinforced with extra material on the volar side of the thumb to give extra support to the TMC joint vs. control with no splint. Both groups received instructions on hand exercises - Intervention group: Assistive devices and/or splints vs. control group: no intervention. Both groups received information about hand osteoarthritis - Intervention group: Custom made neoprene splint vs. Control group: Usual care

Outcome measures / Results:	**Time points:**	Variable.
	Pain:	VAS: **Pain short term <45 days**: The meta-analysis for the pain variable in the short term with 141 patients (2 studies), indicated that there was no statistically significant difference between the orthosis & usual care control groups and a small effect size (Effect size - 0.29, CI 95% -1.00 to 0.42, p=0.42), I^2=73%). **Pain Long term > 3 months:** n= 203 (3 studies) indicated that the group using orthoses had a reduction in pain compared with the control group (no or usual care), with a statistically significant difference and a medium effect size (Effect size -0.52, CI 95% -0.94 to -0.11, p=0.01), I^2 = 50%]
	Physical Function:	Variety of functional scores employed: AUSCAN, Michigan, DASH, Cochin HFS, COPM, Hand dexterity O'Connor test. **Short term function results:** The meta-analysis for the function variable in the short term, with 141 patients (2 studies), indicated that there was no statistically significant difference between the groups and a small effect size (Effect size 0.11, CI 95% -0.22 to 0.44, p=0.53), (^{2}=0%]. **Long term function results**: The meta-analysis for the function variable in the long term, with 201 patients (3 studies), indicated that the group that used orthosis had an improvement in function compared with the control group, with a statistically significant difference and a medium effect size (Effect size -0.44, CI 95% -0.72 to -0.15, p=0.002), I^2=0%)
	Global assessment:	-
	ROM:	-
	Strength:	Jamar hydraulic dynamometer, pinch strength measured with a pinch gauge. **Pinch short-term:** The meta-analysis for the pinch strength variable in the short term, with 142 patients, indicated there was no statistically significant difference between the groups and a very small effect size (Effect size - 0.02, CI 95% -0.35 to 0.31 p =0.91), I^2=47%). **Pinch long-term**: The meta-analysis for the pinch variable strength in the long term, with 136 patients (2 studies), indicated there was no statistically significant difference between the group that used orthoses and the control group with a small effect size (Effect size-0.18, CI 95% - 0.52 to 0.16, p=0.30), I^2=0%]
	Others:	Quality of life (Short Form 36 Health Survey Questionnaire) Inflammation, stiffness, patient satisfaction (Likert scale), use of analgesics.
	Imaging:	-
	Adverse Effects:	-
Authors Conclusions:	The orthosis for rhizarthrosis presents low-quality evidence for reducing pain in the long term and moderate evidence for an increase in function in the long term. Also stated: *Since imprecision and inconsistency of the data were aspects which influenced the quality of the evidence, future studies with larger samples and standardized data are needed.*	
Notes:	• No side effects so splints are safe. NB short term • Low quality evidence for pain reduction short and long term (most 3 /12, some 6 /12, 1x 1yr) • Moderate evidence for an increase in function long term. • No difference concerning function and pinch strength (long- and short-term) • Heterogeneity was assessed and only low risk of bias homogenous studies were used in meta-analysis. 3 studies in meta-analysis had low risk of bias	

Study complete reference:	**Study type / Evidence level:**
Rannou, F.; Dimet, J.; Boutron, I.; Baron, G.; Fayad, F.; Mace, Y.; Beaudreuil, J.; Richette, P.; Ravaud, P.; Revel, M.; Poiraudeau, S. Splint for base-of-thumb osteoarthritis: a randomised trial [Summary for patients in Ann Intern Med. 2009 May 19;150(10):I-34; PMID: 19451557] Ann Intern Med 2009;150(10):661-9	Randomised Control Trial Moderate (+) Quality

Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: France **Centres:** Cochin Hospital [Contributed 79 patients: Intervention 40, Control 39] Lariboisiere Hospital Paris [Contributed 33 patients: Intervention 17, Control 16] **Setting:** Tertiary care hospitals **Funding Sources:** Programme Hospitaalier de Recherche Clinique National **Dropouts:** 14 (13%)	***n:*** 112 **Mean age (years):** 63.0 (7.9) **Gender (M:F):** **Incl. Criteria:** Pain @base of thumb >30mm on VAS • Radiographic evidence of @ least 2/4 items (osteophytes, joint space narrowing, subchondral bone sclerosis, subchondral cysts) • At least 1of TM joint enlargement or decreased first web space at TM **Excl. Criteria:** Post traumatic OA, crystal arthritis, inflammatory arthritis, neurologic disorder in past 2/12, Previous hand surgery, Collagen diseases (Dupytrens Marfans Ehlors-Danlos) Hand or wrist infiltration within 2/12 skin disease interfering with wearing the splint. Previous splint for basal thumb OA, bilateral OA base thumb with no predominant symptomatic side, psychiatric disorder needing treatment in past 3/12. Inability to speak French, Pregnancy. **Stage CMCJOA:**	Two study groups: Splint versus "Usual Care" 1. Splint group: Custom fabricated X-lite splint not neoprene as stated) or usual care, worn at night only. 2. Usual care group – no details provided by GP/Rheumatologist

Outcome measures / Results:

Time points: Baseline, 1-month, 6-month and 12-months.

		Splint Group	**Control Group**	**Mean Difference between groups, (95% CI), Significance (*p=)***
Pain:	VAS 0-100			
	Mean change at 1 month (±SE)	-10.1 (±3)	-10.7 (±3.3)	0.6, (-07.9 to 9.1), 0.89
	Mean change at 12 months (±SE)	-22.2 (±3.2) (N = 52)	-7.9 (± 3.5) (N = 45)	-14.3, (-23.4 to -5.2), **0.002**
Physical Function:	Function CHFS (range, 0–90)			
	Mean change at 1 month (± SE)	1.3 (± 1.4) (N=54)	-0.3 (± 1.5) (N = 47)	1.6, (-2.3 to 5.5), 0.42
	Mean change at 12 months (± SE)	-1.9 (± 1.6) (N = 49)	4.3 (±1.7) (N = 46)	-6.3, (-10.9 to -1.7), **0.008**
Global assessment:	Patient perceived disability VAS 0-100			
	Mean change at 12 months (±SE)	-11.6 (±3.1) (N= 51)	1.5 (±3.4) (N = 46)	-13.1, (-21.8 to -4.4), **0.003**

ROM: No significant changes within or between groups

Strength: No significant changes within or between groups

Others: -

Imaging: Kallman score no significant changes within or between groups

Adverse Effects: No adverse effects from splint reported

Authors Conclusions: In this randomised trial, nighttime splinting had no effect compared with usual care after 1 month, but it clinically significantly reduced patients' pain and disability after 12 months.

Notes: Patients, assessors and health providers not blinded to the study intervention. Slightly underpowered 112/120. Limited information as to what usual care entailed. Use of co-interventions higher in control group which could have reduced the apparent treatment effect attributable to the splint alone. *Study states splint is neoprene but the picture shows a rigid thermoplastic material (X-lite).*

Study complete reference:	Study type / Evidence level:
Can, A,. Tesel, N,. The effects of hand splinting in patients with early-stage thumb carpometacarpal joint osteoarthritis: a randomised, controlled study. Turkish Journal of Medical Sciences. 2020 Jun 15 UI 32536106	Randomised Control Trial Low (-) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Turkey **Centres:** Single **Setting:** Out-patient hand clinic **Funding Sources:** **Dropouts:** 17/80 (21%)	***n:*** 66 (80 hands) **Mean age (years):** Not stated **Gender (M:F):** Not stated **Incl. Criteria:** Clinical & radiological diagnosis CMC OA **Excl. Criteria:** Prior treatment CMCJOA 6/12, post traumatic OA, prior hand surgery, other hand conditions, PVD, pregnancy, skin conditions, cognitive dysfunction. **Stage TBOA:** CMCJOA: 1&2	Two study groups: 1) Splint group: prefabricated CMC-MCP short opponens splint, in abduction with MCPJ at 15 degrees flexion, constant use 3/52, then for aggravating tasks 3/52. Task Modification education 2) Non-splint – oral information on how to accommodate ADLs

Outcome measures / Results:

Time points: Baseline. 6-Weeks.

		Baseline (Splint)	Baseline (No Splint)	6-Weeks (Splint)	6-Weeks (No Splint)
Pain:	VAS, not reported	-	-	-	-
	AUSCAN (mean SD)	13.5 (3.7)	13.7 (4.1)	7.3(4.1)	12.3 (5.3)
Physical Function:	AUSCAN	24.1 (7.8)	23.1 (7.6)	11.8 (7.2)	20.4 (9.4)
	QDASH	53.2 (16.1)	48.2 (18.3)	25.2 (15.8)	44.6 (22.6)
Global assessment:	-				
ROM:	Kapandjii opposition	9. 5(1.6)	9.8 (0.4)	9.5 (1.2)	9.8 (0.4)
Strength:	Grip Jamar (kg)	14.3 (6.7)	13.8 (5.7)	17.2 (6.6)	14.1 (5.8)
	Lat pinch (kg)	6.4 (1.9)	6.2 (1.9)	7.8 (2.7)	6.1 (2.2)
Others:	NHP (quality of life)	375.9 (±175.9)	309.1 (±151.1)	257.8 (±142.1)	273.1(±156.4)

Imaging: -

Adverse Effects: -

Authors Conclusions: Splint is effective for improving pain, function, grip strength, pinch strength and QoL at the end of 6 weeks, future studies with larger sample size and longer follow up are needed. Reports statistically significant changes from baseline to 6 weeks within the splint group but not the no splint group for pain, function pinch and grip strength and quality of life. No analysis of the differences between the groups.

Notes: Limited detail about recruitment and concealment of allocation, no blinding. 5 hands were lost from the splint group and 12 from the non-splint group – number of people? No ITT, how can you use 2 hands and measure separately and is the sample size met if analysis was per person?

They used VAS scale for pain to determine sample size and then did not use this as an outcome measure – 2 points VAS, would this equate to 4 points on the AUSCAN? The difference between the groups was 5 points so this may be fine but it is not clear. It says the authors called the patients weekly to evaluate adherence to the splint; it is unclear whether or not the non-splint group received weekly phone calls.

Study complete reference:	**Study type / Evidence level:**
Adams J, Barratt P et al. The clinical and cost effectiveness of splints for thumb base osteoarthritis: a randomised controlled clinical trial. Rheumatology 2020;00:1–16	Randomised Control Trial High (++) Quality

Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: UK **Centres:** 17 **Setting:** NHS **Funding Sources:** UK versus Arthritis grant **Dropouts:** 45 (13%) withdrew from trial, of which 16 from splintage group.	***n:*** 349 **Mean age (years):** 62.6 **Gender (M:F):** 75:274 **Incl. Criteria:** Patients aged ≥30 with symptomatic CMCJOA (Pain >5 & Dysfunction >9 AUSCAN). Signs and symptoms of BTOA on clinical ax **Excl. Criteria:** All other study types * ○ Consultation with therapy dept or treatment of same thumb problem ○ Steroid to wrist thumb fingers past 2/12 ○ Fractures or other significant injury / surgery to hand in past 6/12 ○ History serious illness or disease e.g. inflammatory arthritis in hand ○ Progressive neurological signs ○ Acute swollen hand joint ○ Dementia /significant disorder affecting communication ○ Previous splints thumb base OA ○ Skin disease ○ Participant in drug or medical device trial past 12/52 **Stage CMCJOA: NR**	Treatment delivered over an 8/52 period. Hand exercises to all; at least 3x per week, 20 mins each. Splints minimum 6 hours day. **Groups:** 1. Therapist supported self-management programme (SMM), n= 116 2. Therapist supported self-management plus verum thumb splint (SSM+S) (2 choices TP and soft) SSM+S, n= 116 3. Therapist supported self-management programme plus placebo splint (SSM+PS) (2 choices), n= 117

Outcome measures / Results:

Time points: Baseline, 8 and 12 weeks.

Pain:

sAUSCAN (Pain):	Mean differences between groups at 12 weeks (95% CI) p value	12/52 mean pain (&function) scores had improved for all groups,
SSM+ splint vs SSM:	0.0 (-0.8, 0.9) p= 0.963	No evidence of a mean treatment difference in AUSCAN in scores between groups
SSM+ placebo splint vs SSM:	0.7 (-0.2,1.5) p=0.124	
SSM+ Splint vs SSM+ placebo splint:	-0.6(-1.4, 0.1) p=0.105	

Physical Function:

AUSCAN (function)	Mean difference between groups week 12 (95%CI) p value:	
SSM+S vs SM	-0.6 (-2.9, 1.7) 0.594	No evidence of a mean treatment difference in AUSCAN in scores between groups
SSM+PS vs SSM	-0.4 (-2.0, 1.2) 0.63	
SSM+S vs SM+PS	-0.2 (-1.8, 1.3) 0.772	

Global assessment: -

ROM: -

Strength: -

Others: Self-report measures, all improved but with no significant differences between the groups, not statements regarding MCII/MCID.

Stiffness- AUSCAN hand stiffness ordinal score, Michigan Hand Questionnaire satisfaction, Leisure section of the DASH, Work productivity and activity questionnaire, Arthritis self-efficacy pain scale, Generic health related quality of life, Short form 12 version 2 Physical and mental health component scores, Euro Quol (health staus) questionnaire, Health utilization questionnaire, Global assessment of change

No significant difference between responder criteria

	Imaging:	Not used to determine presence or degree of hand OA
	Adverse Effects:	Ten adverse reactions were reported: 3 in the SSM group (3%), 5 in the SSM+S Group (4%) and 2 in the SSM+PS Group (2%).
Authors Conclusions:	All groups receiving "high quality" self-management improved hand pain, function and QoL outcomes. No difference in short term outcomes between verum and placebo splints. No apparent benefit of adding a thumb splint to a high-quality evidence based supported self-management programme for OA delivered by therapists. (Different actions for thumb splints may exist that are not captured through pain and function)	
Notes:	Only 8/52 treatment- and 12/52 follow up (short), first trial to use placebo splints. Biomechanical impact assessed but not proprioceptive feedback. Pain and function improved from baseline to 8 and 12 weeks across all treatment groups. There were no clinically relevant or statistically significant differences between groups at either time point. Only 2 types of verum splints offered (Patient choice), Splints not worn at night. Pragmatic- No restriction to analgesia. Adherence – patient self-report diaries potentially open to inaccuracy. Discussion re barriers to engaging self-management principles. Patients with concurrent hand symptoms NOT excluded (tendinitis DeQ, CTS all can cause thumb pain), as long as pain considered to be primarily due to TBOA.	

Appendix 2.2: Evidence Summary Tables: Key Question 2: Are steroid injections effective in the treatment of thumb base osteoarthritis?

Study complete reference:		**Study type / Evidence level:**
Jahangiri A, Moghaddam FR, Najafi S: Hypertonic dextrose versus corticosteroid local injection for the treatment of osteoarthritis in the first carpometacarpal joint: a double-blind randomized clinical trial. J Orthop Sci (2014) 19:737–743; DOI 10.1007/s00776-014-0587-2		Double-blind Randomised Control Trial High (++) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Iran **Centres:** Single academic center **Setting:** Outpatient clinic **Dropouts:** 5/60 = 8.3%. (3/30 + 2/30)	***n*** **=** 60 **Mean age (yrs):** 63.6 **Gender (M:F):** 16:44 **Incl Criteria:** Age 40+, with baseline Thumb CMCJ pain 30+/100 on VAS and pain 3+ months duration. Radiographic evidence of CMCJOA. Had to be motivated to receive injection. **Excl Criteria:** Previous fracture, tendonitis, inflammatory diseases arthropathy, local infections, and metabolic bone disease within 6 months prior to study begin. Co-morbidities; diabetes, clotting disorders, neuropathy, any corticosteroid injection during the last 3 months or contraindications to steroid injection. Pregnancy or breast-feeding. Injection to CMCJ within last 6 months. **Stage CMCJOA:** 2+	Two study groups: 1) Steroid (40mg methylprednisolone) 2) 20% Dextrose intraarticular injections. Each group received 3 injections, with the steroid injection group receiving x2 saline injection (placebo) to preserved blinding vs. triple injection schedule of the dextrose group. Injections delivered according to anatomical landmarks. Participants were instructed not to use a brace, physiotherapy, or analgesic medications.

Outcome measures / Results:

Time points: Baseline, 1 month, 2 months and 6 months.

Pain: Visual Analogue Scale (VAS) – Two modalities were assessed: 1) pressure applied to the CMCJ at rest and 2) VAS on CMCJ movement:

1) Tenderness: Pressure applied to the CMCJ at rest

Intensity of tenderness was assessed with Fischer's pressure algometer to measure pain threshold to pressure. The applied force was 40 N/cm2 for all participants. The two groups were comparable at baseline with mean (Standard Deviation (STD)) scores of 6.4 (1.8) in the corticosteroid group and 6.7 (1.7) in the dextrose group (p=0.56). At one month, the corticosteroid group appears to outperform the dextrose group (p=0.001). This advantage is lost at 2-months (p=0.88) and by 6-months the dextrose group appears to outperform the steroid group (p=0.001). Tabulated data is not presented.

2) Pain after CMCJ movement

Both LC and DX groups demonstrated significant improvements in pain (47 % vs 76 % decrease respectively). Mean VAS scores after CMCJ movement are not presented for timepoints 1-month and 2-months, though they are presented comparatively, with dextrose outperforming steroid at 2- and 6-months by 1.0 and 1.1 VAS points (both p=0.02). There is no significant difference at 1-month. Numerical values are presented for baseline and 6-month data:

Pain on movement (VAS)	Baseline, Mean (STD)	6-Months, Mean (STD)	*p*-value
Local Corticosteroid	4.5 (1.6)	2.4 (1.8)	<0.001
Dextrose Prolotherapy	5.0 (2.1)	1.2 (1.6)	<0.001

Physical Function: Self-administered Health Assessment Questionnaire – Disability Index (HAQ-DI). Assesses ability to perform three daily activities: eating, gripping, and dressing. Each scored from 0-3 with 0 being 'with no difficulty' and 3 being 'unable to do'. The total scores were comparable at baseline at 4.37 in the steroid group, and 4.6 in the dextrose prolotherapy group. In both groups, significant improvements were recorded with improvement to 2.6 (Δ = -1.5) in the steroid group, and 1.6 (Δ = -2.8) in the dextrose prolotherapy group.

Global assessment: -

ROM: -

Strength: Strength of lateral pinch grip was measured objectively in pounds (lb), by baseline hydraulic pinch gauge. The baseline pinch strength was comparable at 11.6 lb in the steroid group and 9.6 lb in the dextrose prolotherapy group which represented a significant difference between groups (p=0.03). This finding was acknowledged but not discussed further in the paper. It may diminish the reliability of observed findings.

Absolute values at subsequent timepoints are not reported, but the comparative improvements between groups are presented with the value of the dextrose group scores subtracted from the value of the steroid group scores (Steroid-Dextrose = x). The baseline 2lb grip advantage in the corticosteroid cohort increases at 1-month to 2.9lb (p=0.005), thereafter the dextrose group outperforms the

		steroid group at 2-months (1.1lb difference) and at 6-months (0.8 difference), with the initial significant difference lost (p= 0.45). Overall, both steroids and dextrose groups are reported to have significant improvements in grip strength.

Pinch Grip (pounds, lb.)	Baseline, Mean (STD)	6-Months, Mean (STD)	p-value
Local Corticosteroid	11.6 (3.6)	12.7 (4.3)	<0.001
Dextrose Prolotherapy	9.6 (3.4)	11.9 (3.4)	<0.001

Others:	-
Imaging:	Initial radiographs; CMCJOA Stage 1+ included. No follow-up imaging. Injections not performed under image guidance.
Adverse Effects:	No significant adverse effects reported. Three patients reported transient increases in pain, subsiding after a few days. No local infections or complications.
Authors Conclusions:	[We conclude] that there is good evidence to support the use of DX over LC injection for the treatment of OA of CMC1 in terms of pain relief and function restoration. Our results showed that LC, though initially successful, was not as effective as DX. After 6 months of treatment, both DX and LC injection had diminished the severity of symptoms, and increased function, but DX seemed to be more effective. In the short term, LC abated the symptoms rapidly, but after a while the manifestations partially recurred. In the DX group the symptoms reduced more slowly and constantly, and the treatment effect remained more steady. The difference was remarkable at 6th months when symptoms abated and functions improved more desirably in DX.
Notes:	This trial is a well-designed randomised control trial (++) comparing efficacy of dextrose prolotherapy to steroid injection. Notably one of few to include power calculations in the methodology. Unfortunately recruitment was only to the minimum group size, resulting in being underpowered after subject drop-outs. The study has two active treatment arms, but no placebo control group. It therefore represents a superiority trial between prolotherapy and corticosteroid administration, and as such the results do not directly address the SIGN 50 questions posed in the present study. The study protocol prohibited patients from using concomitant bracing, physiotherapy or analgesia. This limits the clinical application of this trial as it is unusual that these interventions are applied in isolation. Absence of concomitant splinting or therapy renders the findings not directly applicable to clinical practice. The difference in baseline grip strength is found to be significant between the two groups, reported as p=0.03 but while acknowledged, this is not discussed further in the paper. This may decrease the reliability of reported findings with regards to strength.

Study complete reference:	Study type / Evidence level:
Meenagh GK, Patton J, Kynes C, Wright GD. A randomised controlled trial of intra-articular corticosteroid injection of the carpometacarpal joint of the thumb in osteoarthritis. Annals of the Rheumatic Diseases. 2004;63:1260–3.	Randomised Control Trial High (++) Quality

Study details:	Patient characteristics:	Interventions / Comparators:
Country: Northern Ireland **Centres:** 1 **Setting:** Hospital Outpatient Clinic **Funding Sources:** None disclosed **Dropouts:** 5	***n:*** 40 **Mean age (yrs):** 60 **Gender (M:F):** 4:36 **Incl. Criteria:** Symptomatic CMCJ OA referred to hospital. Fulfill ACR criteria for hand OA diagnosis. **Excl. Criteria:** History of inflammatory arthritis, previous thumb base trauma, or previous steroid joint injection to either CMCJ. **Stage CMCJOA:** Average Grade 3 (2 to 4). 75% had grade 3.	Two study groups: Single fluoroscopic guided intra-articular injections of: 1) 5 mg triamcinolone hexacetonide (0.25 ml) 2) 0.9% saline (0.25 ml) (placebo)

Outcome measures / Results:

Time points: Baseline data and three timepoints at 4-, 12- and 24- weeks.

Pain: VAS: There were no significant differences between the steroid and placebo groups. In both steroid and placebo groups there was an initial improvement in pain at 4-weeks which did not reach statistical significance. This effect was reduced or was reversed at 12- and 24-week timepoints.

Assessment of joint tenderness on palpation: There were no significant changes in the tenderness to palpation score employed in this study in either group at any timepoint.

Clinical feature		4 weeks	12 weeks	24 weeks
VAS	Pl	18.5 (3.5 to 20.1), **p = 0.02**	23.3 (6.0 to 29.3), p = **0.01**	1.0 (0.5 to 1.5), **p = 0.01**
	St	10.5 (28.0 to 12.6), **p = 0.02**	3.5 (28.5 to 4.9), p = **0.04**	0.0 (0.0 to 0.5), p = 0.19
Joint Tenderness	Pl	1.0 (0.0 to 1.3), **p = 0.01**	1.5 (0.0 to +∞), p = **0.03**	1.0 (0.5 to +∞), **p = 0.01**
	St	0.0 (21.0 to 0.9), **p = 0.02**	0.5 (0.0 to 1.0), p = **0.03**	0.0 (0.0 to 0.5), p = 0.18

Physical Function: -

Global assessment: Patient + Physician Global Assessment. The questions asked for these scores and the scoring system are not included in the study. The authors report a significant improvement in both patient and physician global assessment scores at 4, 12 and 24 weeks in the placebo group and significant improvements in the steroid group at 4 and 12 weeks, with the effect being lost at 24 weeks.

<u>Median changes in clinical variables within the Placebo (Pl) and Steroid (St) groups compared to baseline scores:</u>

Patient global assessment	Pl	0.5 (0.0 to 1.2), **p = 0.02**	1.0 (0.5 to 1.5), p = **0.01**	1.0 (0.5 to 1.5), **p = 0.01**
	St	0.5 (0.0 to 1.0), **p = 0.02**	0.5 (0.0 to 1.0), p = **0.04**	0.0 (0.0 to 0.5), p = 0.19
Physician global assessment	Pl	1.0 (0.5 to +∞), **p = 0.01**	1.5 (0.0 to +∞), p = **0.03**	1.0 (0.5 to +∞), **p = 0.01**
	St	0.5 (0.0 to 1.0), **p = 0.02**	0.5 (0.0 to 1.0), p = **0.03**	0.0 (0.0 to 0.5), p = 0.18

ROM: -

Strength: -

Others: <u>Median change in baseline morning stiffness (minutes) between Placebo and Steroid groups:</u>

Morning Stiffness (minutes)	Pl	2.5 (0.0 to 3.0), p = 0.17	2.5 (210.0 to 3.8), p = 0.37	5.0 (25.0 to 8.5), p = 0.21
	St	0.0 (25.0 to 2.5), p = 0.35	0.0 (27.5 to 1.3), p = 0.67	0.0 (27.5 to 1.0), p = 0.58

Imaging: No follow-up imaging was performed. All patients had pre-intervention radiographs to confirm and stage the diagnosis.

Adverse Effects: No adverse effects were observed.

Authors Conclusions: No benefit of steroid injection over placebo in moderate to severe osteoarthritis of the thumb base.

Notes:	Details of outcome measures are not reported in full. Recruitment short of power calculations. The details of the patients and physician global function scores are not detailed in the paper.

Study complete reference:		Study type / Evidence level:
Shalom Stahl et al. Comparison of Intraarticular Injection of Depot Corticosteroid and Hyaluronic Acid for Treatment of Degenerative Trapeziometacarpal Joints *JCR: Journal of Clinical Rheumatology* • Volume 11, Number 6, December 2005. 10.1097/01.rhu.0000191194.39926.c9		Quasi-randomised non-blinded efficacy trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Israel **Centres:** 1 **Setting:** Clinic **Dropouts:** None reported	***n:*** 52 **Mean age (yrs):** 62 **Gender (M:F):** 6:46 **Incl. Criteria:** Full inclusion criteria not published. Symptomatic patients with Stage II arthritis included. **Excl. Criteria:** Not stated **Stage CMCJOA:** II	Two study groups: Single intraarticular injection, unguided, of 1ml volume with either: 1) Methylprednisolone 40mg (25 patients) 2) Sodium hyaluronate 15mg (27 patients).

Outcome measures / Results:		
	Time points:	Patients were assessed at baseline, and at 1, 3 and 6-month interval.
	Pain:	Pain at rest and after activity scored on a visual analog scale (VAS). Baseline scores demonstrated similar values between groups (VAS 4.5 & 4.2 at rest, VAS 7.7, 7.9 after activity). Both steroid and HA produced significant relief of pain recorded at 1-month and sustained to 6-month follow-up (p=0.001), with no significant difference between the two groups in terms of the degree of pain relief conferred. At 1, 3 and 6-month intervals the VAS for the steroid group improved by 1.8(±2.0), 1.9(±1.8) and 2.2(±2.0) at rest, and 2.0(±2.3), 2.5(±2.0) and 2.7(±2.2) after activity. In the HA group the results were similar with improvements of 2.2(±2.0), 2.0±(2.0) and 2.2(±2.1) at rest and 1.9(±1.8), 2.2(±1.8) and 2.2(±1.9) after activity.
	Physical Function:	Purdue Pegboard function test: The authors report a statistical significant increase in PPT performance in the HA group at 6-months with an improvement from 11.9 to 12.7. The steroid group demonstrated an improvement from 11.9 to 12.6, which did not reach statistical significance.
	Global assessment:	-
	ROM:	-
	Strength:	Grip and Pinch (lateral, 2-point and 3-point) strength measurements assessed with use of dynamometer. Significant improvements were observed in grip strength at 1, 3 and 6-month follow-up in the steroid group. In the steroid group the average grip strength improved from 19.8kg to 21.3kg at 6-months. Similar figures were available for the HA group, with an increase from 19.7kg to 21.1kg, though whilst there was a progressive improvement in grip strength in the HA group it did not reach significance until the 6-month follow up. With regards to the pinch strength, improvements were noted in the steroid group in all pinch type modalities, however they did not reach statistical significance. Improvements in the HA group reached statistical significance in the tripod and lateral pinch types at 3 and 6-month follow-ups. The absolute figures improved from 4.3kg to 4.6kg in the tripod grip and 5.4kg to 5.7kg in the lateral pinch. There was no significant improvement in 2-point (pulp-to-pulp) pinch in either group.
	Others:	-
	Imaging:	The study states that patients had Grade II osteoarthritis of the thumb CMCJ. No further imaging was taken and the injections were not performed without image guidance.
	Adverse Effects:	There were no adverse effects noted in either arm of the study.
Authors Conclusions:	Both corticosteroid and HA groups had improvement in pain throughout the 6-month follow-up period. Steroids had an improvement in grip strength throughout the follow-up period. HA group demonstrated significant improvement in tripod, pulp to side grips and Purdue pegboard at 3 and 6 months and significant improved grip strength by 6 months.	
Notes:	Study non-blinded, quasi-randomised efficacy trial. Randomisation by hospital number. Despite the same average age, there are wide age ranges which are not evidently well matched and this may lead to differences in functional expectations as well as score achieved in the PPT for reasons other than CMCJOA. Power calculations were not performed as part of this study. In absolute values the difference between the HA and steroid grip strengths are 0.1kg and a PPT score of 0.1. It is unlikely that either of these would be clinically significant and makes the study vulnerable to potential sources of error from rounding and lack of adequate power to detect such a small difference.	

Study complete reference:		Study type / Evidence level:
Monfort J et al. Comparative efficacy of intra-articular hyaluronic acid and corticoid injections in osteoarthritis of the first carpometacarpal joint: Results of a 6-month single-masked randomized study. Joint Bone Spine 82 (2015) 116–121. 10.1016/j.jbspin.2014.08.008		Single-center, single-blinded, prospective, randomised, active-controlled trial. Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Spain **Centres:** 1 **Setting:** Outpatient clinic **Dropouts:** Not stated	***n*=** 88 **Mean age (yrs):** 62.8 **Gender (M:F):** 11:77 **Incl. Criteria:** All patients aged 18+ years with diagnosis CMCJ OA between 2005 to 2009, as defined by criteria of the ACR. Must have had symptoms for at least the 90 days prior to the start of the study, requiring treatment with analgesics or NSAIDs on a routine basis, and had an available confirmatory X-ray diagnosis (Kellgren–Lawrence grade I–III) within the previous 6 months, given written informed consent, and been able to understand and follow the study procedures. **Excl. Criteria:** - Any previous surgical intervention to CMCJ, or diagnosis of STT joint OA or previous physiotherapy. - physical therapy performed by a physiotherapist at home or in a specialized center - microcrystalline arthritis - participation in a clinical trial in the previous three months - presence of any medical condition judged by the investigator to preclude the patient's inclusion in the study, including hepatic or renal dysfunction, pregnancy or lactation. - Known allergy to corticoids, paracetamol, or hyaluronic acid injections. - Concomitant treatment with antiepileptic drugs, oral anticoagulants, Aspirin >325 mg/day, lithium, potassium-sparing diuretics, digoxin, minocycline, metalloprotease inhibitors, methotrexate, or regular use of analgesic and/or NSAIDs; treatment with chondroitin sulphate, glucosamine sulphate, diacerein, oral or parenteral corticosteroids - Corticosteroid injection in any other joint during the previous 3 months. - **Stage CMCJOA:** Kellgren-Lawrence II-III. The mean difference of grade was not significant between study groups in either of three analyses.	Two study groups: 1. Hyaluronic acid; 3x injections at 1-week intervals of 0.5ml HA (Suplasyn®) 2. Corticosteroid; 0.5ml Injection of (bethamethasone disodium 1.5mg + bethamethasone acetate 1.5mg)

Outcome measures / Results:		
	Time points:	Baseline, 7, 14, 30, 90, 180 Days.
	Pain:	10-point visual analogue scale (VAS) for pain and use of rescue analgesia (including paracetamol). There was no significant difference observed between HA and Steroid groups on initial VAS analysis at any of the time points. The authors performed further subgroup analysis of patients selecting groups with baseline FIHOA scores of ≥5, and first VAS ≥3 and then VAS ≥5. These demonstrated no significant improvement in VAS if the baseline VAS was ≥3 but in those patients with a baseline VAS ≥5, there was a significantly improved VAS in the Hyaluronic Acid group over the steroid group at 180 days. There were no significant differences in use of rescue medication between groups.
	Physical Function:	Functional Index for Hand OsteoArthritis (FIHOA). Demonstrated no significant improvement in functional scoring between HA and Corticosteroid groups, though both groups did demonstrate an improvement at all follow-up time points. There was no minimally important clinical difference defined for the FIHOA score. In subgroup analysis of patients with an initial FIHOA score of ≥5 and VAS ≥5, significant improvement as noted in the HA scores vs the Corticosteroid group at 90- and 180-day follow-up.
	Global assessment:	Patient's general condition was assessed by the patients and investigators from 'very bad' to 'very good' on a 5- point Likert scale. More patients were rated as 'Good' or 'Very Good' by assessors in the HA group vs Corticosteroid with this effect being notably pronounced at 90-day (61.6% vs 30.8%) and 180-day (53.4% vs 28.6%) follow-up. In patient global self-assessment scores were notably favourable for HA at 90- and 180-day follow-up.
	ROM:	-
	Strength:	-

	Others:	Short Form-36 (SF-36) quality of life questionnaire, using a Spanish validated version, with subdivisions MCS-36 (mental component) and PCS-36 (Physical component). There was no significant difference between HA and corticosteroid groups for either subdivision at 90- or 180-day follow-ups. These scores were not reported in the subgroup analyses performed.
	Imaging:	No additional imaging. Radiograph within 6-month before study required. Injections under USS guidance.
	Adverse Effects:	10 patients (5 of Bethametasone group and 5 of the HA group) shown minor or moderate local pain after intra-articular injection (5 of them including swelling (2 of the Bethametasone group and 3 of the HA)), which have disappeared at the following visit.
Authors Conclusions:	Intraarticular, low-molecular-weight hyaluronic acid injections into the thumb CMC joint in OA are more efficient than corticosteroids in improving functionality and pain, with persistent effects after 6 months.	
Notes:	Study concludes that hyaluronate may have more sustained pain-relieving properties than steroid injections, which perform best in the first few weeks. Notable efforts to match injection schedules - 3x vs. 3x. The synergistic effect of multiple steroid injections at one week intervals is unknown and is not representative of normal UK practice. Excluded patients on the basis of previous or current physiotherapy which is not representative of UK practice. Some patients lost prior to study begin (12%), with no redundancy in recruitment this fell short of their power calculations. Further subgroup analysis was not accounted for in power calculations. The study was not truly randomized as allocation based on clinic numbers, therefore also potentially had poor concealment of group allocation. The use of an assessor who was blinded to the treatment is noted but patients were not blinded. No placebo control. Single blinded study. Subgroup analysis was not included in the initial study design and power calculations.	

Study complete reference:		Study type / Evidence level:
Trellu S, Dadoun S, Berenbaum F, Fautrel B, Gossec L.: Intraarticular injections in thumb osteoarthritis: A systematic review and meta-analysis of randomized controlled trials. Joint Bone Spine 82 (2015) 315–319. 10.1016/j.jbspin.2015.02.002		Systematic Review of Controlled Trials. Data from 9 trials were examined in detail, with 6 trials being combined to a meta-analysis. One of these trials has not been published. Moderate (+) Quality
Study details:	**Study inclusion criteria and patient characteristics:**	**Interventions / Comparators:**
Country: France **Centres:** Not applicable **Setting:** Not applicable **Funding:** **Dropouts:** Not reported	Studies included were controlled trials published in English, French, German or Spanish. All controlled trials reporting the efficacy on pain and/or functional capacity and/or pulp pinch force of intra-articular injections of corticosteroids and/or hyaluronic acid in thumb OA were selected. ***Figures refer to the combined data of meta-analysis studies** ***n*** **=** 428 **Mean age (yrs):** 63 **Gender (M:F):** 60:368	This review examined collated results in 3 categories: 1. Corticosteroid vs. placebo 2. Hyaluronic acid vs. placebo 3. Corticosteroid vs. hyaluronic acid

Outcome measures / Results:		
	Time points:	There is some heterogeneity between studies with regards to time intervals, however, of the 6 studies used in meta-analysis 3 studies each used the intervals 4, 12 and 24 weeks. The shortest study included had follow-up for just 12 weeks, with the longest being 1 year.
	Pain:	Pain was an outcome measure in all of the papers included within the meta-analysis. Standardised response means were employed to compare heterogenous scoring modalities. The meta-analysis results demonstrated significant superiority of HA over steroid for pain relief at 24 weeks, with no significant benefit at earlier timepoints. Neither steroids nor HA provided significant pain relief as compared with placebo at any time point.
	Physical Function:	Function is assessed with a variety of scores and pinch grip measures between papers. Of those included in the meta-analysis, 1 studies employed the DASH score (insert citations – Mandl) , 2 use the Dreiser functional index (roux, Monfort), one uses the Purdue pegboard test (Stahl) and one uses the Durüoz Hand Index (Bahadir). The results are compared between scoring systems using standardised response means and demonstrated no significant differences between hyaluronic acid and steroid therapy. There was a significant improvement for hyaluronic acid over placebo at 12 weeks.
	Global assessment:	Despite some of the included studies performing a global assessment, this was not included in the meta-analysis. The heterogeneity of grading methods used may have influenced this decision.
	ROM:	-
	Strength:	Two studies included in the meta-analysis commented on pulp pinch force; the studies by Bahadir and Stahl. These studies both demonstrated an superiority in the pulp pinch force scores amongst the HA group at 24 weeks, with Bahadir suggesting positive response at 12 weeks also. Fuchs et al., not included in the meta-analysis, also assessed strength but was found to have no significant difference. The meta-analysis results indicated no difference at short to medium term follow up but favoured HA at 24 weeks.
	Others:	-
	Imaging:	Image guided injections were administered in 3 papers of 6 included in meta-analysis. Two used fluoroscopy and one ultrasound.
	Adverse Effects:	Adverse effects were not commented on in this review.
Authors Conclusions:	Results demonstrated high degree of heterogeneity, but hyaluronic acid demonstrated advantage over placebo. HA may be useful to improve functional capacity whilst corticosteroid may be effective pain relief.	
Notes:	Robust methodology for this systematic review. PROMs scores are compared in a linear fashion from 0-100. Notable inclusion of unpublished literature (Mandl 2012) with a large patient group may influence outcomes of the meta-analysis particularly with the conclusion of hyaluronic acid demonstrating superiority over placebo. Heterogeneity of available papers makes reliable comparisons difficult. The number of patients included in the meta-analysis is disproportionately represented by a study that is not published (Mandl 2012).	

Study complete reference:		Study type / Evidence level:
Riley (2019) Injection therapy for base of thumb osteoarthritis: a systematic review and meta-analysis. BMJ Open 2019 Sep 11;9(9):e027507		Systematic review of randomized controlled trials. High (++) Quality
Study details:	**Study inclusion criteria:**	**Interventions / Comparators:**
Country: UK **Centres:** Oxford University **Funding Sources:** Supported by charitable foundation (Doris Hillier Arthritis and Rheumatism grant)	Systematic review of nine studies. Any prospective study relating to an injection-based intervention for base of thumb osteoarthrtitis (trapeziometacarpal) was included. Studies had to contain an injection-based intervention and a comparator/s (ie, both non-randomised controlled trials (non-RCT), and RCTs, including semi-randomised / quasi-randomised, cluster randomised trials and comparative case series). Studies were excluded if patients were under the age of 18 years and if treatment was for inflammatory arthritis such as rheumatoid. Review articles, studies not published as a full article (conference abstracts) and case studies were excluded.	Studies were assessed for comparative evidence in: 1) Steroid v. placebo 2) Steroid v. hyaluronic acid 3) Hyaluronic acid v. placebo

Outcome measures / Results:		
	Time points:	Not available in this systematic review
	Pain:	With regards to the studies involving steroid as an intervention or comparator, there were no new studies identified from this systematic review that are not already included in our current review. Meta-analysis of Monfort et al. and Stahl et al. (both of which compared corticosteroid against hyaluronic acid) demonstrated no difference to VAS (pain) at rest between the treatment arms in both the short and medium term. Meta-analysis of Bahadir et al. and Stahl et al. (both of which compared corticosteroid against hyaluronic acid) showed no difference in VAS (pain) with activity in the short or long term but noted a small reduction in the medium term. They also arrived at similar conclusions with regards to steroid vs. placebo (Heyworth et al. and Meenagh at el.) whereby there was no difference in pain in the short and medium term.
	Physical Function:	Similar findings to those that are already included in our review. Meta-analysis of Stahl et al. and Bahadir et al. (both of which compared corticosteroid against hyaluronic acid) showed no difference in tip pinch and grip strength. Similarly no differences were found to effect on function in studies comparing corticosteroid against placebo (Heyworth et al. and Meenagh et al.) and corticosteroid vs. dextrose (Jahangiri et al.)
	Global assessment:	-
	ROM:	Reported as 'function'
	Strength:	Reported as 'function'
	Others:	-
	Imaging:	-
	Adverse Effects:	-
Authors Conclusions:	Evidence is equivocal on the use of injection therapy of thumb base osteoarthritis.	
Notes:	Nine studies (RCTs) were included in this systematic review, of which seven had steroid in one treatment arm. All of these seven studies were already included in the present review.	

Study complete reference:		Study type / Evidence level:
Bahadir C, Onal B, Dayan VY, Gürer N. Comparison of therapeutic effects of sodium hyaluronate and corticosteroid injections on trapeziometacarpal joint osteoarthritis. Clinical rheumatology [Internet]. 2009;28(5):529–33		Randomised Control Trial Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Turkey **Centres:** Single Centre **Setting:** Clinic (Research Hospital) **Funding Sources:** Not disclosed	***n:*** 40 **Dropouts:** 0 **Mean age (yrs):** • Steroid 62.9 (+/- 9.1) • Hyaluronate 60.8 (+/-7.3) **Gender (M:F):** All female **Incl. Criteria:** Not specified. In bilateral thumb OA, the more painful side was assessed **Excl. Criteria:** Previous fracture, carpal tunnel syndrome, an operation or major trauma to the hand, inflammatory systemic diseases, De Quervein tendonitis, or any previous injection in this joint. **Stage CMCJOA:** Stages II and III	Two study groups: 1) Steroid 1x injection 2) Hyaluronate 3x injections at 1 week intervals.

Outcome measures / Results:		
	Time points:	0, 1, 3, 6, 12 months
	Pain:	Pain was better improved in the steroid injection group at 1-month and 6-monthsin comparison with the hyaluronate group. VAS pain score showed improvement and was maintained for a period of 12 months in the steroid group and 6 months in the hyaluronate group.
	Physical Function:	-
	Global assessment:	-
	ROM:	-
	Strength:	Grip strength improved in both groups. Grip strength was better in the steroid group than hyaluronate group at 1 month.
	Others:	Hand function as a measure of DHI (Duruoz Hand Index) improved in both groups. This was statistically significant at month 1 in the hyaluronate group; and at months 1,3 and 6 in the steroid group. Except for month 12, DHI was significantly lower in steroid when compared to the hyaluronate group.
	Imaging:	-
	Adverse Effects:	No adverse side effects
Authors Conclusions:	Corticosteroid intra-articular injections provided more effective and longer lasting pain relief during the 12-month follow-up period. Hyaluronate also provided significant pain relief for a 6-month follow-up period. However, after 6 months, hyaluronate ceased to provide effective pain relief. There was no improvement in pinch strength in either study group during the 12-month period. Grip strength improved in both groups during the 12-month period.	
Notes:	Acceptable quality (+) study showing similar outcomes comparing steroid to hyaluronate with better sustained response of pain relief from steroid injections. Different injection regimes, non-blinded injecting physician, female only cohort.	

Study complete reference:		Study type / Evidence level:
Fowler et al. Hand (2015) Intra-articular corticosteroid injections to manage trapeziometacarpal osteoarthritis – a systematic review. A Fowler, M G Swindells, F D Burke; Hand (N Y). 2015 Dec;10(4):583-92. Epub 2015 Jun 17. DOI: 10.1007/s11552-015-9778-3		Systematic review (level IV – 5 case series and 4 RCTs mix) Moderate (+) Quality
Study details:	**Study inclusion criteria:**	**Interventions / Comparators:**
Country: **Centres:** **Setting:** **Funding Sources:**	**Inclusion:** Injection of corticosteroid with or without local anaesthetic into the TMJ for osteoarthritis & Assessment of outcome as either pain relief and/or functional improvement. **Exclusion:** Non-human studies Not published in English Studies including injection into other joints Descriptive studies or reviews Studies not directly assessing response to steroid injections Studies involving surgical interventions	Treatment with steroid injection vs. any other injectable comparator; saline / hyaluronic acid / hylan / sodium hyaluronate

Outcome measures / Results:		
	Time points:	Narrative synthesis with no specific extractable results
	Pain:	-
	Physical Function:	-
	Global assessment:	-
	ROM:	-
	Strength:	-
	Others:	-
	Imaging:	-
	Adverse Effects:	-
Authors Conclusions:	Some evidence to support efficacy of steroid injections and potential significant short-term benefits to be gained from steroid injections. Steroid injections likely to result in pain relief, most likely in first 1 – 3 months post-injection. Studies were heterogenous with regards to their technique, steroid type, splinting, post-injection treatment and analgesic use. Evidence to support treatment was limited. The authors concluded that steroid injection was a low risk procedure that is worth considering before more invasive treatments	
Notes:	This was a narrative review. Meta-analysis was not possible due to variation in practice and reporting. Four of the studies included were retrospective case series. Four RCTs (Bahadir, Heyworth, Meenagh and Stahl) were already included in this review and therefore assessed separately.	

Study complete reference:		Study type / Evidence level:
Fuchs S, Monikes R, Wohlmeiner A, Heyse T. Intra-articular hyaluronic acid compared with corticoid injections for the treatment of rhizarthrosis. Osteoarthritis Cartilage. 2006;14:82–8		Randomised controlled trial Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Germany **Centres:** Two (Unna and Havixbeck) **Setting:** **Funding Sources:** Funded by TRB Chemedica AG (supplied hyaluronic acid)	***n:*** 56 **Dropouts:** **Mean age (yrs):** 59.5 median age **Gender (M:F):** 11M: 45F **Incl. Criteria:** 44 – 80 years with symptomatic OA. Pain (VAS > 4 for 6 months) **Excl. Criteria:** Drug / alcohol abuse, psychotic disorders, epilepsy, risk of suicide, unable to understand with high probability of noncompliance, recent corticosteroid or glycosaminoglycans within 3 months or sodium hyaluronate within 6 months prior to first injection. known allergy or other contra-indications to administered reagents, critical skin conditions at injection side, hemarthrosis or joint effusion, non-osteoarthritic joint disease (rheumatoid arthritis, inflammatory joint diseases, chondrocalcinosis), immune deficiencies, malignant diseases, uncontrolled diabetes, use of anticoagulants or joint infection **Stage CMCJOA:** Kellgren score (mean of 2.1)	Two study groups: 1) Steroid injection (corticosteroid triamcinolone Volon A10) 3x injections 2) Hyaluronic acid (Ostenil mini (TRB Chemedica AG)) 3x injections

Outcome measures / Results:		
	Time points:	Seven assessment points. Participants were seen weekly for the first 5 weeks and treatment was administered within meetings 2 – 4. A washout period was introduced after the first visit. Participants were assessed at 3, 14 and 26-weeks after injection. 27-weeks was the final endpoint.
	Pain:	VAS pain score was measured. Triamcinolone (TA) provided better pain relief up to week 14. Week 26 demonstrated slight superiority of sodium hyaluronate. Triamcinolone had faster onset of pain relief, with maximum effect of improvement found at 2 and 3 weeks after first injection. At this time point, pain scores were better than sodium hyaluronate. Pain relief from hyaluronate was moderate and reached a maximum after 26 weeks. Results were not statistically significant.
	Physical Function:	-
	Global assessment:	-
	ROM:	-
	Strength:	-
	Others:	-
	Imaging:	-
	Adverse Effects:	4 (14.3%) within each treatment group (8 total). 5 (3 SH and 2 TA) caused early withdrawal.
Authors Conclusions:	Both hyaluronate and steroids were effective in treating TBOA. 88% in the hyaluronate group and 79.1% in the steroid group demonstrated improvement in pain after 26 weeks. Both treatment options relieved clinical symptoms (pain, lack of function, loss of range of motion). Steroids had a quicker onset of action which was maximum at 2 – 3 months. This effect decreases towards the end of study. Pain relief in the hyaluronate group was more moderate and reached a maximum after 26 weeks. Similar observations was found to other measured parameters such as swelling and lateral pinch pain. This effect is thought to be not due to symptomatic pain relief but due to regeneration of viscoelasticity of the synovial fluid by refilling the emptied hyaluronan stores.	
Notes:	Steroids demonstrated faster onset of pain relief. Hyaluronate achieved a more moderate relief at a longer time period. Similar observations could be made for other parameters such as swelling of the joint. For the lateral pinch (key grip) strength and lateral pinch pain after 6 months of treatment, there was moderate superiority for the hyaluronate group. For palmar abduction, opposition and pulp pinch power had moderate superiority in the hyaluronate group throughout the study.	

Appendix 2.3: Evidence Summary Tables: Key Question 3: Is surgical treatment effective in treating thumb base OA?

Study complete reference:		**Study type / Evidence level:**
Corain M, Zampieri N, Mugnai R, Adani R. Interposition arthroplasty versus hematoma and distraction for the treatment of osteoarthritis of the trapeziometacarpal joint. J Hand Surg (APV) 2016; 21(1):85-91.		Randomised controlled trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Italy **Centres:** 1 **Setting:** DGH **Funding Sources:**	***n:*** 120 **Dropouts:** Nil **Mean age (yrs):** 63 (45 – 77) **Gender (M:F):** 11:53, 15:41 **Incl. Criteria:** All patients with CMCJOA. **Excl. Criteria:** Rheumatoid arthritis, previous surgery, previous fracture, diabetes mellitus. **Stage CMCJOA:** Eaton Stage III / IV	Two study groups: 1) Trapeziectomy with tendon interposition (APL) (n= 64) 2) Trapeziectomy with K wire distraction (n= 56)

Outcome measures / Results:		
	Time points:	3 months, 12 months and then mean 6.8 years.
	Pain:	Pain score VAS significantly improved from pre to postop in both groups. Group 2 had statistically less pain than group 1 at follow up ($p < 0.05$).
	Physical Function:	No difference in postoperative DASH: trapeziectomy + APL mean (SD) - 18.2 (1.2) versus trapeziectomy - 17 (1.9). No pre-operative scores to compare to.
	Global assessment:	
	ROM:	No difference in Kapandji score between groups at start but not measured post op.
	Strength:	Pinch and grip strength improved for both groups and there was no statistical intergroup difference.
	Others:	-
	Imaging:	Lateral unloaded radiographs: the height of the space between the base of the thumb metacarpal and the scaphoid showed a mean value of 6.5 mm, range 4-12 mm, for both groups.
	Adverse Effects:	Group 1: 11 cases of FCR tendinitis. No complications in group 2.
Authors Conclusions:	They demonstrate that the trapezium excision and bone space distraction technique requires a smaller incision, a shorter surgical time, an easier surgical technique, and a less painful recovery, maintaining overlapping levels of functional recovery.	
Notes:	Computer randomisation. Unclear whether assessors were blinded or not.	

<table>
<tr><td colspan="2">Study complete reference:</td><td colspan="2">Study type / Evidence level:</td></tr>
<tr><td colspan="2">Gangopadhyay S, McKenna H, Burke, FD, Davis TRC. Five- to 18-Year follow-up for treatment of trapeziometacarpal osteoarthritis: a prospective comparison of excision, tendon interposition, and ligament reconstruction and tendon interposition. J Hand Surg 2012; 37A:411–417.</td><td colspan="2">Randomised Controlled Trial
Moderate (+) Quality</td></tr>
<tr><td>Study details:</td><td colspan="2">Patient characteristics:</td><td>Interventions / Comparators:</td></tr>
<tr><td>Country: UK
Centres: 2
Setting: DGH
Funding Sources:</td><td colspan="2">n: 153 (174 Thumbs – 21 bilateral)
Dropouts: 21
Mean age (yrs): 57 (44 – 74), 57 (40 – 75), 57 (44 – 75)
Gender (M:F): Only female participants, men excluded.
Incl. Criteria: Thumb base osteoarthritis refractory to conservative treatments.
Excl. Criteria:
Stage CMCJOA: Eaton II – IV</td><td>Three study groups:
1) Trapeziectomy
2) Trapeziectomy and palmaris longus interposition
3) Trapeziectomy and LRTI (FCR)</td></tr>
<tr><td>Outcome measures / Results:</td><td>Time points:
Pain:
Physical Function:
Global assessment:
ROM:
Strength:
Others:
Imaging:
Adverse Effects:</td><td colspan="2">Median 6 years (5-18 years)
Subjective scale 0-6. Significant improvement from baseline to final assessment but no intergroup difference (P=0.383)
Writing, turning, a key, opening a screw-top jar, handling coins and knitting did not differ between groups at any stage.
Subjective restriction of activity. No difference between groups.
Thumb opposition and MCPJ hyperextension did not differ between groups before or after surgery.
Grip, key and tip pinch using Jamar. No difference between time points or groups.
-
-
14 patients from all groups had pain at rest, of these 4 underwent revision surgery.</td></tr>
<tr><td>Authors Conclusions:</td><td colspan="3">The outcomes of the three variations of trapeziectomy were similar. There appears to be no long term benefit of LRTI.</td></tr>
<tr><td>Notes:</td><td colspan="3">1 year follow up reported previously: Davis TRC, Brady O, Dias JJ. Excision of the trapezium for osteoarthritis of the trapeziometacarpal joint: a study of the benefit of ligament reconstruction or tendon interposition. J Hand Surg 2004; 29A:1069–1077.
Many of the patients underwent concomitant procedures, such as carpal tunnel decompression or MCPJ stabilisation.
No validated PROMs reported.</td></tr>
</table>

Study complete reference:		**Study type / Evidence level:**
Marks M, Hensler S, Wehrli M, Scheibler A-G, Shindele S, Herren D. Trapeziectomy with suspension-interposition arthroplasty for thumb carpometacarpal osteoarthritis: a randomized controlled trial comparing the use of allograft versus flexor carpi radialis tendon. J Hand Surg Am 2017; 42(12):978e986.		Randomised controlled trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Switzerland **Centres:** Single Centre **Setting:** Hospital **Funding Sources:** Unclear **Dropouts:** 2	***n:*** 60 **Mean age (yrs):** 64 (FCR), 65 (Allograft) **Gender (M:F):** 9:51 **Incl. Criteria:** Eaton Stage II+ and failure of non-surgical treatment. **Excl. Criteria:** Lack of German language, pregnancy, lack of capacity to consent. **Stage CMCJOA:** Eaton Stage II+	Two study groups: 1) Trapeziectomy with allograft suspension-interposition (n= 31) 2) Trapeziectomy with FCR tendon suspension-interposition (n= 29)

Outcome measures / Results:		
	Time points:	6 weeks, 3, 6, 12 months
	Pain:	MHQ pain score improved from baseline to 1 year ($p<0.05$). There was no difference between groups.
	Physical Function:	The total baseline MHQ score increased from 51 (95% CI, 46-56) to 83 (95% CI, 78-87) at 12 months after surgery in the FCR group ($P < 0.05$) and from 53 (95% CI, 47-58) to 76 (95% CI, 69-84) for the allograft group at the last follow-up ($P <0.05$). MHQ, DASH, SF-12 physical and mental health all improved in both groups but there was no statistical difference between groups.
	Global assessment:	-
	ROM:	Kapandji index. No difference pre and post op or between groups.
	Strength:	Grip and key pinch strength using digital pinch gauge and Jamar dynamometer. No difference pre and post op or between groups.
	Others:	-
	Imaging:	Radiographs to measure scaphoid – metacarpal distance. Distance reduced but there was no statistical difference between groups.
	Adverse Effects:	Total 15 complications (no statistical difference). Allograft group (10): one patient needed revision surgery. CRPS (1), thenar atrophy (1), partial rupture FCR (7), tendinitis (2) – one had tendinitis and partial rupture. FCR group (5): CRPS (2), trigger thumb (1), pain (1), tendinitis (1)
Authors Conclusions:	Use of FCR autograft or allograft improves symptoms, with no difference between them. Higher complication rate in the allograft group and the authors therefore reserve this technique for revisions or need for a large amount of graft.	
Notes:	'As treated' rather than intention to treat approach to analysis. 2 dropped out for the allograft follow up at 12 months.	

Study complete reference:		Study type / Evidence level:
Nilsson A, Wiig M, Alnehill H, Berggren M, Björnum S, Geijer M, Kopylov P, Sollerman C. The Artelon CMC spacer compared with tendon interposition arthroplasty. Acta Orthopaedica 2010; 81:2: 237-244.		Randomised controlled trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Sweden **Centres:** 7 **Setting:** Hospital **Funding Sources:** Unclear **Dropouts:**	***n:*** 109 patients (111 Thumbs) **Mean age (yrs):** 61 (Control), 59 (Artelon) **Gender (M:F):** 4:33 (Control), 11:61 (Artelon) **Incl. Criteria:** Painful thumb base osteoarthritis with radiographic evidence of OA. **Excl. Criteria:** Scaphotrapeziotrapezoid arthritis. Serious comorbidity. Cancer. **Stage CMCJOA:** Eaton I – III	Two study groups, recruited with a 2:1 ratio: 1) Partial trapeziectomy and Artelon CMC joint spacer (n= 72) 2) Trapeziectomy and tendon interposition (n= 37).

Outcome measures / Results:		
	Time points:	Post op, 6 months, 1 year
	Pain:	VAS pain score (0-10). Significant decrease in pain at 1 year in both groups and statistically better relief in control group (P<0.001) than Artelon at 1 year.
	Physical Function:	The median decrease in DASH score after 1 year was -26 (-49 to 1) in the spacer group and -18 (-46 to 1) in the control group, only including those with surgery in the dominant thumb and analysed on per protocol basis.
	Global assessment:	
	ROM:	Radial and palmar thumb abduction improved in both groups.
	Strength:	Maximal tripod and pinch strength with pinch gauge and grip strength with Jamar dynamometer improved in both groups with no difference between groups at 1 year.
	Others:	Patient satisfaction (1-5) improved in both groups. Patient assessments of their thumb function after 1 year – Artelon - score above 3 in 60% (21/35) patients versus above 3 in 65% (17/26) in the control group. The corresponding figures for satisfaction were 66% (23/35) and 69% (18/26), respectively.
	Imaging:	Joint space and subluxation measured using plain radiographs. 4 radiographic complications identified in implant group
	Adverse Effects:	6 implants removed within one year. No complications in the control group.
Authors Conclusions:	The intention-to-treat analysis of tripod pinch strength, the primary outcome measure, did not show any statistically significant superiority of the Artelon CMC spacer over tendon interposition arthroplasty.	
Notes:	40% of cases had protocol deviations. Tripod pinch was the primary outcome rather than a patient centred outcome. Observers were blinded.	

Study complete reference:		**Study type / Evidence level:**
Salem H, Davis TRC. Six year outcome excision of the trapezium for trapeziometacarpal joint osteoarthritis: is it improved by ligament reconstruction and temporary Kirschner wire insertion? J Hand Surg (E) 2011; 37E(3): 211-219.		Randomised Controlled Trial Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: UK **Centres:** 1 **Setting:** Hospital **Funding Sources:** No external funding **Dropouts:**	***n:*** 111 (131 Joints) **Mean age (yrs):** Not reported in this paper. **Gender (M:F):** 8:51 (Trapeziectomy), 9:46 (Trapeziectomy + LRTI) **Incl. Criteria:** Painful thumb osteoarthritis, refractory to conservative treatments. **Excl. Criteria:** - **Stage CMCJOA:** -	Two study groups: 1) Trapeziectomy (n= 59) 2) Trapeziectomy and LRTI with hemi FCR and Kirschner wire stabilisation (n= 55)

Outcome measures / Results:		
	Time points:	3 months, 1 year (previously reported), 6 years. Mean 6.3 (4.2-8.1)
	Pain:	Subjective pain statistically improved in both groups but no intergroup difference.
	Physical Function:	DASH (Trapeziectomy mean, 31; 95% CI, 26–42: Trapeziectomy + LRTI mean 30; 95% CI, 22–35) and Patient Evaluation Measure (Trapeziectomy mean, 35; 95% CI, 29–41: Trapeziectomy +LRTI mean 34; 95% CI, 27–39) scores were significantly better than preoperatively but there was no difference between groups at any time-point.
	Global assessment:	
	ROM:	Thumb radial and palmar abduction and opposition did not differ at any time-point. Measurements not reported.
	Strength:	Thumb key pinch strength did not differ significantly between the two treatment groups (Trapeziectomy mean 3.7 kg: 95% CI, 3.3–4.2: Trapeziectomy + LRTI mean 4.1 kg, 95% CI, 3.7–4.7) and was not significantly different from the preoperative key pinch strength.
	Others:	Subjective stiffness reduced in both groups but no intergroup difference.
	Imaging:	-
	Adverse Effects:	Persistent pain led to two patients from control group undergoing trapeziectomy and LRTI. Two patients in the LRTI underwent further surgery for persistent pain.
Authors Conclusions:	This study does not provide evidence to support the use of LRTI and temporary K-wire stabilization after trapeziectomy.	
Notes:	Long term follow-up report of previously published study : Davis and Pace: Trapeziectomy for trapeziometacarpal joint osteoarthritis: is ligament reconstruction and temporary stabilization with a Kirschner wire important? J Hand Surg Eur Vol 2009 Jun:34(3):312-21.	

Study complete reference:		**Study type / Evidence level:**
Tagil M, Kopylov P. Swanson versus APL arthroplasty in the treatment of osteoarthritis of the trapeziometacarpal joint: a prospective and randomized study in 26 patients. J Hand Surg Eur 2002; 27B;5: 452-456		Randomised controlled trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Sweden **Centres:** 1 **Setting:** Hospital **Funding Sources:** No external funding source **Dropouts:** 2 patients	***n:*** 26 (13 in each group in final analysis) **Mean age (yrs):** 62 **Gender (M:F):** 2:26 **Incl. Criteria:** Painful CMCJOA refractory to conservative treatment. **Excl. Criteria:** Not documented. **Stage CMCJOA:** Not documented.	Two study groups: 1) Trapeziectomy and Swanson implant 2) Trapeziectomy and APL LRTI

Outcome measures / Results:	**Time points:**	6 months and 2-5 years
	Pain:	VAS pain score (0-100). Subjective pain form during heavy and light work and at night. In both groups, pain improved such they were pain free during light work and whilst sleeping. VAS, decreased from a pre-operative level of 68 mm to 21 mm in the Swanson group and 24 mm in the APL group at the 6 month assessment. Pain during heavy work remained in half of the patients at final follow up.
	Physical Function:	-
	Global assessment:	Subjective satisfaction score. At the 6 months, 11 of the 13 patients in the Swanson group and 11 of the 13 patients in the APL group were subjectively satisfied with the operation.
	ROM:	MCPJ flexion and extension, radial and palmar abduction were measured with goniometer
	Strength:	Thumb tip pinch (primary outcome), key pinch, and grip strength. The thumb tip pinch strength, increased after the operation in both the Swanson (mean, +0.11 kp/cm2; SD, 0.16) and APL (mean, +0.15; SD, 0.20) groups (P=0.03 and 0.03). Both groups improved from baseline but the was no difference between groups.
	Others:	-
	Imaging:	Anteroposterior and lateral views taken to measure trapezial space. In both groups, the trapezial space measured 11 mm pre-operatively and at 6 months it was 9 mm in the Swanson and 5mm in the APL group (p=0.01). Further decreases occurred before the longer term follow up.
	Adverse Effects:	Two dislocations in the implant group along with signs of radiographic cyst formation in the group.
Authors Conclusions:	Short term improvement in both groups but no difference between them.	
Notes:	No clear power calculation, small study. Randomisation process is unclear.	

Study complete reference:		Study type / Evidence level:
Rasmus D. Thorkildsen & Magne Røkkum (2019) Trapeziectomy with LRTI or joint replacement for CMC1 arthritis, a randomised controlled trial, Journal of Plastic Surgery and Hand Surgery, 53:6, 361-369		Randomised Controlled Trial Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Norway **Centres:** Single Centre **Setting:** Hospital **Funding Sources:** No external funding. **Dropouts:** 1 – Elektra converted to trapeziectomy.	***n:*** 40 (20 participants per arm) **Mean age (yrs):** 61 vs. 64 **Gender (M:F):** 12:28 **Incl. Criteria:** Adults (18+) with isolated CMCJOA. **Excl. Criteria:** STT OA, Thumb injury, Pregnancy, follow issues, trapezial cysts. **Stage CMCJOA:** Symptomatic CMCJ OA – almost all Eaton Stage III	Two study groups: 1) Elektra joint replacement 2) Trapeziectomy and LRTI

Outcome measures / Results:	**Time points:**	Primary outcome QDASH at 2 years. 3, 6, 12 and 24 months.
	Pain:	No separate pain score
	Physical Function:	Nelson score significantly better in Elektra group at 3 months (p=0.002) but no other time point. QDASH significantly better at 3 and 6 months (p=0.007 and p=045 respectively) in the Elektra group but no difference at 2 years.
	Global assessment:	
	ROM:	Kapandji score significantly better in Elektra group at 3 months. Abduction and extension significantly better in the Elektra group at final follow follow-up.
	Strength:	Grip, key, tip pinch. No difference between either group at any time point but a significant improvement from baseline.
	Others:	-
	Imaging:	15 of the 19 patients with the Elektra implants showed osteolysis.
	Adverse Effects:	No surgical revisions in the trapeziectomy group. Six patients in the Elektra group needed at least one additional operation for implant related complications.
Authors Conclusions:	There was no difference in primary outcome between the two groups but a significantly better early functional recovery in the joint replacement group.	
Notes:	Randomization was performed using sealed envelopes. Follow up performed by blinded hand therapist. MCID 15 points on QDASH. Intention to treat analysis.	

Study complete reference:		**Study type / Evidence level:**
Belcher HJCR, Nicholl JE. A comparison of trapeziectomy with and without ligament reconstruction and tendon interposition. J Hand Surg 2000; 25B: 4: 350-356.		Randomised controlled trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: UK **Centres:** Single **Setting:** District General Hospital **Funding Sources:** No external funding. **Dropouts:**	***n:*** 43 Hands (37 patients). **Mean age (yrs):** 63 (SE 2), 58 (SE 1) **Gender (M:F):** 1:18 (Trapeziectomy), 4:19 (Trapeziectomy + LRTI) **Incl. Criteria:** CMCJ OA 'needing' surgery **Excl. Criteria:** Rheumatoid Arthritis, concomitant procedure. **Stage CMCJOA:** Unclear	Two study groups: 1) Trapeziectomy (n= 19) 2) Trapeziectomy and LRTI - APL slip (n= 23)

Outcome measures / Results:		
	Time points:	Median 13 months (range 7-29 months)
	Pain:	VAS thumb pain (1-10). Improved in both groups but no statistical difference.
	Physical Function:	Questionnaire on ADLs. Improved in both groups but no statistical difference.
	Global assessment:	VAS scores (1-10): hand function, thumb pain, satisfaction. Improved in both groups but no statistical difference.
	ROM:	ROM IPJ, MCPJ, arc of motion, Kapandji. Reduction in ROM in both groups. No statistical difference.
	Strength:	Jamar grip strength and pinch-meter for thumb pinch. Both groups improved. No statistical difference.
	Others:	Questionnaire on ADLs. Subjective improvement in both groups
	Imaging:	Stress radiographs performed before and after. Distance measured between scaphoid and metacarpal base. Reduced height in both groups with no statistical difference.
	Adverse Effects:	8 complications: 3 had recurrent pain, 1 weak thumb, 2 scar neuromas, 1 FCR tendon rupture, 1 loss of sensation in SBRN distribution.
Authors Conclusions:	Both procedures were effective. LRTI did not provide any benefit over simple trapeziectomy but lengthened the procedure.	
Notes:	No record of previous treatments before being considered for surgery. No validated PROM.	

Study complete reference:		**Study type / Evidence level:**
Brennan A, Blackburn J, Thomson J, Field J. Simple trapeziectomy versus trapeziectomy with flexor carpi radialis suspension: a 17-year follow-up of a randomized blind trial. J Hand Surg European Volume. 2020;46(2):120–4		Randomised Controlled Trial Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: UK **Centres:** Cheltenham **Setting:** District General Hospital **Funding Sources:** No external funding **Dropouts:** 47%	***n:*** 28 (34 Thumbs) **Mean age (yrs):** 76 (67 – 86) **Gender (M:F):** 6:22 **Incl. Criteria:** Failed conservative therapies. Stage III or IV osteoarthritis, recruited between 2003-4. **Excl. Criteria:** **Stage CMCJOA:** Stage III to IV	Two study groups: 1) Trapeziectomy with LRTI as per Burton & Pellegrini using half of FCR (n= 33) 2) Trapeziectomy (n= 32) Both groups had 2 stab incisions in the forearm as would be used for harvesting the FCR (blinding the assessor). Following surgery, both in Bennett's plaster for 4 weeks and then mobilised by therapist for further 4 to 6 weeks.

Outcome measures / Results:	**Time points:**	17.5 yrs (15 to 20) PO by physiotherapist
	Pain:	Not separately reported. As part of Quick DASH. A Grind Test was done - Grind Test painful in 1 in each group.
	Physical Function:	As part of Quick DASH. Quick DASH scores: Trapeziectomy = 5 (0 – 23); Trapeziectomy with LRTI = 9 (5 – 21) p=0.23
	Global assessment:	Not assessed
	ROM:	Measured with goniometer using standardised methods - radial and palmar abduction in degrees and first web span as distance in cm between thumb and index nail beds in maximum radial abduction. All measurements were good in both groups. Radial abduction was better (Trapeziectomy 79, LRTI 71) in Trapeziectomy (p=0.04) but no difference in other ROMs. Trapeziectomy was better than LRTI for radial and palmar abduction and radial abduction also reached significance at 12 mo. This improvement was maintained. Clinical significance of better radial abduction in Trapeziectomy is uncertain.
	Strength:	Jamar dynamometer and pinch meter used – No significant diff between groups at 17.5 yrs.
	Others:	Satisfaction score VAS (0 – 100) = Trapeziectomy = 100 (95 -100) LRTI = 100 (96-100), no difference, both groups highly satisfied.
	Imaging:	Standard AP and Lat X-rays pre-op and at each post-op visit. Mean Scapho-metacarpal distance measured and height ratio and height loss calculated. In the first study, there was significant diff between the groups at all points (LRTI better distance) but difference became relatively less at 12 mo. However, now there were no differences (4mm in each, p=0.88)
	Adverse Effects:	Not assessed in this long term study. In the first study (Field et al 2007), there were more adverse effects in LRTI but numbers were too small to draw conclusions.
Authors Conclusions:	No benefit with FCR sling in addition to trapeziectomy, even in the long term. Excellent satisfaction scores for both. "gap" on X-ray no different in the long term, so is it worth trying to preserve?	
Notes:	This is a long term follow-up paper of the same cohort of patients in the following paper - To Suspend or Not to Suspend: A randomized single blind trial of simple trapeziectomy versus trapeziectomy and flexor carpi radialis suspension. J Field and D Buchanan, Journal of Hand Surgery (European Volume 2007) 32E: 4: 462-466. Out of 65 patients, only 28 (34 thumbs) were available. 6 had died and 31 not available. However, initial study was RCT and the characteristics of the available patients did not differ, hence reducing selection bias. Original paper (Field et al 2007) does not mention if the surgeons/patients were blinded as to which operation they were going to do and at what point the surgeon was told. For the initial study, Wajon (2015) through personal communication, commented that assessors were blinded, so objective assessment detection bias was low. This paper mentions that the independent assessor, the hand therapist, was blinded.	

Study complete reference:		**Study type / Evidence level:**
DeSmet L, Sioen W, Spaepen D, Ransbeeck H van. Treatment of basal joint arthritis of the thumb: trapeziectomy with or without tendon interposition/ligament reconstruction. Hand Surg. 2004;9:5–9.		Randomised controlled trial. Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Belgium **Centres:** Single Centre **Setting:** Department of Orthopaedic Surgery **Funding Sources:** No external funding mentioned. **Dropouts:** 1; patient in trapeziectomy group failed and was converted to arthrodesis. Results were not included.	***n:*** 56 (22 Trapeziectomy, 34 Trapeziectomy + LRTI) **Mean age (yrs):** Trapeziectomy: 61.5, Trapeziectomy + LRTI 58 **Gender (M:F):** All female. **Incl. Criteria:** Painful primary osteoarthritis, refractory to conservative therapies. **Excl. Criteria:** Systemic disease, Rheumatoid arthritis, Post-traumatic arthritis. **Stage CMCJOA:** Not reported	Two study groups: 1) Trapeziectomy + LRTI using full FCR (mobilised within a week) 2) Trapeziectomy (mobilised straight away)

Outcome measures / Results:		
	Time points:	Mean - Trapeziectomy 34 m (9 to 84), LRTI 26 m (9 to54)
	Pain:	VAS – Trapeziectomy 3.25 (0 -8), LRTI 2.4 (0-7) Not different between groups.
	Physical Function:	Subjective score (Excellent to worse) and functional score for activities – no difference. DASH – Trapeziectomy 33 (0 -77), LRTI 27 (0 -94) – no difference.
	Global assessment:	Not done
	ROM:	Web angle mean 63.6 preop improved to 84.8 post op, improved angle in 42% in both groups, not compared.
	Strength:	Grip and key pinch measured using standardized techniques and reported as percentage of preop values. Actual measurements not provided.
	Others:	Significant but weak correlation between key pinch and remaining trapezial height was found but not compared between the groups, analysed as a whole.
	Imaging:	PA x-rays with hand flat on table. Distance between scaphoid and metacarpal base measured. Reported as percentage of preop trapezial height. Trapeziectomy 32%, LRTI 57.5%, significant difference.
	Adverse Effects:	Not reported except one failed trapeziectomy who went on to have fusion, not included in analysis.
Authors Conclusions:	No significant difference for pain relief, patient satisfaction, mobility, key and grip strength or DASH. Trapezial height was better preserved in the LRTI group and there was a significant correlation between this and key pinch force in the whole group although the height preserved did not correlate with the DASH. The authors subjective scores and functional scores correlated well with the DASH.	
Notes:	Randomisation not clear - "Choice of procedure was at random" Unclear at what point the surgeon knew which operation to perform. One trapeziectomy had arthrodesis and left out of remaining analysis. Not clear if patients or assessors (independent) were blinded – DASH and subjective/functional scores filled by patients. Objective scores filled by assessors. Unclear if either group aware of the procedure prior to final review. Multiple risks of bias, overall results did not show any difference between the two procedures.	

Study complete reference:		**Study type / Evidence level:**
Study complete reference - To Suspend or Not to Suspend: A randomized single blind trial of simple trapeziectomy versus trapeziectomy and flexor carpi radilais suspension. J Field and D Buchanan, Journal of Hand Surgery (European Volume 2007) 32E: 4: 462-466		Randomised Control Trial Moderate (+) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: UK **Centres:** Cheltenham **Setting:** District General Hospital **Funding Sources:** No external funding **Dropouts:** Nil	***n:*** 65 **Mean age (yrs):** 55 (49 – 75) **Gender (M:F):** 9:56 **Incl. Criteria:** Failed conservative therapies, Stage III or IV osteoarthritis, recruited between 2001-3 **Excl. Criteria:** **Stage CMCJOA:** Stage III or IV	Two study groups: 1) Trapeziectomy with LRTI as per Burton & Pellegrini using half of FCR (n= 33) 2) Trapeziectomy (n= 32) Both groups had 2 stab incisions in the forearm as would be used for harvesting the FCR (blinding the assessor). Following surgery, both in Bennett's plaster for 4 weeks and then mobilised by therapist for further 4 to 6 weeks.

Outcome measures / Results:		
	Time points:	Baseline pre-operative examination. Assessed post-operatively by a physiotherapist at 3, 6 and 12 months post-operative timepoints.
	Pain:	VAS (0 – 10) - No difference between the groups but significantly better than pre-op in both.
	Physical Function:	Not formally assessed (but results report that there was no difference in pain with writing, unscrewing jars and turning taps at any point between the groups).
	Global assessment:	Not assessed
	ROM:	Measured with goniometer using standardised methods - radial and palmar abduction in degrees and first web span as distance in cm between thumb and index nail beds in max radial abduction. All measurements improved in both groups and this improvement was significant at 12 mo. No significant difference between groups at any stage but trapeziectomy was better than LRTI for radial and palmar abduction but only radial abduction reached significance at 12 mo. Web span was no different at any stage. Significance of better radial abduction in trapeziectomy is uncertain.
	Strength:	Jamar dynamometer and pinch meter used – Both increased post op but no significant diff between groups at any stage.
	Others:	Patients asked if they would have the operation again – 64 of 65 said yes (except 1 CPRS patient).
	Imaging:	Standard AP and Lat X-rays pre-op and at each post-op visit. Mean Scapho-metacarpal distance measured and height ratio and height loss calculated. There was significant diff between the groups at all points (LRTI better distance) but difference became relatively less at 12 mo.
	Adverse Effects:	Finger swelling, stiffness and CRPS symptoms were specifically questioned. Superficial wound infection – 2 trapeziectomy, 1 LRTI Radial nerve irritation – 1 in each group Wound adherence – volar wound only, so all in LRTI. All resolved by 12 mo. ($p<0.01$) CRPS – 1 trapeziectomy, 4 LRTI ($p<0.01$), 4 had resolved at 12 mo. Overall more adverse effects in LRTI but numbers too small to draw conclusions.
Authors Conclusions:	No benefit with FCR sling in addition to trapeziectomy.	
Notes:	Paper does not mention if the surgeons/patients/assessors were blinded as to which operation they were going to do and at what point the surgeon was told. Wajon (2015) through personal communication commented that assessors were blinded, so objective assessment detection bias was low. Unclear about the patient reported subjective outcomes of pain. Pain score VAS but no PROMs. ROM and grip measured in a standardised fashion.	

Study complete reference:		Study type / Evidence level:
Gerwin M, Griffith A, Weiland AJ, Hotchkiss RN, McCormack RR. Ligament Reconstruction Basal Joint Arthroplasty Without Tendon Interposition. Clin Orthop Relat R. 1997;342(NA;):42–5.		Randomised Control Trial Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: USA **Centres:** Single centre **Setting:** Hospital for Special Surgery (tertiary referral unit) **Funding Sources:** No external funding mentioned.	***n:*** 20 **Dropouts:** None mentioned **Mean age (yrs):** LRTI 61, LR 62 **Gender (M:F):** Not mentioned **Incl. Criteria:** Not specified. **Excl. Criteria:** Not specified. **Stage CMCJOA:** Not specified.	Two study groups: 1) Trapeziectomy + LRTI (n= 9) 2) Trapeziectomy + ligament reconstruction (LR) (n= 11)

Outcome measures / Results:		
	Time points:	Average of 23 months follow-up, range not provided.
	Pain:	Not reported.
	Physical Function:	Ability to accomplish 6 activities – turn key in lock, cut food with knife, open door, open jar, tie shoes and fasten buttons or hooks. All were able to perform all activities.
	Global assessment:	Not done.
	ROM:	Radial (LRTI 42, LR 40) and palmar abduction (LRTI 47, LR 44) and ability to touch volar aspect of 5th MP joint with thumb were no different at 23 mo. Metacarpo-phalangeal and interphalangeal ROM was measured as well and were no different.
	Strength:	Two point pinch (LRTI 3.6 kg, LR 4.1 kg) and three point pinch (LRTI 4.2, LR 5.3) at 23 m were slightly greater in the LR group and significant (p values not provided and graph legend in Fig 4 states that the strengths were not significantly different). Lateral pinch (LRTI 4.8 kg, LR 5.4 kg) and grip (LRTI 24, LR 27.7) were not significantly different. Does not state exactly how these measurements were taken although the radiographic stress X-rays were done with a calibrated pinch meter.
	Others:	VAS overall satisfaction – subjective satisfaction with LRTI (72%) and LR (76%) were similar.
	Imaging:	Lateral X-ray of basal joint at rest and under stress (calibrated pinch meter to ensure full pinch of 5 kg during x-ray) – no difference in height of reconstructed basal joint at rest or with pinch. Proximal migration with pinch was 0.7mm in LRTI and 0.3mm in LR, two third of LRTI and three fourths of LR had had no prox migration with pinch but difference not significant.
	Adverse Effects:	Not reported
Authors Conclusions:	No differences between the 2 groups with and without tendon interposition. In LR, smaller incision and technically easier.	
Notes:	LRTI done as per Burton and Pellegrini using radial half FCR, transverse incision in forearm for harvesting but no K-wire was used. In LR alone, proximal harvesting done at wrist, fixed to metacarpal base with mini Mitek anchor. Duration of immobilization and rehabilitation not mentioned. Randomisation methodology is not specified. The timing of the surgeon being informed of randomization allocation and the surgery to perform is not specified. "Patients returned for blind assessment" – not mentioned if assessor was blinded or patients knew what operation had been done at the time of final review. Loss to FU if present, not mentioned. Small number of patients. Range of FU not mentioned (ave 23 m).	

Study complete reference:		Study type / Evidence level:
Hart R, Janecek M, Siska V, Kucera B, Stipcak V. Interposition suspension arthroplasty according to Epping versus arthrodesis for trapeziometacarpal osteoarthritis. European Surgery - Acta Chirurgica Austriaca [Internet]. 2006;38:433–8		Randomised Control Trial Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Czechia **Centres:** Department of Orthopaedics, Znojmo, and Department of Trauma, Brrno. **Setting:** **Funding Sources:** Not mentioned. **Dropouts:** Nil	***n:*** 37 patients (40 thumbs studied, 20 in each group). **Mean age (yrs):** 59 (49 – 75) **Gender (M:F):** 13:24 **Incl. Criteria:** Severe pain, loss of strength and loss of motion at thumb base that causes impaired function. Not mentioned if conservative treatments are trialled. **Excl. Criteria:** Post-traumatic osteoarthritis, Rheumatoid arthritis, previous surgery or co-existing hand condition. **Stage CMCJOA:** Primary osteoarthritis Stage IV	Two study groups: 1) Trapeziectomy with LRTI (half FCR) 2) Arthrodesis trapeziometacarpal joint with crossed K-wires. Both groups immobilized for 6 weeks.

Outcome measures / Results:	**Time points:**	6 months and then at mean of 6.8 yrs (2 to 10)
	Pain:	Assessed as part of Buck-Gramko (B-G) score – Subjective assessment by patient completing a questionnaire about pain, strength, daily function, dexterity, cosmetic appearance, willingness to have op again and overall satisfaction. All measures, subjective and objective, were better in arthrodesis group at 6 mo and mean total score was also better ($p<0.05$) in favour of arthrodesis (42.6) vs LRTI (35.3). At final follow up, pain relief was similar as were other subjective parameters, except willingness to have surgery again, which was better for arthrodesis (1 unwilling in arthrodesis vs 4 in LRTI) but otherwise no difference in subjective outcomes between the groups at final review.
	Physical Function:	-
	Global assessment:	Not assessed.
	ROM:	As part of B-G score – Palmar and radial abduction, opposition of thumb tip to little finger palmar crease, MCP hyper-extension. At 6 mo, all movements were better in arthrodesis. At final follow up, for objective measures, scores for radial and palmar abduction were significantly better for LRTI.
	Strength:	Subjective assessment only as above.
	Others:	Total B-G score obtained by adding subjective and objective scores: Excellent 49 – 56, Good 40 – 48, Fair 28 – 39 and Poor <28. At 6 mo, total mean score was better ($p<0.05$) in favour of arthrodesis (42.6) vs LRTI (35.3). At final follow up, for objective measures, scores for radial and palmar abduction were significantly better for LRTI, for subjective measures, willingness to have surgery again was better for arthrodesis (1 unwilling in arthrodesis vs 4 in LRTI) but otherwise no difference. Total score between arthrodesis (50.9) and LRTI (51.3) were not statistically significantly different.
	Imaging:	Not done/ reported.
	Adverse Effects:	2 CRPS in each group, all got better with physiotherapy. No non-unions but 4 needed 10 weeks in plaster for delayed union.
Authors Conclusions:	Recovery time from T+LRTI was longer and more painful at the first assessment at 6 mo, as op was complex and took longer to provide pain relief. At 6 mo, objective and subjective outcomes better in arthrodesis. At final assessment, outcomes similar but subjective function slightly better in LRTI in older people but not significant difference. Subjective results not so satisfactory in younger people having LRTI. Authors recommended arthrodesis for younger and LRTI for older patients.	
Notes:	Randomisation method unclear "Randomly allocated one or the other op as they came in". Does not mention at what stage the surgeon knew who was being allocated to what operation. Does not specify if patients or assessor knew the operation performed at the time of assessment. Unclear if patients reporting subjective outcomes and assessor (mentioned that reviewer not involved in original operation) reporting objective outcomes knew the operation performed.	

Study complete reference:		**Study type / Evidence level:**
Kriegs-Au G, Petje G, Fojtl E, Ganger R, Zachs I. Ligament reconstruction with or without tendon interposition to treat primary thumb carpometacarpal osteoarthritis. A prospective randomized study. J Bone Joint Surg Am. 2004;86-A:209–18		Randomised Control Trial Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: Austrria **Centres:** Single centre **Setting:** Dept of General Orthopaedics, Orthopaedic Hosppital Speising, Vienna **Funding Sources:** Not mentioned. **Dropouts:** 12 excluded from analysis from total recruited – reasons given – 5 changed their mind and 7 moved and could not be traced. Those who had bilateral thumb operation, only the first thumb was included.	***n:*** 43 initially recruited but 31 were analysed (LRTI 16, LR 15) **Mean age (yrs):** of the 31 analysed LRTI 58 (42 to 78) LR 59 (42 to 75) **Gender (M:F):** LRTI – 4M,12F LR – 2M,13F **Incl. Criteria:** All symptomatic, not responded to conservative treatment. No significant diff found between strengths, ROM and trapezial height pre-op **Excl. Criteria:** RA, post traumatic, second operated thumb in bilateral patients. **Stage CMCJOA:** LRTI 3 Sg II, 11 Sg III, 2 Sg IV LR 2 Sg II, 11 Sg III, 2 Sg IV	Two study groups: 1) Trapeziectomy + LRTI 2) Trapeziectomy +LR Half of FCR in both, longer length in LRTI harvested through separate forearm incision, spica for 3 weeks then custom thumb splint until 6 weeks. Active ROM and thenar strengthening exercises begun at 6 weeks.

Outcome measures / Results:		
	Time points:	LRTI n=16 seen at 50 m (35 to 62) LR n= 15 seen at 46.2 m (32 to 64)
	Pain:	Assessed post op as part of Buck-Gramcko (B-G) score – pain frequency of never, occasional, frequent or constant were assessed post op while pain at rest or at strain were reported pre-op. Pain levels not different in the 2 groups.
	Physical Function:	As part of B-G score, subjective strength, daily function, dexterity, cosmetic appearance, have surgery again and overall assessment were recorded. Strength, dexterity, daily function, overall assessment were no different between the groups. Cosmetic appearance and willing to have surgery was better in LR (p=0.038) and while all in LR gave excellent score, 4 in LRTI were unwilling to have op again due to impaired strength, daily function and dexterity compared to pre-op. Overall score showed significant difference between LRTI 44.6 and LR 51.3 (p = 0.036), so LR excellent grade and LRTI good grade as per BG score. Additionally, an ADL questionnaire was used to assess difficulty with writing, brushing teeth, threading needle, turning key, opening tight jar, using knife or scissors, buttoning clothes, zipping clothes, picking up small objects and playing cards). No difference was seen. No difference in returning to previous occupation between the groups.
	Global assessment:	Overall assessment as part of B-G score but not a generic global score, not different in the grps.
	ROM:	As part of BG score, radial and palmar abduction and opposition to palmar crease of little finger measured. Significantly greater mean degrees of radial abduction and palmar abduction were seen in LR than LRTI with greater average increases compared to pre-op in LR. Opposition was not different. MP hyperextension was present in 4 in each group and none progressed post op.
	Strength:	Tip pinch (2 point tip pinch strength measured with pinch meter) and Grip strength (Martin vigorimeter) expressed in Pa. No significant diff between the groups. At final review, tip pinch increased in both but more (32% vs 9%) in LR and grip decreased in both but less so (20% vs 48%) in LR compared to LRTI.

	Others:	Return to previous occupation – did not differ between grps.
	Imaging:	Pre op and at follow ups, standard PA and oblique views of the thumb were taken. At final review, oblique views of thumb at rest and under stress (maximum pinch effort) were taken. Distance between scaphoid and metacarpal base and length of metacarpal measured and index of the height of the arthroplasty space was calculated by dividing the distance by the metacarpal length both at rest and stress. These post op indices were used to compare the degree of proximal migration of MC at rest and stress. No significant difference was found between the groups with early or late post op index or % decrease in height with rest or pinch.
	Adverse Effects:	2 in each group had temporary paraesthesia of the superficial radial nerve one severe CRPS in LRTI, remained impaired at final follow up.
Authors Conclusions:	Tendon interposition does not improve the long term subjective and objective outcomes after ligament reconstruction for treating advanced TBOA. Both procedures have favourable outcomes. Proximal migration does not affect post-op thumb strength, function and pain. Overall LR had excellent and LRTI has good BG scores, so the former had statistically significantly better overall outcome. LR had better thumb abduction, willingness to undergo operation again and cosmesis as compared to LRTI but all other parameters of the BG score did not suggest a difference between the two.	
Notes:	Randomised using computer generated randomisation list with a block size of 4 patients. Does not state if surgeons were blind till the time of surgery and at what point in the pathway the treatment allocated was made available to them. Also does not state if patients knew what operation they had had when assessed. Independent assessors - Final review done by author not involved in operation or patient care and strength measured by independent ergotherapists at each time point - but not clear if they knew the treatment? Numbers were small – 43 initially and then 31 analysed finally, although reasons given.	

Study complete reference:		Study type / Evidence level:
Vermeulen GM, Brink SM, Slijper H, Feitz R, Moojen TM, Hovius SER, et al. Trapeziometacarpal Arthrodesis or Trapeziectomy with Ligament Reconstruction in Primary Trapeziometacarpal Osteoarthritis. J Bone Jt Surg. 2014;96(9):726–33.		Randomised Control Trial Low (-) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: The Netherlands **Centres:** Single Centre **Setting:** Dept of hand and wrist surgery, Utrecht **Funding Sources:** **Dropouts:** 2 LRTI and 3 Arthrodesis dropped out prior to surgery but all who had the operation were assessed.	***n:*** 43 initially recruited but 38 were analysed as 5 dropped out before the surgery **Mean age (yrs):** 59 **Gender (M:F):** All female **Incl. Criteria:** Female > 40 yrs with Gr 2 to 3 primary OA, failed non-op treatment. **Excl. Criteria:** Men, post traumatic or inflammatory arthritis **Stage CMCJOA:** 2 to 3 Eaton and Glickel	Two study groups: 1) Trapeziectomy with LRTI using a third of FCR (modified Weilby technique) (n = 21) 2) Arthrodesis using plates and screws (non-locking 2.3mm T-plate) (n = 17).

Outcome measures / Results:		
	Time points:	3 months and 12 months
	Pain:	As part of PRWHE score (0 to 50) and DASH score – Pain scores improved from baseline 33.9 to 16 (LRTI) at 12 mo and 39.5 to 19.9 (Arth)
	Physical Function:	As part of PRWHE score (0 to 100/2) and DASH score – improved from 28.8 to 11.2 (LRTI) and 34.9 to 17.7 (Arthrodesis). Both procedures resulted in significant improvement from baseline as assessed by PRWHE (62.6 to 27.1 LRTI and 74.4 to 37.5 Arthrodesis) and DASH (44.3 to 20.6 LRTI and 33.9 to 33.9 Arthrodesis) overall but intergroup analysis not reported as p values due to insufficient power but showed similar results between the two.
	Global assessment:	Not assessed
	ROM:	IPJ flexion extension – no significant change in either group. MCPJ flexion extension – Flexion decreased and extension increased significantly in both from baseline values. CMC palmar abduction (intermetacarpal distance) - no significant change in either group. Opposition (Kapandji) – significantly lower at 3 months in both but returned to baseline at 12 mo. Intergroup comparisons showed similar results but not reported as p values.
	Strength:	Key, tip and 3 point pinch using baseline pinch gauge and grip strength using hydraulic dynamometer, best of 3 – Tip pinch did not change over time in either group. The other three measures decreased at 3 months significantly in but returned to baseline at 12 mo in LRTI but Arthrodesis group did not show significant change over time.
	Others:	At 12mo, would they have the operation again? – 86% LRTI and 53% Arthrodesis (p=0.025) Return to work or normal activities at weeks from surgery – mean 12.7 weeks LRTI vs 10.6 Arthrodesis.
	Imaging:	Taken as oblique radiographs to confirm union at 6 to 8 weeks after Arthrodesis before starting strengthening exercises or for investigating delayed union between 3 and 6 months , not mentioned if taken for all patients.
	Adverse Effects:	Six in LRTI (3 mild and 3 moderate). Fifteen in Arthrodesis (6 mild, 6 mod and 3 severe). Significantly more moderate and severe complications in Arthrodesis group (p=0.016). Severe included 2 symptomatic non-unions requiring revisions and one CRPS I with pain and limited function at 12 mo.
Authors Conclusions:	First single blind RCT single centre Level 1 study to compare these procedures. Results applicable to 40+ women only with diagnosis of OA. Primary outcome assessment showed that both groups had significantly improved DASH and PRWHE results over time while the changes between the groups were similar. However, Arthrodesis led to significantly more severe and moderate complications needing revision surgery. On this basis, the study was terminated early. Sufficient power to compare between groups was therefore not reached.	

	Commonly believed notions of increased ROM and decreased strength in LRTI as compared to Arthrodesis were not found in this group with similar results in both. Patients would have LRTI again more often vs Arthrodesis.
Notes:	• 45 subjects per group was needed for 80% power (PRWHE 15+/- 25 points). Not recruited due to surgeons reporting high complication rate in Arthrodesis group. Hence outcome measures were underpowered and therefore p values not calculated. Surgeons not blinded to treatment allocation. • Method of arthrodesis done using a specific technique and hence results not applicable for arthrodesis in general. • Assessments were done by independent and blinded hand therapists but not impossible for the experienced ones to work out the operation from the scar. • Not clear if patients were blinded, either at time of surgery or at final review.

Study complete reference:		**Study type / Evidence level:**
Wajon A, Vinycomb T, Carr E, Edmunds I, Ada L. Surgery for thumb (trapeziometacarpal joint) osteoarthritis. Cochrane Database Syst Rev [Internet]. 2015;2(2):CD004631.		Systematic Review of Randomised control trials High (++) Quality
Study details:	**Patient characteristics:**	**Interventions / Comparators:**
Country: **Centres:** **Setting:** **Funding Sources:** **Dropouts:**	***n:*** 670 in 11 studies 1. 4 studies (n= 421) compared Trapeziectomy with LRTI. 2. 2 studies (n=113) compared LRTI with joint resurfacing 3. 1 study (n=40) LRTI to fusion. 4. 1 study (n=26) LRTI to joint replacement. **Mean age (yrs):** Varied **Gender (M:F):** Varied. Mostly female. **Incl. Criteria:** Prospective, RCTs, quasi-RCTs or controlled studies where intervention was surgery for TBOA. Studies that compared at least 2 interventions were included. **Excl. Criteria:** Not meeting above criteria – list if excluded studies with reasons included. Non-surgical interventions excluded. **Stage CMCJOA:** Any	Any surgery for TBOA – 1) Metacarpal osteotomy 2) Trapezio-metacarpal fusion 3) Trapeziectomy 4) Trapeziectomy + LRTI 5) Trapeziectomy + LR 6) Trapezictomy + Interposition 7) Joint replacement 8) Artelon resurfacing

Outcome measures / Results:		
Studies reporting similar measures of outcomes for pain, physical function, ROM, strength,, imaging and adverse events were pooled for analysis.	**Time points:**	Highly variable in individual studies.
	Pain:	LRTI had 2.8mm lower pain or 3% reduction than Trapeziectomy at 3 to 54 m (3 studies, n=162)
	Physical Function:	LRTI has 0.2mm lower or 0.03% decreased function score than Trapeziectomy at 7 to 97 m (3 studies n=211)
	Global assessment:	Eg patient satisfaction, "would I have the op again" - Not reported in included studies for pooling.
	ROM:	2 studies showed significantly more palmar abduction in LRTI vs Trapeziectomy alone.
	Strength:	No difference seen in included comparative studies.
	Others:	Quality of life eg SF36 and Reoperation rate – Not reported in included studies.
	Imaging:	One study n=42 showed scapho-metacarpal distance of 2.3mm for Trapeziectomy and 0.1mm less for LRTI.
	Adverse Effects:	Incidence was 10/100 for Trapeziectomy and 19/100 for LRTI (4 studies, n=328) or an absolute increased risk of 9%.
Authors Conclusions:	No studies compared sham or non-op treatment with surgery. No conclusive evidence that one technique better than another for pain relief and physical function. Studies not of high enough quality to provide conclusive evidence.	
Notes:	11 studies, 670 participants 7 surgical procedures as stated above. Most had unclear risk of bias, affecting the validity of reported results. None showed benefit of one surgery over another for any of the primary outcome measures. Low quality evidence suggests LRTI may not provide additional benefit over Trapeziectomy alone. Low quality evidence from 2 studies (n=51) suggests that LRTI may not improve function or slow joint degeneration or cause more adverse events compared to LR. Uncertain of benefits or harm from other surgical techniques due to low quality evidence from single studies with low reporting of the primary outcomes. Further research likely to change estimates of this review.	

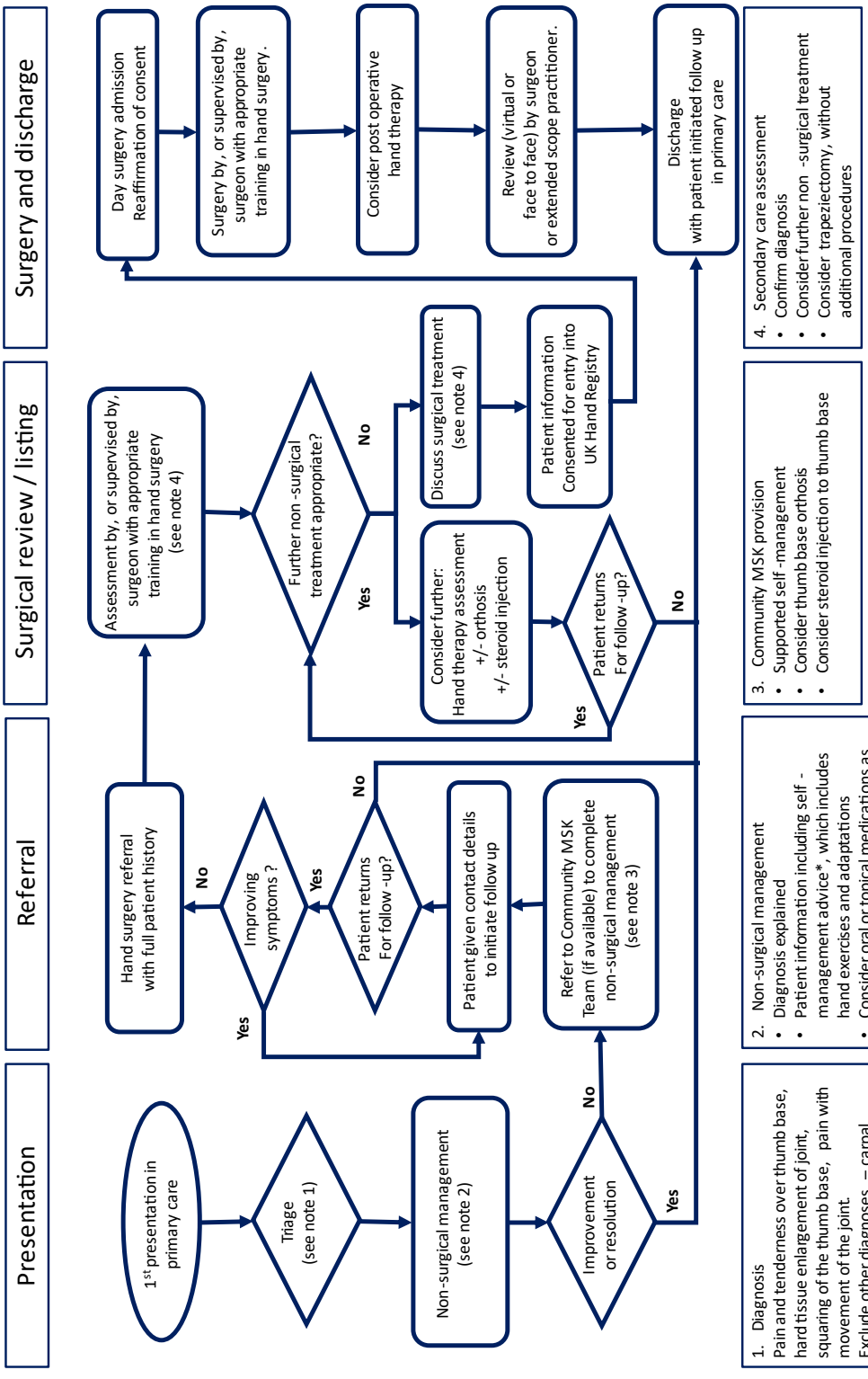
Appendix 3: Key clinical practice recommendations

- Non-invasive treatment should be offered to all patients presenting with symptomatic thumb base osteoarthritis (high evidence). Non-invasive treatment consists of a multimodal comprehensive package of self-management that includes the following components: education about the condition; exercise; task modification; pacing; forming healthy habits; pain management.

  Patients should understand the principles of self-management as a priority and actively engage in self-management strategies. Healthcare professionals should support the self-management programme to optimise outcome. They should direct the patients to high quality resources and educational material. Where facilities exist, referral to the local hand therapy service or MSK service with hand therapy expertise should be considered.

- Splints should be considered as an option in the treatment ladder for those who have not responded to a self-management package of treatment (low to moderate evidence). They should be prescribed to fit to a person's lifestyle and requirements (activities of daily living, job, hobbies) but should not be the first and only non-invasive treatment prescribed.
- Intra-articular corticosteroid injection provides short-term pain relief (low to moderate evidence) and should be considered in those who have not responded to a comprehensive self-management programme +/- splint. Where expertise is available, performing this in the out-patient setting using landmark technique should be considered.
- If symptoms fail to resolve with self-management +/- splint +/- steroid injection, surgery should be considered in patients with TBOA (moderate evidence). When surgery is indicated, additional procedures do not appear to confer any benefit over simple excision of the trapezium (low evidence).

Appendix 4: Patient flow algorithm



* Pulvertaft Hand Centre
Basal thumb arthritis | The British Society for Surgery of the Hand
Versusarthritis
The Osteoarthritis Thumb Therapy (OTTER) II Trial: a study protocol
EULAR HPR Guide for Hand Osteoarthritis

** NICE Guidance: Osteoarthritis in over 16s

Appendix 5: Support Tool: quick reference guide

- Non-invasive treatment should be offered to all patients presenting with symptomatic thumb base osteoarthritis (TBOA). This consists of a multimodal comprehensive package of self-management.
- Healthcare professionals should support the self-management programme by directing the patients to high quality resources and educational materials listed below (see links). Where facilities exist, referral to the local hand therapy service or MSK service with hand therapy expertise should be considered.
- Splints should be considered for those who have not responded to a self-management package.
- Intra-articular corticosteroid injection should be considered in those who have not responded to a self-management programme +/- splint. This can be performed in the out-patient setting using landmark technique.
- If symptoms fail to resolve with the above treatment, surgery should be considered in patients with TBOA. When surgery is indicated, additional procedures do not appear to confer any benefit over simple excision of the trapezium.

Resources and Educational Materials to support self-management

Pulvertaft Hand Centre

Basal thumb arthritis | The British Society for Surgery of the Hand

https://www.versusarthritis.org/about-arthritis/conditions/hand-and-wrist-pain/

The Osteoarthritis Thumb Therapy (OTTER) II Trial: a study protocol

EULAR HPR Guide for Hand Osteoarthritis

Appendix 6: Quality of evidence assessment of included studies (Risk of bias tables)

Risk of bias table: non-invasive treatment

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias) Subjective/patient reported outcomes	Blinding of outcome assessment (detection bias) Objective outcomes	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
Arazpour 2016	?	?	−	?	?	+	?
**Bani 2013	+	+	−	+	+	+	?
Becker 2013	+	+	−	?	?	−	?
Cantero-Tellez 2018(a)	−	−	−	+	+	+	?
**Davenport 2012∞	+	+	+	+	+	−	?
Gomes Carreira 2010	+	?	−	?	?	+	?
Cantero-Tellez 2018(b)	?	?	?	?	+	+	?
Sillem 2011	+	−	−	−	−	+	?

Van der Vegt	+	−	−	−	−	+	?
Villafane 2013∞	+	+	+	?	+	+	?
Weiss 2004	−	−	−	?	−	?	?
Wajon 2005	?	?	?	+	+	−	?
Hermann 2014	+	+	−	+	+	+	?
Rannou 2009	+	+	−	+	+	+	?
Can 2020	+	?	?	+	+	−	−
Adams 2020∞	+	+	+	+	+	+	+

- ∞ Assessor and participant blinded, hand therapist delivering treatment not blinded.
- Cantero-Tellez 2018(a): Effect of immobilisation of metacarpophalangeal joint in thumb carpometacarpal osteoarthritis on pain and function. A quasi-experimental trial. J Hand Ther 2018;31(1):68-73.
- Cantero-Tellez 2018(b): Necessity of Immobilizing the Metacarpophalangeal Joint in Carpometacarpal Osteoarthritis: Short-term Effect. Hand. 2018;13:412–7.
- ** SIGN quality assessment scored as high ROB overall, due to other aspects of study e.g., design/ statistical bias.

Risk of Bias Table: Joint Injections

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias) Subjective/patient reported outcomes	Blinding of outcome assessment (detection bias) Objective outcomes	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
Heyworth 2008	+	+	−	+	+	+	?
Monfort 2015	+	?	?	+	+	+	?
Stahl 2005	?	?	?	?	?	+	?
Meenagh 2004	+	+	+	+	+	−	?
Bahadir 2009	?	?	−	+	+	+	?
Fuchs 2006	?	?	?	+	+	−	?
Jahangiri 2014	+	+	+	+	+	−	?

Risk of Bias Table: Surgical Treatment

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias) Subjective/patient reported outcomes	Blinding of outcome assessment (detection bias) Objective outcomes	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
Belcher 2000	+	+	?	?	?	+	?
Brennan 2020	+	?	?	?	+	+	?
Corain 2016	+	?	?	?	?	?	?
DeSmet 2004	?	?	?	?	?	?	?
Field 2007	+	?	?	?	+	+	?
Gangopadhyay 2012	+	+	?	?	+	+	?
Gerwin 1997	?	?	?	?	?	?	?
Hart 2006	?	?	?	?	?	+	?
Kreigs Au 2004	+	?	?	?	?	+	?
Nilsson 2010	?	?	?	?	+	−	?
Salem 2012	+	?	?	?	+	+	?
Tagil 2002	?	?	?	?	?	+	?

Thorkildsen 2019	+	+	?	?	+	+	?
Vermeulen 2014	+	?	?	?	+	−	?

Appendix 7: Included study references

Non-invasive treatment

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