Review Article

The Treatment of Primary Arthritis of the Finger and Thumb Joint

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Summary

Background: Primary finger and thumb joint arthritis is common, with a markedly rising prevalence from age 50 onward. As the population as a whole ages, the need for effective, stage-appropriate treatment of this condition is increasing.

Methods: This review is based on pertinent publications retrieved by a selective search in the PubMed and Cochrane Library databases.

Results: Pain on movement and morning stiffness are commonly reported symptoms. Thorough physical examination and plain x-rays are mandatory. In the early stages of primary finger and thumb joint arthritis, a conservative, multimodal treatment approach involving the use of splints, physiotherapy, and non-steroidal anti-inflammatory drugs can be helpful. The intra-articular injection of hyaluronic acid or cortisone seems to relieve pain in the short term, but its long-term efficacy in primary finger and thumb joint arthritis is questionable. Arthrodesis (joint fusion) is a reliable surgical treatment option for arthritis of the metacarpophalangeal and interphalangeal joints of the thumb. For mobility-preserving surgery of the metacarpophalangeal joints of the second through fifth fingers, silicone implant arthroplasty remains the gold standard. Symptomatic, advanced arthritis of the distal interphalangeal joint is most effectively treated with arthrodesis.

Conclusion: The efficacy of conservative treatment has been documented in high-quality clinical trials, while that of surgical treatment has not. The various surgical methods have yielded benefits in routine clinical use, but these remain to be assessed in randomized and controlled trials.

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Arthritis is the leading joint disease in adults worldwide (1). The hand is most frequently affected by arthritis of the distal interphalangeal (DIP) joint, followed by arthritis of the carpometacarpal (CMC) joint of the thumb (rhizarthritis), arthritis of the metacarpophalangeal (MCP) joints, and finally proximal interphalangeal (PIP) joint arthritis. (e1, e2). Radiological signs of arthritis can be found in up to 81% of the elderly population (e1, e3). Heberden nodes of the DIP joints are found in 58% and Bouchard nodes of the PIP joints in 30% of over-60s in the USA (e4).

Etiology

Primary arthritis cannot be attributed to a specific causative factor. Diagnostically, it must be differentiated from the various forms of secondary arthritis. However, the following risk factors for primary arthritis have been identified (2, e5–e8):

- Female sex
- Age over 40 years
- Menopause
- Family history of arthritis
- Overweight
- Joint laxity
- Occupational exposure or previous joint injury

A systematic review showed that obesity was positively associated with hand arthritis in 64% (16/25) of the studies investigated (e9). An estimated relative risk of 1.9 was calculated on the basis of these findings (e9). A meta-analysis of cohorts from four European centers found an association between hand arthritis and certain genetic configurations (e10). There is a marked increase in the prevalence of arthritis from age 50 onward (e11, e12). The authors of another meta-analysis identified a relative risk of 0.81 (95% confidence interval [95% CI]: [0.73; 0.9]) for men compared with women (e13). The age-adjusted

Figure 1:

A mucoid cyst over the distal interphalangeal joint of the index finger with a cleft nail resulting from damage to the germinal matrix

Figure 2: The grind test: the examiner grips the first metacarpal and exerts axial strain on the carpometacarpal joint while making rotational movements.

prevalence of radiologically demonstrated arthritis of the first CMC joint (CMC-1) in adults over 30 years old was determined to be 7% in men and 15% in women (e14).

Method

A selective survey of the English-language literature on the treatment of primary arthritis of the finger and thumb joints was carried out with the following search-term combinations in the databases PubMed and Cochrane Library: “osteoarthritis” AND “hand” AND “therapy”; “osteoarthritis” AND “finger” AND “therapy”; “osteoarthritis” AND “thumb” AND “therapy”; “arthrosis” AND “hand” AND “therapy”; “arthrosis” AND “finger” AND “therapy”; “arthrosis” AND

“thumb” AND “therapy”. Case reports, review articles, biomechanical studies, and animal experimental studies were excluded, as were studies with heterogeneous disease pathogenesis where it was not possible to extract the relevant data (eTable 1).

Diagnosis

Symptoms

The intensity of pain often correlates with radiologically demonstrated degeneration of the joints in the upper extremity (e15). Nevertheless, radiologically arthritic joints can sometimes be used without pain, or very early stages of arthritis can cause pronounced pain (e16). The disease course cannot be reliably predicted.

Medical history

The patients often complain of early-morning stiffness and report that their joint pains are worsened by loading (2, e5). The pain may fluctuate and may be more severe during acute flares of inflammation (2, e5). These symptoms are frequently accompanied by weakness of grip on certain activities (e17). Opening a bottle is typically much more difficult for patients with CMC-1 arthritis and they have to resort to compensatory maneuvers. The patients generally complain of pain palmar to the joint with radiation into the thenar (e17). In most cases the pain is relieved by resting the hand. Differential diagnoses must be carefully ruled out and any comorbidities that might affect the treatment must be documented.

Clinical examination

Patients with advanced arthritis have a spindle-shaped area of swelling around the joint (2, e5, e18). Destruction caused by the arthritis may result in grotesque deformities (2, e5). The pain in the symptomatic joint is assessed by palpation of the surrounding structures. The stability of the capsuloligamentous apparatus is tested in the sagittal and frontal planes. The neighboring joints must be examined in detail to establish any relevance to the future treatment. Passive and active motion are assessed using the neutral zero method (e19), documenting the maximal extension and flexion, both actively and passively, relative to the defined neutral position of the joint. Adhesions of the tendons may be revealed, for instance, if the passive is greater than the active range of motion. In an acute inflammation phase, reddening and excessive warmth around the joint may mimic phlegmon or intra-articular empyema. In this case one must actively search for skin lesions. In particular, mucoid cysts, which occur preferentially at the DIP joint, may spontaneously perforate and cause empyema (e20). These cysts form as an “overflow” in an arthritic joint with excessive inflammatory fluid (Figure 1). With increasing progression of a mucoid cyst the germinal matrix of the nail may be damaged, resulting in nail deformities (e21).

In patients with symptomatic CMC-1 arthritis, the grind test may provoke pain (Figure 2) (e22). To carry out this test, the examiner grips the patient’s first

metacarpal and exerts axial strain on the CMC joint while making rotational movements. In contrast, slight distraction of the joint should result in alleviation of the pain. Advanced stages of CMC-1 arthritis are characterized by prominent swelling of the joint capsule at the dorsoradial metacarpal base, often associated with marked adduction contracture of the first metacarpal. The latter is unavoidably accompanied by compensatory overextensibility in the thumb MCP joint, the so-called Forestier sign. The palmar plate and the check rein ligaments are elongated by this pathological strain and no longer able to limit extension in the joint as they should. This increases the patient's weakness of grip. The end result can be pronounced functional impairment, often with subsequent arthritis of the MCP joint.

The differential diagnoses are de Quervain's tenosynovitis, radiocarpal arthritis, arthrosis of the scapho-trapezo-trapezoidal (STT) joint, and, in rare cases, Wartenberg syndrome (e23).

The diagnosis can be confirmed by means of trial infiltrations of short-acting local anesthetics. If infiltration adequately alleviates the pain or briefly relieves it entirely, the affected site has been clearly identified.

Plain radiography

Radiographic examination is to be performed posterior-anteriorly and strictly laterally while centered on the affected joint (2, e5). An overall view of the hand is not sufficient; the technical limitations of radiography may mask information about the joint of interest. With a view to infections or episodes of inflammation, osteitis must be sought. The presence of weakened trabecular structures or osteolysis clearly points to osteitis.

Plain radiographic examination is essential to narrow the range of possible diagnoses and to plan the next steps accordingly (2, e5, e24, e25).

The Eaton and Littler classification of arthritis of CMC-1 has proved its worth (Table 1) (e26).

All other joints of the thumb and fingers can be evaluated using the classification developed by Kellgren and Lawrence (Table 2) (e27).

Computed tomography

Early stages of arthritis can be reliably detected by means of computed tomography. It may also occasionally be helpful to use computed tomography to image the implant bed when planning insertion of a resurfacing arthroplasty, because it enables assessment of bone quality. This is relevant particularly in the case of advanced osteopenia or massive erosive arthritis with marked subchondral cyst formation on the joint of interest (e24).

Magnetic resonance imaging

Magnetic resonance imaging plays a minor part in assessing primary arthritis and deciding on the appropriate treatment. However, recent technical advances have improved visualization of the cartilage and synovial membrane, so that even early stages of arthritis in

TABLE 1

Classification of arthritis of the first CMC joint according to Eaton and Littler (e16, e26)

Stage	Plain radiographic findings
1	Subtle joint space widening
2	Joint space narrowing, osteophytes, loose bodies <2 mm
3	Advanced joint space narrowing, osteophytes, loose bodies >2 mm
4	Stage 3 findings plus arthritis of the STT joint

CMC, Carpometacarpal; STT: scapho-trapezo-trapezoidal

TABLE 2

Plain radiographic classification of arthritis according to Kellgren und Lawrence (e27)

Stage	Findings
1	Subchondral sclerosis
2	Slight joint space narrowing, early osteophyte formation, irregular joint surface
3	Large osteophytes, joint space narrowing, irregular joint surface
4	Severe joint space narrowing or even obliteration, deformity of bone ends

TABLE 3

Classification of arthritis according to Noyes and Stabler (e32)

Stage	Macroscopic/arthroscopic findings
1	a) Cartilage softening with residual resilience b) Cartilage softening with no resilience
2	a) <50% vertical cartilage substance loss b) >50% vertical cartilage substance loss
3	a) Complete loss of cartilage, subchondral zone intact b) Complete loss of cartilage, subchondral zone damaged

so-called small joints can be reliably detected (e28). This can be useful in the planning of correction osteotomy of the first metacarpal because of early CMC-1 arthritis or in establishing the indication for arthroscopic synovectomy or cartilage smoothing, which are helpful only in early arthritis (e29, e30).

Classification of arthritis

The macroscopic (arthroscopic) classifications of cartilage lesions introduced by Outerbridge (1961) and by Noyes and Stabler (1989) are still routinely used by clinicians (Table 3) (e31, e32).

Figure 3:
Intraoperative view facilitating the dorsal approach to the metacarpophalangeal joint of the middle finger during motion-preserving surgery with a silicone implant

Figure 4:
Intraoperative view facilitating the dorsal approach to the proximal interphalangeal joint during motion-preserving surgery with implantation of a resurfacing arthroplasty

Treatment

The primary goal of treatment should be preservation of function with full or at least partial relief of pain. Each patient's treatment should be decided on an individual basis. The site, stage, and symptoms of arthritis must be taken into consideration, together with the patient's general condition and previous illnesses and the occupational or personal demands on the affected arm.

Conservative treatment

The authors of a prospective study with 50 patients (follow-up: 12 months) investigated the effect of a customized orthosis together with patient training on CMC-1 arthritis (3). The orthosis was worn for 16 h

daily over a period of 30 days. Both at 30 days and at the end of the follow-up period a year later, pain as assessed on a visual analog scale (VAS) was significantly reduced (baseline vs 30 days: 5.99 [standard deviation, SD, 2.47] versus 2.61 [SD 2.1], $p < 0.0001$; baseline versus 12 months: 5.99 [SD 2.47] versus 3.22 [SD 2.47] $p < 0.0001$) (3). Pinch strength was also significantly higher after 30 days (4.52 kg [SD 1.22] versus 5.17 [SD 0.9], $p < 0.0001$) (3).

Kjeken et al. performed a meta-analysis on the efficacy of orthosis for the treatment of CMC-1 arthritis (4). Pain was effectively reduced over a period of 3 months (standardized mean difference [SMD] 0.8, 95% CI [0.45; 1.15]) (4–7). Placing arthritic finger PIP joints in a resting position overnight for a period of 3 months was also found to bring about reduction of pain as measured at 3 months ($p = 0.002$; median -1.5 , range $[-6; 2]$) and 6 months ($p = 0.001$; median -2.0 , range $[-8; 4.5]$) after the end of treatment in a prospective controlled study (8). Moreover, at 6 months there was a significant difference between the treatment group and the controls ($p = 0.049$; median -0.5 , range $[-9; 2.5]$).

Another meta-analysis by Aebischer et al. showed no significant difference between ready-to-use and individually adapted orthoses in reduction of pain caused by an arthritic first CMC joint (SMD -0.01 , 95% CI $[-0.43; 0.4]$; $p = 0.95$) (9). A multimodal approach combining manual therapy/physiotherapy and an orthosis is more effective than a single-track approach in this situation (SMD -3.16 , 95% CI $[-5.56; 0.75]$; $p = 0.01$) (9). The superiority of multimodal treatment is supported by the findings of a retrospective study of 35 patients by O'Brien and Giveans (10). The cornerstones of conservative treatment are patient education, mobilization of CMC-1, and strengthening and active exercising of the thenar musculature. The QuickDASH score (Disabilities of Arm, Shoulder, and Hand [11]) decreased significantly from 37.0 before the commencement of treatment to 29.9 after treatment ($p < 0.01$). The VAS pain score also went down significantly, from 3.34 to 2.74 ($p < 0.01$).

A meta-analysis of exercise programs for arthritis of the hand by Østerås et al. showed a tendency towards a positive effect of exercise on pain, function, and stiffness. One of the studies analyzed concentrated exclusively on the first CMC joint, comparing specific and unspecific exercise in 39 participants (12, 13). In this randomized trial there was no significant difference between the specific and unspecific exercise schemes at 3 and 6 months after documentation of the DASH score, pain level, and grip strength (13). Specific physiotherapy (a passive additional mobilization technique) also seemed to lessen pain, at least in the short term, as demonstrated by Villafañe et al. in a double-blind, randomized study of 28 patients with CMC-1 arthritis (14). The pain threshold rose significantly from 3.85 kg/cm² (SD 1.26) before the exercise program to 4.75 kg/cm² (SD 1.45) 2 weeks after completion of treatment ($p < 0.007$) (14).

Baltzer et al. investigated the efficacy of photobio-modulation therapy in 34 patients with arthritis of the PIP and/or DIP joints (85 joints), following them up for 8 weeks after treatment. Pain decreased significantly in this period ($p < 0.001$; effect size $\eta^2 = 0.37$; [$\eta^2 > 0.01$: small effect size; $\eta^2 > 0.06$: moderate effect size; $\eta^2 > 0.14$: large effect size]) and mobility increased significantly ($p < 0.001$; effect size $\eta^2 = 0.29$) (15).

A double-blind, randomized trial with 60 patients tested the efficacy of desensitization by mobilization of the radial nerve. Two months after treatment, sensitivity to pain differed significantly between the intervention group and the control group ($p < 0.001$; partial effect size $\eta = 0.14$) (16). Pinch strength also increased significantly in the treatment group ($p = 0.047$; partial effect size $\eta = 0.046$) (16).

A meta-analysis showed a moderate effect of nonsteroidal antirheumatics (NSAR) and cyclooxygenase-2 inhibitors regarding pain reduction, with a number needed to treat (NNT) of 3 (95% CI [2; 6]) (17).

In conclusion, conservative multimodal treatment, in combination with orthoses if indicated, seems to be worthwhile as initial approach, particularly in early primary arthritis of the finger and thumb joints.

Intra-articular injection treatment

The data from studies on intra-articular administration of hyaluronic acid and cortisone are relatively consistent. These substances seem well suited for short-term pain relief, but their long-term effect on pain and joint function is questionable. These data are presented in the *eMethods* (18–25).

Surgical treatment

The surgical treatment options are listed in *eTable 2*.

Rhizarthritis

Eaton and Littler stage 1 arthritis of the first CMC joint (e26) can be treated with arthroscopic synovectomy/denervation. The data on arthroscopic synovectomy are sparse regarding our predefined criteria (26) and the efficacy of denervation is also not confirmed by high-quality studies (27). Denervation comprises division and coagulation of the terminal, articular branches of the median nerve, the superficial radial nerve, and the lateral cutaneous nerve of the forearm. However, these procedures for treatment of early CMC-1 arthritis can achieve temporary symptom relief and postpone the need for more invasive surgery.

In CMC-1 arthritis of Eaton and Littler stages 2–4 (e26), trapezectomy is indicated. Trapezectomy with or without tendon interposition/suspension is a proven option for surgical treatment of advanced CMC-1 arthritis (28–31). The principal goal of pain reduction is reliably achieved by this method. Thus grip strength can often be improved with no loss of mobility.

Key messages

- In the early stages of first carpometacarpal joint (CMC-1) arthritis, conservative multimodal treatment with mobilization, orthoses, and analgesic/anti-inflammatory medication may be effective.
- Trapezectomy, with or without interposition/suspension, is an effective surgical treatment for symptomatic advanced CMC-1 arthritis.
- Prosthetic treatment of the proximal interphalangeal joint preserves mobility but continues to entail a relatively high complication rate.
- Intra-articular injections have neither improved grip strength nor reduced pain significantly in the long term in randomized controlled trials.

Metacarpophalangeal joint of thumb

Data from high-quality studies are also sparse for treatment of the MCP joint of the thumb, although arthrodesis is a proven procedure (32). Tension-band arthrodesis is far more cost effective than modern locking plates.

Interphalangeal joint of thumb

Analogous to arthrodesis of a DIP joint, arthrodesis of the IP joint of the thumb can be reliably achieved with double-threaded screws (33).

Metacarpophalangeal joints of fingers

Also for the MCP joints of the fingers there are few high-quality studies. However, insertion of a silicone arthroplasty remains the gold standard for preservation of mobility (*Figure 3*) (34).

Proximal interphalangeal joint

There is a relatively wide range of PIP joint prostheses (*Figure 4*). Although these prostheses are sometimes very effective in achieving functional improvement and pain reduction, the complication rate is higher than for the well-proven silicone arthroplasty (35–39). Moreover, modern prostheses for the PIP joint are often two or even three times more expensive than a silicone arthroplasty. However, they provide more stability than silicone implants and are thus better suited for the index and middle fingers (37).

Distal interphalangeal joint

Although again data are sparse, arthrodesis can be considered a reliable method with a very high consolidation rate and very high patient satisfaction (40).

Conclusion

Few high-quality studies have been carried out in hand surgery up to now. Therefore, future studies must evaluate the surgical techniques and findings using the tools of evidence-based medicine. Only scientifically evaluated treatments which are superior to other procedures from the medical viewpoint but considerably more expensive can be adequately

proposed and favored. On the other hand, the efficacy of conservative treatment is well-confirmed.

Multimodal approaches with mobilization techniques, orthoses, and analgesic/anti-inflammatory treatment may be effective in the short to medium term, depending on the stage of disease. Among the surgical procedures, the reliability of resection arthroplasty of the first CMC joint with or without suspension/interposition for the treatment of advanced CMC-1 arthritis has been demonstrated. All other interventions require verification under controlled conditions in evidence-based studies. This knowledge gap in hand surgery needs to be filled.

Conflict of interest statement

The authors declare that no conflict of interest exists.

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► Supplementary material

For eReferences please refer to:

www.aerzteblatt-international.de/ref1618

eMethods, eTables:

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CLINICAL SNAPSHOT

A Fall With Consequences

A 66-year-old man under the influence of alcohol complained of very severe pain on the left side of the chest and in the left upper quadrant of the abdomen, radiating to the back. In view of these symptoms and his known history of stenosis of a single coronary vessel and implantation of a stent, the emergency physician presented him to the chest-pain unit. The ECG and laboratory findings were consistent with an NSTEMI (myocardial infarction without T-wave elevation; troponin I concentration 0.36 ng/mL, creatine kinase concentration 2553 U/L). Coronary angiography ruled out acute myocardial infarction and did not reveal any other pathological changes. The next day, the patient related that he had recently fallen on the left side of his chest. This piece of information, seen in the context of the laboratory findings, would have been a clue to the correct diagnosis if it had been known initially. Plain films and a computed tomographic scan of the chest revealed a left-sided diaphragmatic hernia of indeterminate age with an incarcerated intrathoracic stomach (*Figure*). This finding is said to be associated with acute diaphragmatic hernia after trauma in 1–5% of cases. The patient had an upside-down stomach that was already gangrenous because of strangulation. He underwent an emergency gastrectomy and esophagojejunostomy and was discharged from the hospital 7 days later.

(Partial) left enterothorax with upside-down stomach and accompanying mediastinal shift and right pneumonia. Because of the lack of a visible soft-tissue reaction or fatty tissue inhibition, the radiologist considered acute diaphragmatic rupture to be unlikely.

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Supplementary material to:

The Treatment of Primary Arthritis of the Finger and Thumb Joint

by Christian Karl Spies, Martin Langer, Peter Hahn, Lars Peter Müller, and Frank Unglaub

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eTABLE 1

Flow chart of selective literature survey

Article extraction	n
PubMed	313
Cochrane Library	18
Abstracts after removal of duplicates	329
Abstracts discarded	275
Full texts obtained	54
Full texts discarded	24
Articles included	30

eTABLE 2

Surgical treatment for primary arthritis of the finger and thumb joints

Reference	Diagnosis	Surgical procedure	Number of patients (interventions)	Design; duration of follow-up	Main result/key message	Complications	Evidence level according to Oxford Centre for Evidence-based Medicine
Badia 2007 (26)	Thumb CMC joint arthritis stage 1 (Eaton and Littler)	Arthroscopy: synovectomy, debridement with corrective osteotomy of first MC	43 (43)	Retrospective; 43 months, range 24–64	Pinch strength 73% of other hand, B-G score 48.4	1 patient with progression of CMC-1 arthritis with subsequent trapezectomy	4
Loréa 2003 (27)		Denervation	14 (14)	Prospective; 8 months, range 6–12	12 patients had pain reduction by 84% from status before surgery, 1 patient by 70%, 1 patient by 60%	Temporary postop. paresthesia in the area supplied by the superficial radial nerve	4
Davis et al. 2004 (28)	Thumb CMC joint arthritis stages 2–4 (Eaton and Littler)	Trapezectomy with/without suspension/interposition	162 (183)	Prospective; 12 months; randomized intervention groups: n = 62 with trapezectomy (a), n = 59 trapezectomy with PL interposition (b), n = 62 trapezectomy with semi-FCR suspension (c); 1 patient LFU; follow-up visits 3 and 12 months	VAS: sig. diff. between groups preop. (p = 0.35); 3 months postop.: p = 0.58; 12 months postop.: p = 0.4; pooled data preop. PA 34° (SD 11); RA 33° (SD 11); 12 months postop. PA 40° (SD 10); RA 39° (SD 10) – sig. diff. between groups: p > 0.3; sig. diff. preop. for key (p = 0.48), pinch (p = 0.55), grip strength (p = 0.4); 3 months postop.: p = 0.93, p = 0.75, p = 0.17; 12 months postop.: p = 0.57, p = 0.70, p = 0.17; sig. diff. preop. – 3 months postop. (p > 0.5) for all strength parameters of overall population; sig. increase in strength of overall population preop. – 12 months postop. (p < 0.001); increase in pinch strength after 12 months of 1.1 kg (95% CI [0.6; 1.6]) for (a); 0.7 kg (95% CI [0.2; 1.2]) for (b); 1.2 kg (95% CI [0.7; 1.7]) for (c)	11 patients with CRPS type 1; 1 patient from (a) with postop. instability	2b
Gangopadhyay et al. 2012 (29)		Trapezectomy with/without suspension/interposition	153 (174)	Follow-up study to Davis et al., prospective; median 6 years, range 5–18	VAS: sig. diff. between groups preop. (p = 0.407); min. 5 years postop.: p = 0.383; sig. diff. after min. 5 years for key (p = 0.471), pinch (p = 0.681), grip strength (p = 0.908)	4 patients underwent revision; 2 patients from (c) had hemiarthroplasty after 12 years' freedom from pain; 1 patient from (a) had secondary FCR suspension; 1 patient suffered a neuroma of the superficial radial nerve	

Reference	Diagnosis	Surgical procedure	Number of patients (interventions)	Design; duration of follow-up	Main result/key message	Complications	Evidence level according to Oxford Centre for Evidence-based Medicine
Marks et al. 2017 (30)		Trapezectomy with FCR suspension or allograft suspension	60 (60)	Prospective; randomized: allograft group vs. FCR group; 2 patients LFU; follow-up at 12 months	sig. diff. DASH: preop. FCR 45 (SD 17) vs. allograft 41 (SD 16); $p = 0.4$; 12 months post-op.: FCR 18 (SD 17) vs. allograft 23 (SD 21); $p = 0.26$; sig. improvement DASH and grip strength preop. to postop.: $p < 0.05$; sig. diff. pinch strength: preop. FCR 3.5 kg (SD 2.2) vs. allograft 3.2 kg (SD 2.0); $p = 0.6$; 12 months postop.: FCR 4.1 kg (SD 2.9) vs. allograft 3.4 kg (SD 2.1); $p = 0.31$; sig. diff. grip strength: preop. FCR 19.9 kg (SD 9) vs. allograft 19 kg (SD 11); $p = 0.91$; postop. 12 months 22 kg (SD 9) vs. allograft 23 kg (13); $p = 0.87$	There were 15 (26%) complications, all but one of which healed; allograft group: 1 patient with revision due to FCR rupture followed by healing and 1 patient with persistent pain that did not resolve	1b
Spekreijse et al. 2015 (31)		Trapezectomy + semi-FCR suspension via MC-1 bone tunnel (BP group) vs. trapezectomy + semi-FCR suspension around APL (Weilby group)	72 (72)	Prospective, single-blinded, randomized: BP group 36 patients, Weilby group 36 patients; BP group: LFU 9; Weilby group: LFU 10; 5.3 years, range 3.8–6.4	PRWHE: sig. diff. between groups preop. to 5 years postop.: $p = 0.42$; improvement in PRWHE for both groups from 1 to 5 years postop.: $p = 0.32$, effect size 1.0; DASH: sig. diff. between groups preop. to 5 years postop.: $p = 0.05$; no sig. improvement in DASH for both groups from 1 to 5 years postop.: $p = 0.15$, effect size 1.5; sig. diff. grip strength preop. to 5 years postop.: $p = 0.81$; improvement in grip strength for both groups from 1 to 5 years postop.: $p = 0.02$, effect size 2.3; sig. diff. pinch strength preop. to 5 years postop.: $p = 0.47$; no sig. improvement in pinch strength for both groups from 1 to 5 years postop.: $p = 0.90$, effect size 0.1	20 complications in BP group, 17 in Weilby group: sig. diff. ($p < 0.48$)	1b
Schmidt et al. 2004 (32)	Thumb MCP joint arthritis	Arthrodesis screw	26, including 6 with primary arthritis	Retrospective; 32 months, range 21–44	Arthrodesis was achieved for all cases of primary arthritis	–	4
Cox et al. 2014 (33)	Thumb IP joint arthritis	Arthrodesis screw	29 (48), including 17 joints with primary arthritis; 4 thumb IP joints without clarified etiology were included	Retrospective; 12 months, range 2–50; 2 patients LFU	Consolidation rate 94%	3 pseudarthroses, including 1 on IP joint of thumb; 1 iatrogenic phalangeal fracture	4
Neral et al. 2013 (34)	Finger MCP joint arthritis	Space-filling SI implant	30 (38), including 5 joints with post-traumatic arthritis	Retrospective; 56 months, range 8–170	Sig. increase in ROM from preop. to postop. ($p < 0.001$); sig. decrease in DASH ($p < 0.001$); sig. decrease in VAS ($p < 0.001$); sig. diff. in grip ($p = 0.6$) and pinch strength ($p = 0.3$) in comparison to the contralateral hand; sig. diff. in pinch strength between treated MCP-2 and treated MCP-3 ($p < 0.1$)	4 (11%) revisions of SI implant due to loosening or breakage, 4 suture granulomas, 1 extensor tendon revision due to postop. deviation; 4 (11%) breaks of SI implant	4

Reference	Diagnosis	Surgical procedure	Number of patients (interventions)	Design; duration of follow-up	Main result/key message	Complications	Evidence level according to Oxford Centre for Evidence-based Medicine
Branam et al. 2007 (35)	PIP arthritis	Resurfacing arthroplasty vs. silicone arthroplasty	25 (48)	Retrospective; two intervention groups: silicone arthroplasty group 15 (27) with 2 (5) patients LFU, 45 months, range 7–110; resurfacing arthroplasty group 10 (21) with 1 (1) patient LFU, 19 months, range 6–36	SI implant ROM: preop. 53° (SD 24), postop. 49° (SD 25); sig. diff.; prosthesis ROM: preop. 52° (SA 17), postop. 53° (SD 28); sig. diff.; 7 (32%) of SI implants and 4 (21%) of prostheses were unsatisfactory for ROM; sig. diff. in grip strength preop. to postop.: SI implant 18 kg vs. 19 kg (p = 0.74), prosthesis 9 kg vs. 14 kg (p = 0.22)	SI implant group: 3 (14%) removals due to 1 × instability, 1 × pain, 1 × infection; prosthesis group: 2 implant dislocations; 2 implant loosening; 2 nondislocated intraoperative fractures	4
Daecke et al. 2012 (36)		SI implant vs. TI surface replacement arthroplasty vs. PY surface replacement arthroplasty	43 (62)	Prospective; three intervention groups: 18 SI implant, 26 TI prosthesis, 18 PY prosthesis; 3 years with 79% patient recruitment	DASH: SI: sig. diff. preop. 57 (SD 16), postop. 19 (SD 21); p = 0.05; TI: preop. 65 (SD 17), postop. 42 (SD 19); p = 0.2; PY: sig. diff. preop. 68 (SD 18), postop. 48 (SD 19); p = 0.01; VAS: sig. diff. SI: preop. 8.1 (SD 3.3), postop. 0.7 (SD 1.3); p < 0.001; TI: preop. 6.8 (SD 2.5), postop. 3.9 (SD 2.8); p = 0.02; PY: preop. 8.1 (SD 1.8), postop. 2.7 (SD 2.9); p = 0.01; sig. diff. preop. to postop. for ROM (SI) p = 0.14, TI p = 0.8, PY p = 0.82; sig. diff. between groups for ROM, p = 0.42; sig. diff. between groups for implant survival (p = 0.18)	SI: 2 (11%) explantations due to implant breakage; TI: 7 (27%) explantations due to loosening and 2 contractions, 1 swan neck deformity, 1 suture granuloma; PY: 7 (39%) explantations due to loosening, dislocation, limited ROM	2b
Schindele et al. 2015 (37)		Titanium surface replacement arthroplasty	10 (10)	Prospective; 12 months	ROM: sig. diff. preop. 42° (SD 16), – postop. 51° (SD 28); p = 0.312; grip strength: sig. diff. preop. 22 kg (SD 6), postop. 27 kg (SD 8); p = 0.108; VAS: sig. diff. preop. 7.9 (SD 0.4), postop. 15 (SD 17); p = 0.007; DASH: sig. diff.: preop. 43 (SD 12), postop. 15 (SD 17); p = 0.007	1 periarthral ossification, 1 contracture	4
Bravo et al. 2007 (38)		PY surface replacement arthroplasty	35 (50), including 14 (19) with primary arthritis	Retrospective; 37 months, range 27–46	ROM: sig. diff. preop. 42°, postop. 49°; grip strength: sig. diff. preop. 21 kg, postop. 28 kg (p < 0.05); pinch strength: sig. diff. preop. 3 kg, postop. 5 kg (p < 0.05)	1 contracture; 1 extensor tendon conflict; 1 loosening with consecutive revision of prosthesis; 2 instability with soft tissue revision	4
Burton et al. 2002 (39)		Interposition arthroplasty	9 (12)	Retrospective; 36.5 months, range 12–66	VAS: sig. diff. preop. 3.0 (SD 0), postop. 0.08 (SD 0.29) (p < 0.001); ROM: sig. diff. preop. 56.1° (SD 16.2), postop. 47.0° (SA 18.1) (p = 0.14); grip strength: sig. diff. preop. 16.3 kg (SD 8.0) vs. postop. 17.9 kg (SD 6.7) (p = 0.30)	–	4
Villani et al. 2012 (40)	DIP arthritis	Arthrodesis screw	64 (107)	Retrospective; 5 patients LFU; 26 months, range 7–67	VAS: preop. 6.2, postop. 1.1; 100% bony healing	4 removals of screw due to: 2 × mechanical irritation of material, 1 × CRPS type 1, 1 × painful callus	4

APL, Tendon of abductor pollicis longus muscle; B-G score, Buck-Gramko score; BP, Burton–Pellegri; CMC-1, carpometacarpal joint 1; CRPS, complex regional pain syndrome; DASH, Disabilities of Arm, Shoulder and Hand; diff., difference; DIP, distal interphalangeal joint; FCR, tendon of flexor carpi radialis muscle; IP, interphalangeal joint; LFU, lost to follow-up; MCP-1, metacarpophalangeal joint 1; min., at least; MC, metacarpal; p, p value; preop., preoperative; PA, palmar abduction; PIP, proximal interphalangeal joint; PL, tendon of palmaris longus muscle; postop., postoperative; PRWHE, Patient-rated Wrist and Hand Evaluation Score; PY, pyrocarbon; RA, radial abduction; ROM, range of motion; SD, standard deviation; SI, silicone; sig., significant; TI, titanium; VAS, visual analog scale; vs, versus

eMETHODS

INTRA-ARTICULAR INJECTION THERAPY

Intra-articular injection of the thumb carpometacarpal joint (CMC-1) was analyzed in a double-blind, randomized trial with three intervention groups (hyaluronic acid $n = 20$, cortisone $n = 22$, placebo $n = 18$) (18). There were no significant differences among the groups at any time up to 6 months after completion of treatment with regard to grip or pinch strength or pain intensity ($p > 0.05$). The DASH score (Disabilities of Arm, Shoulder and Hand) also revealed no significant differences between the groups, but decreased significantly in all groups over the course of the study period ($p < 0.05$) (18).

In another double-blind, randomized, placebo-controlled trial, the effect of intra-articular injection of cortisone into the CMC-1 joint was investigated in 35 patients (intervention group $n = 17$; placebo group $n = 18$) (19). In neither group did the pain level decrease significantly up to the last follow-up examination at 24 weeks after completion of treatment (intervention group: median Δ 0.0, interquartile range IQR $[-12.5; 2.3]$, $p = 0.52$; placebo group: median Δ 14.0, IQR $[-12.5; 16.9]$, $p = 0.32$) (19).

The efficacy of intra-articularly administered cortisone for treatment of arthritis of the proximal (PIP) or distal (DIP) interphalangeal joint was compared with placebo in a further double-blind, randomized trial of 60 patients with follow-up for 12 weeks (20). There were no significant differences between the intervention group and the control group at any time up to 12 weeks after completion of treatment with regard to grip or pinch strength (grip strength at 12 weeks: intervention group 16.21 kg, standard deviation SD 6.24, 95% confidence interval CI $[13.65; 18.77]$; placebo group 15.23 kg, SD 7.70, 95% CI $[12.6; 17.79]$; $p = 0.832$; pinch strength at 12 weeks: intervention group 6.50 kg, SD 1.88, 95% CI $[5.84; 7.17]$; placebo group 6.24 kg, SD 1.75, 95% CI $[5.58; 6.90]$; $p = 0.236$). The groups differed significantly in movement pain at 12 weeks (intervention group: visual analog scale VAS 2.2, SD 2.9, 95% CI $[1.1; 3.3]$; placebo group: VAS 4.0, SD 3.2, 95% CI $[2.8; 5.1]$; $p = 0.014$) but not in pain at rest (intervention group: VAS 0.8, SD 1.7, 95% CI $[0.1; 1.5]$; placebo group: VAS 0.9, SD 2.2, 95% CI $[0.2; 1.6]$; $p = 0.513$) (20).

Figen and Ustün investigated the effect of intra-articularly administered hyaluronic acid versus placebo in a randomized study of 33 female patients with CMC-1 arthritis (21). Pinch strength improved significantly from baseline to 6 weeks ($p = 0.002$) and from 6 weeks to 24 weeks ($p = 0.002$). Pain intensity decreased significantly in the intervention group between baseline and 24 weeks ($p = 0.002$) (21).

Bahadir et al. compared intra-articular injection of cortisone and hyaluronic acid into the CMC-1 joint in a double-blind, randomized trial (22). The study included 40 female patients followed up for 12 months. In the cortisone group the pain level was significantly lower after 12 months than at baseline (VAS 5.9, SD 1.6 versus VAS 4.9, SD 2.0; $p = 0.013$), while the hyaluronic acid group showed no significant difference during the same period (VAS 6.5, SD 2.0 versus VAS 6.0, SD 2.1; $p = 0.158$). The difference between the two intervention groups was not significant ($p = 0.128$) (22). Di Sante et al. came to the same conclusion in a case series of 31 patients: intra-articular administration of hyaluronic acid to the CMC-1 joint yielded no significant reduction in pain at 6 months after completion of treatment ($p = 0.6$) (23). Kroon et al. drew the same conclusion after a systematic review of the literature (24). It thus seems questionable whether cortisone and hyaluronic acid are worthwhile therapeutic options.

A single-blinded pilot study investigated the efficacy of infliximab in 10 patients with interphalangeal (IP) joint arthritis (25). The authors treated 56 IP joints with infliximab and 34 IP joints with physiological saline solution. Infliximab was administered once each month for 1 year and the last examination took place 1 week after the final infiltration. Spontaneous pain was significantly reduced by infliximab up to the end of the study period (VAS 75.33, SD 10.15 versus VAS 32.5, SD 15.1; $p < 0.002$). No significant decrease in pain was observed in the control joints. The level of pain provoked by palpation also went down significantly in the intervention group (VAS 68.5, SD 12.1 versus VAS 38.3, SD 17.5; $p < 0.008$). In neither the intervention group nor the control group was there a significant increase in grip strength (25).