Full Length Article

JHS(E)

The Journal of Hand Surgery
(European Volume)
XXE(X) 1–9

DOI: 10.1177/1753193415609656
jhs.sagepub.com
SAGE

A new surgical technique for the treatment of scaphotrapezial arthritis associated with trapeziometacarpal arthritis: the narrow pseudoarthrosis

M. Rubino[1], L. Cavagnaro[2] and V. Sansone[3]

Abstract

We describe a technique for treating Eaton stage IV osteoarthritis of the first ray, which is a development of our previously published technique for treating trapeziometacarpal arthritis. This simple technique is based on a limited resection arthroplasty of the first trapeziometacarpal and the scaphotrapezial joints, with the aim of inducing the formation of a narrow pseudoarthrosis at both sites. A total of 26 consecutive patients were treated for Eaton stage IV arthritis at a mean follow-up of 4.7 years (range 3.2–6.6). There were statistically significant improvements in all clinical parameters: mean appositional and oppositional pinch strength, mean DASH score (65 points pre-operatively to 8.7 points at final follow-up), and in mean visual analogue scale score (8.6 to 0.2 points). Although a larger cohort and a longer follow-up will be necessary to evaluate this new technique fully, these results encourage us to believe that the limited excision arthroplasty of the trapeziometacarpal and scaphotrapezial joints is a viable alternative to the existing surgical treatments for stage IV thumb arthritis.

Level of evidence: 4

Keywords

Thumb, osteoarthritis, trapeziometacarpal, scaphotrapezial joint, arthroplasty, pseudoarthrosis

Date received: 23rd March 2015; revised: 21st August 2015; accepted: 24th August 2015

Introduction

The basal joint of the thumb, or trapeziometacarpal (TM) joint is the second most common site of osteoarthritis (OA), affecting 8% of men and up to 25% of women (Heyworth et al., 2008). Scaphotrapezial (ST) arthritis associated with TM arthritis is certainly much less frequent than the classic TM arthritis or rizoarthrosis, nonetheless the ST joint is the most common site of joint degeneration associated with TM OA (Melone et al., 1987). Indeed, several cadaveric studies have shown that approximately 50% of patients with severe osteoarthritic degeneration of the TM joint also have advanced OA in the ST joint (Bade and Koebke, 1996; Brown et al., 2003; North and Eaton, 1983).

It is generally accepted that ST OA will often remain stable and clinically free of symptoms in the mid- to long-term (Glickel et al., 1992). This justifies an initial conservative approach based on rest, splint therapy, oral anti-inflammatory medication, and intra-articular steroid injections. However, because of the low success rate of conservative therapy in more advanced cases, many symptomatic patients require surgical treatment for pain relief and recovery of thumb function.

Although a gold standard for the operative treatment of combined ST and TM OA does not exist, suspensionplasties or ligament reconstruction with tendon interposition arthroplasty after total trapezial excision are currently the most popular techniques

[1]Istituto Ortopedico Galeazzi IRCCS, Milano, Italy
[2]Clinica Ortopedica dell'Università degli Studi di Genova, Genova, Italy
[3]Orthopaedic Department of the Università degli Studi di Milano, Istituto Ortopedico Galeazzi IRCCS, Milano, Italy

Corresponding author:
V. Sansone, Orthopaedic Department, Università degli Studi di Milano, Istituto Ortopedico Galeazzi IRCCS, Via Galeazzi 4, 20161 Milano, Italy.
Email: valerio.sansone@unimi.it

used in the treatment of Eaton stage IV, and indeed stage III disease (Burton and Pellegrini, 1986; Eaton and Glickel, 1987; Nordback et al., 2012; Tomaino, 2006; Tomaino et al., 1995). Potential risks associated with these procedures include persistent soreness, stiffness or instability of the thumb, thumb subsidence, clumsiness, weakness, painful neuroma, and numbness (Finsen et al., 2015; Tomaino et al., 1995; Vermeulen et al., 2011; Yang and Weiland, 1998). As with most invasive treatments, post-operative immobilization and subsequent rehabilitation are essential for full recovery.

We recently described an original technique for the surgical treatment of TM OA based on a minimal resection of the articular surfaces of the first metacarpal and the trapezium, to induce the formation of a stable, fibrous non-union at the base of the thumb. We described this as a 'trapeziometacarpal narrow pseudarthrosis' (Rubino et al., 2013). The rationale behind our technique was to address the major issues underlying basal thumb OA: namely instability, lack of mobility, and abnormal transfer of loads. In particular, the instability caused by ligament laxity results in a continuous dorsal subluxation of the base of the first metacarpal over the trapezium, which damages the articular cartilage (Pellegrini, 1991), and this is the main cause of pain. This painful instability is treated by providing a stabilizing cushion of fibro-cartilaginous tissue, which absorbs the mechanical shocks to the joint. The formation of this tissue is a biological response to the resection of the two adjacent joint faces and to the early mobilization (Buckwalter, 2002). This technique was effective in simultaneously removing the degenerated cartilage and the frequently eburnated subchondral bone that cause pain, providing mechanical stability to the previously unstable joint and restoring a good degree of mobility of the thumb.

The excellent results and the very low rate of serious complications we observed in the treatment of TM OA encouraged us to develop the technique in order to treat symptomatic Eaton stage IV patients (advanced disease of both the TM and ST joints). Thus, the procedure has evolved from a single narrow pseudoarthrosis of the TM joint to a double narrow pseudoarthrosis of the TM and ST joints. As with the original single joint technique, the primary aim of our procedure is to achieve the formation of fibrous tissue, between both trapezium and scaphoid, and trapezium and first metacarpal, thus creating two fibrous joints that are intrinsically stable and simultaneously maintain a partial mobility. We believe that, beyond the resolution of pain, the most notable advantage of this simple and minimally invasive technique is the maintenance of the skeletal foundation of the thumb through conservative bone resection.

The purpose of this study was to assess the mid-term clinical outcomes of a cohort of consecutive patients operated for TM joint OA, with a coexisting symptomatic arthritis of the ST joint (Eaton stage IV), using the 'narrow pseudarthrosis' technique. We hypothesized that this surgical procedure is an effective and durable treatment for ST joint degeneration associated with TM OA.

Patients and methods

Between January 2008 and October 2011, a single surgeon operated on 26 consecutive cases (24 patients) of primary, radiographically evident, TM and ST OA (Eaton stage IV) with our technique. Two patients were operated bilaterally. Informed consent was obtained from each patient, and the study was approved by the scientific review board of our institution.

All patients complained of disabling pain at the base of the thumb. To assess whether the observed radiographic involvement of the ST joint contributed to pain, we performed a simple clinical test. This consisted of applying direct pressure on the volar aspect of the ST joint in the area of the scaphoid and trapezial tubercles to determine whether the subject reported this area to be painful (Noland et al., 2012). Surgery was indicated if the patient had both radiographical evidence of ST degeneration and reported positive in the clinical test.

Before undergoing surgery, all patients had received appropriate conservative treatment for at least 6 months. This included one or more of the following treatments: activity modification, splinting, nonsteroidal anti-inflammatory drugs, or steroid injections.

Surgical technique

The operation is performed under regional anaesthesia, using a pneumatic tourniquet at the top of the arm. With the patient supine, and the operated limb placed on a radio-transparent side table, a 5 cm curved (ulnar concave) dorsal incision is made, centred over the TM joint. The TM joint capsule is incised transversally. The articular cartilage of the distal trapezium and the base of the thumb metacarpal is resected by 1–2 mm using a saw to obtain a cut approximately perpendicular to the long axis of the thumb metacarpal. In a similar way, the dorsal joint capsule of the ST joint is incised, and the proximal trapezium and distal scaphoid are minimally resected to obtain a cut orthogonal to the major axis of the scaphoid. During this procedure, care must be taken not to damage the flexor carpi radialis (FCR) tendon. Osteophytes are removed, and the sharp edges of the

Figure 1. Quadrangular joint spaces after resection.

Figure 2. The external ends of the K-wire are bent at 90° and held together with a sterile plaster strip.

saw cuts and any irregularities on the proximal articular surface of the trapezoid are smoothed. The aim is to achieve two quadrilateral spaces with parallel, flat joint surfaces (Figure 1). The joints are then stabilized using two 1.6 mm Kirschner wires (K-wires). They are inserted into the base of the first metacarpal using an in–out technique until they emerge from the skin. Under fluoroscopic control, the ulnar K-wire is then advanced into the trapezium, while the other, more radial K-wire, passes through the trapezium and pierces the scaphoid up to its proximal pole. In order to position the K-wire correctly, a small hooked retractor is used to guide the wire radially during the stabilization of the scaphoid. The two external ends of the K-wires are then bent at 90°, shortened, and held together with a sterile plaster strip (Figure 2). An intra-operative X-ray is then performed to check the correct positioning of the K-wires; the tip of the wire must reach, but not pass, the proximal pole of the scaphoid. The wound is closed in a standard manner and a bulky dressing is applied.

Post-operatively, the patient is encouraged to move the thumb immediately within the pain-free arc of movement, and if possible, to touch the thumb to the fingers. Splints or rigid bandages are not necessary, as the K-wires, if correctly positioned, allow movement without loosening from the bone, and do not exert undue traction on the skin. After 2 weeks, the stitches are taken out, and the bulky dressing is replaced with a light bandage. After 1 month the K-wires are removed in the outpatient clinic

Assessments

Clinical assessment was performed pre-operatively, at 1, 3, and 6 months, and a final follow-up was performed to gather data for this study. A single, independent examiner performed all assessments.

Pre-operatively, and at the 6-month and final follow-up visits, the Disabilities of the Arm Shoulder and Hand questionnaire (DASH) (McConnell et al., 1999) was completed. The patients were also evaluated at all visits according to the parameters of pain, pinch strength, and thumb range of motion. Pain was measured using a visual analogue scale (VAS), with 0 being complete absence of pain and 10 extreme pain. Appositional and oppositional pinch strength were measured in Newtons (N) using a Jamar hydraulic pinch gauge (Lafayette Instrument Co., Lafayette, IN). The pinch strengths were compared with the contralateral hand in the 22 cases where only one thumb was operated. Thumb range of motion was evaluated according to the Kapandji thumb adduction scale (Kapandji, 1992), and whether patients could perform simple tasks, such as buttoning and unbuttoning a shirt.

Posteroanterior (PA) and oblique radiographs were taken pre-operatively, at 1 month post-operatively, and at final follow-up (Figures 3–5). The radiograph at 1 month was used to check that both the joint spaces have been maintained. This was judged by the presence of a clearly visible, radiolucent space between the bone ends at both TM and ST joints.

The data were analysed using descriptive statistics, and the Student *t*-test, with significance set at $p < 0.05$, was used to compare the pre- and post-operative data.

Results

The mean age of the patient cohort was 73.4 years (SD 5.7). A total of 21 patients were female and three patients were male. The final follow-up was at a mean of 4.67 years (SD 1.07) (range 3.2–6.6). One patient (one thumb) was lost to final follow-up.

In 18 cases the dominant hand was treated. The dominant hand was treated in 77% of the cases that

Figure 3. Pre-operative PA radiograph with evidence of advanced degenerative changes.

Figure 4. Post-operative PA radiograph showing the positioning of the two K-wires.

underwent surgery for one thumb (17 cases). The patients had suffered pain for an average of 4.2 years (range 1–7.5) before seeing an orthopaedic specialist. The mean procedure time was 30.2 minutes (SD 4.1). The tourniquet was inflated an average of 23 minutes (SD 5.2).

Clinical scores

Statistically significant improvements were observed in VAS (at rest and gripping) and DASH scores pre-operatively and at final follow-up ($p < 0.001$ – Table 1). At the first post-operative follow-up (1 month) all patients were almost pain-free when the hand was at rest (mean VAS score 0.7, range 0–1.5), while the mean VAS score rose to 8 (range 5–10) when patients were asked to grip. Of the 26 cases, 23 were pain-free during gripping at the 3 month check-up, and all cases were pain-free at the 6 month follow-up.

Figure 5. PA radiograph at 3 year follow-up. Note the maintenance of the TM and ST joint lines.

Pinch strength

In the 25 cases available at final follow-up, the mean appositional (key) pinch strength had improved from 24.6 N (SD 10.8) pre-operatively to 55.2 N (SD 15.9) at final follow-up, and the mean oppositional (tip) pinch strength from 22.2 N (SD 9.9) to 44.2 N (SD 12.6) ($p < 0.001$). In the patients in whom only one thumb had been operated, the key pinch at final follow-up was 90% of the contralateral hand; for tip pinch it was 100% (Tables 2 and 3).

Thumb range of motion

At 1-month follow-up the average range of motion according to the Kapandji scale was 8 (out of a maximum 10). At the 3-month follow-up, all patients had regained full movement of their thumb with complete flexion and extension, radial abduction and thumb opposition (10 on the Kapandji scale), and were able to button and unbutton a shirt. This mobility was maintained at final follow-up in all cases.

Radiographical results

We saw no evidence of further degeneration to the surrounding joints on the radiographs performed at final follow-up, nor did we observe reduction in the TM and ST joint spaces.

Table 1. Mean DASH and VAS scores.

	Pre-operatively *n* = 26	1 month follow-up *n* = 26	3 month follow-up *n* = 26	6 month follow-up *n* = 26	Final follow-up *n* = 25
Mean DASH[b] score	65 SD 7.2 (range 52–80)	N/A	N/A	6 SD 5.0[a] (range 0–15)	8.7 SD 4.5 (range 0–16)
Mean VAS[c] score at rest	4.8 SD 1.7 (range 2–7.7)	0.7 SD 0.3[a] (range 0–1.5)	0.4 SD 0.4 (range 0–1.1)	0.1 SD 0.2[a] (range 0–0.5)	0.1 SD 0.3 (range 0–0.5)
Mean VAS[c] score gripping	8.6 SD 1.2 (range 6.5–10)	8.0 SD 1.5 (range 5–10)	0.4 SD 0.8[a] (range 0–3)	0.1 SD 0.14 (range 0–0.5)	0.2 SD 0.3 (range 0–1)

Data show mean and SD.
N.B. 1 case lost at final follow-up.
[a]Statistically significant improvement on previous score, $p < 0.001$.
[b]100 point score where 0 is no disability and 100 is complete disability.
[c]10 point scale where 0 = absence of pain and 10 = severe pain.
DASH: Disabilities of the Arm Shoulder and Hand; VAS: visual analogue scale.

Table 2. Mean appositional pinch strength for cases operated on one side only.

	Pre-operatively *n* = 26	1 month follow-up *n* = 21[a]	3 month follow-up *n* = 21[a]	6 month follow-up *n* = 21[a]	Final follow-up *n* = 21[a]
Reconstructed hand	25 N SD 11 (range 7–47)	27 N SD 13 (range 20–58)	42 N SD 9 (range 32–76)	57 N SD 12 (range 40–84)	55 N SD 16 (range 37–82)
Contralateral hand	64 N SD 14 (range 35–98)	62 N SD 12 (range 33–97)	65 N SD 13 (range 37–96)	63 N SD 16 (range 34–98)	61 N SD 18 (range 35–96)

Data show mean and SD, $p < 0.001$.
[a]One case lost at final follow up, 2 patients (4 thumbs) excluded as both thumbs were operated.

Table 3. Mean oppositional pinch strength for cases operated on one side only.

	Pre-operatively *n* = 26	1 month follow-up *n* = 21[a]	3 month follow-up *n* = 21[a]	6 month follow-up *n* = 21[a]	Final follow-up *n* = 21[a]
Reconstructed hand	22 N SD 10 (range 2–38)	26 N SD 14 (range 10–47)	38 N SD 8 (range 17–64)	44 N SD 12 (range 28–76)	45 N SD 12 (range 27–79)
Contralateral hand	46 N SD 15 (range 22–84)	44 N SD 16 (range 28–87)	48 N SD 12 (range 25–82)	46 N SD 18 (range 24–89)	45 N SD 14 (range 20–81)

Data show mean and SD, $p < 0.001$.
[a]One case lost at final follow-up, 2 patients (4 thumbs) excluded as both thumbs were operated.

Complications

No revision surgery was required, and there was no recurrence of pain or loss of thumb functionality and movement in any of the 25 cases at final follow-up. At the first post-operative visit, approximately 14 days after surgery, a superficial painful reaction to one of the K-wires was observed in four cases. It was considered that this was probably due to a slight loosening of the wire from the bone, which caused irritation to the skin. In all cases, the wire responsible was removed and an elastic bandage was applied until the removal of the second wire, at 1 month. However, we observed no difference in the clinical results of these four patients when compared with the rest of the cohort, at any point throughout the follow-up period.

The most relevant complications we observed were two cases of prolonged hypoaesthesia over the dorso-radial surface of the thumb, presumably due to intra-operative damage to the sensory branches of the radial nerve. Nevertheless, both cases had resolved by final follow-up.

Discussion

There is still debate regarding the best surgical treatment for advanced forms of TM OA. In their 2015

Cochrane systematic review of the current accepted surgical treatments for thumb TM joint arthritis, Wajon et al. were unable to identify any additional benefit in terms of pain, physical function, patient global assessment, range of motion, or strength of any of the analysed procedures over another (Wajon et al., 2015). Given the lack of consensus regarding the gold standard treatment to adopt for TM OA, it is even more difficult to decide which surgical procedure to use when TM OA is associated to a severe degeneration of the ST joint. It is possible that the lack of clarity regarding the optimal surgical treatment for OA of the base of the thumb is a result of the limited knowledge about the origin of this multiform condition.

Recently, several hypotheses have appeared in the literature linking ST OA as a cause or consequence of ST joint instability. McLean et al. have also highlighted the role of midcarpal instability associated with lunate morphology (McLean et al., 2009). In either case, alterations to the normal kinematics of the ST joint seem to be significant considerations. Moreover, Tay et al. showed that patients with ST OA may present with midcarpal instability that could worsen after the traditional surgical procedures for ST arthritis (Tay et al., 2007). Thus, they have suggested anticipating the possibility of carpal malalignment after resection arthroplasty or trapeziectomy-type procedures by considering additional stabilization techniques.

The most common surgical treatment of advanced stage arthritis is total trapezial excision, either performed alone or combined rather with suspensionplasties or ligament reconstruction with tendon interposition arthroplasty (the LRTI procedure) (Wajon et al., 2015). These procedures are used to treat both stage III and stage IV disease, with no differentiation being made between isolated TM disease and multiple joint involvement (Burton and Pellegrini, 1986; Thompson, 1989). This approach is indeed appealing, because it is a compromise between restoring physiological function, and addressing the painful arthritic degeneration in both joints (TM and ST) simultaneously. Published data confirms that these techniques can give good results (Brunton and Wilgis, 2010; Fitzgerald and Hofmeister 2008; Hollevoet et al., 1996; Wolf and Delaronde, 2012); nevertheless, total excision of the trapezium with the complex tendon suspension/interposition procedure can be technically challenging. Furthermore, many studies report subsidence of the first metacarpal into the trapezial void, which is exacerbated with pinch (Dell and Muniz, 1987; Dell et al., 1978; Downing and Davis, 2001; Tomaino et al., 1995; Yang and Weiland, 1998); although this subsidence was not correlated with inferior clinical outcomes, a decrease in thumb skeletal length will create some degree of thenar muscle relaxation, which should theoretically decrease thumb pinch strength. Moreover, in our experience, we have found that this procedure requires a long period of post-operative rehabilitation, and is often accompanied by the complication of a painful tendonitis of the FCR tendon (up to 30% of cases in our clinical experience).

Given these premises, a less complex procedure that preserves the anatomy and the bone stock should be a viable alternative: in stage IV disease, we believe that resurfacing the worn articulations while preserving the trapezium appears to be a simpler and more desirable strategy. This approach eliminates the risk of significant shortening and subluxation that accompanies any form of trapeziectomy, and which is particularly likely in patients with intrinsic soft tissue laxity. Indeed, no proximal migration of the metacarpal bone was observed on radiographs, and no patient reported painful impingement on the scaphoid. Our medium term results showed that the TM and ST joint spaces had been maintained in all patients, as was the axial alignment of the thumb in spite of the absence of a bony support (Figure 5). This demonstrates that the fibrous tissue that forms in the joint spaces has sufficient intrinsic stability to withstand the loads of normal use.

Although the narrow pseudarthrosis technique reduces movement due to the transformation of the TM and ST joints from synovial diarthrodial joints into fibrous joints, our results show that this reduction does not seem to affect overall functionality of the thumb (Rubino et al., 2013; Smeraglia et al., 2015). All patients regained full thumb mobility (Kapandji grade 10) by the 3-month follow-up, and according to the DASH criteria had 'no difficulty' with functional tasks at the 6-month follow-up. The clinical success that we observed is due, we believe, to addressing the joint instability that plays an important role in the development of this condition. Furthermore, the number of significant complications was low; this may be due to the minimally invasive nature of the technique and the fact that the patient is encouraged to move the thumb immediately post-operatively. Initial stability at the operated joints is provided by the K- wires, although overall thumb movement is still possible, and indeed encouraged.

There are relatively few studies of the treament of combined TM and ST OA with which to compare our results. In 2014, Langenhan et al. published a retrospective review of 15 patients treated with trapeziectomy for isolated STT arthritis. When patients were followed up at a mean 4.5 years, all patients were pain-free with a mean DASH score of 16 and full recovery of pinch strength compared with the contralateral hand (Langenhan et al., 2014). In the absence of pre-operative data, the statistical significance of these results could not be calculated, however, they are comparable with our study: we observed slightly better DASH scores (mean 8.7 points) but did not see a complete recovery of appositional pinch strength (90% of contralateral hand).

More data is available regarding the results of trapeziectomy performed for the treatment of TM arthritis. In 2012, Salem and Davis published their results at mean a follow-up of 6.2 years for a cohort of 99 patients suffering from advanced stage TM arthritis (Davis and Pace, 2009; Salem and Davis, 2012) treated with either isolated trapeziectomy, or with trapeziectomy and LRTI using the FCR ligament. At final follow-up there was no significant difference in pain or functionality scores for the two groups: 80% of trapeziectomy, 87% of trapeziectomy, and LRTI patients were pain-free or suffered mild discomfort with use, and DASH scores were 31 and 30 points, respectively. Likewise, appositional pinch strength results (key pinch) were more or less the same regardless of the technique, with approximately 83% of strength compared with the contralateral hand, while oppositional (tip pinch) strength was slightly better for trapeziectomy with LRTI (96% compared with 90% for simple trapeziectomy) (Salem and Davis, 2012). Our results were largely comparable with these, although we observed better results in terms of functionality (DASH score) and pain (VAS), and a full recovery of oppositional pinch at final follow-up. However, at 3-month follow-up, Davis and Pace reported only a partial recovery of pinch strength (approximately 60% for both techniques examined), while our cohort had achieved approximately 80% for both types of pinch strength (Davis and Pace, 2009). Indeed, we are encouraged to believe that our technique may produce an a more rapid recovery than that seen following trapeziectomy if our results are compared with those reported in the latest systematic review by Wajon for the Cochrane Library (Wajon et al., 2015). Pain (as rated on a 100 mm VAS scale) was 26 mm for trapeziectomy alone and 30 mm for trapeziectomy with LRTI at between 3 and 54 months post-operatively (Wajon et al., 2015). We observed a considerably lower mean VAS of 0.7 points (on a 10-point scale) at 1-month follow-up. Functional scores were equal for trapeziectomy with or without LRTI at 31 points on a 100-point scale at follow-up between 7 and 97months, whereas we report a mean score of 6 points (on the DASH 100-point scale) at 6-month follow-up.

As an alternative to total excision of the trapezium, techniques based on partial resection of the trapeziectomy with the interposition of a spacer have been proposed. Most recently, Barrera-Ochoa et al. (2014) evaluated their medium term results (mean 5.7 years) of 19 patients suffering from advanced TM arthritis treated with a Pyrocarbon Interposition Implant. Although reported patient satisfaction was high, patients were not pain-free at final follow-up: two cases (10.5%) were revised for symptomatic instability, and the progression of periprosthetic lucency was observed in 26% of cases.

The surgical procedure most closely resembling our technique is the 'double interposition arthroplasty', described by Barron and Eaton (1998), which is based on a conviction, similar to ours, that it is fundamental to maintain a stable foundation at the base of the thumb. After a minimal bony resection, limited to the volar and dorsal horns of the trapezial saddle (whereas the scapho-trapezial joint is left intact), a strip of FCR tendon is first passed through and then left interposed between the TM and the ST joints. The results at a mean follow-up period of 3 years were good: 91% of patients were completely satisfied and 95% of patients reported total or near-total pain relief. However, pinch strength improved by only 12% after surgery and less than full range of motion (90%) was reported. In spite of the positive results, the potential dorsal dislodging of one or both tendon grafts, the durability of a thin soft tissue layer interposed between two hard articular heads, and the donor-site morbidity are obvious concerns. The authors themselves admitted that they could not be certain of the ultimate fate of the graft.

This study reports a relatively large series considering the comparative infrequency of the condition, and only one patient was lost to follow-up. It is a homogeneous patient cohort operated by a single surgeon, and all follow-up evaluations were performed by the same independent examiner. One of the limitations of our study is that it is not randomized or controlled. However, given the relatively small number of cases with stage IV disease in both joints, it seemed more feasible to perform a prospective observational study. A second limitation is that no lateral radiographs of the wrist joint were performed to allow assessment of the midcarpal joint; nevertheless, no clinical evidence of midcarpal instability was noted in our cohort of patients.

In conclusion, we believe that this technique of narrow pseudarthrosis may address the issue of instability that underlies the development of OA of the TM and ST joints, as it aims to preserve the trapezium and to produce two new stable fibrous joints. This should allow near-normal, pain-free functionality of the thumb. By maintaining the trapezium and respecting the bone stock, future surgical treatment is still possible. The procedure is simple to perform, and requires only a minimum of standard surgical instrumentation. It does not require any form of rigid immobilization and post-operative rehabilitation is simplified, given that mobilization is encouraged immediately. Our preliminary results are very encouraging, with an excellent functional recovery in all cases. However, considering trapezectomy with or without LRTI as a benchmark, further controlled studies, with a longer follow-up and a careful radiological assessment, would be advisable to rule out the development of subsidence of the first metacarpal, degenerative changes of the surrounding joints, or midcarpal instabilities.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

References

Bade H, Koebke J. Arthrosis in the peritrapezial joints of the hand. Surg Radiol Anat. 1996, 18: 209–14.

Barrera-Ochoa S, Vidal-Tarrason N, Correa-Vázquez E, Reverte-Vinaixa MM, Font-Segura J, Mir-Bullo X. Pyrocarbon interposition (PyroDisk) implant for trapeziometacarpal osteoarthritis: minimum 5-year follow-up. J Hand Surg Am. 2014, 39: 2150–60.

Barron OA, Eaton RG. Save the trapezium: double interposition arthroplasty for the treatment of stage IV disease of the basal joint. J Hand Surg Am. 1998, 23: 196–204.

Brown GD, 3rd, Roh MS, Strauch RJ, Rosenwasser MP, Ateshian GA, Mow VC. Radiography and visual pathology of the osteoarthritic scaphotrapezio-trapezoidal joint, and its relationship to trapeziometacarpal osteoarthritis. J Hand Surg Am. 2003, 28: 739–43.

Brunton LM, Wilgis EF. A survey to determine current practice patterns in the surgical treatment of advanced thumb carpometacarpal osteoarthrosis. Hand. 2010, 5: 415–22.

Buckwalter JA. Articular cartilage injuries. Clin Orthop. 2002, 402: 21–37.

Burton RI, Pellegrini VD, Jr. Surgical management of basal joint arthritis of the thumb. Part II. Ligament reconstruction with tendon interposition arthroplasty. J Hand Surg Am. 1986, 11: 324–32.

Davis TR, Pace A. Trapeziectomy for trapeziometacarpal joint osteoarthritis: is ligament reconstruction and temporary stabilisation of the pseudarthrosis with a Kirschner wire important? J Hand Surg Eur. 2009, 34: 312–21.

Dell PC, Muniz RB. Interposition arthroplasty of the trapeziometacarpal joint for osteoarthritis. Clin Orthop Rel Res. 1987, 220: 27–34.

Dell PC, Brushart TM, Smith RJ. Treatment of trapeziometacarpal arthritis: results of resection arthroplasty. J Hand Surg Am. 1978, 3: 243–9.

Downing ND, Davis TRC. Trapezial space height after trapeziectomy: mechanism of formation and benefits. J Hand Surg Am. 2001, 26: 862–8.

Eaton RG, Glickel SZ. Trapeziometacarpal osteoarthritis: staging as a rationale for treatment. Hand Clin. 1987, 3: 455–71.

Finsen V, Wold CB, Russwurm H. Clumsiness: a complication of trapeziectomy for thumb carpometacarpal joint arthritis? J Hand Surg Eur. 2015, 40: 326.

Fitzgerald BT, Hofmeister EP. Treatment of advanced carpometacarpal joint disease: trapeziectomy and hematoma arthroplasty. Hand Clin. 2008, 24: 271–6.

Glickel SZ, Kornstein AN, Eaton RG. Long-term follow-up of trapeziometacarpal arthroplasty with coexisting scaphotrapezial disease. J Hand Surg Am. 1992, 17: 612–20.

Heyworth BE, Lee JH, Kim PD, Lipton CB, Strauch RJ, Rosenwasser MP. Hylan versus corticosteroid versus placebo for treatment of basal joint arthritis: a prospective, randomized, double-blinded clinical trial. J Hand Surg Am. 2008, 33: 40–8.

Hollevoet N, Kinnen L, Moermans JP, Ledoux P. Excision of the trapezium for osteoarthritis of the trapeziometacarpal joint of the thumb. J Hand Surg Br. 1996, 21: 458–62.

Kapandji IA. Clinical evaluation of the thumb's opposition. J Hand Ther. 1992, 2: 102–6.

Langenhan R, Hohendorff B, Probst A. Trapeziectomy and ligament reconstruction tendon interposition for isolated scaphotrapeziotrapezoid osteoarthritis of the wrist. J Hand Surg Eur. 2014, 39: 833–7.

McConnell S, Beaton DE, Bombardier C. *The DASH outcome measure: a user's manual*. Toronto, Ontario, Institute for Work & Health, 1999.

McLean JM, Turner PC, Bain GI, Rezaian N, Field J, Fogg Q. An association between lunate morphology and scaphoid-trapeziumtrapezoid arthritis. J Hand Surg Eur. 2009, 34: 778–82.

Melone CP, Jr, Beavers B, Isani A. The basal joint pain syndrome. Clin Orthop Relat Res. 1987, 220: 58–67.

Noland SS, Saber S, Endress R, Hentz VR. The scaphotrapezial joint after partial trapeziectomy for trapeziometacarpal joint arthritis: long-term follow-up. J Hand Surg Am. 2012, 37: 1125–9.

Nordback S, Erba P, Wehrli L, Raffoul W, Egloff DV. Trapeziectomy and tendon suspension with or without a Mitek anchor fixation in the thumb basal joint osteoarthritis. J Hand Surg Eur. 2012, 37: 625–31.

North ER, Eaton RG. Degenerative joint disease of the trapezium: a comparative radiographic and anatomic study. J Hand Surg Am. 1983, 8: 160–6.

Pellegrini VD, Jr. Osteoarthritis of the trapeziometacarpal joint: the pathophysiology of articular cartilage degeneration. I. Anatomy and pathology of the aging joint. J Hand Surg Am. 1991, 16: 967–74.

Rubino M, Civani A, Pagani D, Sansone V. Trapeziometacarpal narrow pseudarthrosis: a new surgical technique to treat thumb carpometacarpal joint arthritis. J Hand Surg Eur. 2013, 38: 844–50.

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 Eur. 2012, 37: 211–9.

Smeraglia F, Soldati A, Orabona G, Ivone A, Balato G, Pacelli M. Trapeziometacarpal arthrodesis: is bone union necessary for a good outcome? J Hand Surg Eur. 2015, 40: 356–61.

Tay SC, Moran SL, Shin AY, Linscheid RL. The clinical implications of scaphotrapezium-trapezoidal arthritis with associated carpal instability. J Hand Surg Am. 2007, 32: 47–54.

Thompson JS. Suspensionplasty. J Orthop Surg Technol. 1989, 4: 1–13.

Tomaino MM. Suspensionplasty for basal joint arthritis: why and how. Hand Clin. 2006, 22: 171–5.

Tomaino MM, Pellegrini VD, Jr, Burton RI. Arthroplasty of the basal joint of the thumb. Long-term follow-up after ligament reconstruction with tendon interposition. J Bone Joint Surg Am. 1995, 77: 346–55.

Vermeulen GM, Slijper H, Feitz R, Hovius S, Moojen T, Selles R. Surgical management of primary thumb carpometacarpal osteoarthritis: a systematic review. J Hand Surg Am. 2011, 36: 157–69.

Wajon A, Vinycomb T, Carr E, Edmunds I, Ada L. Surgery for thumb (trapeziometacarpal joint) osteoarthritis (Review). The Cochrane Library 2015. DOI: 10.1002/14651858.CD004631.pub4.

Wolf JM, Delaronde S. Current trends in nonoperative and operative treatment of trapeziometacarpal osteoarthritis: a survey of US hand surgeons. J Hand Surg Am. 2012, 37: 77–82.

Yang SS, Weiland AJ. First metacarpal subsidence during pinch after ligament reconstruction and tendon interposition basal joint arthroplasty of the thumb. J Hand Surg Am. 1998, 23: 879–83.