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Original article

Arthrodesis of the thumb metacarpophalangeal joint: Conventional open technique with a locking plate or compression pins versus minimally invasive technique with compression pins or screws

Arthrodèse de l'articulation métacarpo-phalangienne du pouce : technique conventionnelle ouverte par plaque verrouillée ou broche à compression versus technique mini-invasive par broche ou vis à compression

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ABSTRACT

Arthrodesis of the thumb metacarpophalangeal (MCP) joint usually leads to satisfying results when performed with an open technique. The main complication is adhesion of the extensor tendons that sometimes requires hardware removal associated with tenolysis. The goal of this study was to assess whether a minimally invasive technique could reduce the risk of this complication. Arthrodesis of the thumb MCP was performed using an open technique with a locking plate or compression pins in 12 cases (group I) and using a minimally invasive technique with compression pins or screws in 12 cases, for a total of 24 patients aged 48.9 years on average, among which 15 were women. At the last follow-up, the average pain level was rated at 2/10 in group I and 2.3/10 in group II. The QuickDASH was 40.70/100 in group I and 36.24 in group II, grip strength was 79% of the contralateral side in group I and 51% in group II. Pinch strength was 81% of the contralateral side in group I and 45% in group II. Fusion was achieved in all cases in group I and in 7 of 12 cases in group II. Surgical revision for non-union was needed in 5 cases in group II, with hardware removal and tenolysis performed in 2 cases. The non-unions were observed in non-rheumatoid cases. While the two groups were not identical, arthrodesis of the thumb MCP using a minimally invasive technique with compression pins or screws seems to give satisfying results for rheumatoid cases in which no cartilage remains.

Mots clés :
Arthrodèse
Articulation métacarpo-phalangienne
Pouce
Technique ouverte
Technique mini-invasive

RESUMEN

L'arthrodèse de la métacarpo-phalangienne (MCP) du pouce donne habituellement de bons résultats avec des techniques ouvertes. La complication principale est l'adhérence de l'appareil extenseur qui nécessite ablation de matériel et ténolyse. Le but de ce travail était de vérifier si une technique mini-invasive permettrait de diminuer cette complication. Une arthrodèse MCP du pouce a été réalisée 12 fois par technique ouverte par plaque verrouillée ou broches à compression (groupe I) et 12 fois par technique mini-invasive par broches ou vis à compression (groupe II) chez 24 patients d'âge moyen 48,9 ans dont 15 femmes. Au dernier recul, la douleur était en moyenne de 2/10 dans le groupe I et 2,3 dans le groupe II, le QuickDASH à 40,70/100 dans le groupe I et 36,24 dans le groupe II, la force de la poigne 79% par rapport au côté opposé dans le groupe I et 51% dans le groupe II, la force de la pince pollici-digitale

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81% dans le groupe I et 45% dans le groupe II. Toutes les arthrodèses avaient consolidé dans le groupe I et 7 dans le groupe II. Le nombre de reprises pour pseudarthrodèse était de 5 dans le groupe II, dont 2 pour ablation de matériel et ténolyse. Les échecs étaient observés dans les pathologies non rhumatismales. Bien que les 2 groupes ne soient pas identiques, l'arthrodèse de la MCP du pouce par voie mini-invasive par broches ou vis à compression semble donner de bons résultats à condition d'être indiquée pour des étiologies rhumatismales non post-traumatiques et non neuro-orthopédiques.

1. Introduction

Arthrodesis of the thumb metacarpophalangeal (MCP) joint performed using an open technique usually leads to satisfying results with a fusion rate close to 100% [1]. The main complication is adhesion of the extensor tendons to the hardware, often requiring surgical revision for hardware removal and tenolysis [2]. No study has assessed whether a minimally invasive arthrodesis technique can lower the hardware removal and tenolysis rate.

The main hypothesis was that the rate of surgical revision after arthrodesis of the thumb MCP for non-union is lower when a minimally invasive technique with compression pins or screws is used. Secondary hypotheses where that the rate of surgical revision for hardware removal and tenolysis is lower when a minimally invasive technique with compression pins or screws is used compared to an open technique with locking plates or compression pins.

2. Material and methods

All medical records of patients operated in our department for arthrodesis of the thumb MCP joint between 2009 and 2016 were reviewed. We excluded patients under 18, pregnant women and patients lost to follow-up.

We included patients operated using an open technique (group I) and a minimally invasive technique (group II). Our series included 24 patients, aged 48.9 years on average (ranging from 29 to 71 years) among which there were 15 women and 9 men (Tables 1 and 2). The indications for arthrodesis of the thumb MCP were defined for several non-traumatic pathologies (systemic diseases in 3 cases, rheumatoid arthritis in 5 cases, neurological or orthopedic disorders in 5 cases, degenerative arthritis in 1 case and post-traumatic arthritis in 10 cases).

All patients were operated in outpatient surgery unit under regional anesthesia.

In 12 cases (group I), a conventional open technique was performed using a dorsal approach through the extensor pollicis brevis tendon. After removing the remaining cartilage from the articular surface, fixation was performed using either break-away pins (PercuFIX™, Stryker, Kalamazoo, USA) or a locking plate (Aptus®, Médartis, Basel, Switzerland) (Fig. 1).

In 12 cases (group II), a minimally invasive technique was performed using a percutaneous approach, without resection of the articular surfaces. The fixation was performed using either break-away pins (PercuFIX™, Stryker, Kalamazoo, USA) or cannulated screws (Omnitech® Evolution, Biotech, Memphis, USA; or Handmotion®, Newclip Technics, Haute Goulaine, France) (Fig. 1). The thumb was immobilized in a Spica-type splint for 6 weeks in both groups followed by self-directed rehabilitation.

The outcomes evaluated at the last follow-up were pain on a numeric scale ranging from 0 (no pain) to 10 (worst imaginable pain), QuickDASH ranging from 0 (no disability) to 100 (extreme disability), grip strength as a percentage of the contralateral side, pinch strength as a percentage of the contralateral side and fusion of the MCP joint based on X-rays. Complications, surgical revisions for non-union, hardware removal or tenolysis were also reported.

Given the large variability in the indications with frequent bilateral conditions and the small number of patients, no statistical analysis was performed.

3. Results

The analytical results are presented in Tables 3 and 4. At the last follow-up, the average pain was rated at 2/10 in group I and 2.3/10 in group II. The average QuickDASH was 40.70/100 in group I and 36.24/100 in group II. The average grip strength was 79% of the contralateral side in group I and 51% in group II. The average pinch strength was 81% of the contralateral side in group I and 45% in group II. Complete fusion of the arthrodesis on X-rays was obtained in all 12 cases in group I and in 7 of 12 cases in group II. There was no surgical revision for non-union in group I, while in group II,

Table 1
Characteristics of a series of 12 patients who underwent thumb MCP arthrodesis using an open approach.

Patient	Age	Gender	Dominant side	Injured side	Indication	Technique
(*n*)	(y)	(M/F)	(R/L)	(R/L)		
1	38	F	R	R	Rheumatoid arthritis	2 PercuFIX™
2	33	F	R	R	Spastic thumb	2 PercuFIX™
3	54	F	L	R-L	Post-traumatic arthritis	2 PercuFIX™
4	45	F	R	L	Post-traumatic arthritis	Medartis plate
5	52	M	R	L	Rheumatoid arthritis	2 PercuFIX™
6	56	F	R	R	Post-traumatic arthritis	Medartis plate
7	58	F	L	R	Post-traumatic arthritis	2 PercuFIX™
8	59	M	R	R	Post-traumatic arthritis	2 PercuFIX™
9	40	F	R	L	Neurological	3 PercuFIX™
10	32	F	R	R	Rheumatoid arthritis	2 PercuFIX™
11	71	M	R	R	Neurological (tetraplegia)	3 PercuFIX™
12	48	M	R	L	Post-traumatic arthritis	Medartis plate

M: male; F: female; R: right; L: left.

Table 2
Characteristics of a series of 12 patients who underwent thumb MCP arthrodesis using a minimally invasive approach.

Patient	Age	Gender	Dominant side	Injured side	Indication	Technique
(*n*)	(y)	(M/F)	(R/L)	(R/L)		
1	40	F	R	L	Rheumatoid arthritis	2 PercuFIX™
2	35	M	R	R	Post-traumatic arthritis	2 PercuFIX™
3	47	M	R	L	Post-traumatic arthritis	2 Biotech screws
4	56	F	R	R	Rheumatoid arthritis	2 PercuFIX™
5	52	F	R	L	Neurological	2 PercuFIX™
6	35	F	R	R	Post-traumatic arthritis	2 PercuFIX™
7	67	M	R	L	Rheumatoid arthritis	2 PercuFIX™
8	56	F	L	R	Rheumatoid arthritis	2 PercuFIX™
9	56	F	R	L	Degenerative arthritis	2 PercuFIX™
10	59	M	R	L	Neurological (tetraplegia)	2 Newclip screws
11	29	M	R	L	Neurological	2 PercuFIX™
12	54	F	R	L	Post-traumatic arthritis	2 PercuFIX™

M male. F female. R right. L left.

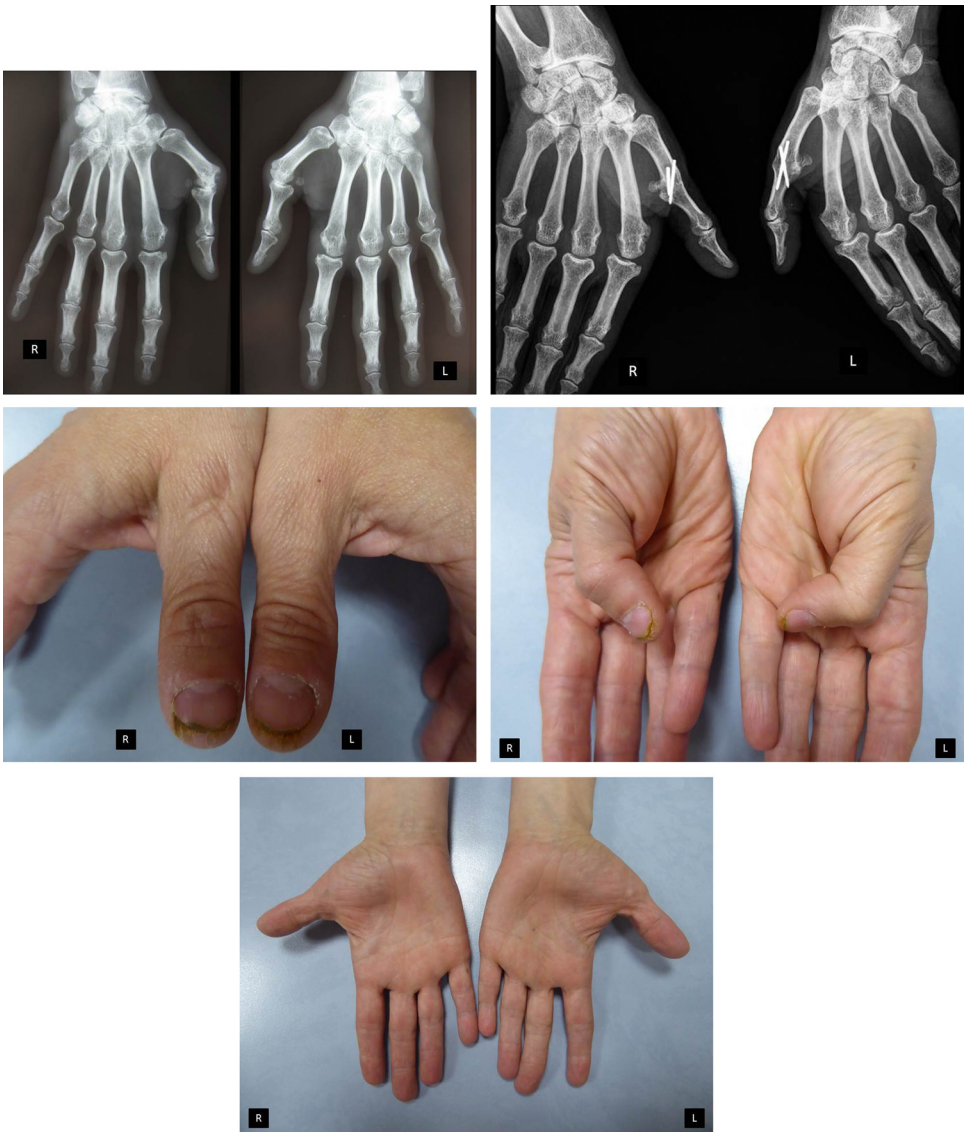

Fig. 1. Clinical case in a patient with rheumatoid arthritis. Conventional open technique on right hand. Minimally invasive technique on left hand. X-ray before surgery (A). X-ray after surgery (B). Scar after surgery. On right hand, the scar is large with some adhesions; on left hand, the scar is invisible (C). Motion after surgery. On right hand, opposition is limited (Kapandji score at 8); on left hand, opposition is better (Kapandji score at 9) (D). Motion after surgery. Opening of the first web space is the same in both hands (E).

Table 3
Results of a series of 12 patients who underwent thumb MCP arthrodesis using an open approach.

Patient	Follow-up	Pain	QuickDASH	Grip	Pinch	Fusion	Complications	Revision	Associated lesion and treatment
(*n*)	(months)	(0–10)	(0–100)	(%)	(%)	(Y/N)	(Y/N)	(Y/N)	
1	102	2	40.91	117	112	Y	Adhesive scar	N	Contralateral
2	82	0	38.64	–	–	Y	N	N	Flexor tenotomy
3	6	3	36.36	73	86	Y	N	N	Wrist ganglion via arthroscopy
4	18	8	86.36	–	–	Y	N	N	–
5	28	0	9.09	–	–	Y	N	N	Flexor tenosynovitis
6	18	6	65.91	133	200	Y	N	N	–
7	12	1	9.09	12	4	Y	N	N	R 1 3 4 trigger finger
8	95	0	4.55	60	–	Y	2 broken PercuFIX™	N	Carpal tunnel syndrome
9	103	0	72.73	–	–	Y	N	N	Ipsilateral wrist arthrodesis
10	88	4	36.36	–	–	Y	N	N	Rheumatoid wrist
11	6	0	–	–	–	Y	N	N	–
12	21	0	47.73	–	2	Y	N	N	–

% of contralateral side.

Table 4
Results of a series of 12 patients who underwent thumb MCP arthrodesis using a minimally invasive approach.

Patient	Follow-up	Pain	Q DASH	Grip	Pinch	Fusion	Complications	Revision	Associated lesion and treatment
(*n*)	(months)	(0–10)	(0-–100)	(%)	(%)	(Y/N)	(Y/N)	(Y/N)	
1	79	0	40.91	85	89	Y	N	N	Contralateral
2	8	5	27.27	77	-	N	Failure	Y (NU)	–
3	13	7	56.82	26	10	N	Failure	Y (NU)	–
4	23	0	0	50	45	Y	N	N	Pain R2345
5	23	1	50	28	57	Y	Impingement	Y (HR)	Chinese flap
6	63	0	9.09	39	10	N	Failure	Y (NU)	Previous CL ligament reconstruction
7	67	5	59.09	42	44	N (PercuFIX broken)	N	N	PIP implant L4L5
8	6	2	68.18	62	–	N	N	N	Wrist implant
9	87	8	75.75	–	–	Y	CRPS1	N	CMC1 implant (psy)
10	87	0	-	–	–	Y	Impingement	Y (HR)	Pronation osteotomy
11	65	0	0	–	–	Y	N	N	Wrist extensor tenodesis
12	81	0	11.36	–	57	Y	N	N	Wrist ganglion

% of contralateral side; HR: hardware removal; NU: nonunion; CL: collateral ligament; CRPS1: chronic regional pain syndrome type 1; psy: patient with psychiatric disorder; L4L5: left ring and little fingers.

surgical revision was needed in 5 cases, with hardware removal and tenolysis performed in 2 cases.

4. Discussion

The main function of the thumb MCP joint is to ensure stability during thumb to index finger pinch grip [3]. Most authors recommend performing arthrodesis for degenerative, monoarticular, posttraumatic or rheumatoid lesions of the thumb MCP for several reasons: it is easy to perform, the clinical outcome is often satisfactory, and the thumb column's mobility is preserved. According to some authors, when the lesions affect more than one joint in the thumb column, arthrodesis of the thumb MCP joint should not be performed as it might reduce the mobility and increase mechanical loads on the adjacent joints [4]. But some other authors believe that arthrodesis of the thumb MCP can still lead to satisfactory clinical outcomes even when more proximal lesions coexist [5].

Several arthrodesis techniques for the thumb MCP joint have been described. Most of them give good results in terms of fusion but many require surgical revisions for hardware removal and tenolysis of the adhesions to the extensor tendons. The rate of surgical revision was estimated at 33% when a tension-band wiring technique was used, of which 23% were symptomatic [6]. Double-threaded screws greatly reduce the immobilization time due to the stability of the fixation [6]. However, no significant difference was found between tension-band wiring techniques and techniques using double threaded screws [7]. Some authors have promoted the use of an X-fuse® implant, which is buried in the bone and therefore does not protrude under the extensor tendons [8]. Other authors simply use an axial K-wire [9].

Regardless of the technique used, the position in which to perform the arthrodesis is also debated. Some authors recommend 10° to 15° of flexion [10], others 2° to 20° of flexion combined with 15° of pronation [11], while some others recommend 15° of flexion, 5° of abduction and 20° of pronation [12], and finally some authors recommend 20° of flexion for women and 25° of flexion for men based on debatable criteria [13].

The fusion rate for arthrodesis of the thumb MCP joint is less than 100% [2]. In addition to hardware protrusion [14], other complications have been described such as pain requiring sesamoid removal or neuroma on one of the cutaneous branches of the radial nerve damaged by the surgical approach [15].

Although it has been demonstrated on the distal interphalangeal joints of the hand [16] and ankle [17] that a percutaneous arthrodesis, without opening the joint and removing the cartilage, can lead to satisfactory results, no publication reports such results for the thumb MCP joint. The goal of our study was to compare the results of an open technique to that of a minimally invasive technique.

Our study has shown that the clinical results in terms of pain and QuickDASH were comparable in both groups but that grip strength and pinch strength were higher in group I. We also observed a higher rate of surgical revision for the minimally invasive technique. All failures of the minimally invasive technique occurred in patients where the arthrodesis was needed for post-

traumatic, neurological or orthopedic indications. These cases had a lot of cartilage present, and not removing it was likely the cause of these failures. This suggests that when cartilage is still present, percutaneous arthrodesis is not indicated. All the arthrodesis procedures performed in rheumatoid arthritis cases did fuse. This suggests that when the cartilage had been destroyed by the arthritis, percutaneous arthrodesis can be indicated.

One weaknesses of our study is that the use of different materials with different approaches could bias the results. In fact, screws differ little from compression pins.

The main hypothesis of our study was not verified as the surgical revision rate for non-union after arthrodesis of the thumb MCP joint was higher when a minimally invasive technique with compression pins or screws was used compared to an open technique with locking plates or compression pins. The secondary hypothesis was not verified as the surgical revision rate after arthrodesis of the thumb MCP joint for hardware removal and tenolysis was higher when a minimally invasive technique was used compared to an open technique.

5. Conclusion

While the two groups were not identical, arthrodesis of the thumb MCP joint using a minimally invasive technique with compression pins or screws seems to give good results in cases where no cartilage remains before the surgery.

Disclosure of interest

Philippe Liverneaux has conflicts of interest with Newclip Technics, Argomedical, Biomodex, Zimmer Biomet
The other authors declare that they have no competing interest.

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