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Original Research

Outcomes of Thumb Metacarpophalangeal Joint Arthrodesis Using the XMCP Intramedullary Interlocking Device



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Purpose: The intramedullary interlocking device for metacarpophalangeal (MCP) joint arthrodesis (XMCP, Extremity Medical, Parsippany, NJ) has been shown to promote union at a precise angle, provide strong fixation without the need for prolonged immobilization, and lower the incidence of hardware irritation and revision surgery. In this study, we evaluated the clinical outcomes of patients undergoing MCP joint arthrodesis with the XMCP system using a retrospective chart review, patient reported outcomes, and radiographic analysis.

Methods: A retrospective chart review and phone survey was conducted on 57 patients (58 cases) from a single institution between 2017 and 2022. The primary outcome was patient satisfaction, including pre- and postoperative Numeric Rating Scale (NRS) pain scores, Disabilities of Arm Shoulder and Hand (QuickDASH) outcomes, perceived grip strength, and willingness to undergo the procedure again. Secondary outcomes included the need for revision procedures, successful fusion of arthrodesis, and postoperative complications.

Results: Of the 57 patients who underwent MCP joint arthrodesis of the thumb using the XMCP fusion device, a total of 43 (75%) completed the phone survey. The average age of patients was 67 years with an average clinical follow-up of 9 months (range 1–65 months). Patients who participated in the phone survey questionnaire had an average QuickDASH score of 24.7 ± 20.5 . Average perceived NRS scores were 6.2 ± 3.5 and 1.2 ± 2.1 before and after surgery, respectively. Average perceived grip strength of patients was 3 ± 1.3 out of 5. When evaluating for concurrent procedures, there was no statistically significant difference in pre- or postoperative NRS scores. In total, 38 (88%) patients were satisfied with the procedure, and 39 (91%) patients would undergo the procedure again.

Conclusion: Metacarpophalangeal joint arthrodesis of the thumb with the intramedullary fusion device is reproducible, allows for immediate use without immobilization, has a low number of complications, and provides improved function and pain relief.

Level of Evidence: Therapeutic III.

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The human thumb is essential for proper hand function, such as hand grip and finger opposition, often withstanding 50% of the total workload of the hand.¹ Pathologies, such as rheumatoid arthritis,

osteoarthritis, post-traumatic arthritis, and chronic joint instability, can lead to significant loss of function, deformity, and pain in the thumb metacarpophalangeal (MCP) joint. There are various surgical options for MCP joint disease, including arthroscopic synovectomy, ligament reconstruction and MCP joint arthrodesis.² Surgical techniques for MCP joint arthrodesis have been described and include Kirshner wires with or without tension band, plate fixation, cannulated screws and intramedullary screw fixation methods aimed at providing stronger fixation and less hardware irritation.²⁻⁷ The ideal technique for MCP joint arthrodesis would facilitate

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Table 1
Patient Demographics

Number of patients	57 (%)
Sex	
Male	15 (26%)
Female	42 (74%)
Hand*	
Left	22 (38%)
Right	36 (62%)
Smoking status	
Active	8 (14%)
Never	33 (58%)
Former	16 (28%)
Diabetes	
Yes	10 (18%)
No	47 (82%)
Indication*	
OA	22 (38%)
RA	4 (7%)
Chronic instability	14 (24%)
Hyperextension CMC arthritis	18 (31%)

CMC, carpometacarpal.

* A total of 57 patients were included with one patient receiving a bilateral procedure, yielding a total of 58 cases.

timely thumb mobilization and clinical union and be universally applicable to current arthrodesis indications.

The intramedullary interlocking device for MCP joint arthrodesis (XMCP, Extremity Medical, Parsippany, NJ) has been shown to promote union at a precise angle, provide strong fixation without the need for prolonged immobilization, and lower the incidence of hardware irritation and revision surgery. XMCP can also be used concomitantly with other procedures.^{3,7} There are two previous case series assessing the outcomes of the XMCP device for MCP joint arthrodesis; however, both included small sample sizes. In this study, we evaluated the clinical outcomes of patients undergoing MCP joint arthrodesis with the XMCP system using a retrospective chart review, patient reported outcomes, and radiographic analysis.

Materials and Methods

This was an institutional review board-approved study conducted on all patients between 2017 and 2022 at a single academic center who were treated with the XMCP fusion device. One surgeon performed all 58 cases. Indications for surgery included painful MCP joint osteoarthritis of the thumb, chronic MCP joint instability, instability/hyperextension deformity of the MCP joint from carpometacarpal (CMC) arthritis, and rheumatoid arthritis derived deformity of the thumb. All patients who had undergone MCP joint arthrodesis of the thumb with the extremity medical XMCP intramedullary fusion device at our center were included.

Data collection

For the retrospective portion of this study, Current Procedural Terminology code 26841 was used to identify all patients who received MCP joint arthrodesis of the thumb. Radiographic evaluation was performed to determine which patients received the extremity medical XMCP intramedullary fusion device. Patient charts were reviewed, and demographic data collected including patient age, sex, smoking status, medical comorbidities, procedure laterality, prior wrist arthrodesis or arthroplasty procedure, additional procedures performed, indications for the procedure, and time to follow-up (Table 1). Postoperative complications, such as infections and hospital readmissions, were also collected. Radiographic review was performed to assess for osseous union and

Table 2
Phone Survey Results

Number of patients	43 (%)
Average QuickDASH score	24.8
Average grip strength	3.1
Patient satisfaction	
Very satisfied	30 (70%)
Somewhat satisfied	8 (19%)
Indifferent	1 (2%)
Somewhat dissatisfied	3 (7%)
Very dissatisfied	1 (2%)
Average VAS (average \pm SD)	
Before surgery	6.2 \pm 3.5*
After surgery	1.2 \pm 2.1*
Would undergo surgery again?	
Yes	39 (91%)
No	4 (9%)

SD, standard deviation. VAS, visual analog scale.

* Significant reduction of pain from the preoperative to postoperative period, $P < .001$.

signs of implant loosening or hardware failure. Union was defined as bridging bone on three of four joint quadrants on orthogonal radiographs.

For the phone survey portion of the study, patients were contacted and asked if they would be willing to participate in a phone survey. Verbal consent was obtained via phone before proceeding with the survey questions (Table 2). Data collected included Disabilities of Arm Shoulder and Hand (QuickDASH) scores, Numeric Rating Scale (NRS) pain scores, perceived grip strength compared to the contralateral hand, satisfaction with procedure, and willingness to repeat procedure.

Categorical variables were reported as means and standard deviations (ranges), and categorical variables were reported as percentages. Changes in categorical variables were evaluated using paired t-tests and differences between studied groups were evaluated using independent t-tests. Chi-square or Fisher's exact tests (where appropriate) were used to evaluate associations between categorical variables. Significance was set at 0.05.

Surgical technique

Preoperative evaluation for implant size using templating software is recommended with true postero-anterior and lateral radiographs of the thumb MCP joint. Of the four sizes, the largest implant that would fit within the medullary canal diameter was chosen. Alternatively, intraoperative determination can be made with C-arm fluoroscopy by viewing the canal fill of trial rods. A dorsal incision is placed over the thumb MCP joint (Fig. 1). Dissection is carried down to the extensor tendon apparatus and the extensor tendon is incised on either the radial or ulnar border and mobilized. The joint capsule is then entered via a dorsal longitudinal incision. The collateral ligaments are identified and released in a subperiosteal fashion off the metacarpal head while flexing the thumb MCP joint, allowing full access to the articular surface (Fig. 2). Blunt retractors can aid in elevation of the metacarpal head for exposure.

A guidewire is then placed in the central axis of the metacarpal head into the intramedullary canal (Fig. 3), followed by a cannulated drill. An appropriately sized implant is then placed into the metacarpal (Fig. 4). Next, a hole is created on the dorsal portion of the metacarpal neck with a reamer device to expose cancellous bone and allow the insertion of the set angled device into the phalanx at 25°. A guidewire is placed in the central axis of the proximal phalanx via an antegrade fashion. A modified drill and rasp device is then placed over the guidewire, contouring the



Figure 1. Operative plan for a dorsal incision over the thumb metacarpophalangeal joint.



Figure 2. Flexion of the thumb metacarpophalangeal joint allows full visualization of the articular surface.

phalangeal base to cancellous bone. After measuring lag screw length using a depth gauge over the guidewire, an appropriately sized implant is selected. The lag screw is then inserted through the dorsal metacarpal window, engaging the metacarpal implant and passing into the proximal phalanx intramedullary canal. It is important to place the implant in the correct amount of pronosupination for natural cascade of pinch grip. The morse taper locking mechanism will engage after self-compression across the fusion site. Fluoroscopic imaging confirms proper placement (Figs. 5 and 6). Finally, the capsule is repaired with a non-absorbable suture, and a standard dermal closure is performed.

We typically place patients into a thumb spica splint, but this may vary depending on concurrent procedures performed. The patients return to the clinic at two weeks postoperatively for suture removal and to begin range of motion exercises.

Results

A total of 57 patients at our institution underwent MCP joint arthrodesis of the thumb between July 2017 and September 2022 using the extremity medical XMCP intramedullary fusion device. One patient had bilateral procedures of the thumb, for a total of 58 cases. The average postoperative follow-up time was 9 months (range 1–65 months). Average patient age was 64 ± 9 years (range 29–79), with 42 females (74%) and 15 males (26%). There were 36 (62%) patients who received an MCP joint arthrodesis of the right thumb and 22 (38%) of the left thumb. Seventy-five percent of patients (44/58 cases) underwent additional procedures of the

hand concurrently with the MCP joint arthrodesis of the thumb. The most common concomitant procedures were thumb CMC arthroplasty (33/58) and carpal/cubital tunnel release (9/58). Surgical indications for MCP joint arthrodesis included primary osteoarthritis of the MCP joint (22/58), instability/hyperextension deformity of MCP joint from CMC osteoarthritis (18/58), chronic MCP joint instability (14/58), and rheumatoid arthritic deformities (4/58). Of the 58 procedures performed, 43 achieved radiographic osseous union of the MCP joint. Average time to radiographic union was 107 days (range 35–1056 days). Average time to last radiograph was 173 days (range 10–1559 days).

There were complications in six patients following the procedure. Five patients developed a superficial wound infection, requiring one patient to be admitted for intravenous antibiotics and the other four to receive oral antibiotics. All patients had resolution of the infection after receiving antibiotics. One patient required a revision procedure of their MCP joint arthrodesis due to hyper-supination of the thumb from index procedure.

In total, 43 of the 57 (75%) patients who had undergone the procedure were able to participate in the phone survey questionnaire. The average follow-up from time of surgery to time of phone survey was 56 months (range 3–63 months). Patients who participated in the phone survey questionnaire had an average QuickDASH score of 24.7 ± 20.5 . Average perceived NRS scores before surgery were 6.2 ± 3.5 and after surgery were 1.2 ± 2.1 , with an average decrease of 5.0 points ($P < .001$). Average perceived grip strength of patients was 3.0 ± 1.3 out of 5. Thirty-eight (88%) patients were satisfied with the procedure, and 39 (91%) patients would undergo the procedure again. There were no cases of



Figure 3. A guidewire is placed in the central axis of the metacarpal head into the intramedullary canal.

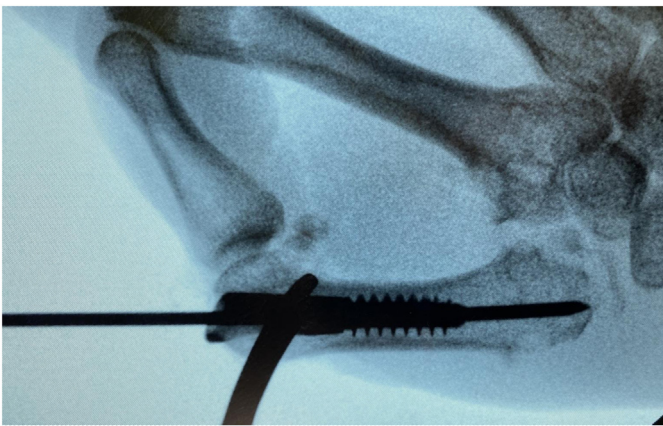


Figure 4. An appropriately sized implant is placed into the metacarpal.

hardware failure. Out of the 15 patients with nonunion, 12 participated in the phone survey. All three patients who did not participate were classified as nonunion due to lack of follow-up and not because of documented nonunion. Out of the 12 patients with nonunion who participated in the survey, one was very dissatisfied, one was somewhat dissatisfied, one was somewhat satisfied, and the other nine were very satisfied with the procedure.

There was no association between sex, smoking status, diabetes, and postoperative occurrence of nonunion ($P = .133$, $P = .152$, and



Figure 5. Postero-anterior radiographic view of the XMCP fusion device.

$P = .073$, respectively). Neither history of wrist arthrodesis ($P = .320$) nor previous wrist arthroplasty ($P = .292$) were associated with postoperative occurrence of nonunion. There were no differences in grip strength, *QuickDASH*, preoperative NRS, or postoperative NRS scores between those with and without nonunion ($P = .07$, $P = .34$, $P = .26$, $P = .29$, respectively).

No statistically significant differences were seen in *QuickDASH*, preoperative NRS, and postoperative NRS scores between patients who received concomitant procedures versus MCP arthrodesis alone (Table 3).

Discussion

Metacarpophalangeal joint arthrodesis of the thumb using the extremity medical XMCP intramedullary fusion device can be performed in isolation or in conjunction with other procedures, more commonly CMC arthroplasty of the thumb. Our analysis is consistent with previous literature given that MCP joint arthrodesis of the



Figure 6. Lateral radiographic view of the XMCP fusion device.

Table 3
Average QuickDASH and Pre-/Postoperative VAS Scores When Controlling for Additional Procedures During MCP Joint Fusion

	MCP Joint Fusion only*	Additional Procedure†	P value
	Mean ± SD	Mean ± SD	
QuickDASH Score	29.6 ± 22	23.2 ± 20.1	.397
Preoperative VAS	5.6 ± 3.9	6.4 ± 3.4	.542
Postoperative VAS	2.0 ± 3.4	1.0 ± 1.5	.389

VAS, visual analog scale; SD, standard deviation; MCP, metacarpophalangeal; QuickDASH, Disabilities of Arm Shoulder and Hand.

* Paired data available for 10 out of 14 cases.

† Paired data available for 33 out of 44 cases.

thumb with the intramedullary fusion device is reproducible, has few complications, and provides improved function and pain relief in patients with osteoarthritis, rheumatoid arthritis, chronic MCP joint instability, or MCP joint hyperextension deformity from CMC arthritis.^{3,7}

Previous studies have indicated that the optimal angle of fusion is between 10° and 32°. ^{8,9} There have been smaller case series that have evaluated the clinical and radiographic outcomes of the XMCP intramedullary fusion device. Vanderzandan et al³ reviewed 17 patients who underwent MCP joint arthrodesis of the thumb using an intramedullary device and performed by a single surgeon. Five patients had osteoarthritis, three had rheumatoid arthritis, seven had MCP joint instability alone, and two had post-traumatic conditions. Only one patient had MCP joint arthrodesis alone, while 12 of the 17 patients underwent simultaneous CMC arthroplasty. Final radiographs were evaluated for arthrodesis angle, osseous fusion,

and implant fixation with a mean follow-up time of 4.9 months (range 5 weeks to 23 months). All 17 patients had clinical and radiographic evidence of fusion at an average time of 8 weeks. The average fusion angle was 24.4° (range 23° to 25°). There were no hardware complications, infections, revisions, or indications for hardware removal. Comparatively, our cohort had almost double the amount of follow-up (9 vs 4.9 months), and more than three-times the number of patients (57 vs 17). We additionally collected prospective patient reported outcomes in 75% of our patients and had a lower proportion of patients undergo CMC arthroplasty at time of procedure (53% vs 70%).

In a different study, Novoa-Parra et al⁷ reviewed 9 patients who underwent MCP joint arthrodesis using the XMCP system at a fixed angle of 25° between 2012 and 2016. Seven patients were women, and two were men. The average patient age was 85 years (range 55–73 years). The average follow-up time was 27.6 months (range 6–51 months). Indications for the procedure included post-traumatic conditions in two patients, osteoarthritis in three patients, rheumatoid arthritis in three patients, and spastic hand in one patient. Seven of the patients had simultaneous procedures besides MCP joint arthrodesis. All patients achieved complete union at mean time of 8.5 (±1) weeks and achieved a fusion angle of 25°. There were no complications, cases of implant migration or rupture, peri-implant soft tissue irritation, or revision surgeries. Pain levels as measured by visual analog scale were significantly reduced for all patients (8.11 ± 1.05 vs 1.55 ± 1.13, $P = .001$). Functional ability, as measured by QuickDASH, was significantly improved after the surgery (61.00 ± 18.02 vs 25.34 ± 19.65, $P = .006$). All patients' pain decreased by at least 10 points using the QuickDASH score when comparing preoperative and postoperative scores. Eight out of nine patients reported being satisfied with the procedure and said they would undergo it again. The one outstanding patient had a spastic hand and gained little functionality from the procedure. Comparatively, our present study did not have the same clinical follow-up time (9 vs 28 months). However, with the addition of our prospective phone survey we were able to achieve a mean follow-up time of 56 months in 75% of our patients. We additionally had a larger sample size of patients (57 vs 7). Our case series provided similar results in terms of pain reduction (postoperative NRS 1.2 vs 1.5), functional outcomes (postoperative QuickDASH 25 vs 25), and patient satisfaction (91% vs 89% satisfied and would undergo the procedure again).

We had a similarly low complication rate compared to the other studies with only one patient requiring revision surgery from hypersupination placement of the implant. Although previous studies report near 100% fusion rates compared to our rate of 74%, such studies had few participants, and it is unclear how radiographic union was determined. Alternatively, we provide strict radiographic criteria. Interestingly, patients with radiographic nonunion had no worse patient reported outcome scores, indicating that the implant successfully improved pain and function irrespective of osseous healing or that such patients had enough bony bridging to stabilize the joint and may have continued to complete fusion.

Limitations

One of the limitations to our study was the average follow-up time of 9 months (range 1–65 months). Although we were able to obtain longer follow-up times from the prospective phone call surveys (average follow-up of 56 months), we did have cases of patients who did not have long enough clinical/radiographic follow-up to comment on their radiographic fusion, pain outcomes, and functional outcomes. Having strict radiographic criteria for bony union may have excluded patients who were clinically fused

and stable, thus lowering our reported union rate. It can also be difficult to quantify the amount of bridging bone via radiographs on a small joint that is obscured by hardware and often has overlapping bony projections. Recall bias does exist in this study due to the collection of patient assessments of preoperative function using a postoperative phone survey as patients may not accurately remember their preoperative status. Although most patients were able to be included in the phone survey portion of the study, 14 (25%) patients were not able to be reached. However, only three of these patients were part of the nonunion group, and only one of these patients had a documented postoperative complication. Another limitation of the study is the large proportion of patients who underwent additional procedures at the same time of MCP joint arthrodesis or had previous wrist fusion/wrist arthroplasty procedures. These additional procedures could have an impact on the patient's pain scores, functional outcomes, and patient satisfaction scores when answering the prospective phone survey questions. However, there was no difference in pre- and postoperative visual analog scale scores when controlling for concomitant procedures.

Overall, MCP joint arthrodesis of the thumb using the extremity medical XMCP intramedullary fusion device is a simple procedure that can be performed as an isolated operation or in conjunction with other procedures, more commonly CMC arthroplasty of the

thumb. Metacarpophalangeal joint arthrodesis of the thumb with the intramedullary fusion device is reproducible, allows for immediate use without immobilization, has a low number of complications, and provides improved function and pain relief.

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