Arthroplasty for Fifth Carpometacarpal Joint Arthritis

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J Wrist Surg 2015;4:110–114.

Abstract

Keywords

- ▶ carpometacarpal joint
- ▶ arthritis
- ▶ arthroplasty
- ▶ arthrodesis

Background Fifth-carpometacarpal (CMC)-joint fractures and dislocations can produce carpometacarpal joint arthritis. The purpose of this study was to evaluate the radiographic and clinical outcomes of arthroplasty for fifth carpometacarpal joint arthritis.

Material and Methods A series of six patients who had symptomatic advanced fifth-CMC arthritis and had failed to respond to conservative treatment. All patients underwent Dupert's technique of fifth-CMC arthroplasty with a mean follow-up of 17.6 months. Results were reviewed clinically and radiographically.

Results Union between the fourth and fifth metacarpals was observed at an average of 6.2 weeks after surgery. Grip strength improved. Range of motion (ROM) of the fifth metacarpophalangeal (MCP) joint and the fifth metacarpal height remained unchanged. Visual analog scale (VAS) results improved significantly.

Conclusion Despite the medium-term follow-up and small number of patients, our results suggest fifth-CMC arthroplasty with arthrodesis of the fourth and fifth metacarpal bases may be a reliable procedure for fifth-CMC arthritis.

Carpometacarpal (CMC) joint injury forms less than 1% of all hand and wrist injuries.^{1,2} However, CMC joint fractures and dislocations are often missed. One study showed that 71% cases of CMC joint dislocation are missed in the emergency room.³ Although fifth-metacarpal base fractures are relatively common, fifth-CMC joint arthritis due to trauma is relatively rare. Fifth-CMC arthritis can cause ulnar wrist pain and weakness. Pain worsens with increased activity, especially on making a tight fist. As the disease progresses, the patient may complain of rest pain and CMC joint instability and deformity. Usually, it is possible to make an accurate diagnosis after obtaining medical history, physical examination, and radiographic evaluation. Radiographic studies confirm joint degenerative changes. When conservative treatment such as rest, immobilization, medication, and local injection are ineffective, surgical treatment should be considered.

Surgical treatment options include 5th CMC arthrodesis, silicone elastomer interposition arthroplasty,⁴ and tendon interposition arthroplasty.^{4–6} Dubert⁷ has published a technique in which he performed the so-called “stabilized arthroplasty,” that is, fifth-metacarpal base excision with fourth and fifth metacarpal arthrodesis. Most surgeons have preferred to use autologous cancellous bone graft to ensure a successful fusion.⁸ The senior author of this paper (L.R.S.) has been using a similar procedure for fifth-CMC arthritis. However, he utilized the removed fifth metacarpal base as a bone graft to fuse the proximal parts of the fourth and fifth metacarpals to avoid damage to a donor site.

The purpose of this study was to report the results of this fifth-CMC joint arthroplasty and its usefulness as a salvage technique for painful fifth-CMC joint arthritis.

Materials and Methods

From January 2006 to January 2011, six patients were identified with symptomatic advanced fifth-CMC arthritis who had failed to respond to conservative treatment. The data of these patients were reviewed retrospectively after the investigators obtained institutional review board approval. There were five male patients and one female, with a mean age of 45 (SD 10) years (range 31–55 years). One case was on the left side, the other five cases were on the right side. The average follow-up period was 17.6 months (range 9–36 months).

Assessment

We evaluated subjective outcomes using Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and pain visual analog scale (VAS). Clinical and radiographic results were recorded before and after surgery. We recorded grip strength, range of motion (ROM) of the metacarpophalangeal (MCP) joint, and the height of the fifth metacarpal.

Surgical Technique

Technique

All patients underwent excision of the base of the fifth metacarpal and fusion of the fourth and fifth metacarpals. Between the fourth and fifth metacarpal, a 5-cm longitudinal incision was made. Skin and subcutaneous tissue were dissected, and the extensor tendons were retracted to expose the fifth CMC joint. About 8 mm of the fifth metacarpal base was excised. The extensor carpi ulnaris (ECU) insertion was preserved partially. At a level just distal to the excision site of the fifth metacarpal, the fourth and fifth metacarpal bone surfaces adjacent to each other were prepared for fusion using an osteotome or a burr. The hamate and fourth metacarpal articulation was maintained. Meanwhile, the excised base of the fifth metacarpal was prepared for grafting between the fourth and fifth metacarpals. After the position and height of the fifth metacarpal were determined, two to three Kirschner wires (K-wires) or two screws were used to fix the fourth metacarpal, fifth metacarpal, and bone graft.

Ulnar gutter splint was applied to immobilize the hand and forearm. Sutures were removed at 2 weeks, and the splint was discarded at 6 weeks. After this point, rehabilitation was started. The patient was instructed to avoid contact sports for a period of 6 months.

Statistical Assessment

Descriptive statistics (standard deviation and mean) were calculated for all measured variables. We analyzed the data using paired *t*-tests to assess for statistical significance ($\alpha = 0.05$).

Results

No patients were lost to follow up. Union was obtained at an average of 6.2 weeks (range 5–7 weeks) after surgery. Grip strength significantly improved from 33.6 (SD 12.2) kg before surgery to 44.2 (SD 12.7) kg after surgery ($t = -4.566$,

$p = 0.006$). The flexion extension of the fifth MCP joint and the fifth metacarpal height remained unchanged. The ROM of the fifth MCP joint was 88.5° (SD 3.6°) before surgery and 87.8° (SD 2.6°) after surgery ($t = 1.195$, $p = 0.286$). The fifth metacarpal height was 53.7 (SD 4.0) mm before surgery and 52.3 (SD 3.6) mm after surgery ($t = 1.754$, $p = 0.140$). VAS results improved from 2.8 to 0.2 after the surgery. DASH scores improved from 20.7 to 1.9 (►Figs. 1–9, ►Table 1).

Discussion

The shallow, saddle-shaped articular surface of the hamate provides articulation for the base of the fifth metacarpal.⁹ The shape of the articular surface on the hamate provides minimal stability but allows an increased range of motion, which is required for power grip.¹⁰ The fourth and fifth CMC joint flexion-extension arcs are 15° – 20° and 25° – 30° , respectively.^{11,12} The second and third metacarpals, which act as the central cantilever, are firmly fixed to the carpals. Therefore the fourth and fifth CMC joints and the flexible first CMC joint can move in the form of a cone around the second and third metacarpals. This kind of movement facilitates the palm for better grip. In addition to joint range of motion, other important factors that affect the function of the fifth metacarpal include metacarpal height, angulation, and rotation. A prospective controlled study showed that if the metacarpal height decreased by 2 mm, the grip strength would decline by 8%.¹³ Angulation and malrotation of the metacarpal not only affects involved fingers but also may affect the neighboring finger, resulting in appearance impairment and dysfunction.¹⁴ Therefore, the objectives of surgical treatment for

Fig. 1 Case 1. A 31-year-old man, who had his right fifth metacarpal base fracture operated on 2 years ago, suffered from fifth CMC joint pain. The preoperative X-ray showed fifth CMC joint osteoarthritis changes.

Fig. 2 Case 1. X-ray 6 weeks after operation showing evidence of bony union.

traumatic fifth CMC joint should be to eliminate arthritis pain, maintain fifth metacarpal height, and retain fifth-CMC-joint activity as much as possible.

The surgical procedures that can be performed include fifth-CMC arthrodesis.¹⁵ However, this procedure can decrease the mobility of the transverse arch and can predispose to arthritis at the triquetrum-hamate joint.⁶ Arthroplasty with silicone elastomer and tendon arthroplasty can be performed, but these procedures have their disadvantages as well.^{4,6} In Dupert's fifth-CMC arthroplasty procedure, the fifth metacarpal base is excised and the fourth and fifth metacarpal shafts are fused. The main features of this procedure include: (1) after the removal of the fifth metacarpal

Fig. 3 Case 1. X-ray of 13 months after arthroplasty showed solid fusion and normal fifth metacarpal height.

base and intra-articular osteophytes, the main cause of local pain is eliminated; (2) the level of the fourth and fifth metacarpal fusion is at the proximal metacarpal shaft, which maintains the normal height of the fifth metacarpal and angle between the fourth and fifth metacarpals; (3) because the range of motion of the fourth CMC joint is $\sim 15^{\circ}$ – 20° ,^{11,12} therefore, the fourth and fifth metacarpal fusion may retain most of the flexion-extension of the fifth-CMC joint.

CMC pain is mainly due to exposed subchondral bone and friction with the hamate, along with impaction of osteophytes and synovitis. Resection of the fifth metacarpal base and CMC joint débridement eliminates the main cause of pain and improves the grip strength significantly. In this

Fig. 4 Case 1. 13 months after operation, the extension of the right fifth MCP joint was the same as the contralateral side.

Fig. 5 Case 1. 13 months after operation, the flexion of the right fifth MCP joint was the same as the contralateral side.

Fig. 6 Case 2. A 55-year-old woman, who had her right fifth metacarpal base fracture operated on 3 months ago, suffered from fifth CMC joint pain and swelling.

Fig. 7 Case 2. The preoperative X-ray showed destruction of the fifth CMC joint.

series of cases, VAS score significantly improved from 2.8 preoperative to 0.2 postoperative. Although the ROM of the fourth CMC is less than that of the fourth CMC joint,¹¹ the fifth CMC joint can still retain most of the flexion-extension arc after the fusion between the metacarpals. This preserved motion will contribute to preserve motion and grip strength. In addition, the proximal metacarpal fusion not

only retains the interval between the fourth and fifth metacarpals but also maintains the height and angle of the fifth metacarpal, which helps in preserving the appearance and function of the hand. Finally, union of the proximal parts of the fourth and fifth metacarpal with the removed fifth metacarpal base as a bone graft was obtained at an average of 6.2 weeks after surgery. Because of the

Fig. 8 Case 2. Posteroanterior (PA) view X-ray of 9 months after arthroplasty showed the maintenance of the fifth metacarpal height.

Fig. 9 Case 2. Lateral view X-ray of 9 months after arthroplasty.

Table 1 Clinical and radiological results before and after fifth CMC arthroplasty

Pt. No.	Preoperative					Postoperative				
	Jamar grip strength (kg)	ROM of 5th CMC joint (°)	5th metacarpal height (mm)	VAS score	DASH score	Jamar grip strength (kg)	ROM of 5th CMC joint (°)	5th metacarpal height (mm)	VAS score	DASH score
1	100	91	58	3	20	140	90	53	0	0.8
2	30	93	48	3	25	60	90	47	1	3.3
3	70	86	56	4	22.5	100	86	55	0	2.5
4	60	88	50	2	18.3	80	87	50	0	1.7
5	85	83	53	2	17.5	90	84	52	0	0.8
6	100	90	57	3	20.8	115	90	57	0	2.5
Mean	34	89	54	3	20.7	44	88	52	0.2	1.9

reliable bone healing and no damage at the donor site, this procedure was easily accepted by the patients.

In summary, fifth-CMC joint arthroplasty with fusion of the fourth and fifth metacarpals can alleviate and eliminate pain, maintain fifth-metacarpal height, and preserve motion of the fifth CMC joint. Therefore, this procedure is a reliable method for treating fifth-CMC-joint traumatic arthritis.

Conflict of Interest

None

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

IRB Approval

Institutional review board approval from University of Louisville was obtained for this study.

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