# Modified Step-Cut Osteotomy for Metacarpal and Phalangeal Rotational Deformity

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**Purpose** Rotational deformity of metacarpal and phalangeal fractures can jeopardize normal hand function and cause aesthetic problems for patients. We have found the Z-cut metacarpal osteotomy, initially described by Manktelow, to prove predictable and provide precise restoration of rotation and function. Therefore, we reviewed our experience with this technique.

**Methods** The senior authors identified 12 patients treated with rotational step-cut osteotomies for digital rotatory deformities. The cases were reviewed retrospectively. Seven had metacarpal and five had phalangeal malunions.

**Results** All 12 patients had correction of their deformities, obtained union of the osteotomy, and maintained or improved their motion. There were no perioperative complications.

**Conclusions** Metacarpal step-cut osteotomies are a technically simple and effective method for correction of digital rotational deformities resulting from fracture malunions. Unlike other types of osteotomies, this technique affords precise intraoperative control at the osteotomy site, a large surface area for bony healing, and rigid fixation with early digital motion. *(J Hand Surg 2009;34A:335–340. © 2009 Published by Elsevier Inc. on behalf of the American Society for Surgery of the Hand.)*

**Key words:** Metacarpal, osteotomy, rotational, step-cut.



ROTATIONAL DEFORMITY AFTER malunion of metacarpal and proximal phalangeal fractures may affect function of both the injured as well as adjacent digits.[1–3] Whereas some rotational deformities are minor and are acceptable to patients, others may result in functional and aesthetic problems that warrant surgical correction.[1,4,5]

Rotational osteotomies have been successful in a limited number of case series in the literature.[3,4,6–14] There is no consensus, however, regarding the ideal level of osteotomy, type of cut, and definitive fixation technique.

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We present a case series of metacarpal, step-cut osteotomies using lag screw fixation. The technique is a modification of Manktelow and Mahoney's description in 1981 of a procedure in which they used interosseous wires.[4] The procedure is extremely effective at restoring anatomy and function because it affords precise intraoperative control at the osteotomy site, a large osteotomy surface area that allows predictable healing, and rigid fixation that permits early digital range of motion.

## PATIENTS AND METHODS

The study was composed of 15 patients treated at both the Massachusetts General Hospital and the Chirurgia della Mano e Microchirurgia in Florence, Italy, between 2000 and 2007. Patients' medical records were reviewed and patients were asked to return for a follow-up evaluation if they had incomplete information. Complete follow-up data were available for 12 of 15 patients and form the basis of this report. The average

 

duration of follow-up was 25 months (range, 4–68 months).

All 12 patients were treated for scissoring deformities that caused functional or cosmetic problems. The degree of deformity before and after surgical correction was measured by one of the authors (A.J., G.L., or J.B.J.). Four patients were female and 8 were male, with a mean age of 32 years (range, 14–55 years).

Seven original fractures involved the metacarpal, including 4 at the base, 2 at the diaphysis, and 1 at the head. Three were at the index ray, 2 at the small ray, and 2 at the ring ray. Five original fractures involved the proximal phalanx, including 4 diaphyseal and 1 base fracture. Two included the small finger, 2 the ring finger, and 1 the middle finger. Importantly, 1 fracture was a Salter-Harris 2 fracture through the base of the proximal phalanx of the ring, and 1 fracture was part of a replanted digit. The right and left hands were equally involved and all patients were right-handed. Seven of the 12 patients had their initial fractures managed surgically and 7 patients had limited range of motion before the procedure (Table 1).

**TABLE 1. Osteotomy Cases**

| Gender | Age | Side (Dominance) | Digit | Fracture Type | Postoperative Deformity | Preoperative TAM | Postoperative TAM | Follow-Up (mo) | Prior Treatment | Subsequent Procedure |
|---|---|---|---|---|---|---|---|---|---|---|
| F | 34 | R (R) | Index | MC shaft | 0 | 220 | 270 | 7 | Plating | |
| F | 20 | R (R) | Small | MC head | 0 | 30 | 215 | 24 | Tenolysis/capsulotomy | Flexor tenolysis |
| M | 14 | L (R) | Ring | P1 base | 0 | 270 | 270 | 26 | Pinning | |
| F | 37 | L (R) | Small | MC base | 0 | 240 | 270 | 4 | Pinning | |
| F | 42 | L (R) | Index | MC base | 0 | 270 | 270 | 11 | Plating | |
| F | 32 | L (R) | Small | P1 shaft | 0 | 170 | 250 | 7 | Cast | |
| M | 26 | L (R) | Ring | MC shaft | 0 | 220 | 270 | 13 | Cast | |
| F | 25 | R (R) | Index | MC base | 0 | 150 | 200 | 66 | Pinning | |
| M | 34 | L (R) | Ring | MC base | 0 | 270 | 270 | 50 | Cast | |
| M | 29 | R (R) | Middle | P1 shaft/replant | 5 | 270 | 270 | 10 | Pinning | |
| M | 41 | R (R) | Ring | P1 shaft | 0 | 270 | 270 | 8 | Cast | |
| M | 55 | R (R) | Small | P1 shaft | 0 | 190 | 190 | 68 | Pinning | |

MC, metacarpal; TAM, total active motion.

## Surgical technique

The metacarpal step-cut osteotomy is ideal because it affords precise correction, control of the bony fragments, a large surface area for healing, and minimal fixation with lag screws. Other methods of performing a metacarpal osteotomy use a simple transverse cut that does not allow for complete control of the fragments during correction and fixation, has a small healing surface area, and requires plating, which may yield greater scar formation and postoperative stiffness. Using a step-cut allows the metacarpal to be cut by 2 hemi-transverse cuts spaced 2–3 cm apart. The deformity is corrected through resection of a dorsal wedge of bone that connects these hemi-transverse cuts (Fig. 1, 2).

Before the surgical procedure, the amount of rotational deformity is measured. The deformity is largest at the midpoint of finger flexion and decreases as the finger moves into a fully flexed position. At the maximal point of deformity, the degree of rotation is estimated compared with the normal position of the finger. This measurement is used to determine the amount of dorsal bone resection needed for correction, with the guideline that 2 mm of resection achieves a 20° or 2-cm correction at the fingertip (Figs. 1 and 2).[4]

In their original description, Manktelow and Mahoney[4] suggested the direction of the transverse step-cuts be marked on the skin before incision.