

## 24 Correction of Malunion in Metacarpal and Phalangeal Fractures

Hermann Krimmer

### Abstract

We regard the technique for correction of rotational malalignment by using a special rotational plate as safe and reliable. It facilitates difficult surgery significantly. Precise surgery with premounting the plate, correct position of the osteotomy, and early rehabilitation are key points for good clinical outcome.

**Keywords:** malunion, metacarpal fractures, phalangeal fractures, correction osteotomy, rotational plate

### 24.1 Trauma Mechanism

Symptomatic malunited fractures of the metacarpals or phalanges can significantly affect hand function. Isolated fractures of metacarpals and phalanges are the commonest injuries of the upper extremity, which constitute about 10% of skeletal fractures in general and 40% of all upper extremity fractures. The failures include nonunion and malunion, which disturb hand function or are cosmetically unacceptable. Frequently, these failures are followed by reduction of finger movement, degenerative changes in neighbored joints, and algodystrophy. The management of nonunion and malunion in the metacarpals and phalanges is influenced by the multiple gliding structures and the propensity for stiffness making this kind of surgery challenging.<sup>1</sup>

Complications associated with these fractures are also prevalent, and can arise with both conservative and surgical treatment of hand fractures, making treatment of complications an essential part of caring for these injuries. Failed conservative treatment might be caused by just looking on the radiograph missing the clinical situation mostly in case of rotational malalignment. Complications of surgery are usually determined by fixing the fracture in a wrong position or with insufficient stability leading to secondary malalignment.<sup>2</sup>

### 24.2 Classification

Rotational and axial deformity are indications for correction osteotomy. Correction osteotomy should be performed in case of severe deformity leading to significant restriction of function. If only slight deformity is present, it depends on patients' complaints and profile.

### 24.3 Clinical Signs and Tests

Whereas axial deformity is obvious, rotational deformity needs precise clinical testing by examination of finger movement from extension to full flexion. Already 10 degrees of malrotation at the metacarpal site lead to 2-cm dislocation at the fingertip (► Fig. 24.1).



Fig. 24.1 Rotational malalignment at the ground phalanx of the middle finger.

### 24.4 Evidence

Correction of rotatory malunion of the proximal phalanx might be done either at the site of the malunion or the base of the metacarpal. An osteotomy at the site of the malunion offers the best condition for full correction of the deformity but involves an increased risk for tendon adhesions leading to contractures of the proximal interphalangeal (PIP) joint and even the metacarpophalangeal (MCP) joint.<sup>3</sup> Osteotomy at the metacarpal side provides less risk for tendon adhesions but can lead to imbalance of the intrinsic muscles and if additionally, axial deformity is present to some kind of Z-deformity. Nowadays with the low-profile implants, we absolutely recommend performing the osteotomy at the site of the malunion as full correction of the deformity only can be achieved by that.

## 24.5 Authors Favored Treatment Options

### 24.5.1 Time for Surgery

Early recreation of the fracture or osteotomy is more likely to be rewarded with favorable results than late operation. However, if severe swelling and restriction of motion at the MCP and PIP joint are present, one should initially go for physiotherapy to improve soft tissue conditions and wait for surgery. In case of additional nonunion, early surgery of course is necessary.

### 24.5.2 Technique

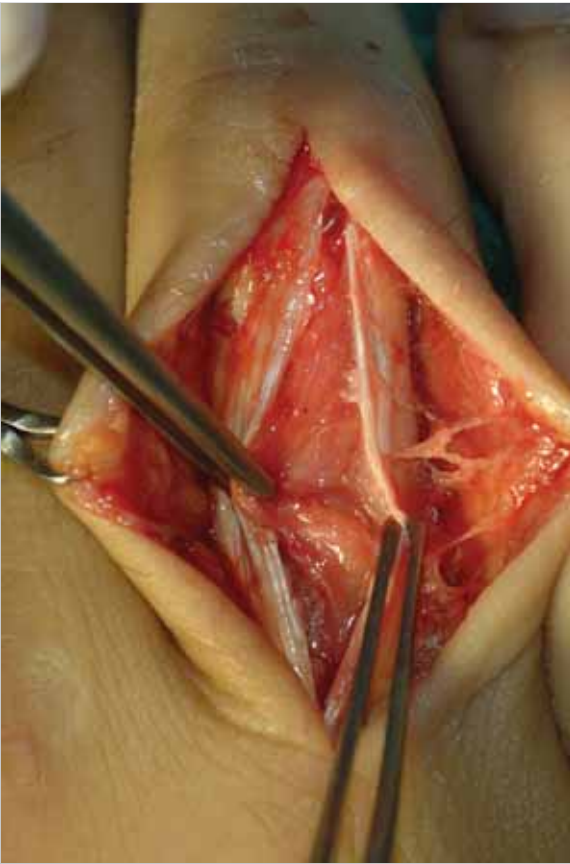
For correction of malrotation, two important points are essential: first, premounting the plate before osteotomy and second, precise control of the amount of correction and the functioning result. A special rotational plate with an oblong hole in the distal part which allows a controlled correction after the osteotomy facilitates correction of malrotation (► Fig. 24.2).



**Fig. 24.2** Rotational plate with offset holes to prevent bone splitting and screw collision. Mark for the osteotomy, 1.5-mm plate thickness 0.8 mm for phalangeal correction, and 2 mm with plate thickness 1.3 mm, 1.5 and 2.0 Trilock screws polyaxial with 15 degrees of freedom. (Agreement by Medartis Basel, Switzerland)

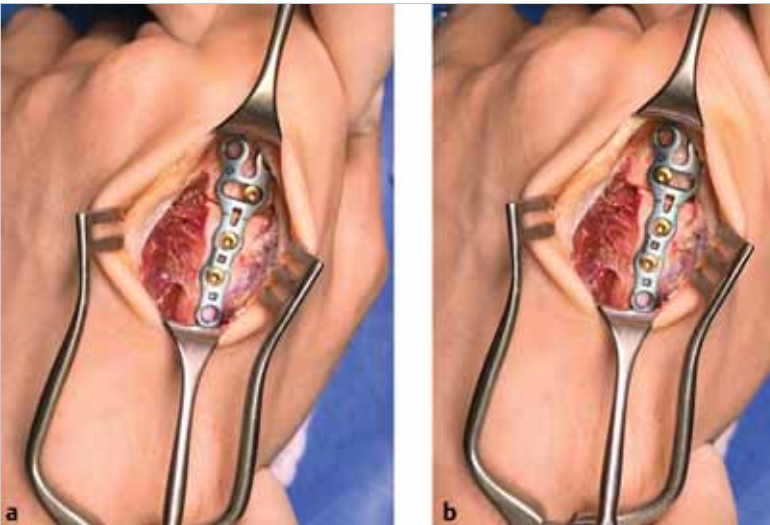
We prefer a dorsal approach splitting the extensor tendon in case of phalangeal correction with harvesting a periosteal flap from ulnar or radial for later covering, at least partially, the implant (► Fig. 24.3). In case of metacarpal correction, the extensor tendons are mobilized to one site.

## Correction of Malunion in Metacarpal and Phalangeal Fractures



**Fig. 24.3** Dorsal approach to the ground phalanx with tendon split and harvest of a periosteal flap.

Usually, a complete transverse osteotomy is performed. First, the plate is fixed with two screws in the proximal part and one screw in the oblong hole in a radial position if correction to the radial site is necessary or ulnar vice versa. The plate has a mark where the osteotomy has to be done after removing the plate. When the osteotomy is completed, the plate is fixed again and by the screw in the oblong hole, the correction is guided till the correct position is reached (► Fig. 24.4a, b).



**Fig. 24.4** Intraoperative view of rotational plate at the metacarpal (a) before and (b) after correction.

For precise check of the rotation bending, the neighbor fingers in the palm is helpful (► Fig. 24.5a, b). After tightening the screw, the other screws are inserted leading to three screws on each site (► Fig. 24.6). The plate offers locking screws as well which are preferable in poor bone

quality. For correction at the metacarpals, usually 2-mm screws are used and for phalangeal correction 1–5 mm screws are used. It is essential to precisely check the screw length on a true lateral view to avoid flexor tendon laceration.

## Correction of Malunion in Metacarpal and Phalangeal Fractures

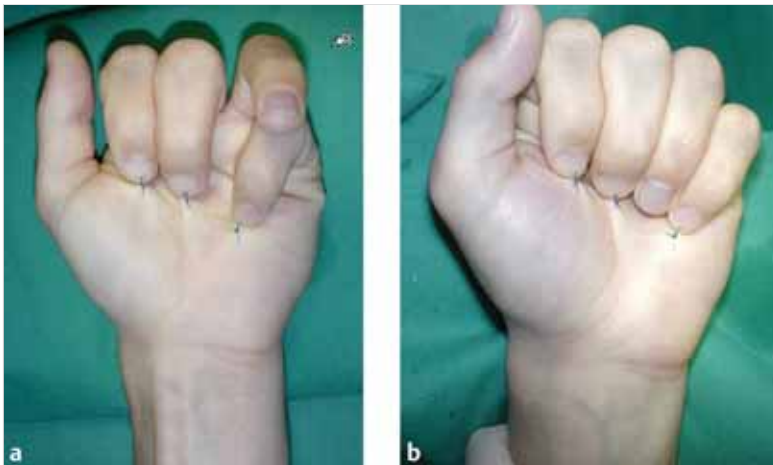


Fig. 24.5 (a) Neighbor fingers fixed to the palm. (b) Check for accuracy after correction.



Fig. 24.6 Postoperative radiograph following correction osteotomy at the metacarpal.

In case of axial deformity at the ground phalanx, it is even more important to perform the osteotomy at the site of the malunion to avoid Z-deformity. It might be done through a dorsal as well as a lateral approach using an opening wedge osteotomy by fixation with a small plate (► Fig. 24.7).



Fig. 24.7 (a, b) Correction of axial deformity at the ground phalanx by open wedge osteotomy and fixation with 1.5-mm grid plate.

Postoperative protocol should start with immediate mobilization protecting the hand for 2 weeks in an intrinsic-position in case of phalangeal correction, whereas an ulnar-sided splint leaving finger motion free is sufficient in case of metacarpal correction.

## 24.6 Clinical Results

Using this technique with the rotational plate, all osteotomies out of seven united in a correct position and all patients were satisfied with the result. This confirms the data of the literature where the authors found a high satisfaction rate following correction of malunions at the hand.<sup>4</sup> If restriction of motion is present, hardware removal with tenolysis or even arthrolysis is necessary, however, prerequisites are solid bony union and at least a time interval of 6 months to the previous surgery.

## 24.7 Tips and Tricks

In case of combination of axial and rotational deformity, a dome (curved) osteotomy might be an alternative allowing correction in all planes. Anyway, whatever kind of technique is used, premounting the plate distal of the osteotomy should be performed.

## 24.8 References

- [1] Freeland AE, Lindley SG. Malunions of the finger metacarpals and phalanges. *Hand Clin.* 2006; 22(3):341–355
- [2] Balam AK, Bednar MS. Complications after the fractures of metacarpal and phalanges. *Hand Clin.* 2010; 26(2):169–177
- [3] Büchler U, Gupta A, Ruf S. Corrective osteotomy for post-traumatic malunion of the phalanges in the hand. *J Hand Surg [Br].* 1996; 21(1): 33–42
- [4] Karthik K, Tahmassebi R, Khakha RS, Compson J. Corrective osteotomy for malunited metacarpal fractures: long-term results of a novel technique. *J Hand Surg Eur Vol.* 2015; 40(8):840–845

## Comments

- 1 AU: Please reword for clarity, if required. Should this be 'ulnar site'?

## Comments

---