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TECHNICAL NOTE

Minimally invasive correction of phalangeal malunion under local anaesthesia

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Posttraumatic malunion of the proximal phalanx of the fingers may cause visible deformities and impair hand function. Severe dysfunction requires surgical correction, most often via open corrective osteotomies. However, such an approach requires longer bone healing time, inevitably results in a scar, and has a higher potential for extensor tendon adhesion. When performed under general anaesthesia it is also difficult to assess dynamic finger position such as rotational malunion. Thus, the authors have devised and applied a technique of minimal invasive corrective osteotomy under local anaesthesia, permitting active flexion and extension, which leads to more accurate reduction, and earlier recovery.

Keywords : malunion ; phalanges ; finger ; osteotomy : corrective.

INTRODUCTION

Posttraumatic malunion of the proximal phalanx of the fingers may cause cosmetic deformities and functional deficits. These include scissoring or crossing of the fingers, disturbance in tendon balance, and reduction of grip strength (*5,6*). Functional disability must be surgically corrected, the standard method being open corrective osteotomy. Studies on open corrective osteotomy are quite rare and most of the time limited to a small number of cases with a short follow-up (*2,9*). Buchler *et al* and Trumble *et al* have reported reliable correction of deformity, function and successful healing (*3,7*). Yong *et al* reported a trapezoid rotational bone graft osteotomy technique which restored bone length in posttraumatic metacarpal and phalangeal fracture malunion (*10*).

However, open approaches to the phalangeal malunion site inevitably leave a scar and increase risk of extensor tendon adhesions (*3*). Wedge osteotomies carry a risk of inadvertent intraoperative injury to the extensor tendon, and require more time for bone healing (*3,7*). Any procedures performed under general anaesthesia disable active flexion and extension, precluding evaluation of dynamic finger position.

Thus, we devised a technique of minimally invasive correction of phalangeal malunion, performed

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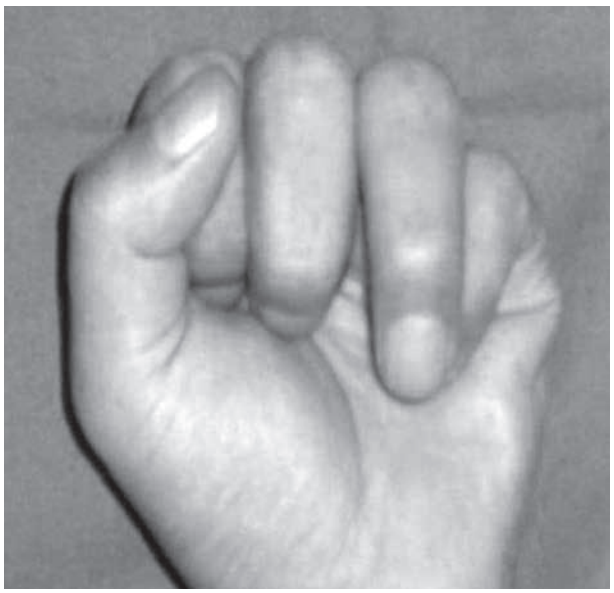

Fig. 1. — Photograph of the patient's left hand making a fist, 6 months after closed reduction and Kirschner wire fixation of a fracture of the 4th proximal phalanx. Scissoring of the 4th finger over the 5th finger is caused by rotation of the fracture segment.

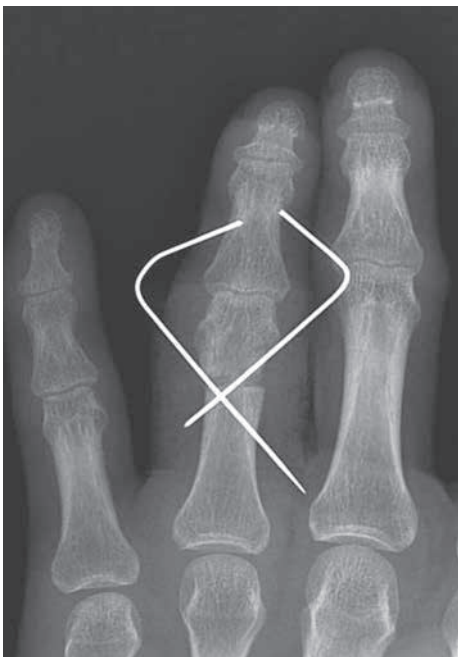

Fig. 2. — Immediate postoperative radiograph, showing the osteotomy line and oblique insertion of Kirschner wires.

under local anaesthesia enabling intraoperative assessment of finger position and function.

Illustrative case

A 41-year-old male presented with posttraumatic phalangeal malunion. He had received closed reduction and Kirschner wire fixation for the fracture of his left fourth proximal phalangeal bone 6 months previously. Upon physical examination, ulnar rotation and scissoring of the fourth finger was seen on grasping (Fig. 1). Radiographs revealed malunion of the left fourth proximal phalangeal bone. It was decided to perform minimally invasive correction with the patient in a conscious state.

Operative technique

The affected hand and arm was prepared, and digital nerve block was performed on the affected finger. The operator located the exact previous fracture and thus malunion site with fluoroscopy assistance, and marked the location of both lateral ends of the original fracture line. A 2 mm stab incision was done at these lateral ends using a No. 11 scalpel. An osteotomy was then performed as follows. First, a 1.5 mm Kirschner wire was drilled horizontally from one side of the previous fracture site to the other side, creating a tunnel in the malunited bone. A 1.7 mm Kirschner guide wire, followed by a 1.9 mm Kirschner guide wire was drilled into the same site, sequentially widening the tunnel. Then, a 2 mm osteotome was inserted into the stab incision and the osteotomy was performed. Repeated K-wiring fragilised the malunion site, so that the osteotomy was easily completed.

The normal anatomical grasping position was adjusted while the alert patient repeated active finger flexion and extension, and two 1.1 mm Kirschner wires were inserted, transfixing the osteotomy site in opposite oblique directions (Fig. 2).

The Kirschner wires were removed four weeks after insertion. Follow-up radiographs taken three months after correction showed union of the osteotomy (Fig. 3), and long term follow-up at 2 years showed a well corrected rotational deformity, no functional deficits and barely discernible stab incision scars (Fig. 4).

***Fig. 3.* —** Follow up radiographs 3 months after correction

Fig. 4. — Photograph of the left hand with fingers in flexion, 2 years after correction.

DISCUSSION

The proximal phalanx of the fingers is fractured more frequently than the distal or middle phalanges. Open or closed reduction of the fractured site may result in malunion (*1*). Malunion is the term used to define fractures that have healed with deformity (*4*). While Buchler *et al* found nonsurgical treatment to be the most frequent cause of malunion, usually through incomplete initial reduction or secondary displacement, Bannasch *et al* noted that there was no significant difference in the incidence of malunion following closed or open reduction (*1,3*). Posttraumatic malunion of the proximal phalanx of the fingers may cause cosmetic deformities and accompanying functional deficits. These include scissoring or crossing of the fingers, disturbance in tendon balance, and reduction of grip strength (*5,6*). In a cadaver study, Vahey *et al* noted an extensor lag at the proximal interphalangeal joint when shortening and angulation of the proximal phalanx was present (*8*). When functional disability is severe, surgical correction is mandatory in order to reestablish a correct bone and tendon relationship (*6*).

The standard method of treatment has been open correction with osteotomies. Early studies on open corrective osteotomy are quite rare and most of the time limited to a small number of cases with a short follow-up (*2,9*). A historical cohort study was reported by Buchler *et al*, who reviewed 90 corrective phalangeal osteotomies performed over twenty years, for posttraumatic malunion (*6*). The authors found the best method to correct lateral angulation, flexion, or extension deformities to be an incomplete opening-wedge osteotomy (*3*).

The direction and method of osteotomy has evolved over the years. A closing wedge osteotomy or opening wedge osteotomy at the fracture site was usually used for correction. Some have advocated correction at the base of the metacarpal of the affected finger. A proximal osteotomy of the affected finger's metacarpal may provide correction of rotation without potential adhesions, but this method may elicit a "Z" deformity when angulation accompanies the malrotation (*7*).

Yong *et al* found that most wedge osteotomies affected bone length, and reported a trapezoid rotational bone graft osteotomy technique that restored bone length in posttraumatic metacarpal and phalangeal fracture malunion (*10*).

The authors agree that a corrective open osteotomy should be performed at the site of the fracture ; however, the site of the original fracture has the greatest potential for producing additional adhesions

of the flexor and extensor tendons that surround the proximal phalanx. The minimally invasive method introduced here uses short stab incisions, Kirschner wires and a 2 mm osteotome, therefore avoiding the dissection of surrounding tendons and avoiding additional adhesions. The osteotomy requires lighter tapping, and is more likely to follow the intended vector designed by the operator, because of the pre-tunneling process using Kirschner wires. As the patient is awake and conscious, active flexion and extension can be performed until the most accurate alignment is found.

The minimally invasive correction procedure proposed here is simple, reproducible, and is an accessible solution for malunions of the proximal phalanx.

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