Two extension block Kirschner wire technique for mallet finger fractures

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We treated 32 displaced mallet finger fractures by a two extension block Kirschner-wire technique. The clinical and radiological outcomes were evaluated at a mean follow-up of 49 months (25 to 84). The mean joint surface involvement was 38.4% (33% to 50%) and 18 patients (56%) had accompanying joint subluxation.

All 32 fractures united with a mean time to union of 6.2 weeks (5.1 to 8.2). Congruent joint surfaces and anatomical reduction were seen in all cases. The mean flexion of the distal interphalangeal joints was 83.1° (75° to 90°) and the mean extension loss was 0.9° (0° to 7°). No digit had a prominent dorsal bump or a recurrent mallet deformity.

We believe that this technique, when properly applied, produces satisfactory results both clinically and radiologically.

Mallet deformity of the finger involves avulsion of the extensor tendon from the base of the distal phalanx, with or without a bony fragment. Wehbe and Schneider¹ recommended non-operative treatment for most mallet fractures and concluded that reduction is not crucial because of bone remodelling. However, others consider that restoration of the joint surface by accurate reduction is important, in order to prevent secondary osteoarthritis, loss of movement, and a poor cosmetic outcome. They advocate operative treatment, especially where the fracture involves more than 30% of the articular surface² or there is volar subluxation.³⁻⁵ Although open repair has been proposed, it is technically demanding and liable to complications, which include skin breakdown, infection, loss of reduction, joint stiffness, nail growth deformity, soft-tissue scar formation and avascular necrosis.⁵ Several authors have described percutaneous procedures that permit indirect anatomical reduction of fractures to avoid the disadvantages of the open method.⁶⁻⁹ Extension block pinning, which consists of a dorsal extension block Kirschner (K)-wire and a second volar wire to hold the distal interphalangeal joint in extension, was described in 1988 by Ishiguro et al.⁶ This simple and reliable method has been modified by several authors¹⁰⁻¹² to improve the accuracy of reduction and stability of fixation. We consider that more accurate reduction and stable fixation is achieved when two small extension block K-wires are used, thereby producing a more favourable outcome.

The aim of this study was to describe our refinement of Ishiguro's technique using two small extension block K-wires and to present the outcome in 32 patients.

Patients and Methods

We reviewed 32 consecutive patients with a mallet fracture of a distal phalanx treated by our modified technique between May 2001 and May 2006. There were 22 males and ten females with a mean age of 28.1 years (17 to 47). The indication for operation was a displaced mallet finger fracture involving more than one-third of the articular surface, with or without volar subluxation of the distal phalanx (Figs 1a and 2a). Comminuted or open fractures were excluded. The mean joint surface involvement was 38.4% (33% to 50%), and 18 patients (56%) had associated subluxation. The mean time from injury to operation was 22 days (1 to 22). The mean follow-up was 49 months (25 to 84).

The procedure was generally performed under digital block anaesthesia with image intensifier control. With the distal and proximal interphalangeal joints held in maximum flexion, a 0.9 mm K-wire is introduced just behind the fragment and driven proximally into the head of the middle phalanx at an angle of 30° to its long axis. A second K-wire is inserted 2 mm to 3 mm apart from and parallel to the first. Closed reduction is achieved by extension of the distal phalanx along with dorsal translation when there is volar subluxation

Fig. 1a

Fig. 1b

Fig. 1c

A 27-year-old man with a mallet fracture of the ring finger. a) The pre-operative radiograph showed a fracture involving more than one-third of the base of the distal phalanx, with volar subluxation at the distal interphalangeal joint. b) Anatomical reduction with an aluminium splint to protect the wires and block the movement of the distal interphalangeal joint. c) Anteroposterior view.

of the distal phalanx. A third 0.9 mm K-wire is inserted from the volar side across the distal interphalangeal (DIP) joint to maintain extension and reduction. The wires are cut short and a volar aluminium splint is applied to protect them and prevent movement of the DIP joint (Figs 1 and 2b and c). Regular dressings and pin care hygiene is encouraged. The wires are removed in outpatients six weeks post-operatively, when bridging trabeculae were seen in radiographs, and the fracture sites were non-tender. After removal of the wires, active exercises of the DIP joint were started. No protective splint was subsequently used.

Radiographs were taken immediately after fixation and at two weeks, six weeks, two months, then every six months after union. The range of active movement was measured with a goniometer at each visit and any complications were documented. Crawford's rating system¹³ was applied to assess outcome (Table I), which was graded as excellent, good, fair or poor.

Results

All fractures united at a mean time of 6.2 weeks (5.1 to 8.2). Congruent and satisfactory joint surfaces (anatomical or intra-articular step-off of < 1 mm) were present in all patients, and no arthritic changes were observed at final follow-up (Fig. 2d). The mean active flexion of the DIP was 83.1° (75° to 90°) and the mean loss of voluntary extension was 0.9° (0° to 7°) at final follow-up. Nail ridging occurred

in three cases but disappeared at a mean eight months (6 to 10) with normal growth. A mild superficial infection at a pin entry site occurred in two cases and settled with regular dressings only. There were also two cases of transient nail deformity. No skin breakdown occurred, but there was mild scarring at a dorsal pin site in one case. No finger had a prominent dorsal bump or recurrent mallet deformity (Figs 2e and 2f). All patients were satisfied with function and cosmesis. According to Crawford's classification (Table I), the outcome was excellent in 22 (68.8%), good in eight (25.0%), and fair in two (6.2%) patients. The K-wires were removed at a mean of 44 days (36 to 58) post-operatively.

Discussion

Ishiguro's method is easier than open surgery and indirect manipulation reduces the possibility of the fragment becoming comminuted. However, when the dorsal fragment is large, markedly displaced or rotated, it is not easily controlled indirectly with a single K-wire.

We have routinely used two parallel extension block pins 2 mm to 3 mm apart to achieve better control of the dorsal fragment. The technique of insertion of the wires is similar to that of the original Ishiguro method, but the wires are smaller and are inserted at a lower angle (30° to the axis of the middle phalanx). Anatomical reduction is obtained more easily with two extension block wires because they create a wall that prevents rotation of even a large fragment when a

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

Fig. 2e

Fig. 2f

A 65-year-old woman with a) a fracture fragment involving 50% of the articular surface, b) anatomical reduction was achieved and a volar splint applied, c) Anteroposterior view, d) the final follow-up radiographs showed a healed fracture with a congruous joint surface. No arthritis changes were observed and there was full active flexion and extension of the distal interphalangeal joint of the fourth finger was regained. Photographs showing e) lateral view in full extension and f) in full flexion.

Table 1. Outcome assessment: Crawford's evaluation criteria¹³

Excellent	Full extension, full flexion, no pain, loss of extension between 0° and 10°
Good	Full flexion, no pain, loss of extension between 10° and 25°
Fair	Any loss of flexion, no pain, loss of extension > 25°
Poor	Any loss of flexion, persistent pain

reduction force is applied. The parallel and lower angled wires make contact with a wide area of the fragment, which is strongly compressed when the distal phalanx is extended, thereby achieving and maintaining a better reduction. Also, the use of smaller wires is less traumatic and reduces pin-related complications. Anatomical reduction with a comparable range of movement was achieved in all cases. The

complications were largely related to difficulties with reduction and fixation. Transient nail ridging occurred after vigorous manipulation or repetitive reduction manoeuvres in patients with volar subluxation of the DIP joint, marked displacement of a fracture fragment or an old fracture (more than three weeks after injury). Dorsal scarring occurred after repeated insertion of the dorsal pin due to a technical error. Therefore, a meticulous reduction technique is as important as careful pinning, especially in patients with an old fracture, marked displacement or palmar subluxation.

In conclusion, we have found that two-extension block K-wires, when correctly applied, produces good radiological and clinical outcomes by achieving anatomical reduction and stable fixation with relatively few complications.

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