



## Modified Extension Block Technique for Bony Mallet Injury of the Hallux

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### ABSTRACT

Bony mallet injury of the hallux is uncommon. In the few reports of this injury, authors have described surgical treatments such as closed reduction with percutaneous pinning and open surgical fixation with Kirschner wires or a suture anchor. However, the appropriate surgical management for this injury remains controversial. In this article, we describe a case of bony mallet injury of the hallux repaired with the modified extension block technique using 3 Kirschner wires. This method is an effective and simple treatment to allow anatomic reduction of the displaced articular fracture fragment without incision, residual hardware, or the complications associated with open surgical treatment.

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Bony extensor avulsion fracture of the base of the distal phalanx (bony mallet injury) of the hallux is uncommon. In 2001, Hennessy and Saxby (1) termed this injury “mallet toe” because it occurs by the same mechanism as mallet finger. Few reports have described surgical treatment of this injury (2–5). Prior studies have reported closed reduction using Kirschner wire fixation or extension block techniques (2,3). Others have reported open surgical fixation with Kirschner wires and a suture anchor (4,5). However, the appropriate surgical management for this injury remains controversial. In this article, we report a case of bony avulsion fracture of the base on the distal phalanx of the hallux repaired with a modified extension block technique.

### Case Report

A 42-year-old male presented with pain and swelling in his right hallux. He was injured after his toe was caught on a Kendo uniform (hakama) during practice, forcing his hallux into a hyperplantarflexion position. On physical examination, there was swelling of the distal phalanx, with some bruising and tenderness on palpation of the dorsal aspect of the hallux. The patient’s hallux was in a flexed position and he was unable to actively extend the interphalangeal (IP) joint.

A radiographic image of the right foot revealed a bony avulsion at the base of the distal phalanx of the hallux (Fig. 1). Plain sagittal

reconstruction computed tomography (CT) showed that the avulsed fragment included approximately 50% of the joint surface and was displaced dorsally, within 30° of the apex. Three-dimensional CT clearly showed the shape of the large bony fragment (Fig. 2). Because of the displacement of the large articular fragment, surgical reduction and fixation was performed. Owing to the fact that this injury occurred by the same mechanism that causes mallet finger, we used the modified extension block technique for the treatment of large mallet finger fractures (6).

Outpatient surgery was performed under peripheral digital nerve block anesthesia with an image intensifier a week after the injury. First, the IP joint was maximally flexed, and a 1.6-mm Kirschner wire was inserted into the distal portion of the proximal phalanx just proximal to the fragment through the extensor tendon. The wire provides an extension block for the bony fragment when the IP joint is extended. The fragment was reduced by pushing up the plantar aspect of the distal phalanx and extending the IP joint. After the fracture was reduced, a second 1.1-mm Kirschner wire was placed through the fragment perpendicular to the fracture line from the dorsal to the plantar aspect. The wire is useful for secure fixation of the bone fragment and allows movement of the IP joint. Next, the IP joint was kept in the neutral position and a 1.6-mm Kirschner wire was inserted obliquely from the distal phalanx into the proximal phalanx to fix the IP joint and maintain the reduction. Intraoperative radiographs showed that the fragment was reduced correctly, with good congruity of the joint surfaces (Fig. 3). A plantar splint was applied for protection of the hallux and heel weight-bearing was permitted. Six weeks after surgery, CT was performed to evaluate healing of the fracture and the Kirschner wires were removed (Fig. 4). After removal of the Kirschner wires, active and passive range of motion exercise was permitted. At the 6-month follow-up visit,

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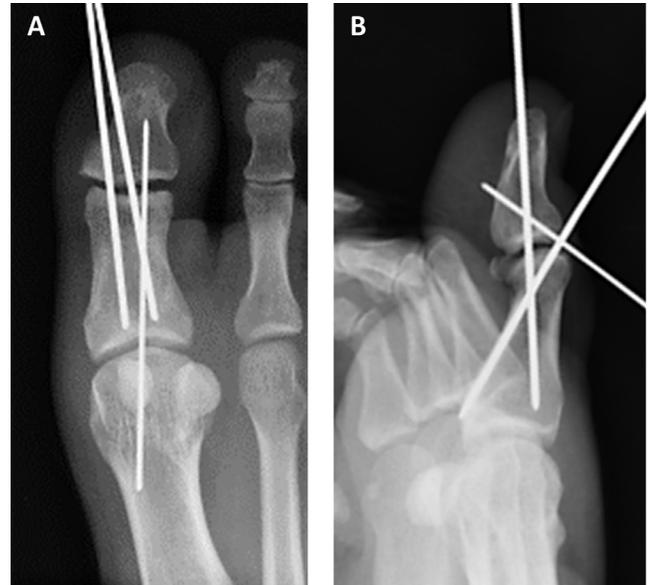


**Fig. 1.** Anteroposterior (A) and oblique (B) radiographs of the right foot showing a bony avulsion fracture at the base of the distal phalanx of the hallux.

radiography showed complete fracture healing (Fig. 5). The patient demonstrated no extensor lag, and the active motion of the IP joint was 0° in extension and 45° in flexion. He returned to Kendo practice without symptoms. One year after the surgery, the patient remained asymptomatic without complications.

**Discussion**

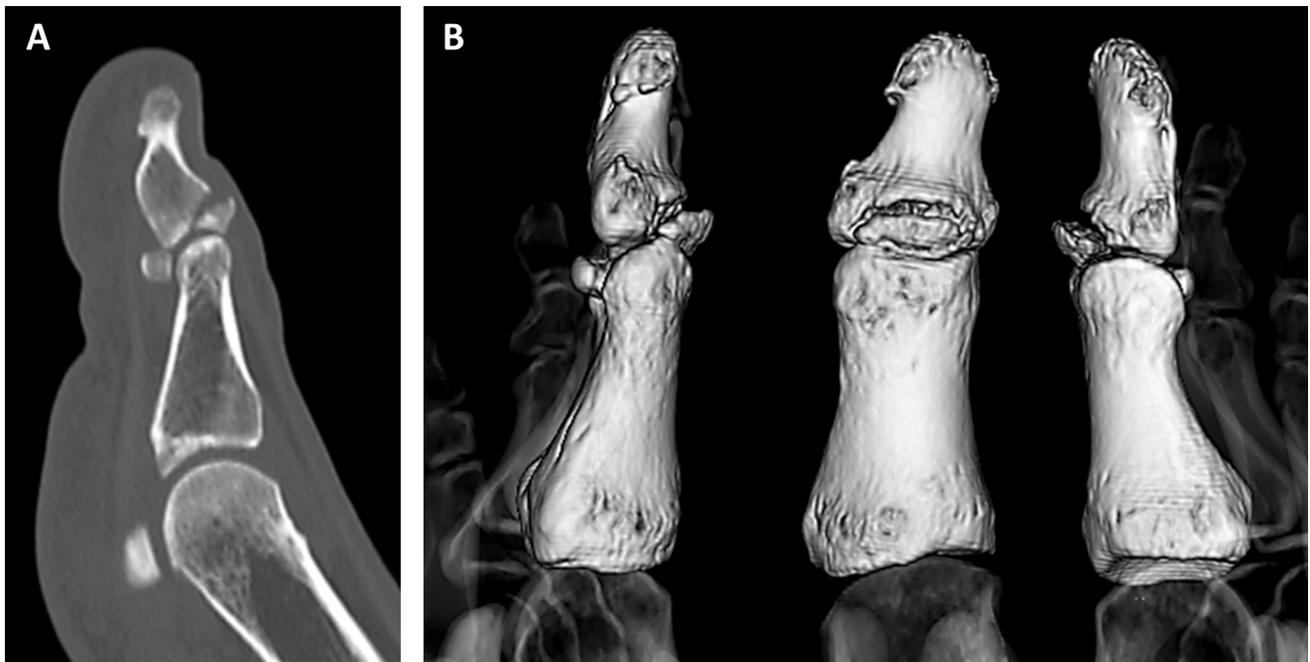
Bony avulsion fracture of the base of the distal phalanx of the hallux is a rare injury. This injury has been termed “mallet toe” by Hennessy and Saxby (1), because it is caused by the same mechanism as mallet finger. In our literature review, we identified reports describing this injury occurring as a result of hyperplantarflexion (1–8). Hennessy and



**Fig. 3.** Intraoperative anteroposterior (A) and lateral (B) radiographs showing anatomic reduction and Kirschner wire fixation. The smaller Kirschner wire was placed through the fragment perpendicular to the fracture line.

Saxby (1) and Rapoff and Heiner (7) each reported a case treated conservatively with a splint. In the first case, a satisfactory clinical outcome was achieved; however, the fracture fragments were not accurately reduced and the patient experienced a slight extensor lag of the IP joint. They described the nonsurgical treatment was successful.

Several authors described satisfactory results after surgical treatment (2–5). Closed reduction and percutaneous pinning procedures were described by 2 authors (2,3). Nakamura (2) performed a closed reduction and temporary fixation of the IP joint using a Kirschner wire. Wada and Yui (3) treated a patient with the extension block method with 2 Kirschner wires, a procedure described by Ishiguro et al (8) for



**Fig. 2.** (A) Sagittal reconstruction computed tomography image showing the avulsed fragment, involving ~50% of the joint surface and displaced dorsally with 30° of apex. (B) Three-dimensional computed tomography image showing the shape of the large bony fragment.



**Fig. 4.** Sagittal reconstruction computed tomography image 6 weeks after surgery showing a healed fracture with a congruous joint surface.



**Fig. 5.** Lateral radiograph at the final follow-up visit showing bone union. No arthritis changes were observed and there was no extensor lag of the interphalangeal joint.

the treatment of mallet finger. Martin et al (4) performed open reduction and fixation with Kirschner wires, because the reduction of the fragment and articular surface was inadequate with the closed technique. Hong and Tan (5) reported 2 cases of open surgical fixation with a suture anchor without transarticular immobilization of the IP joint. They recommended this technique because there is less damage of the IP joint and the possibility of early postoperative mobilization of the IP (5). In our patient, because the avulsed bony fragment was large, we chose closed reduction with the modified extension block technique.

In 1988, Ishiguro et al originally described this operation for closed reduction of mallet finger fractures using an extension block Kirschner wire technique (8). In the original technique, the surgeon passively flexes the distal IP and proximal IP joints to ensure the displaced fracture fragment moves distally and volarly because of periosteal continuity. The blocking wire assists in reducing and maintaining reduction. This technique is a simple and reliable procedure that permits indirect anatomic reduction of the fractured fragment and does not require a surgical incision. However, in some cases with large fragments involving > 50% of the joint surface, the proximal bone fragments are not adequately reduced, because the large fragment is rotated dorsally by the extension block wire. A modification of the extension block technique was described by Hofmeister et al (6). They placed an additional Kirschner wire through the bony fragment perpendicular to the fracture line from the dorsal to the volar aspect. This Kirschner wire is useful for secure fixation and prevention of rotational and dorsal displacement of the fragment. Additionally, when the IP joint is fixed by the next Kirschner wire, the neutral position can be maintained more safely without loss of reduction compared with the original technique.

In conclusion, the bone fragment of a bony mallet injury of the hallux is commonly larger than that of a mallet finger. Therefore, this modified extension block technique can be applied to a bony avulsion fracture of the base of the distal phalanx of the hallux to increase the range of motion of the IP joint and reduce permanent extensor lag. Furthermore, this technique allows anatomic reduction of the fracture fragment without relying on surgical exposure and decreases the complications associated with open surgical treatment. We recommend this surgical procedure be performed early: the sooner the treatment is performed after the injury, the simpler it is to achieve reduction (8). If closed reduction is difficult to achieve with our technique, open reduction and internal fixation is required.

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