# Type IIb Bony Mallet Finger: Is Anatomical Reduction of the Fracture Necessary?

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## Abstract

One-third of all mallet fingers are associated with a fracture. Many different management strategies have been described. Some authors recommend nonsurgical management for all mallet fractures. In contrast, others suggest mandatory open reduction and internal fixation for bony mallet injuries with a large displaced dorsal fragment and associated distal interphalangeal (DIP) joint subluxation.

We retrospectively studied 3 cases of a mallet fracture with a large displaced dorsal fragment and subsequent DIP joint subluxation managed with closed reduction using only percutaneous pinning of the DIP joint. All 3 patients had satisfactory pain-free and functional clinical outcomes at their particular follow-up (4, 6, or 19 months).

Closed reduction and internal fixation of the subluxated joint using only Kirschner wires produced satisfactory outcomes for the 3 type IIb bony mallet fingers. Anatomical reduction of the fracture may be unnecessary in patients such as those in our case series. One aim of this pilot study is to justify larger, prospective studies.


Mallet finger is a common injury. Its incidence is 10 per 100,000 person-year.[1] Doyle[2] wrote that there are 4 types of mallet fingers: closed, open, open with loss of tissue, and fracture. Closed injuries are encountered most often. The management mainstay remains splinting for 6 to 8 weeks. One-third of all mallet fingers are associated with a fracture.[3] There are 3 types of these bony mallet fingers: I, fractures without subluxation; II, fractures with subluxation; and III, epiphyseal injuries. Each type has 3 subtypes based on fragment size in relation to articular surface: a, <1/3 mm; b, 1/3-2/3 mm; and c, >2/3 mm.

Whereas the diagnosis of mallet fracture is straightforward, the interventions are diverse. Wehbé and Schneider[3] analyzed 21 mallet fractures, including 8 type II fractures, and recommended conservative management for all mallet fractures regardless of displacement and subluxation, with the exception of irreducible epiphyseal injuries, and injuries in nonadherent patients. Kalainov and colleagues,[4] who described 22 nonsurgically managed fractures (21 patients), including 13 type II fractures, also concluded that mallet fractures should be managed without surgery. In contrast, other authors have advocated surgical intervention for bony mallet injuries with displaced dorsal fragments and distal interphalangeal (DIP) joint subluxation and for patients who want to avoid splints. Four widely used techniques are (1) open reduction and internal fixation (ORIF) using Kirschner wires (K-wires),[5] lag screw, or hook plate[6]; (2) pullout wire suture[7]; (3) tension-band wiring[8]; and (4) extension block pinning, a closed reduction technique that avoids more soft-tissue dissection.[9,10] However, complication rates can be high, and the role of surgical intervention remains controversial.

Those surgical techniques are aimed at obtaining anatomical reduction of the dorsal fragment. Casscells and Strange[11,12] reported use of a single intramedullary wire as an option in managing mallet fractures to immobilize DIP joint without reducing the fracture. In the present article, we address management and technique of single intramedullary wire fixation in the setting of joint subluxation.

## Materials and Methods

We retrospectively reviewed trauma data that had been prospectively collected from 2007 through 2010. This study was approved by our institutional review board. Inclusion criteria were a closed bony mallet finger with subluxation (type II) and complete follow-up until bony union. During the 4-year period, 3 cases were diagnosed and managed (**Table, Figures 1-3**). Patient 1 was a 44-year-old woman, patient 2 a 15-year-old boy, and patient 3 a 28-year-old man. The fingers fractured were left

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Figure 1. Lateral radiographs of left little, left middle, and left ring fingers (patients 1 to 3, respectively) show type IIb mallet fractures with subluxation and 52% mean joint surface involvement.

Figure 2. Postoperative lateral radiographs for patients 1 to 3 show adequate reduction of distal interphalangeal joint and internal fixation with single Kirschner wire.

little (patient 1), left middle (patient 2), and left ring (patient 3). All injuries were sustained during sports activity, and all radiographs confirmed a type IIb fracture. Mean joint surface involvement was 52%. Closed reduction and cross-pinning of the DIP joint were performed 5, 22, and 56 days after injury, respectively. All operations were performed by the senior author (CSM).

Management began with preoperative examination. Patients were evaluated for lack of active DIP joint extension but with intact passive extension. More important, joint status was assessed radiographically in the office. Attempts were made to reduce the subluxated DIP joint, and reductions were confirmed fluoroscopically. Patients with an easily translated joint were deemed candidates for closed reduction and longitudinal percutaneous pinning. In the operating room, fluoroscopy was used over the duration of the entire procedure. Performing a dorsal translatory maneuver of the distal phalanx allowed the subluxated DIP joint to be reduced without difficulty, even 56 days after injury. A single 0.045-inch K-wire was then placed at the distal aspect of the distal phalanx, just volar to the end of the nail plate. Under anteroposterior and lateral fluoroscopic guidance, the wire was drilled with low-power targeting for the intramedullary canal of the distal phalanx. After confirmation of the optimal position of the wire in the distal phalanx and its proposed trajectory into the medullary canal of the middle phalanx, the joint was held reduced, and a single pass was made across the DIP joint. The wire crossed the DIP joint as far into the middle phalanx as possible, while the articular surface was held in its anatomical location. Wire position was again confirmed with fluoroscopy. The finger was placed in a simple aluminum foam splint positioned volarly to protect the exposed end of the pin.

Patients were initially examined in the outpatient clinic 1 week, 6 weeks, and 12 weeks after surgery. Radiographs were obtained at these visits. Pain, extension lag, flexion loss, and presence of a dorsal bump were documented. Outcomes were classified according to the criteria of Crawford.[13]

## Results

There were no wound complications. After 38 to 44 days, the pins were removed in the outpatient clinic. Nighttime use of volar tip protection splints was continued another 2 weeks, and a range of motion program was started. All 3 patients had satisfactory pain-free and functional clinical outcomes at their

Table. **Patient Data**

| Patient | Age, y | Sex | Injured Digit | Surgery Timing, d | Pin Removal, d | ROM[a] | Follow-Up, mo |
|---|---|---|---|---|---|---|---|
| 1 | 44 | F | Left little | 5 | 38 | 0°/65° | 6 |
| 2 | 15 | M | Left middle | 22 | 43 | 0°/80° | 4 |
| 3 | 28 | M | Left ring | 56 | 44 | 0°/85° | 19 |

Abbreviation: ROM, range of motion.
[a]Postoperative extension/flexion.

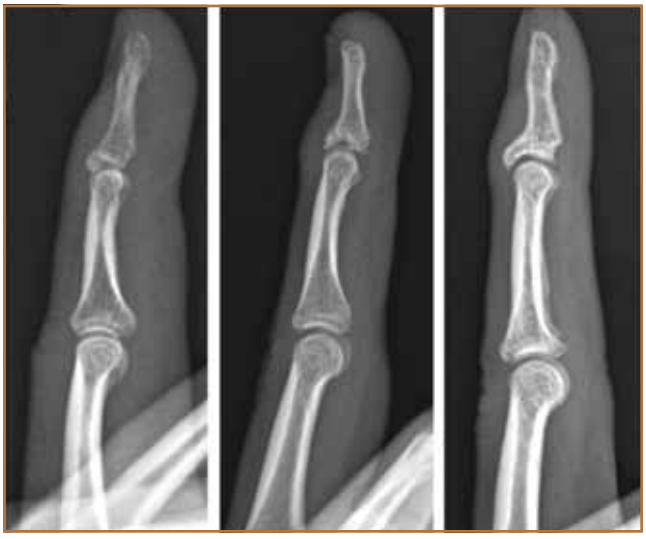

Figure 3. Final follow-up radiographs, patients 1 to 3 (6, 4, and 19 months after surgery, respectively). Joint remodeling with longer follow-up is well demonstrated in patient 3.

particular follow-up (6, 4, or 19 months), and 2 had complete return of range of motion. Patient 1 had no extension lag but lost 25° of flexion. All patients had a slight bump on the dorsal aspect of the DIP joint. Radiographs showed a healed fracture and well-maintained joint position with DIP joint remodeling in all patients.

## Discussion

Nonsurgical management of bony mallet fingers can produce satisfactory outcomes, and surgical management can have poor outcomes. Wehbé and Schneider[3] analyzed 21 patients with a mallet fracture (8 with a type II fracture) managed either with or without surgery. The authors concluded that surgical management showed no advantage over nonsurgical care. They noted a dorsal bump in 85% of the patients—a finding independent of type of management. Fifty percent of the surgically treated patients complained of pain at long-term follow-up. Bischoff and colleagues[14] found poor outcomes in 21 of 51 patients with a bony mallet injury managed with tension-band wiring. The authors concluded that outcomes are less predictable with this technique and that it should be used with caution.

Nonsurgical management can also have adverse outcomes, particularly with type II fractures. Kalainov and colleagues[4] reported a case series of 22 closed mallet finger fractures (13 with palmar subluxation) in 21 patients with a bony mallet finger managed with a splint for a mean of 5.5 weeks. Ten percent of the patients had transient skin irritation. Dorsal bumps and swan-neck deformities were more common in the subluxation group. In addition, DIP joint extension lag and flexion loss were more evident in the type II group than in the type I group. Furthermore, 8 of the 13 cases whose subluxated bony mallet finger was managed nonsurgically showed moderate arthritic changes. In contrast, only 1 of the 9 cases without subluxation showed these changes.

Other results have prompted investigators to recommend surgical management. In a recent retrospective study, 80% of mallet fractures managed with ORIF had good or excellent outcomes.[5] Only 1 of the 20 patients in that study had a surgical complication (wound infection), and none had posttraumatic arthritis.

Badia and Riano[15] reported use of another minimally invasive technique, in which a K-wire was placed to hold the DIP joint in extension and then another K-wire was used as a joystick to reduce the fragment. Uneventful healing occurred in all 16 patients.

Our method is focused on correcting the subluxation of the DIP joint and avoiding the adverse outcomes reported by Kalainov and colleagues,[4] which seemed to be related to joint subluxation. To our knowledge, only a few authors have described the single-wire technique for bony mallet fingers.[11,12,16] Pin removal can easily be done after fracture union, at a mean of 6 weeks. Our patients' early outcomes indicated that sufficient remodeling had occurred to allow full extension and flexion without reduction of the dorsal fragment. Patient 1 lost 25° of flexion but was satisfied with her outcome. In all cases, a dorsal bump was present but did not limit function.

For bony mallet fingers, both surgical (ORIF) and nonsurgical management can be associated with both satisfactory and suboptimal outcomes. The single-wire technique may be a good alternative in the management of type IIb bony mallet fingers. It combines speed and reliability in DIP joint reduction, and there is no need for extensive dissection or a second dorsal pin. Its basic prerequisite is the ability to relocate the joint by closed means and confirm the relocation by orthogonal radiographic views before pinning. The best way to minimize damage to the articular cartilage of the DIP joint is to make only 1 pass with the wire. It is therefore imperative to perform this procedure under fluoroscopic guidance. The starting point for the wire and its proposed route across the DIP joint must be carefully assessed before the joint is reduced and the wire passed. This technique cannot be used if the subluxation cannot be reduced by closed means. Although removal of the exposed wire is easy, under certain circumstances the patient must be alerted to the possibility that a wire will be buried (no splint) and that its removal will require a second, small surgery.

The obvious limitations to this study are its retrospective design and small sample size. Several studies with larger patient samples have been conducted, but not with this particular surgical modality. Drawing final conclusions from our small-cohort pilot study would be inappropriate, but the present findings do suggest that joint realignment produces satisfactory outcomes and that anatomical reduction of fractured fragments is unnecessary. One aim of this pilot study is to justify larger, prospective studies.

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