Placement of an Intramedullary Nail for the Treatment of Proximal Ulnar Fractures

Michael J. Kern, MD, Nicholas D. Casscells, MD, and Evan H. Argintar, MD

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Introduction

The fixation of olecranon fractures with intramedullary olecranon nails has been demonstrated to be an effective treatment option that may result in decreased soft-tissue irritation.

Proximal ulnar fractures occur commonly and frequently require surgical fixation. Tension banding and dorsal olecranon plates have demonstrated good outcomes with regard to union and function, but they frequently require a secondary procedure for hardware removal because of soft-tissue irritation¹⁻³. Multiplanar intramedullary olecranon nails are an additional option for fixation that has been shown to be effective in the management of this injury⁴, and likely result in decreased soft-tissue irritation and the eventual need for hardware removal (Figs. 1-A through 1-D, Video 1). At the time of writing, we knew of only one proximal ulnar intramedullary device (Olecranail; Mylad Orthopedic Solutions) that offered multiplanar screw fixation in the proximal segment (Fig. 2).

After positioning and approach, the fracture should be provisionally reduced. A guidewire should then be placed along the ulnar axis with fluoroscopic guidance to confirm the start point and trajectory. After confirmation, reaming and olecranon nail insertion are performed. Interlocking screws are placed with the aid of a targeting system or under direct fluoroscopic guidance. Compression across the nail and fixation of coronoid fragments are possible through the use of a multiplanar nail. Once screw placement has been completed and confirmed with fluoroscopy, the wound can be closed.

Step 1: Positioning and Approach

Proper positioning of the patient during this procedure allows for improved access to the fracture and increased accessibility for fluoroscopy.

- Place the patient in the lateral decubitus position with the arm hanging over a bolster or support.
- Place a sterile pneumatic tourniquet proximal to the elbow.

- Make a dorsal longitudinal incision extending from the tip of the olecranon distally until the entire fracture site is exposed.
- Identify and protect the ulnar nerve.

Step 2: Reduce the Fracture

Reduce and provisionally hold the fracture following a limited periosteal elevation.

- Expose the fracture site and clear any interposed soft tissue and fracture hematoma.
- Perform a limited periosteal elevation at the fracture site to assess reduction.
- Reduce the fracture and stabilize the reduction with provisional fixation.
- If the fracture is nondisplaced, the initial posterior approach and provisional reduction steps can be avoided, and the intramedullary device can be inserted without directly opening the fracture site.

Step 3: Ream the Olecranon and Place the Nail

The olecranon is then reamed, and the intramedullary nail is inserted.

- Insert a guidewire at the tip of the olecranon along the anatomic axis of the ulnar medullary canal. Exact alignment of the starting point with the anatomic axis is critical to avoid cortical wall blowout during reaming in later steps, and fluoroscopy should be used for definitive confirmation. Depending on the extent of the initial incision, a second, more proximal dorsal incision through the triceps tendon in line with the longitudinal fibers can be used to access the starting point.
- Advance the reamer over the guidewire under fluoroscopic guidance along the ulnar axis.
- Assemble the intramedullary nail and its targeting guide.

- Insert the nail and guide into the bone, burying the proximal extent of the nail deep to the posterior ulnar cortex at final positioning.
- If coronoid screws are anticipated, place a rotational guide using the medial and lateral distal humeral epicondyles as reference points to ensure proper orientation for the proper targeting of the coronoid screws. The rotational guide attaches to the targeting system and contains side-specific alignment rods that should parallel the axis of the humeral epicondyles. Each alignment rod is clearly labeled by side (left or right) and by orientation (medial or lateral).
- Proper rotational alignment is critical in order to avoid ulnar nerve injury during proximal screw insertion in later steps.
- If compression across the nail is desired, especially in the absence of comminution of osseous defects, advance the nail slightly further to accommodate the distance that the proximal fragment will travel along the nail during compression.

Step 4: Insert the Screw

Place proximal interlocking screws using the targeting system.

- Begin by placing the drill sleeve through the most distal guide-hole.
- Make a small incision and bluntly dissect to allow passage of the sleeve down to bone.
- Drill the screw hole and measure the depth off the drill markings. Care should be taken to avoid plunging with the drill, particularly during proximal screw insertion, to avoid injury to nearby neurovascular structures.
- Insert the appropriate screw.
- Compress the proximal fragment along the nail according to the surgeon's discretion. This can be done using the compression knob, which screws into the targeting guide. Continued clockwise rotation will result in compression across the fracture site (Video 1, time point 2:40).
- Avoid compression in unstable fracture patterns or fractures with severe comminution.
- Place the remainder of the screws using the identical technique according to fracture pattern and surgeon preference.
- If desired, place a targeting pin through the drill sleeve to identify the exact location of each screw prior to drilling.
- Targeting pin placement is then confirmed using fluoroscopy. If the position of the pin is acceptable, the pin is removed and the screw can be placed after drilling. This technique can be valu-

able during the fixation of coronoid fragments.

- The nail in this series allows for a total of four proximal screws, three coronoid screws, and two diaphyseal screws.
- Of note, the transverse proximal interlocking screw should be drilled from medial to lateral to minimize the risk of ulnar nerve injury.
- Confirm screw positioning fluoroscopically.

Step 5: Close the Wound

Close the wound with subdermal sutures and either staples or interrupted horizontal mattress nylon sutures.

- Repair the triceps tendon split with a running absorbable suture.
- Close the superficial wound with absorbable subdermal sutures.
- Close the skin incision with either staples or interrupted horizontal mattress nylon sutures.

Results

A total of twenty-eight patients with unstable olecranon fractures were treated with intramedullary olecranon nailing in our series, and union was achieved in all patients by eight weeks⁵. Functional examination at twelve weeks revealed that range of motion was within 10° of that of the contralateral, normal elbow in all patients. All patients were available for the one-year follow-up evaluation, at which time all had fully returned to normal activities. Hardware removal was required in one patient because of a prominent screw head along the ulnar shaft.

What to Watch For

Indications

- Nondisplaced proximal ulnar fractures.
- Displaced proximal ulnar fractures.
- Proximal ulnar nonunion.
- Olecranon osteotomy fixation.
- Large coronoid fractures.

Contraindications

- Acute infection.
- Olecranon fracture of <1 cm in size.
- Ulnar fractures that extend >2 cm beyond the coronoid.
- Severe articular comminution with dissociation from the posterior ulnar cortex.
- Pediatric fractures.
- Unusual ulnar anatomy such as a narrowed canal or severe bowing.

Pitfalls & Challenges

- Overcompressing the fracture can disrupt the reduction or leave the proximal end of the nail prominent.
- Poor start point positioning can cause cortical wall blowout during initial reaming.
- Shift or displacement of the provisional reduction during reaming will be difficult to correct once the reaming has been completed.

Clinical Comments

- In tension band constructs and dorsal olecranon plates, the hardware is prominent and causes soft-tissue irritation that commonly will require hardware removal.
- The interlocking screws directly engage internal

threads within the nail and thus do not need to be bicortical in all locations.

- This particular implant system does not offer different sizes or lengths. Consequently, use of this implant is contraindicated in pediatric patients as well as in patients with unusual ulnar anatomy, such as a narrowed medullary canal or severe ulnar bowing.
- Additional fixation around the nail is occasionally necessary in more comminuted fracture patterns. Supplemental screws can be placed adjacent to the nail (Video 1, time point 4:33). Supplemental plates with unicortical screws can also be employed for isolated fracture segments. Small miniplates tend to work well for these comminuted pieces, and their low profile complements the benefits of this system.

Michael J. Kern, MD

Nicholas D. Casscells, MD

Orthopaedic Surgery Department, MedStar Georgetown University Hospital, 3800 Reservoir Road N.W., 1 PHC, Washington, DC 20007

Evan H. Argintar, MD

MedStar Georgetown Orthopaedic Institute, MedStar Washington Hospital Center, Physicians Office Building, Suite 5000, 106 Irving Street N.W., Washington, DC 20010

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References

1. Hume MC, Wiss DA. Olecranon fractures. A clinical and radiographic comparison of tension band wiring and plate fixation. Clin Orthop Relat Res. 1992 Dec;285:229-35.
2. Bailey CS, MacDermid J, Patterson SD, King GJ. Outcome of plate fixation of olecranon fractures. J Orthop Trauma. 2001 Nov;15(8):542-8.
3. Lindenhovius AL, Brouwer KM, Doornberg JN, Ring DC, Kloen P. Long-term outcome of operatively treated fracture-dislocations of the olecranon. J Orthop Trauma. 2008 May-Jun;22(5):325-31.
4. Argintar E, Martin BD, Singer A, Hsieh AH, Edwards S. A biomechanical comparison of multidirectional nail and locking plate fixation in unstable olecranon fractures. J Shoulder Elbow Surg. 2012 Oct;21(10):1398-405. Epub 2011 Dec 11.
5. Argintar E, Cohen M, Eglseider A, Edwards S. Clinical results of olecranon fractures treated with multiplanar locked intramedullary nailing. J Orthop Trauma. 2013 Mar;27(3):140-4.

Fig. 1-A

Fig. 1-B

Figs. 1-A through 1-D A patient who sustained a transolecranon fracture-dislocation. **Figs. 1-A and 1-B** Preoperative anteroposterior (**Fig. 1-A**) and lateral (**Fig. 1-B**) radiographs.

Fig. 1-C

Fig. 1-D

Figs. 1-C and 1-D Anteroposterior (**Fig. 1-C**) and lateral (**Fig. 1-D**) radiographs made after open reduction and intramedullary nail fixation of the olecranon fracture.

Fig. 2
Image of the Olecranon Nail, a multiplanar intramedullary olecranon nail designed by Mylad Orthopedic Solutions. (Reproduced, with permission, from Mylad Orthopedic Solutions.)