

Clinical Outcomes of Limited-Open Retrograde Intramedullary Headless Screw Fixation of Metacarpal Fractures

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Purpose To evaluate clinical and radiographic outcomes in patients treated with limited-open retrograde intramedullary headless compression screw (IMHS) fixation for metacarpal neck and shaft fractures.

Methods Retrospective review of prospectively collected data on a consecutive series of 39 patients (34 men; 5 women), mean age 28 years (range, 16–66 y) treated with IMHS fixation for acute displaced metacarpal neck/subcapital (N = 26) and shaft (N = 13) fractures at a single academic practice between 2010 and 2014. Preoperative magnitude of metacarpal neck angulation averaged 54° (range, 15° to 70°), and shaft angulation averaged 38° (range, 0° to 55°). Patients used a hand-based orthosis until suture removal and began active motion within the first week. Clinical outcomes were assessed with digital goniometry, pad-to-distal palmar crease distance, and grip strength. Time to union and radiographic arthrosis was assessed. Twenty patients reached minimum 3-month follow-up, with a mean of 13 months (range, 3–33 mo).

Results All 20 patients with minimum 3 months of follow-up achieved full composite flexion, and extensor lag resolved by 3-week follow-up. All patients demonstrated full active metacarpophalangeal joint extension or hyperextension. Grip strength measured 105% (range, 58% to 230%) of the contralateral hand. No secondary surgeries were performed. There were 2 cases of shaft re-fracture from blunt trauma following prior evidence of full osseous union with the screw in place. All patients achieved radiographic union by 6 weeks. There was no radiographic arthrosis at latest follow-up. One patient reported occasional clicking with metacarpophalangeal joint motion not requiring further treatment.

Conclusions Limited open retrograde IMHS fixation proved to be safe and reliable for metacarpal neck/subcapital and axially stable shaft fractures, allowed for early postoperative motion without affecting union rates, and obviated immobilization. This technique offers distinct advantages in select patients. (*J Hand Surg Am.* 2014;39(12):2390–2395. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Therapeutic IV.

Key words Metacarpal fracture, hand trauma, headless screw, intramedullary fixation, minimally invasive surgery, clinical outcomes.

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FIXATION BURIED BENEATH THE articular surface is well accepted for various upper extremity fractures.^{1–9} Multiple fixation techniques for displaced and markedly angulated metacarpal neck and subcapital fractures and axially stable shaft fractures include percutaneous and limited open antegrade (ie, bouquet pinning),¹⁰ retrograde (ie, longitudinal intramedullary fixation),¹¹ transmetacarpal Kirschner wire constructs,¹² and plate fixation.¹³ Each technique has advantages and disadvantages. There is no consensus on an optimal treatment modality.¹³

The use of quantitative 3-dimensional computed tomography techniques to better define articular fracture characteristics is well established.^{1,15–19} Recent 3-dimensional computed tomography data from our group support the use of an articular starting point for these extra-articular fractures.¹ We now report clinical and radiographic outcomes of limited-open retrograde intramedullary cannulated headless screw fixation. A case report from our institution previously described this technique for a subcapital metacarpal neck fracture with limited distal bone stock precluding plate fixation.¹⁴

Retrograde intramedullary fixation using a cannulated headless screw can be achieved using a limited-open extensor-splitting approach and represents only one additional step beyond longitudinal intramedullary retrograde Kirschner wire fixation of these fractures through the metacarpal head articular surface. The headless design allows for fixation buried beneath the articular surface and allows for early postoperative motion.²⁰ Direct visualization of the starting point additionally potentially eliminates multiple attempts at achieving the correct starting point during percutaneous Kirschner wire insertion for retrograde intramedullary fixation.

With increasing clinical experience using this technique for metacarpal neck fractures, we have expanded our indications in select cases to include fractures presenting after callus formation precluding closed reduction and axial-stable transverse mid-diaphyseal fractures that are reducible with closed manipulation. The purpose of the present study was to determine the clinical and radiographic outcomes in patients treated with limited-open retrograde intramedullary headless screw fixation for metacarpal neck and shaft fractures. We hypothesized that this technique would yield satisfactory results, represent a reliable alternative to percutaneous Kirschner wire and open plate fixation constructs, and minimize complications associated with these respective techniques.

METHODS

Following institutional review board approval, retrospective evaluation of prospectively collected clinical and radiographic data from our upper extremity trauma database between 2010 and 2014 identified 39 consecutive patients diagnosed and treated surgically for closed, displaced fractures of the metacarpal neck (N = 26) and shaft (N = 13) with limited open retrograde intramedullary headless screw fixation. Twenty-three neck fractures and 10 shaft fractures treated were in the small finger (Table 1). Two patients with splitting of the metacarpal heads were excluded from this cohort of extra-articular neck and shaft fractures. The cohort included 5 women and 34 men, with a mean age of 28 years (range, 16–66 y). Thirty-six patients were right-handed, and the dominant hand was injured in 36 of 39 (92%). All fractures were closed. There were no associated neurovascular insults.

Mean metacarpal neck apex dorsal/volar angulation and mean metacarpal shaft sagittal plane deformity are reported in Table 1. Twenty-five of the 26 neck fractures presented with 40° or greater angulation. A single index finger neck fracture underwent fixation for angulation of 15°. Three axial-stable shaft fractures underwent fixation due to malrotation. One of the rotated shaft fractures had an adjacent digit injury requiring surgical intervention as well and required early motion.

Operative technique

Operative treatment was performed in all cases by the 3 senior authors (D.E.R., M.I.L., M.R.B.) in a single academic hand surgical practice using the identical technique. Limited-open retrograde headless compression screw (HCS) fixation was performed through a small extensor-split over the metacarpophalangeal joint followed by a limited dorsal arthrotomy. Closed reduction without disruption of the fracture site was confirmed under fluoroscopic guidance, and a 1.1 mm Kirschner wire was then inserted under direct visualization through the dorsal corridor of the metacarpal head in line with the medullary canal to achieve provisional fixation. The dorsal-central starting point was well visualized following fracture reduction, dorsal capsulotomy, and passive metacarpophalangeal (MCP) joint flexion. The Kirschner wire was then over-drilled and replaced with a 2.4 mm or 3.0 mm cannulated HCS (Synthes, Paoli, PA) based upon preoperative templating of the dimensions of the isthmus of the intramedullary canal (Fig. 1).

In 5 cases, the patient presented in a delayed fashion with radiographic callus present precluding

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