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

David Ruchelsman, MD1,2, Sameer Puri, MD1,3, Matthew I. Leibman, MD1,2, Mark R. Belsky MD1,2
1. Tufts University School of Medicine, Boston, MA 2. Newton Wellesley Hospital, Newton, MA 3. Tufts Medical Center, Boston, MA

HYPOTHESIS
Treatment of metacarpal neck and shaft fractures utilizing a limited-open retrograde intramedullary headless screw (IMHS) fixation technique would safely allow for early mobilization and avoid complications associated with K-wire and plate/screw constructs without adversely affecting clinical outcomes.

BACKGROUND
• Fixation countersunk beneath the articular surface is well-accepted for various upper extremity fractures
• Quantitative 3D-CT data supports the use of an articular starting point for extra-articular metacarpal fractures.
• Intramedullary headless compression screw fixation allows for early post-operative range of motion, and obviates concerns of pin tract infections or adhesions associated with extensor tendon immobilization.

METHODS
Design:
• Retrospective review of prospectively collected clinical and radiographic data of a cohort of 20 consecutive patients treated with IMHS fixation from 2010-2012.
• Single center academic hand surgery practice with fellowship trained hand surgeons.
• Patient data recorded included patient demographics; pre-op angulation; time to union; MP,PIP, DIP ROM; composite flexion (pad-to-distal palmar crease distance); grip strength.

Technique:
• A small extensor split followed by a limited dorsal arthroscopy over the affected metacarpal head is performed.
• Closed reduction is confirmed under fluoroscopic guidance and a 1.1mm Kirschner wire is 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 is well visualized following fracture reduction, dorsal capsulotomy, and passive metacarpophalangeal (MCP) joint flexion.
• The Kirschner wire is then over-drilled and replaced with a 2.4mm or 3.0mm cannulated HCS (Synthes, Paoli, PA) based upon preoperative templating of the dimensions of the isthmus of the intramedullary canal.
• The extensor mechanism is repaired using 3-0 Ethibond, the skin is closed with 5-0 nylon, and an MP intrinsic plus splint is applied with initiation of full A/AROM within 5 days.

RESULTS
• 4.4 month follow-up (range 1-17.3) was available on 20 consecutive patients treated with IMHS fixation for metacarpal shaft and neck fractures after a 2 year span.
  • All patients achieved clinical and radiographic union by 6 weeks.
  • All patients achieved full composite digital flexion (0 mm pad-to-distal palmar crease distance) at latest follow-up.
  • All patients achieved full or hyperextension of MP joint
• There were no major complications such as infection, non-union, need for secondary surgery, or radiographic arthritis or chondrolysis at latest follow-up.
• One patient reported an occasional intermittent periartricular click with active MP motion that did not require further treatment.

CONCLUSION/DISCUSSION
• Various fixation techniques have been described for reduction and fixation of metacarpal shaft and neck fractures (i.e. percutaneous/limited open antegrade pinning, retrograde intramedullary pinning, transmetacarpal fixation, plate/screw fixation) with no consensus on optimal treatment modality.
• We have previously described in a case report limited-open retrograde intramedullary cannulated headless screw fixation of a subcapital metacarpal neck fracture with limited distal bone stock precluding plate fixation. Traditionally, the use of headless screws has been reserved for fixation of articular and complex periartricular fractures.
• Recently, using 3D-CT analysis, we have demonstrated that the magnitude of metacarpal head articular surface area and subchondral volume occupied with this technique is minimal, and that the articular surface area violation is least during the more clinically relevant sagittal plane arc of motion. This supported the use of an articular starting point for these extra-articular fractures.
• Limited open minimally invasive retrograde IMHS fixation is a safe and reliable technique for metacarpal neck/subcapittal and axially-stable shaft fractures; allows for early postoperative active motion without affecting union rates; obviates immobilization; and avoids complications associated with K-wire and plate/screw constructs. This technique offers distinct advantages in select patients (i.e. athletes).

| Table 1. Basic characteristics of XX cases limited-open retrograde intramedullary headless screw fixation of metacarpal fractures |
|-----------------|-----------------|-----------------|
| N               | 20 hands (17/20 dominant hand) |
| Patients        | 20 (2 Female, 18 Male) |
| Mean Age (range)| 32 years (16-66) |
| Mean follow up (range)| 4.4 months (1-17.3 months) |
| % union at 6 weeks| 100% |
| % Patients with full composite flexion| 100% (0 mm pad-to-distal palmar crease distance) |
| % Patients with full or hyperextension of MP joint| 100% |
| % Grip strength of contralateral hand (range)| 90% (65-116 %) |
| % Significant Complications| 0% |
| % Minor Complications| 5 % (1/20 patients) |