# Intramedullary Fixation for Metacarpal Fractures: A Multi-Institutional Prospective Outcomes Study

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## Background

- Intramedullary fixation (IMF) is an effective treatment for metacarpal fractures.
- Benefits include: stable fixation that allows early postoperative rehabilitation, high fracture union rates, no increase in complications.
- IMF nails have been described for this purpose, however, prospective outcomes reporting are lacking.
- This study assessed the outcomes of metacarpal fractures treated with IMF including patient-reported outcomes (PROs), grip strength, total active digit motion (TAM), and complications.

## Methods

- A prospective multicenter trial enrolled consecutive patients with closed, extra-articular metacarpal fractures treated with IMF.
- All patients with metacarpal fractures that underwent fixation with either headless compression screws (Acutrak 2, Acumed LLC) or headless threaded nails (Innate nail, ExsoMed) were enrolled prospectively.
- Open fractures, those with intra-articular fracture extension, and severe crush injuries to the hand were excluded.
- Radiographic healing was assessed at each postoperative visit and PROs included pain scores, QuickDASH and Short Form Survey (SF-12) scores. Grip strength, goniometric motion measurements, and complications were also obtained.
- Patients were further stratified into subgroups:
  - ‘closed’ reduction - a small incision or percutaneous technique was utilized over the MCPJ for hardware insertion without any additional incisions
  - open’ reduction - an additional incision was made over the fracture site to achieve adequate reduction
- All surgeons participating in the study followed the same operative protocol. Intramedullary headless hardware systems were utilized to place hardware in a retrograde manner from the MCPJ (Figure 2).

## Results

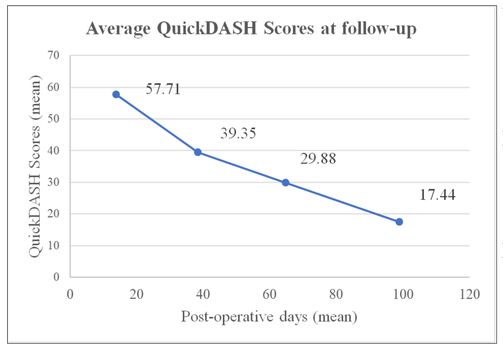
- One-hundred-one fractures were treated in 82 patients with an average age of 33 years (range 14-70 years, SD: 12.3). Most patients were male (70%) laborers (28%) (Table 1).

Table 1 Patient demographics.

| Patient population | n = 82 |
|---|---|
| Age, years | |
| Mean, SD | 33 (12) |
| Sex | |
| Male, n (%) | 58 (70%) |
| Female, n (%) | 24 (30%) |
| Smoking status | |
| Current smoker, n (%) | 21 (26%) |
| Relevant past medical history | |
| Diabetes, n (%) | 6 (7%) |
| Occupation | |
| Laborer, n (%) | 23 (28%) |
| Unemployed, n (%) | 13 (16%) |
| Clerical, n (%) | 15 (18%) |
| Student, n (%) | 5 (6%) |
| Other, n (%) | 17 (21%) |
| Unknown, n (%) | 9 (11%) |

- Figure 1. A 20-year-old male presented after 4th and 5th metacarpal shaft fractures with angulation and malrotation (upper panel).
- Patient was treated with intramedullary screw fixation and demonstrated osseous union at 3-months after surgery (lower panel).

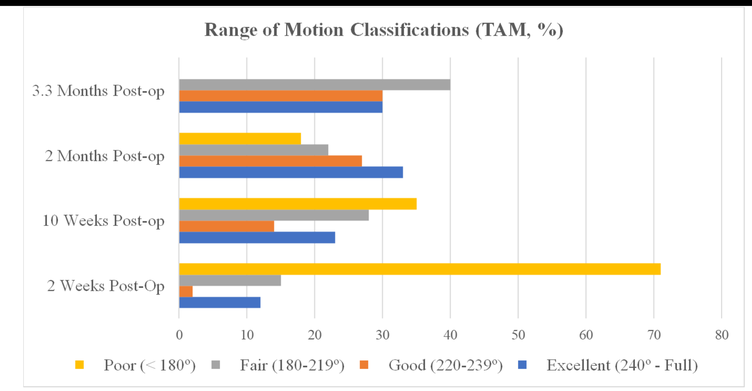
- QuickDASH scores improved by 40 points, with a final mean of 17 following metacarpal IMF (Figure 2). SF-12 components of PCS and MCS at final follow-up were 55.95 and 48.74, respectively. Final average grip strength was 15 kg and TAM was 228º (Figure 3).




- Figure 2. Change in grip strength over time on the operated hand.

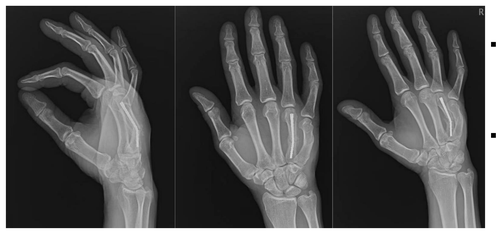
- There was no significant differences in the average PROs (QuickDASH or SF-12 scores) between the ‘closed’ and ‘open’ reduction cohorts at each follow-up visit.
- Average TAM of the ‘closed’ reduction cohort (248.6°) was significantly higher than the ‘open’ cohort (210.3°) at final follow-up (p = 0.008).
- There was significantly more digit motion at the second post-operative visit in the ‘open’ reduction group (average TAM of 218.2°) compared to the and ‘malunion’ cohort, (160°; difference of 58.2°).

## Results




- Figure 3. Total active range of motion measurement percentages shown for each follow-up visit stratified based on Page and Stern’s classification.

- Mean time to fracture union rate was 88 days (SD: 52). Four complications (3.9%) occurred, including 1 hardware failure (Figure 4), 2 proximal screw migrations, and 1 metacarpophalangeal joint contracture, with 3 requiring revision surgery.



- Figure 3. Right hand radiographs of a 43-year-old man, 33 days following IMF screw fixation of the ring finger metacarpal.
- The patient crushed his hand in a door and sustained hardware failure with the screw bending approximately 32 degrees.

## Conclusions

- IMF achieves sufficient stability to allow for early motion and restoration of anatomic function while minimizing complications.
- Results from this study support that IMF is a reliable technique for treatment of closed, extra-articular metacarpal fractures or malunions that produces favorable outcomes with infrequent complications.