

# Effect of Screw Size on Radiographic and Clinical Outcomes in Metacarpal Shaft Fractures

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**INTRODUCTION:** The use of intramedullary headless screws (IMHS) for metacarpal fractures has demonstrated favorable clinical outcomes and adequate stability for early range of motion. IMHS fixation offers superior biomechanical stability compared to Kirschner wires (K-wires) and causes less disruption to the soft tissues compared to dorsal plating. The relationship between screw diameter and canal size is variable, and the impact of this relationship has not been extensively studied. The purpose of this study was to evaluate the influence of screw diameter and the ratio of canal fill on clinical and radiographic outcomes, and identify superior screw size options. We hypothesized that screws with greater canal fill would be associated with decreased radiographic displacement and improved patient disability scores, range of motion, and grip strength.

**METHODS:** We conducted a retrospective analysis of patients treated with IMHS for metacarpal shaft fractures between 2017-2022 at our center. Exclusion criteria included open fractures, inadequate follow up, and alternative treatments. A single surgeon performed all procedures, utilizing retrograde IMHS through an ulnar sagittal band split. Postoperatively, patients were not immobilized and initiated early range of motion on postoperative day 2. Intraoperative radiographs were used to calculate the ratio of screw diameter to metacarpal isthmus diameter at the fracture site. Patients were evaluated during a 6-month follow-up period, and assessments included radiographic displacement, range of motion, QuickDASH (Disabilities of the Arm, Shoulder and Hand) questionnaire scores, and patient satisfaction on a 5-point Likert-scale at postoperative visits on week 2, 6, 12, and 24. Displacement on postoperative radiographs was defined as angulation greater than 10 degrees or displacement exceeding 2mm.

## RESULTS:

A total of 52 patients with 58 metacarpal shaft fractures treated with IMHS were included in the study. All fractures achieved union at an average of 6 weeks. Mean grip strength was 95% (range: 84%-104%) relative to the contralateral side. The average total active motion (TAM) was 248 degrees (range: 240-260). No cases demonstrated extensor lag or required revision surgery. The mean QuickDASH score was 2.1 (range: 0-9.1), indicating minimal disability. Radiographic displacement was observed in 7 cases, exclusively in oblique fractures with 2.5mm screws. None of the cases of displacement involved angulation deformity and six cases involved the small finger. No displacement occurred with 3.0mm screws or when the screw diameter was at least 75% of the isthmus diameter. Comparing patients with radiographic displacement to those without, no significant differences were found in QuickDASH scores, mean TAM, or grip strength.

**DISCUSSION AND CONCLUSION:** Retrograde intramedullary headless screw fixation is a viable treatment option for metacarpal shaft fractures resulting in minimal disability and providing excellent range of motion and grip strength. Our study revealed that screw size may influence radiographic outcomes. Fractures treated with screw diameters smaller than 3.0mm showed a higher likelihood of radiographic displacement, particularly in oblique fracture patterns. Screw diameter greater than 75% isthmus diameter at the fracture site can prevent radiographic displacement. However, radiographic displacement did not correlate with negative clinical outcomes. These findings demonstrate that screw diameter is an important consideration in achieving optimal radiographic outcomes, though favorable clinical outcomes are achievable with smaller diameter screws.

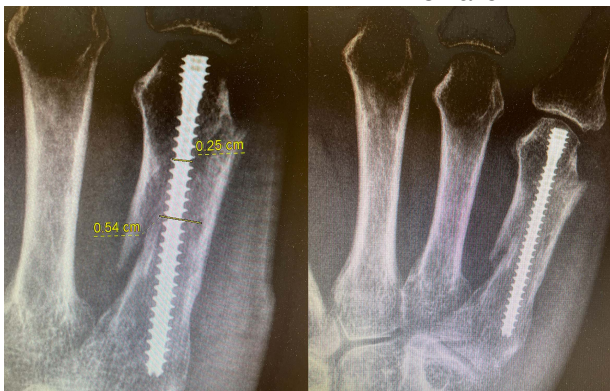


Figure 2. Example of an oblique fracture with screw diameter less than 75% of canal width (2.5mm screw) that shortened. Radiographs at the time of fixation (left) and 12 weeks post-op (right).

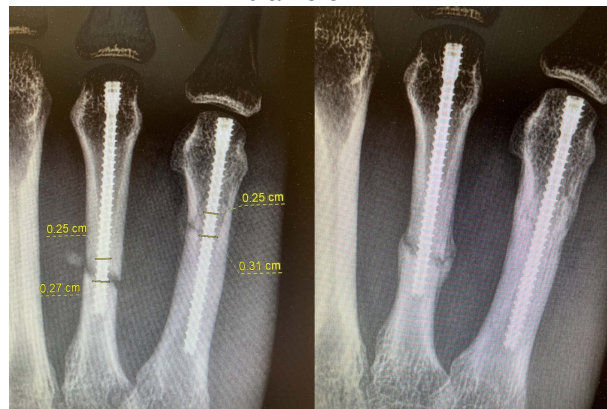


Figure 1. Example of intramedullary headless screw fixation (2.5mm) with screw diameter greater than 75% of canal width at the time of fixation (left) and 12 weeks post-op (right).