The Utility of Plain Films for Nonoperative Fifth Metacarpal Fractures: Are Follow-up Radiographs Necessary?

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Abstract

Background: Fifth metacarpal fractures are often treated nonoperatively with serial radiographs; however, the utility of these radiographs in altering clinical management has not been investigated. We hypothesize that follow-up plain films will not alter clinical management and are therefore unnecessary for most patients. **Methods:** Between 2007 and 2014, patients with a fifth metacarpal fracture at our level I trauma center were retrospectively reviewed. Patients with inadequate documentation or imaging, ipsilateral upper extremity injuries, or who underwent initial surgical fixation were excluded. Initial and postreduction radiographs were reviewed by 4 board-certified attending hand surgeons and 2 hand fellows who indicated their preferred management. At a later date, blinded to their initial management, the reviewers assessed follow-up films taken at least 2 weeks later and indicated their preferred management. **Results:** In total, 60 patients met inclusion criteria, and of those, 30 were randomly selected. There were 9 base, 7 shaft, and 14 neck fractures. Initially, reviewers opted for nonoperative management in 72.2% of base, 71.4% of shaft, and 91.7% of neck fractures. After reviewing follow-up films, reviewers changed from nonoperative to operative management in 0.0% of base, 9.5% of shaft, and 1.2% of neck fractures. **Conclusions:** Follow-up radiographs may not be indicated for most fifth metacarpal base and neck fractures. Follow-up radiographs may change management in select fifth metacarpal shaft fractures as these fractures may displace. Follow-up radiographs should be performed at the discretion of the treating surgeon on an as-needed basis for fractures at risk for displacement.

Keywords: metacarpal fracture, boxer's fracture, postoperative imaging

Introduction

Fractures of the fifth metacarpal are common and account for 20% of all hand fractures.^{9,14} Many of these fractures are sustained from an axial force to the knuckle of a closed fist with a concomitant bending moment. These fractures are generally divided into 3 main categories based on location: fractures of the base, diaphysis, and neck. The natural history following these injuries is one of excellent functional recovery over 2 to 3 months.^{19,20}

Management options include surgical intervention or immobilization with or without closed reduction. The majority of fifth metacarpal fractures are isolated injuries that are simple, closed, and stable; thus, most can be treated nonoperatively. Indications for operative treatment include malrotation, excessive angulation, and longitudinal shortening that cannot be corrected by closed reduction. Several studies have shown that patients are able to tolerate a sub-

stantial amount of apex dorsal angulation, with good short-term and long-term outcomes regardless of the treatment option.^{5,10,17} Furthermore, biomechanical studies have found the flexor system is able to function efficiently with up to 30° of angulation.⁴ In select patients, nonoperative management (NOM) leads to high patient satisfaction and good functional outcomes.¹² Other studies have even advocated for the use of a soft dressing, with no formal casting or splinting, for certain fractures with minimal to moderate displacement.^{11,21}

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At many institutions, all fifth metacarpal fractures are referred to orthopedics after an initial visit. While most orthopedic surgeons agree that initial and postreduction films are necessary, there is little agreement in terms of when and how often follow-up plain films should be obtained. The need for follow-up of nonoperative fifth metacarpal fractures is currently without consensus, and recent data have demonstrated excellent patient-reported outcomes and patient satisfaction with no follow-up for simple fractures after initial evaluation and treatment.¹² Many hand surgeons have their patients follow-up in 2 to 6 weeks after their initial injury, at which point a plain film is obtained to assess for progressive fracture displacement. This offers the surgeon an opportunity to intervene surgically if further displacement of the fracture is noted.

It is currently unknown whether follow-up radiographs change the clinical management of fifth metacarpal fractures or whether these radiographs provide any further utility beyond physical examination findings alone. The purpose of this study is to determine the clinical utility of the first follow-up plain film that is routinely performed for metacarpal fractures of the base, shaft, and neck by assessing the rate that these films change management recommendations.

Materials and Methods

All patients who presented to our level I trauma center with a fracture involving the fifth metacarpal were retrospectively screened for inclusion in our study. Patients with inadequate documentation or imaging, with concomitant injuries to the affected hand and wrist, or who underwent surgical fixation were excluded. Plain radiographs from the initial, postreduction, and the first follow-up clinic visit (range = 14-42 days) were compiled for 30 randomly selected patients. Posterior-anterior, oblique, and lateral hand radiographs were included for review. As this was strictly a radiographic study, patient information such as age, sex, and comorbidities were not identified.

Four board-certified attending hand surgeons and 2 hand surgery fellows reviewed the injury and postreduction films, and indicated their preferred course of care: NOM, closed reduction percutaneous pinning (CRPP), open reduction percutaneous pinning (ORPP), or open reduction internal fixation (ORIF). Reviewers were not asked for their treatment rationale as this was beyond the scope of our study. On a later date, at least 2 weeks after the first review session, the same reviewers assessed the same injury and postreduction films along with follow-up films from the patient's first clinic visit. The management decision was recorded again after viewing follow-up films, while the reviewer remained blinded to their initial management decision. The follow-up radiographs were randomized to avoid recall bias. Furthermore, the reviewers were not informed of the purpose of the study until after their second decision was recorded to avoid

any potential Hawthorne effect. All answers were recorded, and the number of times a follow-up film leads to a change in management was computed.

Descriptive statistics were used to report our findings. A Fisher exact test was used to assess for statistically significant differences between categorical variables. An alpha value of 0.05 was used as a cutoff to determine statistical significance. Fleiss kappa coefficient was used to compute interobserver reliability at the initial encounter and at follow-up for the 3 individual fracture types.

Results

A total of 60 patients with a fracture involving the fifth metacarpal who met our inclusion and exclusion criteria were initially identified. From this group, 30 patients were randomly selected for our study. This yielded 9 base, 7 shaft, and 14 neck fractures in our final analysis; therefore 6 reviewers resulted in 54, 42, and 84 initial and follow-up treatment decisions for the base, shaft, and neck fractures, respectively.

After reviewing initial radiographs, reviewers decided to treat 72.2% of base fractures (39 of 54 treatment decisions), 71.4% of shaft fractures (30 of 42 treatment decisions), and 91.7% of neck fractures nonoperatively (77 of 84 treatment decisions) (Figure 1). Observers were more likely to treat neck fractures nonoperatively compared with shaft fractures ($P = 0.0066$) and base fractures ($P = 0.0037$) based on a review of injury and postreduction radiographs.

After reviewing follow-up films, reviewers changed from an NOM to surgical intervention in 0.0% of base fractures (0 of 54 treatment decisions), 9.5% of shaft fractures (4 of 42 treatment decisions), and 1.2% of neck fractures (1 of 84 treatment decisions). Reviewers were less likely to recommend NOM for shaft fractures (30 of 42) compared with neck fractures (80 of 84; $P = 0.0003$) and base fractures (50 of 54; $P = 0.0112$) (Figure 2). Changes in management recommendations based on follow-up films were less likely to occur for neck fractures (8 of 84 decisions) compared with base fractures (13 of 54 decisions; $P = 0.0282$), but did not differ significantly from shaft fractures (7 of 42 decisions; $P = 0.2560$) (Figure 3).

All changes in treatment recommendations for base fractures were from surgical intervention to NOM, whereas follow-up radiographs led reviewers to recommend surgery for 4 shaft fractures ($P = 0.0337$), and 1 neck fracture ($P = 1.0000$) that reviewers had previously recommended NOM. There was no consensus about the type of operative intervention for the shaft fracture when NOM treatment recommendations were changed to surgical intervention after follow-up images were reviewed. For 1 shaft fracture, all 6 reviewers recommended NOM after reviewing initial images; however, 3 of these 6 reviewers recommended surgical intervention based on follow-up images (ie, 1 reviewer

Figure 1. Management decisions based on initial injury and postreduction radiographs.

Note. CRPP = closed reduction percutaneous pinning; ORPP = open reduction percutaneous pinning; ORIF = open reduction internal fixation.

Figure 2. Management decisions based on follow-up films.

Note. CRPP = closed reduction percutaneous pinning; ORPP = open reduction percutaneous pinning; ORIF = open reduction internal fixation.

recommended ORIF and 2 reviewers recommended CRPP; Figure 4).

In terms of interobserver reliability, initial treatment decisions for base, shaft, and neck fractures had only slight agree-

ment, with kappa coefficients of 0.0954, 0.0136, and 0.0856, respectively.¹⁵ Follow-up decisions for base, shaft, and neck fractures also showed only slight agreement, with kappa coefficients of 0.0471, 0.1158, and 0.1267, respectively.¹⁵

Figure 3. Changes in management between the initial management decision and after review of clinical follow-up radiographs.

Figure 4. (a) Injury (prereduction), (b) postreduction, and (c) 15-day follow-up radiographs of a patient with a right metacarpal shaft fracture revealing loss of reduction.

Note. Fracture angulation was measured at 41°, 29°, and 44° for prereduction, postreduction, and follow-up, respectively. Three of 6 reviewers indicated that they would intervene with surgery after reviewing the patient's follow-up radiographs.

Discussion

This study demonstrated that after the initial treatment choice for NOM for fractures of the fifth metacarpal, follow-up radiographs are of little clinical utility, particularly for fractures involving the base and neck. This study is the first to compare surgeon-specific treatment choices based solely on radiographs at the time of injury and at routine follow-up in an attempt to isolate the utility of follow-up radiographs alone. The results of this study have a potentially large economic impact. An estimated 605,947 hand fractures occur

annually in the United States with approximately 20% (121,189) occurring at the fifth metacarpal.^{9,14} The Medicare reimbursement for a hand radiograph is \$31.22 USD, which would result in a potential savings of \$3,783,533 USD if only 1 fewer radiograph was performed per patient were performed.⁸

When reviewing our data, only a 9.5% of shaft fractures, 1.2% of neck fractures, and 0% of base fractures changed from nonoperative to operative management based on follow-up radiographs. In addition, in the few fractures where the treatment choice was changed, not all reviewers agreed that operative management was necessary as indicated by our low kappa coefficients. Our results suggest that neck and base fractures do not require routine follow-up as they rarely alter management decisions. Our results also suggest that a subset (ie, in our study, 9.5%) of shaft fractures treated nonoperatively may displace enough to lead surgeons to recommend operative intervention after an initial period of immobilization, suggesting that follow-up radiographs for these injuries may be of more utility.

Fractures of the fifth metacarpal can often be managed nonoperatively with excellent results.^{1,3,16} There have been numerous studies comparing immobilization methods with no single method found to be clearly superior.^{13,18} In fact, some studies have advocated for no reduction or routine immobilization for patients without initial severe angulation, rotation, and displacement given the good to excellent outcomes achieved in this patient group.^{6,11,19,21} Studies have shown that patients who sustain a fifth metacarpal fracture are poorly compliant with follow-up, suggesting that the natural history of these injuries is relatively benign.¹² Bridging cortical bone is rarely, if ever, observed during the

routine follow-up period, which further calls into question the utility of these films.

The necessity of these clinical follow-up radiographs has been questioned recently, as some authors believe that most will heal uneventfully as long as a proper initial assessment is performed.^{2,7,12} A recent study demonstrated excellent patient-reported outcomes and patient satisfaction wherein only the more complex injuries were seen by an orthopedic surgeon and the rest of the patients were discharged from the emergency room with no radiographic or clinical follow-up.¹² The present study supports this trend in the literature for no routine follow-up in select patients if conservative treatment was chosen initially and no rotatory malalignment was noted on clinical exam.

The results of this study must be interpreted within the limitations of the study design. The reviewers in this study were asked to assess the radiographic parameters for operative management versus NOM but were not given clinical information such as physical exam findings or patient characteristics such as age, activity level, smoking status, and occupation, limiting the interpretation of their decisions. It is possible that the reviewers in our study may have continued NOM despite malalignment observed on follow-up radiographs if patient factors were considered. While the lack of patient characteristics is a notable limitation of our studies applicability to specific scenarios, we felt that including them would confound the decisions made by our reviewers. Understanding the role that patient factors play in the rationale of our reviewer's treatment decisions is beyond the scope of this study. Second, this study was retrospective, and many patients were excluded based on our inclusion or exclusion criteria, resulting in a potential for selection bias and possibly limiting the generalizability of our finding. Despite this theoretical limitation, we believe that the wide array of fractures in our study was representative of the fractures seen by most orthopedic surgeons.

The present study utilized 6 different hand-specialty reviewers who were blinded to the purpose of the study and prior management decisions, which decreased potential for bias and strengthened the findings of our study. The data in the present study suggest that follow-up radiographs are of little clinical utility in fifth metacarpal fractures of the base and neck that are treated nonoperatively for most patients. Based on these findings, we recommend routine follow-up radiographs only in patients with abnormal exam findings (ie, rotational deformity), increased or persistent pain, or history of potential reinjury. Foregoing follow-up radiographs may decrease consumption of health care resources and allow for more efficient use of physician and patient time. The economic implications of this research are far-reaching given the commonality of these injuries and warrant further investigation.

Conclusions

Follow-up radiographs are not indicated for most fifth metacarpal base and neck fractures. Follow-up radiographs may change management in select fifth metacarpal shaft fractures as these fractures may displace. Ultimately, need for follow-up radiographs should be assessed at the discretion of the treating surgeon on an as-needed basis for fractures at risk for displacement.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

No informed consent was required for this study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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