EDITOR'S CHOICE

Assessing Osteoarthritis Risk After Retrograde Intramedullary Headless Screw Fixation for Metacarpal Fractures: A Minimum Six-Year Follow-Up Study

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Purpose Retrograde intramedullary headless screws are increasingly used for metacarpal fractures, but concerns regarding long-term complications, such as metacarpophalangeal osteoarthritis, persist. This study evaluated osteoarthritic changes following this fixation method.

Methods A retrospective analysis of 41 patients treated with retrograde intramedullary headless screws between 2014 and 2018 was conducted, with a minimum follow-up of 72 months. Fracture healing and joint changes were evaluated through radiographs and computed tomography.

Results At a mean follow-up of 87 months, no osteoarthritic changes or chondrolysis were observed on radiographs or computed tomography scans. The screw affected an average of 17.5% of the metacarpal head's articular surface, with no evidence of erosion over time. Two early postoperative complications related to fracture treatment (one hardware failure and one malunion) occurred, both unrelated to osteoarthritic changes and without impact on long-term outcomes.

Conclusions Retrograde intramedullary headless screw fixation is not associated with long-term osteoarthritic changes over a 6-year follow-up. *(J Hand Surg Am. 2025;■(■):■−■. Copyright © 2025 by the American Society for Surgery of the Hand. All rights are reserved, including those for text and data mining, AI training, and similar technologies.)*

Type of study/level of evidence Therapeutic IV.

Key words Intramedullary screw, metacarpal fracture, percutaneous fixation.

METACARPAL FRACTURES ARE among the most common hand injuries.[1] Despite their prevalence, when indicated, there remains no consensus on the optimal surgical fixation method.[2] Treatment options vary depending on factors such as fracture type and location within the metacarpal. Common approaches include plate and screw fixation, transverse pinning, percutaneous Kirschner wire fixation, and intramedullary nailing.[3]

In recent years, the use of headless compression screws for metacarpal neck and shaft fractures has increased,[1,2,4–7] largely because of their short-term

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advantages, such as reduced surgical time, lower complication and reintervention rates, minimal soft-tissue morbidity, and faster return to work.[8,9]

With the growing popularity of retrograde intramedullary compression headless screw (RICHS) fixation, it is important to assess the potential complications associated with this technique. Although theoretical concerns have been raised about long-term issues such as joint surface defects and the risk of degenerative changes in the metacarpophalangeal joint (MCPJ), these have not been definitively observed in clinical practice.[8,10,11]

This study aimed to evaluate long-term osteoarthritic changes following RICHS fixation of metacarpal fractures. We hypothesize that RICHS is a safe procedure that does not increase the risk of osteoarthritis or negatively affect the joint surface.

MATERIALS AND METHODS

Patients

A retrospective analysis was made of 178 skeletally mature patients treated for metacarpal fractures between December 2014 and 2018. The study was conducted in accordance with the Declaration of Helsinki and approved by the local institutional review board. Inclusion criteria were as follows: short oblique or transverse metacarpal fracture involving the base, shaft, or neck; treatment with RICHS fixation; a minimum postoperative follow-up of 72 months; and a computed tomography (CT) scan performed at 3 months after surgery to assess bone consolidation, with at least one additional scan at the end of the follow-up to evaluate for joint degenerative changes. Exclusion criteria included a history of prior or concomitant injuries to the metacarpals or hand; evidence of arthritis in the MCPJ on preoperative radiographs; use of a metacarpal fracture fixation technique other than RICHS; and unavailability of complete clinical records. A total of 41 patients met the inclusion criteria and had a minimum of 6 years of follow-up. Demographic characteristics were summarized in Table 1.

All patients underwent surgery by the same senior hand surgeon (S.B.O.) in a specialized hand surgery institution.[12,13]

TABLE 1. Demographic and Fracture Characteristics

Variable	Value (%) (n = 41)
Age (y)	27 ± 10,74 (18−57)
Sex	
Female	14.6% (6)
Male	85.4% (35)
Time to surgery (d)	3 ± 2.5 (1−11)
Follow-up (mo)	87 ± 11.2 (72−108)
Dominant hand	
Right	75.6% (31)
Left	24.4% (10)
Affected side	
Right	63.4% (26)
Left	36.6% (15)
Fracture location	
Neck	48.8% (20)
Shaft	41.5% (17)
Base	9.7% (4)
Fracture type	
Transverse	53.7% (22)
Short oblique	46.3% (19)
Trauma cause	
Work-related	58.5% (24)
Sport injuries	41.5% (17)

Surgical technique

The RICHS surgical approach was performed following Urbanschitz et al[14] percutaneous technique, using partially threaded headless screws with diameters of 3.0, 3.2, and 4.0 mm (Osteomed) and 3.2 mm (BRM Extremities). Only one screw was used per fracture. Postoperative care involved a soft bandage for the first week, during which patients began an active range of motion and passively assisted exercises, as well as daily hand usage. From 2 to 4 weeks after surgery, patients were allowed to progressively resume all activities without restrictions.

Assessments

At follow-up, all patients underwent clinical evaluation by an independent senior hand surgeon. Clinical and radiographic assessments were conducted at 3, 6, and 12 months, and annually thereafter until discharge. Assessments relevant to the study objective of monitoring for osteoarthritis included clinical outcomes, radiographic findings, intraoperative and postoperative complications, additional surgical procedures, and any revision surgeries, defined as screw removal for any reason.

All patients underwent preoperative and postoperative sagittal and coronal radiographs of the

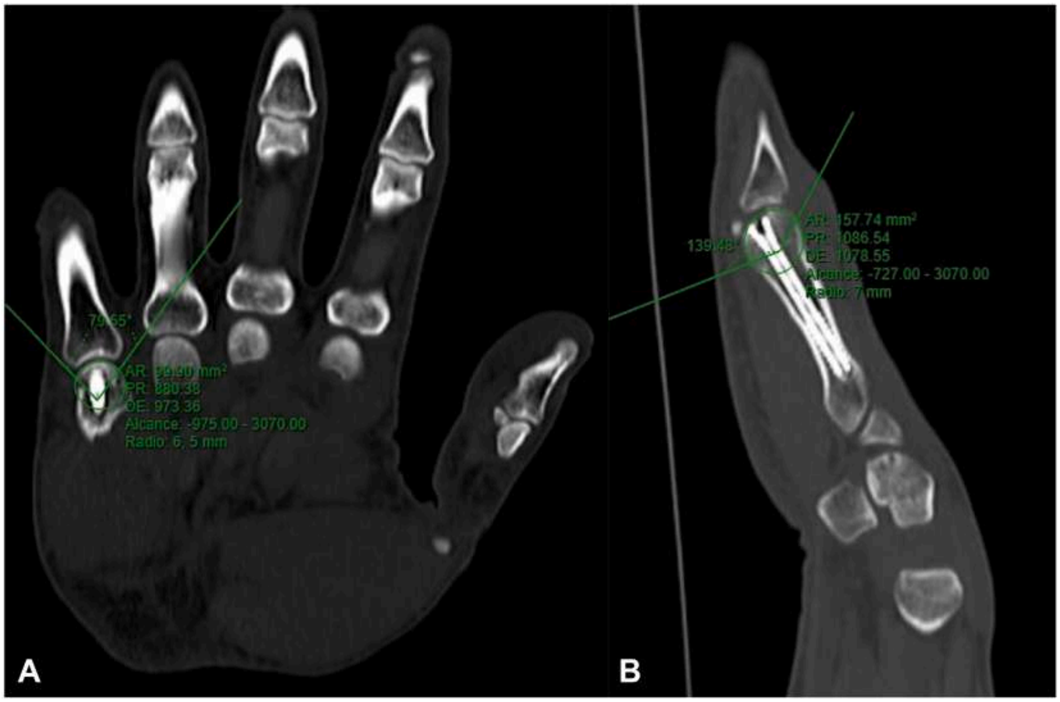

FIGURE 1: Metacarpal head articular surface.

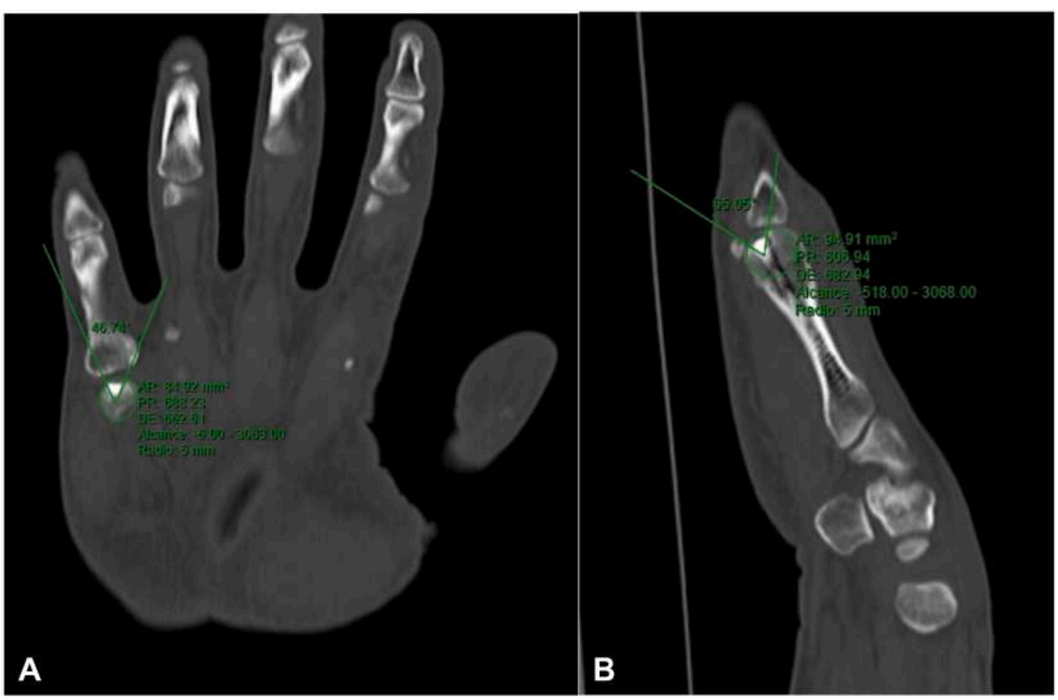

FIGURE 2: Articular surface defect by the screw.

injured metacarpal. Serial postoperative radiographs were obtained until fracture healing was confirmed, followed by annual radiographs throughout the follow-up period to monitor degenerative changes in the MCPJ and assess implant-related complications. Each patient also had a preoperative CT scan and a standardized postoperative CT scan at 3 months to document

TABLE 2. Patient Demographics and Fracture Characteristics

Variable	Value	*P* Value
Affected finger mobility		
Flexion MCP	85° (IQR: 85–90)	.02
Extension MCP	10° (IQR: 5–12.5)	.8
Flexion IP	90° (IQR: 90–90)	.6
Extension IP	0° (IQR: 0–0)	0
Contralateral finger mobility		
Flexion MCP	85° (IQR: 85–90)	
Extension MCP	10° (IQR: 5–15)	
Flexion IP	90° (IQR: 90–90)	
Extension IP	0° (IQR: 0–0)	
Grip strength		
Affected side	35 Kg (IQR: 32.5–44.5)	.7
Contralateral	34 Kg (IQR: 30–42)	
Quick-dash	5 (IQR: 0–10)	.3
Visual analog scale for pain		
in rest	0 (IQR: 0-1)	.1
in activity	0 (IQR: 0–1)	.08
CT		
3-mo consolidation	91.9% (SD 4.74)	.05
Articular surface area of metacarpal head	158 mm^2 (SD 24)	
Articular surface defect by the screw of the metacarpal head	27.mm^2 (17.5%) (SD 8.4)	.8
Sharp van der Heijde score		
Erosion	0 (Normal)	
Join space narrowing	0 (Normal)	

fracture union, defined as >50% cross-sectional trabeculation, and quantify any articular defect. A final CT scan was performed at the end of the follow-up period to evaluate degenerative changes and assess the progression of the articular defect. Degenerative joint disease was staged according to the Sharp Van der Heijde method to assess osteoarthritis of the MCPJ, evaluating articular surface erosion (score: 0–5) and joint space narrowing (score: 0–4).[15,16] To quantify the defect on the articular surface at 3 months after surgery, high-resolution CT scans with a slice thickness of 0.3 mm (Siemens SOMATOM Force) were performed for all patients to evaluate the impact of the screw on the cartilage of the metacarpal head. Three-dimensional reconstructions and articular surface measurements were conducted using OsiriX software (Pixmeo SARL). The articular surface area was calculated by measuring the perimeter of the metacarpal head on each coronal and sagittal CT slice, allowing for the derivation of the radius and angle of the articular surface (Fig. 1) The proportion of the articular surface affected by the screw was calculated by measuring the defect on each CT slice and expressing it as a percentage of the total joint area (Fig. 2).[14,17] All images were independently reviewed by two senior musculoskeletal radiologists to ensure measurement accuracy.

RESULTS

The study included 41 patients with a mean age of 27 years (interquartile range: 20–35 years). The median time to surgery was 3 days (interquartile range: 2–5 days), and the mean follow-up period was 87.2 months (SD: 11.21). The cohort was predominantly men (85.4%), and the dominant hand was affected in 63.4% of cases. Fractures were mostly located in the neck of the metacarpal (48.8%), followed by the shaft (41.5%) and the base (9.7%). Of these, 22 fractures were classified as transverse and 19 as short oblique. The detailed information regarding the affected metacarpal, including the number of patients, location of the fracture, type of fracture, average articular surface in mm^2, average percentage of articular defect, and associated complications, is presented in Table 2.

Radiographic outcomes

The average surface area of the head of the metacarpal was 158 mm^2 (SD: 24 mm^2; range: 111–231 mm^2), whereas the average articular surface area occupied by the cannulated screws was 17.5% (SD: 8.4%; range: 8%–33%). When analyzed according to screw diameter, the mean articular surface defect was 9.3% (average: 14.7 mm^2) for 3.0 mm screws, 13.2% (average: 23.2 mm^2) for 3.2 mm screws, and 25%–28% (average: 41–43 mm^2) for 4.0 mm screws. The average MCPJ surface area occupied by the screws was similar in the CT scan evaluation at 3 months and at the final follow-up. In the final follow-up CT scan, the screw-related defect on the articular surface showed no evidence of erosion in any patient. Consequently, all patients received a score of 0 for both erosion and joint space narrowing.

DISCUSSION

Despite the increase in published articles advocating the RICHS fixation method for metacarpal fractures in recent years, most clinical series have only reported short follow-up periods.[3,6,9,11,18] These studies often warn of a potential theoretical complication, the degeneration of articular cartilage within the MCPJ, which could result from long-term sequelae associated with this fixation technique.[11,19] Our study findings suggest that RICHS fixation for metacarpal fractures is a safe procedure, showing no development of osteoarthritis or chondrolysis even after a 6-year follow-up. These results provide strong evidence supporting its long-term use.

Urbanschitz et al[14] evaluated articular surface defects in cadaveric hands using CT and found that the median defect size on the articular surface ranged from 4.6% to 8.5%, depending on the screw diameter. However, they could not determine the threshold defect size that would be clinically relevant for the development of osteoarthritis. Similarly, ten Berg et al[17] demonstrated that 2.4 mm and 3.0 mm headless compression screws occupied an average of 4% to 5% of the metacarpal head. Kibar et al[19] reported no joint degeneration at the end of the first year of follow-up after using intramedullary headless compression screws, although long-term results were not studied. Warrender et al[3] found that fibrocartilage fills all screw entry sites, maintaining the congruence of the metacarpal head. The mean joint area affected by the screw entry site in our study was 17.5% (SD: 8.4%; range: 8%−33%) of the articular surface occupied by the cannulated screws, representing larger defects than those reported in previous studies. The larger chondral defects observed are attributable to two factors. First, we employed larger diameter screws (4.0 mm and 3.2 mm), which exceed the diameters typically reported in the literature for similar indications. Second, a large proportion of fractures involved the fifth metacarpal, in which the head has a relatively smaller articular surface area compared with other metacarpals. Despite this, no clinical symptoms or radiological signs of joint degeneration were identified during follow-up. Our findings suggest that, even with larger screw diameters, the RICHS fixation method is a safe and effective option for managing metacarpal fractures, with no loss of joint integrity over time. Although all fractures in this study were treated with headless compression screws, we believe that these findings may also be applicable to headless non-compression screws, given the similar biomechanical behavior and minimal articular impact associated with both types of implants.

This study has some limitations. The relatively small sample size may limit the ability to detect uncommon outcomes, although the consistent absence of osteoarthritis across all cases suggests that this finding is robust. Additionally, as this is a single-institution experience, the generalizability of the results to other settings could be questioned; however, given the standardized surgical technique and follow-up protocol, we believe that the findings are likely applicable to comparable clinical environments.

CONFLICTS OF INTEREST

No benefits in any form have been received or will be received related directly to this article.

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