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Original Research

## Long-Term Outcomes and Return to Work After Isolated Coronal Shear Fractures of the Capitellum

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**Purpose:** The purpose of this study was to analyze the ability of patients to return to work after ORIF of isolated capitellar shear fractures and assess long-term functional outcomes.

**Methods:** We retrospectively reviewed the cases of 18 patients with isolated capitellar shear fractures with or without lateral trochlear extension and investigated demographic data, occupation, worker's compensation status, injury characteristics, surgical details, motion, radiographic appearance at final in-person follow-up, complications, and return to work status via in-person and long-term telemedicine follow-ups.

**Results:** Final follow-up was at an average of 76.6 (7–222.6) months or 6.4 (0.58–18.6) years. Of the 14 patients working at the time of injury, 13 patients had returned to work at final clinical follow-up. The work status of the remaining patient was not documented. Mean elbow motion at final follow-up was 4° (range, 0–30) to 138° (range, 130–145) of flexion, 83° of supination, 83° of pronation. Two patients had complications that required reoperation but had no further complications. For the 13 of 18 patients with long-term telemedicine follow-up, the average Quick Disabilities of the Arm, Shoulder, and Hand score was 6.8 (0–25).

**Conclusions:** In our series, rates of return to work were high after ORIF of coronal shear fractures of the capitellum with or without lateral trochlear extension. This was true across all occupational classes including manual labor, clerical, and professional. With anatomic restoration of articular congruity, stable internal fixation, and postoperative rehabilitation, these patients had excellent ROM and functional scores at an average of 7.9 years of follow-up.

**Clinical relevance:** After ORIF of isolated capitellar shear fractures with or without lateral trochlear extension, patients can expect a high rate of return to work with excellent ROM and functionality and low long-term disability.

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Coronal shear fractures of the capitellum are uncommon, representing approximately 1% of all elbow fractures and 6% of distal humerus fractures.<sup>1–3</sup> The favored treatment for displaced coronal shear capitellar fractures is ORIF because nonanatomic reduction leads to obstruction of elbow motion and loose body formation.<sup>1</sup>

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Despite ORIF being the preferred treatment for displaced capitellar shear fractures, supporting evidence is limited to small case series.<sup>2–15</sup> Outcome data after ORIF are limited to small case series reporting short-term follow-ups, with postoperative ROM ranging from 91° to 134° in total arc of flexion-extension and 125° to 173° in pronosupination.<sup>7–10,12,14,16–20</sup> None of these case series have reported data regarding preinjury work status, worker's compensation status, and return to work after surgery. Because many of these patients are in the age group in which returning to work is relevant and the potential for long-term morbidity exists with concerns about avascular necrosis and arthritis, this parameter of patient outcomes is particularly relevant. The primary purpose of this study was to analyze the ability of patients to return to work after

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**Figure 1.** Injury radiograph of isolated coronal shear capitellar fracture in a 53 year old female nurse who sustained a ground-level fall resulting in a closed, isolated capitellar shear fracture with lateral trochlear extension without posterior comminution (type 1A).

**Table 1**

Demographic Data

Demographics and Occupational Information*			
Age	48 (22–78)		
Sex	F: 16	M: 2	
Handedness	RHD: 14	LHD: 1	
Injured Side	Left: 14	Right: 4	
Diabetes	Diabetic: 1	Non-Diabetic: 17	
Smoking	Never: 10	Former: 6	Current: 1
Work Status	Working: 14	Retired/unspecified: 4	
Occupation Category	Manual: 6	Clerical: 2	Professional: 6
Worker's Compensation	Yes: 2	No: 14	Retired: 3

LDH, left hand–dominant; RHD, right hand–dominant.

\* For tallies that do not total 18, information was not available in the electronic health record.

ORIF of isolated capitellar shear fractures. The secondary purpose was to assess functional outcomes after ORIF of these uncommon fractures. We hypothesized that return to work rates would be high, given standard efforts for anatomic reduction, early postoperative motion, early strengthening after fracture healing, and vocational retraining with hand therapy.

## Methods

This study was approved by our Institutional Review Board (IRB) of Mass General Brigham (IRB#2010P002462). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all individual participants included in this study. A retrospective study of all patients who underwent ORIF of distal humerus fractures between November 2002 and August 2020 at an integrated health system consisting of two level I trauma centers and two community teaching hospitals was performed. Patients were identified through query of the institutional billing database, using the common procedural terminology code 24579 (open treatment of humeral

condylar fracture, medial or lateral, with or without internal or external fixation). Patients were included if they underwent operative fixation of an isolated coronal shear fracture of the capitellum with or without trochlear extension. Patients were excluded if they had any medial trochlear or medial column extension or if they did not have at least 6 months of in-person or virtual follow-up.

Our initial query yielded 152 patients with condylar humerus fractures. Of these, 32 patients with isolated coronal shear fractures of the capitellum with or without lateral trochlear extension that required fixation were included in this study. Fourteen patients were excluded because of inadequate follow-up; therefore, a total of 18 patients were included in the final analysis. Classification of fractures was performed on the basis of the classification of isolated capitellar shear fractures with or without lateral trochlear extension as described by Dubberly et al.<sup>9</sup> Only type 1 fractures were included (fractures involving primarily the capitellum with or without involvement of the lateral trochlear ridge), such as that represented in Figure 1. Fractures were subclassified into types A and B, which indicated the absence or presence of posterior column comminution, respectively.<sup>9</sup>

Demographic data, occupation, worker's compensation status, injury characteristics, surgical details, motion, radiographic

**Table 2**  
Fracture Characteristics

Fracture Classification*	
Type 1A	14
Type 1B	4
Closed	17
Open	1

\* Classification of fractures was performed based on the classification of isolated capitellar shear fractures with or without lateral trochlear extension as described by Dubberly et al.<sup>9</sup>. Type 1: fractures involving primarily the capitellum with or without involvement of the lateral trochlear ridge. A: no posterior column comminution, B: posterior column comminution.

appearance at final in-person follow-up, complications, and return to work status were obtained through medical record review. Type of occupation was categorized into professional, clerical, manual, domestic, student, retired, or unemployed.<sup>19</sup> The primary outcome was return to work. The secondary outcomes were 0–10 Likert pain score; *Quick* Disabilities of the Arm, Shoulder, and Hand (*QuickDASH*); return to normal activities; and surgical complications. If a numerical description regarding elbow ROM was not listed in the chart but rather a descriptive report such as “full motion” was used, the numerical assignment was listed as 0° extension, 140° flexion, 80° supination, and 80° pronation. Attempts were made to contact all patients for virtual video follow-up visits. Motion was measured based on the virtual imaging obtained. For those who did not consent to video visits, the most recent assessment in-person was used.

## Results

Of the 18 patients who were included, the average age was 48 years (range, 22–78 years). Demographic data are displayed in [Table 1](#). The majority of the patients were right hand–dominant women. The left elbow was most commonly injured. One patient had diabetes mellitus, and one patient was a current smoker at the time of surgery. Fourteen patients were working at the time of injury, and two patients were injured while working and had worker’s compensation insurance. There were six patients whose occupation was classified as manual; six, professional; two, clerical; three, retired; and one, unspecified.

Fracture characteristics are shown in [Table 2](#). There were 14 type 1A fractures and four type 1B fractures.<sup>9</sup> Seventeen fractures were closed, and one fracture was open. The average time from injury to surgery was 7 days (range, 1–21 days). All fractures were fixed with screws alone. Type, number, and configuration of screws are shown in [Table 3](#). Headless compression screws were used alone (such as that shown in [Fig. 2](#)) or in conjunction with headed screws in 13 of 18 cases (72%). Final follow-up was at an average of 76.64 (7–222.6) months or 6.4 (0.58–18.6) years. For patients who only had clinical, in-person follow-ups (5/18 patients), final follow-up was at an average of 21.9 (7–58.9) months. For patients with telemedicine follow-ups (13/18 patients), final follow-up was at an average of 94.9 (20.4–222.6) months or 7.9 (1.7–18.6) years.

Mean elbow motion was 4° (range, 0–30) to 137° (range, 130–145) of flexion, 83° of supination, and 83° of pronation. Of the 14 patients working at the time of injury, 13 patients had returned to work at final clinical follow-up. The work status of the remaining patient was not documented in the medical record. The average radiographic follow-up was 443 days with a range of 46–2,575 days. Radiographic outcomes are reported in [Table 4](#); there were no documented nonunions and two cases of avascular necrosis.

There were two patients with complications that required reoperation. One patient had failure of fixation requiring revision

**Table 3**  
Fixation Details

Type, Number, and Direction of Screws				
Type of screw	Headless: 11	Headed: 5	Mixed: 2	
Number of screws	2 screws: 11	3 screws: 5	4 screws: 2	
Direction of screws	Anterior-to-posterior: 9	Posterior-to-anterior: 5	Multidirectional: 3	Lateral-to-medial: 1

ORIF at 16 days. At telemedicine follow-up 4.6 years after the initial surgery, this patient reported no additional complications and had 0° to 140° arc of flexion/extension, with 90° of supination and 85° of pronation. The *QuickDASH* score was 2.3. Another patient had avascular necrosis requiring elbow arthroscopy, open capsular release, removal of hardware, and removal of loose bodies at 265 days. At telemedicine follow-up 2.7 years after the initial surgery, this patient reported no additional complications. The ROM in flexion/extension was 30–130, with 90° of pronation and 90° of supination. The *QuickDASH* score was 9.1.

For the 13 patients who participated in the long-term virtual encounter [at an average of 2,887 (620–6,772) days (7.9 years)], the average 0–10 Likert pain score was 0.1, with a range of 0–1. The average *QuickDASH* score was 6.8 with a range of 0–25. All who were working at the time of injury reported that they had returned to work. All these patients denied further complications or surgery.

## Discussion

This study corroborates previous reports that state that isolated capitellar shear fractures are rare injuries<sup>2–15</sup>, with our 20-year review of cases at two level 1 trauma centers and two community teaching hospitals only identifying 32 such cases. We also found that our results were consistent with the previously reported higher prevalence in women, which has been attributed to the higher carrying angle in the female elbow in addition to the higher fracture risk because of postmenopausal osteoporosis.<sup>19,21</sup> This report emphasizes occupational factors related to these rare injuries, namely, preinjury work status, occupational classification, worker’s compensation status, and return to work. We found a remarkably high rate of return to work after ORIF of these fractures followed by aggressive postoperative rehabilitation, with all patients who were working before their injury reporting that they had returned to work at final follow-up. Return to work was high among all occupational classes in our cohort including manual, clerical, and professional careers, although our numbers did not allow for comparison between groups.

Another strength of our study is the long-term follow-up for the majority of patients, with virtual follow-up for 13 patients being at an average of 2,887 (620–6,772) days (7.9 years). To our knowledge, this is the longest follow-up period to document a lack of late developing symptoms for these injuries.

Our study has several limitations. The available preoperative imaging may have limited our ability to classify all of these injuries accurately. Classifying these fractures based on plain radiographs often underestimates the extent of the injury, and as such, CT scans may be beneficial for preoperative planning and has been recommended by some authors.<sup>19</sup> Six patients in our series, however, did not have CT scans for evaluation and classification purposes. As such, we relied on the available plain radiographs and operative reports to determine the extent of trochlear involvement and whether posterior comminution was present.



**Figure 2.** Three-month postoperative radiograph of the same patient post ORIF with headless compression screws in the anterior-to-posterior direction.

**Table 4**  
Radiographic Outcomes

Radiographic Finding	Number of Patients
Articular irregularity without step-off	13
Heterotopic ossification	4
Capitellar osteopenia	2
Avascular necrosis	2
Loose bodies	1

After surgery, this study was limited by the rate of clinical follow-up, which forced us to exclude 14 patients (43%) from the initial 32 patients otherwise qualifying fractures. This challenge is most likely related to the large catchment area of our tertiary referral academic centers that require long-distance travel for many patients. This introduces the possibility of bias and could skew the series to represent patients with different outcomes. In addition, in-person follow-ups were further complicated by the coronavirus disease 2019 pandemic. Despite repeated efforts to contact patients for follow-ups, many were not willing to return for in-person follow-ups, and only 13 of the 18 patients participated in the long-term virtual encounter. As a result, it is unknown what outcomes and complications were not captured in the five patients who did not participate in virtual long-term follow-up. Furthermore, this study was also limited by its retrospective design owing to the rarity of these injuries. As such, the recording of postoperative outcomes, such as ROM, was nonstandardized. For example, in some cases, elbow ROM was not described numerically but rather as being “full” flexion/extension or pronosupination. If there was any abnormality or asymmetry with the contralateral side, we found that surgeons always gave numerical values that could be used for comparison at long-term telemedicine follow-ups.

With respect to patient-reported outcome measures (pROMs), despite inconsistency in the use of particular pROMs in the record during clinical follow-up, we were able to perform QuickDASH surveys at virtual follow-ups for 13 patients at an average of 7.9 years after surgery, with excellent functional outcomes being found [QuickDASH average, 6.8 (0–25)]. This study adds to the body of

evidence of lasting, good patient-reported outcomes after ORIF of these fractures through various other pROMs used in previous studies analyzing these fractures (such as the Mayo Elbow Performance Index and the American Shoulder and Elbow Surgeons score).<sup>7,9</sup>

## Conclusions

In our series, rates of return to work were high after ORIF of coronal shear fractures of the capitellum with or without lateral trochlear extension. This was true across all occupational classes including manual labor, clerical, and professional. With anatomic restoration of articular congruity, stable internal fixation, and postoperative rehabilitation, these patients had excellent ROM and functional scores at an average of 7.9 years of follow-up.

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