Capitellar Fractures—Is Open Reduction and Internal Fixation Necessary?

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Objective: The purpose of this retrospective study was to evaluate the medium-term to longer-term results of type 1 displaced capitellar fractures treated with closed reduction.

Design: Retrospective case series.

Patients: Eight consecutive cases (7 adults; 1 child) with type 1 capitellar fractures.

Intervention: Closed reduction of type 1 capitellar fractures and 4 weeks of postreduction immobilization.

Outcome Measures: Complications (including radiographic), Disabilities of the Arm, Shoulder, and Hand Score, and active elbow range of motion.

Results: Average follow-up was 41.6 months (range, 18–77 months). All 8 fractures were united. The patients obtained near full return of the range of motion when compared with the uninjured contralateral side. Mean average Disabilities of the Arm, Shoulder, and Hand Score scores were 4.36 (SD, 2.68; Range, 0–9). No complications were observed.

Conclusions: This study demonstrated that type 1 capitellar fractures can be treated successfully with closed reduction and cast immobilization.

Key Words: humeral fracture, manipulation, orthopaedic, elbow joint, intraarticular fracture, treatment outcome, follow-up study, recovery of function

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

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INTRODUCTION

The management of fractures of the elbow is challenging because of the complex anatomy and biomechanics of the joint. The capitellum forms the anterior and inferior surface of the distal humerus of the elbow joint. Capitellar fractures are very rare constituting <1% of all elbow injuries.[1,2] These injuries occur almost exclusively in adults and are more common in women.[1,2] Capitellar fractures are caused by shearing forces anterior to the center of the capitellum.

Capitellar fractures are classified according to their pattern of injury, and various classification systems exist. Bryan and Morrey classified this type of injury with a further modification by McKee et al.[3] According to their system, type 1 fractures are 2 part coronal plane injuries; type 2 injuries are chondral sleeve type injuries; type 3 injuries are highly comminuted nonreconstructible fractures; and type 4 injuries involve a large fragment extending beyond the capitellum into the lateral condyle proper. This article looks exclusively at the treatment of type 1 injuries using the Bryan and Morrey classification system. Capitellum fractures may also be classified according to the OTA classification.[4] According to the OTA classification system, these fractures would be classified as 13-B.3.1.2.

The literature reveals a number of differing reports on the preferred treatment of capitellar fractures including internal fixation, excision of the capitellum, and closed reduction.[3,5–11] Unsuccessful treatment of these injuries results in intraarticular incongruity and early degenerative joint disease.[12,13] The advocates of internal fixation report that closed reduction is difficult and often results in the loss of reduction and increased risk of developing avascular necrosis. Previous studies have reported on the use of internal fixation for type 1 fractures with varying clinical and radiological success.[3,5–8] There is also concern that excision of the capitellar fragment may result in valgus deformity of the elbow and subsequent instability.[12,13] Those in favor of closed reduction have reported superior, clinical, and radiological outcomes.[14–17] However, there have also been reports of failure after closed reduction resulting in surgical intervention being required to internally fixate the fracture.[9] As a result of these mixed reports, there is no clear consensus on the management of these fractures.

There are 3 recent reports in the literature on the use of closed reduction to manage type 1 capitellar fractures.[9–11] Both Dushuttle et al and Ochner et al reported good results in patients who underwent closed reduction with 3 weeks of postoperative immobilization.[9,10] Dushuttle et al reported on

a cohort ranging from 12 to 76 years; 7 underwent attempted closed reduction, 3 of these were converted to open reduction and internal fixation (ORIF).[9] Overall, the 4 patients who remained in the closed reduction group had the best range of motion (average elbow flexion extension arc of 140 degrees) compared with the other surgical treatment. Similarly, Ochner et al reported on the results of his series of 9 patients who regained nearly normal elbow range of movement, with no complications including no cases of avascular necrosis.[10] More recently, Puloski et al reported on 7 consecutive patients with type 1 fractures treated with closed reduction and immobilized for 14 days. They reported good short-term (average 18 months) clinical outcomes [including average Disabilities of the Arm, Shoulder, and Hand Score (DASH) score of 9.1 and average elbow flexion extension arc of 126 degrees] with no complications observed radiologically.[11]

Overall, there is a paucity of the literature on the treatment of type 1 capitellar fractures, and studies are limited to case reports with small samples. The purpose of this study was to assess the medium-term to longer-term results of a consecutive case series of patients managed with closed reduction and 4 weeks of immobilization.

Participants

This case series represents all the patients presenting to our clinic in Brisbane, Australia over a period of 5 years with a type 1 capitellar fracture. No patient presenting to our clinic was treated with ORIF.

All adults (n = 7) with type 1 displaced capitellar fractures, who were treated with a closed reduction, were contacted for clinically and radiological examination.

Patients were included if they were a minimum of 18 months after the closed reduction.

We also successfully treated 1 pediatric patient using the same technique and rehabilitation as the adults.

PATIENTS AND METHODS

Patients were contacted and invited to attend a one-time study evaluation. After consent, clinical evaluations were performed by a by an upper limb fellowship trained orthopaedic surgeon who was not involved in the patient's care.

Any plain radiographs that had been taken prereduction and postreduction were retrospectively reviewed for this study. Our standard management of these patients is to obtain plain radiographs and computed tomography scans before intervention, therefore all patients had these available (Figs. 1 & 2). Plain radiographs were also taken routinely postoperatively to assess union and position of the fracture. However, these were taken at various time points. Plain radiographs (anterioposterior and lateral) were taken at the time of the study evaluation specifically for the purpose of this study. All available radiographs were independently reviewed by 2 fellowship trained surgeons on 2 separate occasions to minimize reporting bias. They reported on union, avascular necrosis, and early osteoarthritic changes in the elbow.

Elbow range of motion was measured using a goniometer, with comparisons being made to the contralateral unaffected side by an upper limb fellowship trained surgeon.

FIGURE 1. Lateral radiograph of type 1 capitellar fracture.

The DASH was conducted to measure symptoms, function, and disability. On this score, zero indicates the best score possible (no deficits or symptoms), and 100 indicates the worst score possible. All patients including the pediatric patient (aged 11) scored with the DASH. Although the DASH has not been validated on pediatric patients, there are no other scores measuring symptoms, function, and disability for children. Also, the DASH score has been used as a measure of disability previously in pediatric populations.[18,19]

FIGURE 2. Computed tomography of the same injury. **Editor's note:** A color image accompanies the online version of this article.

FIGURE 3. Lateral radiograph 6 months after injury in the same patient showing complete union with no avascular necrosis or joint degeneration.

For this study, we obtained ethical approval from our institution's human research ethical review board. We will report on the results of the pediatric patient separately to the adult patients.

Closed Reduction Technique

The mean average time from injury to reduction was 3.5 days (range, 1–5 days). Reduction of the fracture was achieved by maximally extending the elbow as the initial step to reduce the deforming forces on the fragment from the radial head. With the elbow extended, firm pressure was placed anteriorly over the position of the fragment lying proximal to the capitellum by the surgeon's thumb. Keeping this pressure applied, the elbow was then flexed trapping the fragment in position between the residual capitellum/distal humerus and the radial head. An intraoperative image intensifier was then used to confirm the

satisfactory reduction of the fracture. Six of the 7 patients required only a single maneuver to achieve anatomic reduction; 1 patient required a repeat reduction maneuver under the same anesthetic to achieve an anatomic reduction. All patients were immobilized in a plaster at 90 degrees for 4 weeks after reduction.

Posttreatment Rehabilitation

After a period of 4 weeks of immobilization, a physiotherapy program consisting of active and passive elbow mobilization was commenced. There were no restrictions on the range of movement, either flexion/extension or pronation/supination, and no further splintage was deemed necessary.

RESULTS

All patients who had this procedure at our institution were able to be clinically and radiologically reviewed for the purpose of this study. This included 7 adult patients and 1 pediatric patient. For the adults, ages ranged from 42 to 71 (median age, 49) years, with 3 women and 4 men. The pediatric patient was 11 years old.

Average time from surgery to clinical and radiological evaluation was 41.6 (range, 18–77) months for all patients included in the study.

Radiographic Outcomes

Radiographs of all 7 adult elbows showed that the fracture had united in an appropriate position with no evidence of osteoarthritic change (Figure 3). Scans at 2 months of 1 patient (aged 71) indicated sclerosis in the capitellar fragment, which could be suggestive of avascular necrosis. However, final radiographs at 35 months after injury demonstrate no evidence of avascular necrosis in this patient.

Clinical Outcomes

Patient regained on average 97% of their active elbow flexion and 83% of elbow extension at the final review as compared with the contralateral side. Supination and pronation was measured as being normal in all 7 patients. Mean difference in extension compared with the contralateral side was 7.8 (range, 0–10) degrees and flexion was 3.6 (range, 0–5) degrees. One patient had a 15-degree extension deficit but had otherwise obtained full return of the range of motion. Table 1 displays the results of flexion and extension range of movement as compared with the contralateral uninjured side, and the DASH scores for the 8 patients.

Mean DASH score was 4.36 (SD, 2.68; range, 2–9). One patient, although having a low DASH score, found that his elbow made him feel less capable than it did before the injury. This was due to his participation in high impact sport (mountain climbing and martial arts). However, he did not feel less capable than his preinjury level of function in his activities of daily living.

TABLE 1. Postreduction Range of Motion and DASH Scores

| Patient | Flexion | | Extension | | DASH Score |
	Injured Limb	Uninjured Limb	Injured Limb	Uninjured Limb	
Pediatric Case	150	150	0	0	0
Adult I	140	140	10	0	2
Adult II	145	150	15	5	9
Adult III	130	135	10	0	4
Adult IV	145	150	5	0	2.25
Adult V	135	140	5	0	4
Adult VI	145	145	5	0	2.27
Adult VII	140	145	10	0	7

Complications

No patients had failure of the closed reduction. No intraoperative complications were reported in the patient's medical file. None of the 7 patients required revision surgery.

Results of Pediatric Case

For the pediatric patient, the DASH score at the final follow-up of 38 months was 0. There was no difference in elbow range of motion compared with the normal contralateral side. No complications were noted on plain radiograph. The pediatric patient has required no further treatment.

DISCUSSION

This group of 8 patients (7 skeletally mature and 1 skeletally immature) demonstrates that type 1 capitellar fractures can be treated very successfully with closed reduction and 4 weeks of postreduction cast immobilization.

In previous studies, they report on 2 to 3 weeks of immobilization after closed reduction. In series of Deshuttle et al, 3 of 7 patients, who initially were managed with closed reduction, had further surgery to openly reduce and internally fixate the fracture. We believe that 3 weeks or less of immobilization is not sufficient time for the fracture to unite. Elbow extension within this period may increase the risk of displacement resulting in poorer outcomes. We found in our series that the longer 4-week immobilization timeframe did not result in elbow stiffness, and no radiological complications were observed.

Our group of 8 patients had no complications as a result of their intervention. This is similar to the findings of previous authors who have reported on the outcomes of closed reduction.[10,11] Complications that have been reported from ORIF include pain associated with metalwork, ulnar neuropathy, elbow contractures, and infection.[8,13] These complications usually require further operative management. When comparing the 2 treatment methods, closed reduction achieves good union rates, range of movement, and functional scores without the reported complications of an open procedure.

Although, we did not encounter any type 1 capitellar fractures that could not be reduced by closed means, we would still recommend consenting the patient for possible ORIF before the anesthetic.

Limitations of this study include the retrospective nature of the study and our small sample size. However, because the incidence of this injury is rare, we believe that our study design and small sample still contribute considerably to the paucity of studies on this topic. Although there are reports of closed management of this very rare type of injury in the literature,[10,16] we believe our series of 7 has the longest average follow-up. Further studies using larger cohorts with prospective study designs are needed. In addition, it would also be beneficial for the future studies to use reliable and validated measures of symptoms, function, disability, and quality of life.

CONCLUSIONS

Closed reduction can achieve anatomic reduction of type 1 capitellar fractures. It can be an effective treatment with predictably good results based on this consecutive series of patients.

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