Closed Reduction and Early Mobilization in Fractures of the Humeral Capitellum

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Summary: Seven consecutive patients with an isolated fracture of the humeral capitellum were treated by a single surgeon at a Level II care facility according to a simple treatment algorithm. Closed reduction was attempted in all cases using a standard technique. After reduction, the arm was splinted at 90° of flexion and mobilized at 14 days. All patients completed a clinical and radiographic follow-up consisting of a radiographic evaluation of reduction, elbow range of motion, Disabilities of the Arm, Shoulder and Hand Questionnaire, and a subjective rating of patient satisfaction. None of the patients required conversion to open reduction internal fixation or excision. Disabilities of the Arm, Shoulder and Hand Questionnaire scores ranged from 6 to 13 points (out of 100; mean, 9). The mean flexion/extension arc of motion obtained was 126° with minimal loss of rotation. Patient satisfaction was rated as excellent in five patients and good in two. All fractures appeared united at the most recent clinical and radiographic review. Closed reduction and early mobilization appears to be a safe and effective method of treating displaced fractures of the humeral capitellum with clinical results comparable to that of open reduction internal fixation.

Key Words: capitellum, closed reduction, early range of motion

INTRODUCTION

Fractures of the capitellum constitute a small proportion of the overall injuries to the distal humerus.1 This injury, however, can be difficult to manage owing to the size, intra-articular location, and tenuous vascular supply to the main bony fragment. Most of these injuries occur in younger women and result from shear of the fragment when the elbow is struck from a direct blow or when a load is applied with the elbow in full extension.2 The most common capitellar fracture pattern (Type 1) results in a Hahn-Steinthal fragment (Fig. 1) and occurs in approximately 80% of cases.3 Current literature confirms a varied approach to these injuries, including internal fixation,4–15 closed management,14,15 and primary excision.16 Many of the current trauma resources focus on open reduction internal fixation (ORIF) as the mainstay of treatment.1,17 Primary excision is used when the fracture is comminuted and cannot be reconstructed. Successful closed reduction has been described in small case reports and mixed treatment series14,16,18 but is considered by many to be unpredictable.3,17 The reported disadvantage of closed treatment is the apparent difficulty in achieving and maintaining reduction. In addition, a prolonged period of immobilization (minimum of 3 weeks) is suggested, which may contribute to clinically significant elbow stiffness and poor functional results.2

A single surgeon at our center has now managed a consecutive series of seven patients with Type 1, displaced capitellar fractures using closed manipulation and early motion. The purpose of the present study is to describe the technique of closed reduction for displaced fractures of the capitellum and to describe the clinical and radiographic results in a series of seven patients.

TECHNIQUE

The reduction technique was performed in all patients by a single surgeon. The patient is brought to the operating room and general anesthesia is induced with full muscle relaxation. The elbow is brought into full extension with the forearm fully supinated. The fragment will typically reduce with this maneuver but rarely direct downward pressure on the fragment is required. The elbow is then flexed with gentle traction and varus tension, thus “locking” the fragment as it is captured by the radial head at approximately 40° of flexion. An image intensifier was used to confirm the fracture reduction and to ensure that the fragment did not displace during elbow flexion (Fig. 2). A posterior splint was applied with the elbow at 90°. Gentle mobilization with active range of motion was encouraged approximately 14 days after reduction.

PATIENT SERIES

Seven consecutive patients with displaced Type 1 (Hahn-Steinthal) fractures of the humeral capitellum were treated by a single surgeon at our Level II trauma facility over a 3-year period from 1999 to 2002. Ethical approval was obtained from our Institutional Research Ethics Board for review of patient files and for prospective clinical evaluation. All patients had undergone treatment of their capitellum.
fracture as per the surgeon’s normal treatment algorithm (Fig. 3). The closed reduction technique used was similar to that described by Ochner et al.14 During the 3-year study interval, there were no patients with displaced fractures that failed closed reduction and required open reduction and/or internal fixation in this single surgeon’s practice.

Follow-up evaluation included clinical and radiographic assessment. Intraoperative, early postoperative, and final review radiographs were assessed for the adequacy of reduction and evidence of union. These were graded as anatomic, near anatomic (less than 2 mm displaced) or displaced (greater than 2 mm). Clinical assessment included objective active range of motion (flexion, extension, pronation, supination), overall patient satisfaction (excellent, good, poor), and completion of the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, a validated, subjective measure of upper extremity function. Reference values for the DASH in the literature include mean scores in patients after internal fixation of both bone forearm fractures and distal humerus fractures of 12 and 20, respectively.19,20

All seven patients were female and all fractures occurred from direct blows to the elbow during falls from a standing height. The mean age of the patients was 32 years (range, 18–44 years). The dominant extremity was affected in four of the seven patients, and three cases involved the Worker’s Compensation Board. All but one case was treated within 36 hours of the injury. This case was delayed by 7 days because the patient was traveling out of the country and chose to return home for treatment. Postoperative immobilization was discontinued approximately 14 days after reduction. Total immobilization time, including pretreatment, lasted for a mean of 16 days (range, 14–21 days). The mean duration of follow-up was 18 months (range, 12–46 months).

Radiographic review revealed anatomic reduction in six cases and near-anatomic (less than 2 mm displaced) reduction in one. There were no cases of lost reduction in the early or late follow-up period (Fig. 4). No cases of avascular necrosis were apparent on plain radiographs.

Clinical complaints were minimal except in one patient who developed a flexion contracture of 45°. Overall elbow
motion was excellent and a functional arc was obtained in six of seven patients. The mean flexion arc measured 126° (range, 80°–145°) with a mean loss of flexion and extension of 3° and 12°, respectively, when compared with the contralateral side. No substantial loss of forearm rotation was noted in any of the patients. Five patients rated their overall satisfaction as excellent with the remaining two rating good. The mean DASH score was 9.1 out of 100 (range, 5.8–13), which is indicative of little to no absence of function. An overall summary of patient demographics and results is shown in Table 1.

**DISCUSSION**

Fractures of the capitellum represent a relatively uncommon injury to the upper extremity but can result in significant functional impairment if treated inappropriately. The optimal course of treatment for these fractures remains somewhat controversial. Unfortunately, many of the studies reporting on management include heterogeneous groups and/or small sample sizes, which complicate any statistical interpretation. Despite this, ORIF remains the recommended treatment modality in much of the contemporary literature. In two recent review papers, reference is made to closed reduction as an option for treatment but ultimately this was discouraged, citing a number of potential disadvantages including poor functional results. Other reasons as to the continued lack of enthusiasm for this technique include 1) lack of experience with the reduction maneuver; 2) perceived duration of immobilization; and 3) consistency in which the reduction is obtained. Interestingly, Dushuttle’s initial series of 17 patients comparing closed and open reduction found that closed treatment in fact yielded the best clinical outcome but was successful in only 50% of cases when it was attempted. Unfortunately, ORIF is also fraught with an equal number and often more serious list of treatment difficulties. These include problems with surgical access and exposure leading to iatrogenic osteonecrosis, fragmentation during fixation, intra-articular hardware, and postoperative stiffness.

In the present study, we describe the results of seven consecutive patients with displaced capitellar fractures treated successfully with closed reduction and early mobilization. At the time of initiation of this study, this group of patients represented all of those who had been treated by a single

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**TABLE 1. Patient Demographics and Clinical Results**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yr)</th>
<th>Side</th>
<th>Dominant Hand</th>
<th>DASH Score</th>
<th>Flexion Arc, Range (Degrees)</th>
<th>Rotation</th>
<th>Overall Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
<td>Right</td>
<td>Right</td>
<td>13</td>
<td>0–145</td>
<td>Full</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>Left</td>
<td>Left</td>
<td>8</td>
<td>0–135</td>
<td>Full</td>
<td>Excellent</td>
</tr>
<tr>
<td>3</td>
<td>44</td>
<td>Left</td>
<td>Right</td>
<td>12</td>
<td>45–125</td>
<td>10 Loss</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>Left</td>
<td>Right</td>
<td>6</td>
<td>0–135</td>
<td>5 loss</td>
<td>Excellent</td>
</tr>
<tr>
<td>5</td>
<td>38</td>
<td>Right</td>
<td>Right</td>
<td>8</td>
<td>0–140</td>
<td>Full</td>
<td>Excellent</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>Right</td>
<td>Right</td>
<td>10</td>
<td>10–130</td>
<td>Full</td>
<td>Excellent</td>
</tr>
<tr>
<td>7</td>
<td>22</td>
<td>Left</td>
<td>Right</td>
<td>0</td>
<td>5–140</td>
<td>Full</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

ROM, range of motion; DASH, Disabilities of the Arm, Shoulder and Hand Questionnaire.

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FIGURE 4. Radiographs of displaced fracture of the humeral capitellum (A) reduced with closed manipulation and early mobilization. The fracture healed in an anatomic position by 2 months (B–C) and the patient maintained excellent elbow range of motion.
surgery in the described period after initiating a treatment algorithm that always included an attempt at closed reduction. Overall, the functional outcomes in these patients were excellent as revealed by the relatively low level of disability (according to the DASH), minimal loss of elbow motion, high patient satisfaction, and a low complication rate. In the single patient with appreciable loss of extension (45°), subsequent imaging with both computed tomography and magnetic resonance imaging confirmed a near-anatomic reduction but evidence of posterior bony impaction (Fig. 5). The posterior bone loss and articular incongruity were not appreciated on plain films but may have potentially led to some loss of extension. If there are questions regarding the fracture pattern or quality of reduction, computed tomography imaging should be obtained. This patient still considered her overall result as good and scored low (13 of 100) in her DASH.

Although our series is small, it represents the largest consecutive group of patients that have been treated successfully with closed reduction as reported in the literature. In a similar sized series by Ochner, closed treatment was performed in nine patients, four of which had been previously included in an earlier study comparing open and closed treatment. Unfortunately, in the study, there is no mention as to the concomitiveness of the patients; hence, little can be drawn from their rate of success using the closed technique. Although most of the patients described minimal complaints, no objective evaluation of functional outcome was performed. The use of the DASH questionnaire, a validated outcome measure used in our study, improves on the validity of the functional assessment.

In light of our outcomes and because of the aforementioned potential problems with internal fixation, we suggest that a serious attempt at closed reduction should always be pursued. We have been encouraged with our rate of success in obtaining reduction using the described technique and the ability with which to maintain the reduction. The capitellum essentially becomes “locked” in position by the concave shape of the radial head during the period of immobilization. The initiation of elbow motion at 2 weeks does not seem to increase the risk of malunion and excellent range of motion can be obtained in the majority of patients.

Our results indicate that a combination of closed reduction and early mobilization appears to be a safe, predictable, and effective method of treating displaced fractures of the humeral capitellum. Clinical results meet or exceed those of ORIF.