Herbert screw fixation of capitellar fractures

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Received 15 February 2012
Accepted 25 March 2012

Egyptian Orthopedic Journal 2013, 48:335-338

Background
Capitellar fractures are rare injuries. Controversy regarding the management of these injuries still continues. If anatomy is not reconstructed accurately, elbow function is suboptimal. The most accepted treatment of capitellar fractures is by open reduction and internal fixation. Recently, Herbert screw system has been recommended for fixation of osteochondral fractures.

Objective
The aim of this study was to evaluate the outcome of Herbert screw fixation in the treatment of capitellar fractures.

Patients and methods
Between May 2007 and July 2010, 10 patients with displaced fractures of the humeral capitellum were treated by open reduction and internal fixation of the capitellar fragments with Herbert screws in Benha University Hospital and Benha insurance hospitals. The mean follow-up period was 14 months (range 6–24 months) and the mean age was 37 years (range 20–48 years).

Results
All patients were evaluated according to the Mayo elbow performance score. Overall, six patients' results were found to be excellent and that of four were good. All patients were satisfied with the operative outcome and had a stable pain-free elbow with good range of motion at follow-up without any avascular necrosis or arthritic changes. The mean extension of the elbow was 7.5° (range 0–20°) and the mean flexion was 132° (range 128–135°). They all had full pronation and supination and had good stability; however, none of them had residual pain.

Conclusion
Treatment of capitellar fractures by Herbert screw leads to minimal articular damage and rigid fixation with solid union and excellent compression as well as early mobilization. Encountering a free capitellar fragment and nonunion should not discourage the use of internal fixation, as avascular necrosis is less likely to occur with good fixation and early mobilization.

Egypt Orthop J 48:335-338

1110-1148

Introduction

Fractures of the humeral capitellum are rare and account for only 1% of elbow fractures [1,2]. Injuries to the capitellum are usually a result of axial loading of the capitellum by forces transmitted through the radial head, the lateral trochlear ridge, and the lateral half of the trochlea. Patients with capitellar fractures usually present with pain and swelling of the elbow after injury. Fractures of the capitellum are frequently missed on the first examination [3]. They are not obvious on anteroposterior radiographs because the fracture line may not be recognized against the background of the distal humerus. They are best seen on a true lateral view [3]. In type IV injuries on lateral view, a double-arc sign representing the subchondral arc of bone of the capitellum and the lateral trochlear ridge is considered pathognomonic [4]. This sign may not be radiographically apparent in all type IV fractures because of the presence of an internally rotated capitellum and trochlea fragment [5,6]. Radiographs must be carefully assessed for the presence of medial trochlear extension, metaphyseal comminution, and associated radial head and/or neck pathology. Exact morphology of the capitellar fracture is often difficult to ascertain from preoperative plain radiographs alone [4,5,7,8]. Computed tomography (CT) scan with sagittal and coronal plane reconstructions is recommended to define the medial extent of the fracture, articular impaction, and metaphyseal and condylar comminution [9]. CT also aids in preoperative planning with regard to the choice of internal fixation implants. Concomitant lateral and/or medial collateral ligament disruptions or their osseous functional equivalents must be recognized and repaired to restore elbow stability. An untreated displaced capitellar fragment undergoes changes resulting from bony absorption to bony proliferation and obliterates the radial fossa [3]. Eventually, arthritic degeneration of the elbow joint ensues, limiting range of motion [10,11] half of the trochlea [4,12]. As the complex nature of capitellar fractures has become better appreciated, treatment options have evolved from closed reduction, immobilization, and fragment excision to a preference for open reduction and internal fixation with Kirschner wires (K-wires), cannulated cancellous screws, and Herbert screws [5,13]. The Herbert screw

offers distinct advantages over other modes of fixation. It provides excellent compression at the fracture site and stable fixation with the least damage to articular surfaces. Moreover, early mobilization can be started and the hardware need not be removed later [3].

This study has 10 cases of capitellum fractures treated by Herbert screw fixation over a period of 2 years with a mean follow-up of 14 months (range 6–24 months).

Patients and methods

Ten patients with a mean age of 37 years (range 20–48 years) and with capitellar fractures were treated by open reduction and Herbert screw fixation between May 2007 and July 2010. The patients presented within 15 days of injury. All of them underwent open reduction of the displaced capitellum. Five patients had fracture after falling on an outstretched hand, three fell on a flexed elbow, and the mechanism of injury was unclear in the remaining two patients. None of the patients had any concomitant injury. Fractures were classified on anteroposterior and lateral radiographs according to the classification of Bryan and Morrey [14]. A careful preoperative plan was executed in each case with regard to reduction and implant fixation. CT was done in cases with comminuted fracture to define the fracture better and to aid in preoperative planning.

Surgical technique

All cases were operated under general anesthesia. The injured elbow was assessed clinically for ligamentous stability. A pneumatic tourniquet was used in all cases. The elbow was handled through an extensile lateral approach. Following dissection through the subcutaneous tissue layers, the lateral column was palpated. The forearm was pronated to move the radial nerve away from the surgical field. A flap was raised by elevating the common extensor origin along with the anterior capsule and connected to the Kocher interval distally. This resulted in a continuous full-thickness anterior soft tissue flap. The fracture site was debrided of hematoma and soft tissue debris to allow visualization of the fracture fragments.

Fracture fragments were reduced and provisionally fixed with K-wires. The terminally threaded Herbert screws, directed posterior to anterior, were used to fix the fracture. The distal thread was buried beneath the articular surface. In two cases, the Herbert screw was inserted from the articular surface to the lateral epicondyle. This required an extensive incision. The radial wrist extensors were repaired to the soft tissue cuff on the lateral supracondylar ridge and the wound was closed in layers.

Postoperatively, the elbow was immobilized in a splint for 4–6 days following which a range of motion exercises were initiated under supervision. Patients were followed up at regular intervals and clinicoradiological evaluation was done. The condition of bone union, evidence of avascular necrosis on radiographs, wound healing problems, or other complications, if any, were recorded. Stability, pain, and range of motion of the elbow joint were evaluated according to the Mayo elbow performance score (Table 1).

Results

Six patients were male and four were female. The right side was involved in seven cases, whereas the left in three. The dominant limb was involved in eight and the nondominant in two cases. Of the capitellar fractures, six fractures were classified as type I, two as type II, and three as type IV. The mean operative time was 1.30 h (range 1–2 h). Preoperatively, in two cases, capitellum fragments were found free and devoid of soft tissue attachments. These were reduced, fixed, and showed good union. No intraoperative or postoperative complication was encountered. The mean extension of the elbow was 7.5° (range 0–20°) and the mean flexion was 132° (range 128–135°). All patients had full pronation and supination. They had good stability, and none had residual pain. Overall, six results were found to be excellent and four to be good. The mean follow-up period was 14 months (range 6–24 months). All patients were satisfied with the operative outcome and

Table 1 Mayo elbow performance score [14]

Function points (*N* = 100 points)	
Pain (maximum 45 points)	
None	45
Mild	30
Moderate	15
Severe	0
Range of motion (maximum 20 points)	
Arc>100°	20
Arc 50–100°	15
Arc<50°	5
Stability (maximum 10 points)	
Stable	10
Moderately unstable	5
Grossly unstable	0
Function (maximum 25 points)	
Able to comb hair	5
Able to feed oneself	5
Able to perform personal hygiene tasks	5
Able to put on shirt	5
Able to put on shoes	5

returned to their previous levels of activity. All fractures healed well. No evidence of avascular necrosis of the fragments was noted (Figs. 1 and 2).

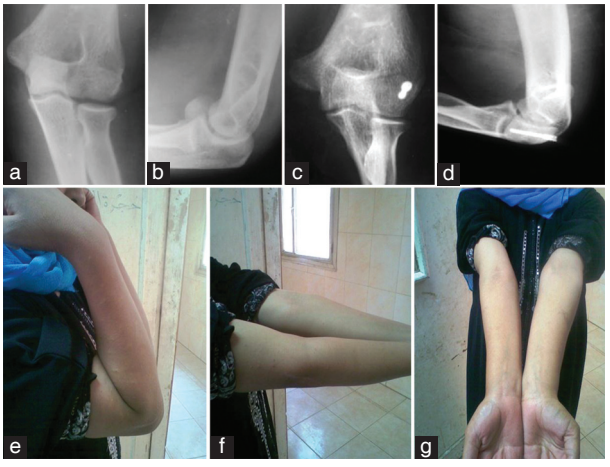
Discussion

A variety of methods of treating capitellum fractures have been described. These include closed reduction, excision, and open reduction with or without internal fixation. Closed reduction of type I capitellar fractures has been reported in a few series [11,15]. Disadvantages of this treatment are the long period of immobilization and unsatisfactory functional results [4,16]. Excision of the capitellar fragment [10,17] is a simple procedure, but after resection of the capitellar fragment, the remaining raw bone surface predisposes the elbow to capsular adhesions and results in restricted elbow mobility, instability, valgus deformity of the elbow, and risk of subsequent ulnar neuritis [3]. Open reduction and internal fixation is a suitable method for maintaining joint congruity while allowing early mobilization. Kirschner wires and AO compression screws have been used with varying degrees of success. Kirschner wires do not offer compression at the fracture site and require subsequent removal [3]. Fixation with compression screws irritates the cartilage of the radial head, as the metal head protrudes from the articular surface. Cannulated screws introduced posteriorly through the humerus into the capitellum avoid this problem [6]. However, if the osteochondral fragment is small, the screw may split it. Accurate reduction and stable fixation of the fracture and early postoperative mobilization have been reported to provide good results [3,12,18,19]. Herbert screws allow rigid fixation at the fracture site, provide fracture site compression through variable thread pitch design, and need not be removed later. These screws can be used both in anteroposterior and posteroanterior directions [3,12,18–20]. In addition, Kirschner wires were used but without penetrating the articular cartilage in cases of comminution. Avascular necrosis is uncommon after open reduction and internal fixation of these fractures [4,14]. The reported incidence of avascular necrosis is 0–30% (3). No patient in our series had avascular necrosis. Mehdian and McKee [21] recommended that encountering a free capitellar fragment should not discourage the use of internal fixation. In our series, two cases of type IV pattern injury were encountered in which there was no soft tissue attachment. The fragments were reduced and fixed. Both the patients have functional elbows with sound radiological union and no signs of avascular necrosis. McKee *et al.* [4]reported one patient of post-traumatic osteoarthritis in their series of six patients. In a large series, Lansinger and Mare [22] found no case of osteoarthritis of the elbow. In this series there is no incidence of osteoarthritis in any of our patients and we believe that if reduction is anatomical with minimal damage to articular cartilage, post-traumatic osteoarthritis should not occur. Traditionally, in delayed diagnoses or old fractures, excision of the fragment is recommended because of the risk of

Figure 1

A 37-year-old man sustained an injury to his right (dominant) elbow when he fell on the flexed elbow. Radiographs showed a fracture of the capitellum that was displaced anteriorly and superiorly (a and b). The fragment was reduced and fixation was secured with Herbert screw directed antroposteriorly (c and d). The fracture united very well and range of motion of the elbow at one year follow-up was from 10° to 135°. There was no evidence of avascular necrosis or degenerative changes and the result was evaluated as excellent.

Figure 2



A 30-year-old female presented two weeks after sustaining a fracture capitellum of her right (nondominant) elbow (a and b). The injury was the result of a fall on outstretched hand. She was treated in a splint and the patient had pain and restricted motion of elbow. Fixation was achieved with one screw and the screw thread buried beneath the articular surface (c and d). Active-assisted elbow exercises were started on the first postoperative day. Functional use of the limb for light tasks was encouraged. Resistive exercises were delayed until the fracture healed radiologically. The patient eventually progressed to have range of motion from 18°–110°. Forearm rotation was not restricted post operative photo (e–g).

osteonecrosis [10,23]. Careful dissection and gentle handling of fragments help to achieve better congruity in such cases. It has been reported that articular cartilage can heal after anatomical reduction and stable internal fixation and joint mobilization [24]. None of these patients have shown any signs of osteonecrosis despite the fact that there was little or no soft tissue attachment or substantial bony support to revascularize the fragments. Literature suggests that if osteonecrosis does not occur within 1 year, it is unlikely to occur [25].

Conclusion

Open reduction and internal fixation with Herbert screws for treatment of capitellar fractures is recommended, because this procedure leads to minimal articular damage and rigid fixation as well as early mobilization. Encountering a free capitellar fragment and nonunion should not discourage the use of internal fixation, as avascular necrosis is less likely to occur with good fixation and early mobilization.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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