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Arthrolysis and delayed internal fixation combined with hinged external fixation for elbow stiffness associated with malunion or nonunion of capitellum fracture

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Background: This study assessed outcomes after treatment of patients with capitellum fracture diagnosed >4 weeks after the trauma (delayed) who presented with stiff elbow.
Methods: We reviewed 7 patients with stiff elbows after delayed diagnosis of capitellum fractures between February 2007 and February 2012. They were treated with arthrolysis by twin incisions, late open reduction and internal fixation, and a hinged external fixator. According to the Bryan-Morrey-McKee classification, 3 patients had type I capitellum fractures and 4 patients had type IV.
Results: Mean follow-up was 28 months (range, 24-38 months). The mean delay from the initial trauma was 3.7 months. The flexion arc improved from a preoperative mean of 24° to a postoperative mean of 122°. The Mayo Elbow Performance Score increased from a mean of 56 points to 93 points. Anatomic fracture union occurred in all cases, and there was no secondary displacement.
Conclusions: Arthrolysis, late internal fixation, and use of a hinged external fixator can solve problems associated with stiff elbow after delayed diagnosis of capitellum fracture. Combined use of these techniques may be a safe and effective treatment option.
Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Stiff elbow; delayed fracture; capitellum fracture; arthrolysis; internal fixation; hinged external fixation

Capitellum fracture is a rare type of coronal shear fracture that accounts for 1% of all elbow fractures and 6% of all distal humerus fractures. Most surgeons have limited experience in treating this condition.[17] Therefore, capitellum fractures are frequently associated with delayed diagnosis and inadequate treatment, which can prevent optimal opportunity for rehabilitation. An unreduced fracture can directly block elbow motion, and the resulting

This study was approved by the Ethical Committee of Shanghai Tenth People's Hospital: No. 2012-Res-008. Written informed consent was obtained from each patient.

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elbow stiffness limits the chances of a favorable outcome.[5,8,28] Internal fixation and immobilization with a traditional external fixator to prevent fragment displacement may jeopardize the goal of rehabilitation.[3] Thus, it is necessary to identify a safe and effective alternative strategy for releasing the stiffness that arises from the delayed diagnosis of capitellum fractures. Here, we present a retrospective case series of patients with elbow stiffness arising from capitellum fractures who were treated with a hinged external fixator after late internal fixation and arthrolysis and discuss the treatment outcome.

Materials and methods

Patients

This study was a retrospective case series of patients who presented to our institution with elbow stiffness and an associated nonunited or malunited capitellum fracture between February 2007 and February 2012. Inclusion criteria were (1) skeletally mature; (2) elbow stiffness with a total range of motion (ROM) of $<100°$; (3) delayed capitellum fracture, defined as capitellum fracture >4 weeks ago; and (4) treated with arthrolysis, late open reduction and internal fixation of the capitellum, and a hinged external fixator. Exclusion criteria were (1) capitellum fracture within the last 4 weeks, (2) other fractures to the elbow experiencing stiffness, and (3) delayed fracture with no elbow stiffness.

Among the 8 patients who satisfied the inclusion criteria, 1 patient was lost to follow-up. The 7 patients included in the final analysis were 1 woman and 6 men with a mean age of 34 years (range, 17-63 years) at operation. The mean delay from the initial trauma was 3.7 months (range, 3-6 months).

All fractures were due to a fall onto the elbow or the result of vehicle accidents. Radiographs and computed tomography scans with 3-dimensional reconstruction were obtained for diagnosis (Fig. 1). Capitellum fracture was assessed according to the Bryan-Morrey-McKee classification[16,22]: type I, complete osteochondral fracture of the capitellum involving little or none of the lateral trochlea; type II, superficial anterior osteochondral fracture; type III, comminuted or compression fracture of the capitellum; type IV, fracture of the capitellum involving most of the trochlea. Among the 7 patients, 3 had type I capitellum fractures and 4 had type IV.

The mean lack of extension before operation was 36° (range, 5°-70°); the mean arc of flexion was 60° (range, 55°-95°). The total ROM of all 7 elbows before operation was 24° (range, 5°-40°). The mean preoperative supination was 70° (range, 20°-90°), and the mean pronation was 64° (range, 20°-90°). Three patients reported chronic pain in the injured elbow, and 2 patients had ulnar nerve paralysis with sensory deficit. Preoperatively, the mean Mayo Elbow Performance Score (MEPS)[18] was 56 points (Table I). All patients underwent arthrolysis by lateral and medial approaches and late internal fixation with screws followed by fitting of a hinged external fixator.

Surgical procedure

Operations were performed under brachial plexus block or general anesthesia with a sterile air tourniquet applied. All patients were treated through a combined lateral and medial approach. The extended Kocher approach[12] was chosen as the lateral approach. The extensor origins of the brachioradialis and extensor carpi radialis longus were reflected anteriorly to provide a window for reduction of the capitellum fracture and anterior release. A medial approach (Hotchkiss)[11] was performed when mobility of the elbow did not reach 0° to 130° after the lateral approach was completed (including fixation and release) as well as when there was ulnar nerve paralysis. The medial incision was performed along the ulnar nerve for ulnar nerve anterior transposition and release of the medial collateral ligament (MCL).

In this case series, all patients underwent release of the ulnar nerve and subcutaneous transposition, and 5 patients underwent release of the MCL. In 2 cases, the fracture line of the capitellum extended to the trochlea. This could not be seen and definitely restored by the lateral approach alone because of the delayed nature of the trauma. Therefore, part of the flexor and pronator origins was detached from the medial epicondyle for reduction of the capitellum fracture and anterior release. The triceps was reflected posteriorly through bilateral approaches to expose the posterior capsule and the olecranon fossa for release.

After exposure of the fracture fragment, reduction and internal fixation were performed. The fracture line could usually be located on the basis of the radiographic and anatomic characteristics of the fracture fragment. After scraping repeatedly with a curet on the fracture line, the fracture space was encountered, and the scar and fibrous callus were removed with a rongeur. The disrupted osseous fragment was separated from the humerus. After trimming of the fracture surfaces, reduction of the capitellum was performed, followed by internal fixation with 2 or 3 AO 3.5-mm cannulated screws (Synthes, Waldenburg, Switzerland) in an anterior to posterior direction and buried beneath the articular surface.

The entire anterior and posterior capsules were excised, leaving the 2 critical ligaments intact (anterior band of the MCL and lateral ulnar collateral ligament) to maximize elbow stability.[19] Before and during surgery, obvious laxity indicated instability of the elbow when a lateral stress test was performed, as did the ''dimple sign'' of the humeroradial joint in the pivot shift test without anesthesia. The collateral ligament was repaired by direct suture or anchor suture if instability presented after capitellum fracture fixation and arthrolysis. In this case series, the MCL was repaired in 1 elbow and the lateral collateral ligament was repaired in 2 elbows with use of bone anchor sutures.[17,23] After a satisfactory ROM was achieved, a hinged external fixator (Orthofix, Verona, Italy)[13,15] was fitted to the elbow along the elbow rotational axis that was identified by C-arm radiography. Distraction of at least 3 mm was applied to each joint to protect the internal fixation and repaired ligament (Fig. 2). The origins of the muscles were reattached, and the wound was closed in layers.

Postoperative treatment

Postoperatively, 25 mg of indomethacin was given 3 times a day for a period of 4 to 6 weeks as a precaution against heterotopic ossification (HO). Early rehabilitation was planned according to the achieved ROM and the restored ligaments at 24 to 48 hours postoperatively. Patients were instructed to perform cycle exercises of flexion and extension, gradually including active and passive exercises twice a day for a half-hour each time in the first week and to sleep with the elbow alternately in as much flexion or