THE OPERATIVE MANAGMENT OF FACTURES OF THE CAPITELLUM BY USING HERBERT SCREWS

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ABSTRACT

The operative management of fractures of the capitellum by using Herbert screws

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Abstract

BACKGROUND: Fractures of the capitellum are rare injuries .The outcome of operatively treated capitellar fractures has not been reported frequently. The purpose of the present study was to evaluate the clinical radiographic ,and functional outcomes following open reduction and internal fixation of the capitellar fractures treated with Herbert screws fixed from anterior to posterior direction.

METHODS: Between 2007 and 2013 ,ten patients with capitellar fractures were treated at our institution. There were five females and five males in our study with a mean age of 40 years. All the fractures were operated within 3 days of injury. A pre operative CT scan was done in all the cases. Open reduction and internal fixation was done using Herbert screws inserted from anterior to posterior direction. Clinical ,radiographic and mayo elbow performance index were evaluated .

RESULTS: Eight type 1 and two type 4 fractures were identified. Two patients had ipsilateral radial head fracture and one patient had ipsilateral olecranon fracture. All patients were operated using anterolateral approach and stabilized by using Herbert screws inserted from anterior to posterior direction. All fractures healed, and no elbow had instability or weakness. The mean ulno humeral motion was $140^{0.}$..All patients had functional arc of elbow motion and full forearm rotation. There were 9 excellent results and one good result according to Mayo elbow performance index.

CONCLUSION: good to excellent outcomes with functional ulno humeral motion can be achieved following internal fixation of these complex fractures by using Herbert screws. Anterolateral and lateral surgical approaches help in visualization of the fracture fragment and anatomical reduction by using anteroposterior screw insertion.

KEY WORDS : Capitellum , fracture, Herbert screws.

INTRODUCTION

- Fractures of the humeral capitellum are rare and account for 1% of elbow fractures.[1,2] and 6% of fractures of the distal humerus [3].
- Fractures of the capitellum are more common in women, which has been attributed to the increased carrying angle of the elbow and increased metabolic susceptibility from osteoporosis in women[4].
- 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[5,6].
- Before the advent of the modern internal fixation techniques, closed reduction or early excission of the capitellum fragment were the adopted treatments. Clinical results after closed reduction or resection of the capitellum were frequently complicated by elbow instability ,decreased range of motion, and arthritis unless anatomical positioning of the fragment was attain
- As the complex nature of capitellar fractures has become better appreciated, treatment options have evolved from closed reduction, immobilization and fragment excission to a preferance for open reduction and internal fixation with kirshner wires (k-wires), cannulated cancellous screws and herbert screws[8,9].
- Open reduction and stable internal fixation helps in early mobilization, preventing stiffness of the elbow ,and subsequent degeneration arthritis, as the articular congruity is maintained by anatamical reduction[10].
- 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 the articular surfaces. Moreover, early mobilisation can be started and the hardware need not be removed later[11].
- The present study was intended to assess the results of operative management of fractures of capitellum by using Herbert screws.

FUNCTIONAL ANATOMY

The condyles of the distal humerus are made of articular and non-articular surfacesThe articular surfaces is divided into two surfaces,the capitellum and the trochlea.The lateral column of the humerus ends in the capitellum[4].

The capitellum which is the first epiphyseal centre of the elbow to ossify ,is directed distally and anteriorly at an angle of 30^0 to the long axis of the humerus[12].

Anteriorly and inferiorly, the capitellum is covered with articular cartillage but is devoid of articular cartillage posteriorly[13].

The head of the radius rotates on the anterior surfaces of the capitellum in the elbow flexion and articulates with its inferior surface in elbow extension[14].

The lateral collateral ligament,which has an important role in elbow stability ,is situated next to the lateral margin of the capitellum.

The rotation centre of the capitellum is displaced 12 to 15 mm forward of the humeral shaft axis and is aligned with the trochlear axis,enabling the radius and ulna to flex and extend co-axially[15].

The radial and medial collateral arteries (branches of the profunda brachii) anostamose with the ascending interosseous and radial recurrent arteries to form the lateral arcade, which supplies the capitellum from its posterior aspects[4,16.]

FRACTURE CLASSIFICATION

Different classifications have been described for capitellar fractures by various authors.

Most widly accepted classification is the three part classification[17.]

TYPE 1 OR HAHN -STEINTHAL FRACTURE.

This fracture which is a coronal shear fracture of the capitellum, involves most of the capitellum with little or no involvement of the trochlea. This is the most common type of capiteller fracture.

TYPE 2 OR KOCHER-LORENZ FRACTURE.

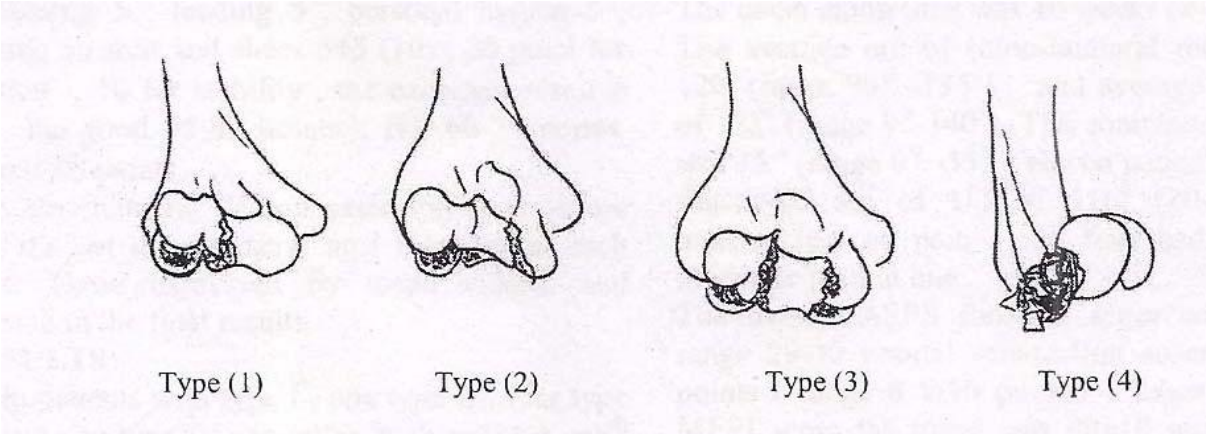
This fracture, which is less commonly encountered than type 1,involves a various amount of articular cartillage of the capitellum with minimal subchondral bone.

TYPE 3

This is a comminuted or compression fracture of the capitellum.

TYPE 4

This is a shear fracture of the distal ends of the humerus extending in the coronal plane across the capitellum to include most of the lateral trochlear ridge and the lateral half of the trochea[6].



CLINICAL EVALUATION

The anatomic landmarks of the elbow are usually preserved with minimal swelling or gross findings.

Pain is present independent of motion,with tenderness on the lateral side of the elbow.

Loss of flexion and extension is likily,often accompanied by crepitus.

Examination of type 1 fracture shows a mechanical block in elbow flexion, which is due to the anteriorly displaced fragment.Type 2 fracture shows a mechanical block in extension as a result of the posteriorly displaced osteochandral fragment[14].

In type 1 fracture, a fullness may be palpated in the antecubital fossa.Diffuse tenderness on the lateral side of the elbow can be a result of a concomitant radial head fractureThe combination of radial head and capitellar fracture is estimated to be 10% to 31% by various authors[4].

RADIAOGRAPHIC EVALUATION

Capitellar fracture are not obvious on AP radio graphs because the outline of the distal humerus is typically unaffected.

These fractures are best seen on a lateral view.Milch [18] has emphasized that if a fragment is seen proximal to the radial head,a capitellar fracture is most likily because radial head fractures do not migrate proximally.

TYPE 1-LATERAL VIEW

A semilunar fragment detached in the coronal plane from the humeral condyle with its articulating surface facing proximally in most cases[4].

TYPE 2

Fractures are most difficult to diagnosis because of the minimal amount of subchondral bone involved[4].

TYPE 4

Fractures are identified by the double arc sign in the lateral view, with one arc representating the subchondral bone of the capitellum and the other, the lateral side of the trohlea[6].

Green span and Norman [19], described the radial head- capitellum view, which can be useful in showing capitellar and radial head fractures. In this modified lateral view of the elbow ,the patient 's arm is abducted 90^0 at the shoulder and flexed 90^0 at the elbow,and the radiographic plate is placed under the elbow. The x-ray beam is centered on the radial head and angled 45^0 dorsoventrally, and eliminating the over lap of the humeroulnar and humeroradial articulation.

CTscan in the axial or transverse plane provide better details of the different fracture patterns of the capitellum[6].

MATERIALS AND METHODS

Ten patients between the age group of 25 to 55 years.(mean age 40 years) with capiteller fractures were treated by open reduction and herbert screw fixation between march 2007 to feb 2013.

All patients presented to us within 3 days of injury.

8 patients had fracture after falling on an outstreched hand and the mechanism of the injury was unclear in other 2 patients.

2 patients had an associated radial head fracture. One patients had an associated olecranon fracture. There were 5 male patients and 5 female patients in our study.

Fractures were classified on anteroposterior and lateral radiographs according to the classification of Bryan and Morrey [17].

CT scan was done in all cases for the better understanding of the fracture pattern and further management.

8 patients had type 1 fracture capitellum and 2 patients had type 4 fracture capitellum.

All patients were operated under general anesthesia under tourniquet control.

6 patients were operated using antero lateral apporch.4 patients were operated using anterior apporch.

In all the cases ,fracture was exposed, fracture pattern defined, anatomical reduction was achieved and stabilized using 2 or 3 Herbert screw depending on the size of the fracture fragment.

In all the cases ,screws were inserted from anterior to posterior direction from the capitellum fragment. Because of the direct visualization of the fracture fragments and the fracture reduction ,It was possible to acheive the anatomical congruity of the articular surface.

The joint was irrIgated and fragments of bone were removed. The remainder of the wound was closed in layers.

Post operatively,the patients were mobilised out of back slab after 3 weeks. Range of

motion excercises were initiated under supervision.

Patients were followed up at regular intervals and clinico-radiological evaluation was done.

The condition of the bone union ,evidence of a vascular 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[20].

MAYO ELBOW PERFORMANCE INDEX SCORE

1. Function
   Pain (max., 45 points)
   None (45 points)
   Mild (30 points)
   Moderate (15 points)
   Severe (0 points)

2. Range of motion (max., 20 points)
   Arc > 100 degrees (20 points)
   Arc 50 to 100 degrees (15 points)
   Arc < 50 degrees (5 points)

3. Stability (max., 10 points)
   Stable (10 points)
   Moderately unstable (5 points)
   Grossly unstable (0 points)

4. Function (max., 25 points)
   Able to comb hair (5 points)
   Able to feed oneself (5 points)
   Able to perform personal hygiene tasks (5 points)
   Able to on shirt (5 points)
   Able to put on shoes (5 points)

   Mean total (max., 100 points)

   Morrey BF, An KN, Chao EYS : Functional evaluation of the elbow. In The Elbow and Its Disorders, edited by B. F. Morrey. Ed. 2, pp. 86-89. Philadelphia, W. B. Saunders, 1993[20].

CASE – 2

Pre-Operative X Rays

3 Months Post –Operative X Rays

5 Years follow up

CASE 4

Pre-Operative CT Scan

4 Years Follow-up X-rays

CASE 6

Pre-operative X-rays

Post Operative

3 Years Follow up

CASE 10

Pre-Operative X-rays

Pre-Operative CT Scan Films

Immediate Post operative X-ray

3 Months follow up

RESULTS/OUTCOMES

- Five patients were male and five were female.
- Right side was involved in six cases and left side in four cases.
- Eight patients had type 1 fracture and two patients had type 4 fracture.
- The mean operative time was 1 hour 30 minutes(range- 1 hour to 1 hour 45 minutes)
- Preoperatively,in two cases capitellum fragments were found free and devoid of soft tissue attachments.these were replaced,fixed and showed good union in due course.
- The mean extension of the elbow was 10^0 (range 0^0 to 20^0) and the mean flexion was 140^0 (range-125 ^{0}to 150^0)
- All patients had full pronation and supination.
- All patients had good stability.
- One patient complained of mild pain on lifting heavy weights and in streneous activites.
- Two patients had an associated radial head chip fracture and were treated conservatively, had good union and good range of movements.
- One patient had an associated olecranon fracture which was treated with k-wire and tension band wiring .Implant removal for healed olecranon fracture done after one year. There was restriction of terminal 5^0 of flexion and extension and full range of supination and pronation was possible.
- Follow up period ranged from 3 months to 6 years(mean 3.2 years).
- All patients were satisfied with the operative outcome and returned to their previous levels of activity.
- All fractures healed well at an average of 8 weeks.(6 weeks to 10 weeks).
- One patient reported mild pain with strenous activity.
- No patient reported difficulty with any functional activity of daily living or had any

subjective complaints consistent with instability of the elbow.

- There was no objective evidence of instability of the elbow in any patient.
- According to Mayo elbow performance index score, there were nine excellent and one good result.
- The latest radiographic evaluation revealed one patient had grade-1 degenerative changes and the remaining patients had no evidence of post traumatic osteoarthrosis.

DISCUSSION

•The most common injury mechanism for capitellum fractures is a fall on outstretched hand, with the radius imparting a shearing force onto the cappitellum[6].

•In our series ,8 patients fell on a outstretched hand.

•Fractures of the capitellum are frequently missed in first examination.In our series,all patients were diagnosed with capitellum fracture in the initial radiographic evaluation.

•8 patients had type 1 fracture and 2 patients had type 4 fracture.

•In type 4 injuries, on lateral view, a double arc sign representing the sub chondral arc of the bone of the capitellum and the lateral trochlear ridge is considered pathogromonic[6].

•Both patients of type 4 fracture in our series presented with double arc sign in lateral view xrays.

•Radiographs must be carefully assessed for the presence of medial trochlear extension, metaphyseal comminution and associated radial head injuries.

•Two patients had associated radial head fracture and other patient had associated olecranan fracture.

•Exact morphology of the capitellar fracture is often difficult to ascertain from preoperative plain radiographs alone[6,9].

•CT scan with coronal and saggital plane reconstructions is recommended to define the medial extent of the fracture, articular impaction, and metaphyseal and candylar comminution[21].

•CT also aids in preoperative planning with regard to the choice of the internal fixation implants[22].

•CT scan was done in all the ten patients in our series.

•Displaced capitellar fractures invariably lead to poor results if untreated. An untreated displaced capitellar fragment undergoes changes resulting from bony absorption to bony proliferation and obliterates the radial fossa[11].

•Eventually arthritic degeneration of the elbow joint ensues limiting range of

motion[14,23].

•Type 4 fractures of the capitellum involving the trochlea are associated with elbow instability if left untreated[4].

•A variety of methods of treating capitellum fractures have been described. These include closed reduction, excission, open reduction with or without internal fixation.Closed reduction of type 1 capitellar fracture has been reported in a few series.[23,24].

•Apart from difficulty in acheiving reduction as a result of rotation of the fractured fragment,maintaining the reduction is even more difficult, with unsatisfactory functional results after this type of treatment[25,6].

•Closed reduction is usually not successful in capitellar fractures because of rotation of the fractured fragment. Infact, it is this rotation which is the displayed fragment migrates proximatly that makes closed reduction of these fracture so difficult[26]. In none of our cases,closed reduction was attempted before open reduction. closed reduction can lead to early arthritis,loss of motion of the elbow or instability as it is usually a non-anatomical reduction[7] .

•The simplicity of the fragment excission is appealing and is recommended by many authors.[14].

•However,Wilson belives that after resction of the capitellar fragment, the remaining raw bone surface predisposes the elbow to capsular adhesions and results in restricted elbow mobility[27].

•Resection performed in type 4 fractures can lead to elbow instability because of removal of the lateral trochlear ridge,which is considred a major stabiliser of the elboe joint[28].

•Jackobsson [29] reported two cases in which the humeral surfaces was reconstructed with an alloy prosthesis made from a cast of the fragment. this procedure required two surgeries.

•First the fragment was resected and an alloy prosthesis made from it, then in the second operation,the prosthesis was inserted in the elbow.because of the poor

functional results and two stages surgery,this procedure has not been adapted.

•Open reduction and internal fixation is a suitable method for maintaining joint congruity while allowing for early mobilization.

•K-wires do not offer compression at the fracture site and require subsequent removal[11].

•Fixation with compression scrrews irritates the cartillage of the radial head,as the head protrudes from the articular surface.

•Accurate reduction and stable fixation of the fracture and early postoperative mobilization has been reported to provide good results[11].

•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 scrwes can be used both in anteroposterior and posteroanterior directions[11].

•In our series,in all patients herbert screws were used from anterior to posterior direction.

•Use of the Herbert screw,for fixation of capitellar fracture was initially described by Simpson and Richards in 1986.[30].

•In the original technique,the screw was inserted anteroposterioly and the tip was burried under the articular cartillage.

• Liberman etal [31]and later Silvari etal[5], proposed posteroanterior insertion of the Herbert screw as the most appropriate route to prevent furthur articular damage to the anterior surface.Although this technique seems appealing ,furthur posterior dissection for insertion of the screw may compromise the vascular supply of the capitellum,which is supplied only from the posterior surface[16] and create a higer rate of avascular necrosis.

•A vascular necrosis is uncommon after open reduction and internal fixation of these fractures[6,17].

•The reported incidence of avascular necrosis is 0 to 30 %[11].

•No patient in our series had a vascular necrosis.

•In our series ,we encountered two cases of type 4 pattern injury in which there was no soft tissue attachment.The fragments were replaced and fixed. Both the patients have functional elbows with sound radiological union and no signs of avascular necrosis.

•MC kee et al ,reported one patient of post traumatic osteoarthritis in his series of 6 patients[6].

•0ne patient in our series presented with early post traumatic arthritic changes but had good mayo elbow performance index score.

CONCLUSION

- Fracturs of the capitellum are rare injuries .

- Double arc sign of elbow seen in the lateral view x-rays helps in diagnosing type 4 fractures of the captillum.
- Non- operative treatment of the capitellum fracture is associated with arthritic degeneration of the elbow.
- Excission of the capitellar fragment results in restricted elbow mobility ,instability and valgus deformity of the elbow.
- Excellent to good outcome with functional ulno-humeral motion can be acheived by open reduction and internal fixation with Herbert screws.
- Pre operative radiographic assessment and CT scan helps surgeons in choosing the right surgical approach and implants.
- Good surgical technique and stable internal fixation are the keys to early mobilization and good functional outcome.
- Anteroposterior screw insertion helps in reducing the fracture fragment under vision and provides stable fixation.
- Anterolateral and lateral surgical approaches help in visualisation of the fracture fragment and anatomical reduction of the fracture fragment under vision.

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