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## Capitellum fracture: Outcome of surgical treatment

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### Abstract

**Background:** Fractures of the capitellum humeri are uncommon injuries accounting for only 1% of all fractures and around 6% of fractures close to the elbow. As the complex nature of capitellar fractures various treatment options have evolved and open reduction and internal fixation (ORIF) with Herbert screw, Biodegradable screw, suture anchor were considered. Purpose of study was to find the mechanism of injuries and clinical outcome of capitellar fractures managed by ORIF.

**Method:** A prospective follow-up study was planned on eight patients of capitellar fractures admitted at Mahatma Gandhi Medical College & Hospital, Sitapura, Jaipur. These patients were followed-up for a period of twelve months and Mayo Elbow Performance Index was assessed.

**Results:** Study includes 08 patients with age range from 24 years to 67 years with mean age  $42.8 \pm 14.55$  years. Females (62.5%) were affected more than males (37.5%). Mechanism of injury were road traffic accident in 05(62.5%), fall on outstretched arm in 02 (25%) and direct blow to the elbow in 01 (12.5%) cases. The average loss of ROM of the affected elbows was  $12^\circ$  of flexion-extension and  $6^\circ$  of supination-pronation compared with the unaffected elbows. The average MEPI Score was  $91.8 \pm 7.88$  (range, 75 to 100) with 06 excellent and 02 good. No evidence of post operative complications was found at the end of follow-up.

**Conclusion:** Capitellum fractures are rare and complex articular injuries. Road traffic accidents are most common mechanism responsible for such injuries. ORIF is recommended to achieve good clinical outcome but may end into stiffness and decreased range of motion.

**Keywords:** Elbow joint, capitellum fracture, internal fixation, herbert screw

### Introduction

Fractures of the capitellum humeri are uncommon injuries accounting for only 1% of all fractures and around 6% of fractures close to the elbow [1-3]. 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 [4].

Due to the small number of soft tissue attachments at this site, almost all of these fractures are displaced [5]. The incidence of distal humeral coronal shear fractures is higher among women because of the higher rate of osteoporosis in women and the difference in carrying angle between men and women [6, 7]. Patients with capitellar fractures frequently present with pain and swelling of the elbow after injury. Capitellum fractures are often more complex than expected upon analyzing conventional radiographs [8, 9]. 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 [4]. Computed tomography is therefore regularly recommended in these cases so as to diagnose the extent of the fracture and to plan operative treatment [7].

An untreated displaced capitellar fragment undergoes changes resulting from bony absorption to bony proliferation and obliterates the radial fossa [4]. Eventually, arthritic degeneration of the elbow joint ensues, limiting range of motion half of the trochlea [10-13].

Hahn first described a fracture of the capitellum in 1853 [14]. Since then, several classifications have been developed for these fractures. The classifications most commonly used for capitellum fractures are the descriptive Bryan and Morrey classification later on modified by McKee and the Dubberley classification [11, 15]. Another classification was proposed by Ring, generally focusing on coronal shear fractures of the distal humerus [8, 16].

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 [7, 17]. As regard to articular surface reconstruction, various implants including Kirschner wires, head-less compression screws, Herbert screws, mini fragment screws and bio-absorbable implants have been adopted. Herbert screw fixation is a good option due to excellent compression at the fracture site, stable fixation with the least damage to articular surfaces and non-prominence of the implant intra-articularly. Moreover, early mobilization can be started [4, 18].

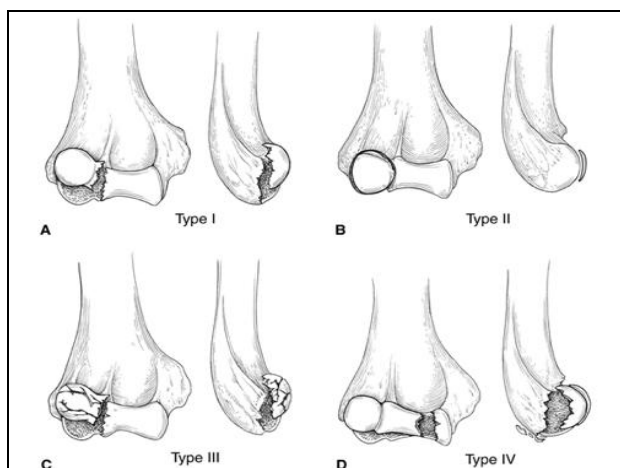
Stiffness, pain, myositis ossificans, articular incongruity, arthritis, and ulno-humeral instability may fail result if reduction is non-anatomic or if fixation fail. [7] So, a retrospective study was planned to find clinical outcome of 8 cases with fractures of the capitellum considering that open reduction and Herbert screws fixation is a reliable and effective management for fractures of capitellum.

### Objectives

1. To investigate the mechanism of injury causing fractures of capitellum.
2. To find out clinical outcome of these patients treated by open reduction and internal fixation.

### Material & Method

Considering capitellum fracture as a rare entity, a prospective follow-up study was planned at Mahatma Gandhi Medical College & Hospital, Sitapura, Jaipur, during January 2018 to December 2019. All age group and both the gender were considered for study. Total 08 patients of capitellum fracture operated during January 2018 to December 2018 were enrolled in study. These patients were followed up three monthly for a period of twelve months. Based on previous studies and expert opinion, a predesigned and pretested proforma was used to collect relevant information of patients. Proforma include two parts: first part for current information which include socio-demographic variables, clinical variables, investigation, mode of treatment, outcome and second part is for follow-up which include clinical assessment, complications occur with time and Mayo Elbow Performance Index. Separate sheet was used for each patient. All patients were assessed clinically and subjected to required investigations including hematological and radiological (X-ray, CT scan). Fractures were classified using the radiographs according to the modified Bryan–Morrey classifications [11, 15]. We classified the fractures in our patients according to above classification.



### Bryan and Morrey Classification

Type I Large osseous piece of the capitellum involved Can involve trochlea

Type II Kocher-Lorenz fracture Shear fracture of articular cartilage Articular cartilage separation with very little subchondral bone attached

Type III Broberg-Morrey fracture Severely comminuted Multifragmentary

Type IV McKee modification Coronal shear fracture that includes the capitellum and trochlea.

### Surgical technique

#### ORIF with lateral column approach

- supine positioning
- lateral skin incision centered over the lateral epicondyle extending to 2cm distal to the radial head
- At times, modification is needed depending upon the fracture pattern.
- Headless/Herbert screw fixation
- minifragment screw using posterior to anterior fixation
- counter sink screw using anterior to posterior fixation
- avoid disruption of the blood supply that comes from the posterolateral aspect of the elbow
- supplemental fixation for concomitant pathology, LUCL/UCL repair via bone tunnels or suture anchors.
- Patients were treated according to fracture pattern.

#### Postoperative care

A long arm posterior plaster splint was applied routinely with the elbow at approximately 90° of flexion, which was kept for 1 week and active range of motion was started and elbow ROM brace was given.

#### Follow up

Patients were followed up every three monthly for a period of twelve months and clinic-radiological evaluation was done. For patients with type 3 and 4 fractures tablet indomethacin 75 MG OD was given for 4-6 weeks. The condition of bone union, and complication such as avascular necrosis on radiographs, wound healing problems or other complications, if any, were recorded. At each follow-up, pain, range of motion, stability of the elbow joint and daily function was assessed by clinical examination, which enabled calculation of the Mayo Elbow Performance Index Score [19].

#### Statistical Analysis

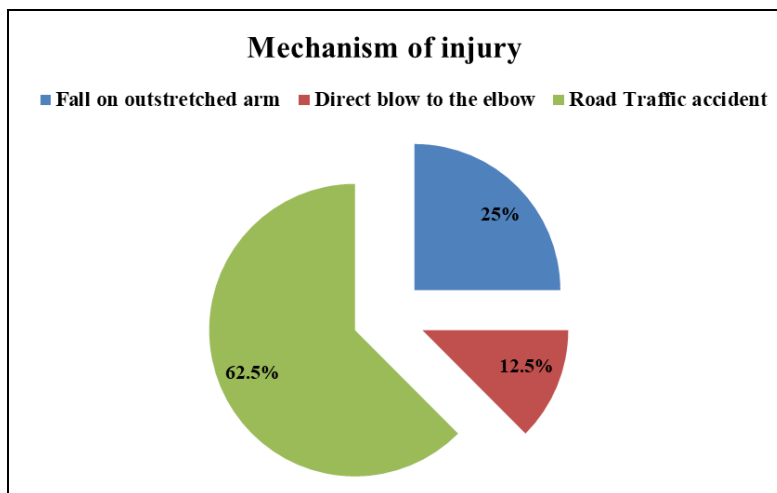
Data was coded and entered in SPSS 24.0 trial version. Data was presented in tables, graph and charts. The paired t-test was used for statistical comparisons with regard to ROM between the affected and the unaffected elbow. P value <0.05 will be considered statically significant.

#### Result

Total 11 patients were admitted in our institute during study period. Out of 11, one patient was excluded due to mental illness, lost to follow-up (01) and one patient did not give consent. Study includes 08 patients with age range from 24 years to 67 years with mean age 42.8±14.55 years. 50% of patients were in the age group of 24 to 40 years. Females (62.5%) were affected more than males (37.5%) which may be due to osteoporosis and poor nutrition. The right hand was involved in six (75%) cases, whereas the left in two (25%). Mechanism of injury were road traffic accident in 05(62.5%), fall on outstretched arm in 02 (25%) and Direct blow to the elbow in 01 (12.5%) cases. (Figure 1)

According to Modified Bryan–Morrey Classification of capitellar fractures, two fractures were classified as type IV, one as type III, one as type II and four as type I. Mean duration of injury and surgery was 5 days (range 1 to 9 days). Mean operating time was 72 minute with range of 55 to 130 minutes. No intraoperative or postoperative complication was encountered. All fractures healed well in their normal anatomic position as seen on radiographs. They had good stability although 2 reported mild pain during activity without restriction of movement at the final follow up (twelve months). (Table 1)

The average loss of ROM of the affected elbows was 12° of flexion-extension and 6° of supination-pronation compared with the unaffected elbows. But the average ROM of the affected and unaffected elbows did not differ significantly with respect to flexion-extension ( $132^\circ \pm 15^\circ$  and  $144^\circ \pm 6^\circ$  respectively;  $p = 0.054$ ), and supination-pronation ( $172^\circ \pm 13^\circ$  and  $178^\circ \pm 3^\circ$  respectively;  $p = 0.22$ ). The average MEPI Score was  $91.8 \pm 7.88$  (range, 75 to 100) with 06 excellent and 02 good. No evidence of post operative complications was found at the end of follow-up. (Table 1)

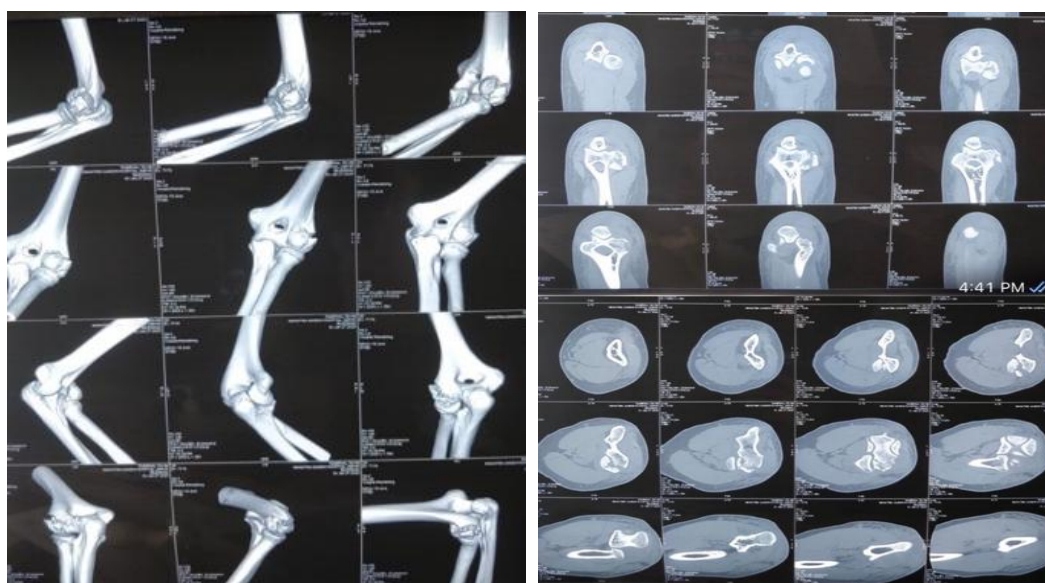


\*Numbers in figure are absolute percentage.

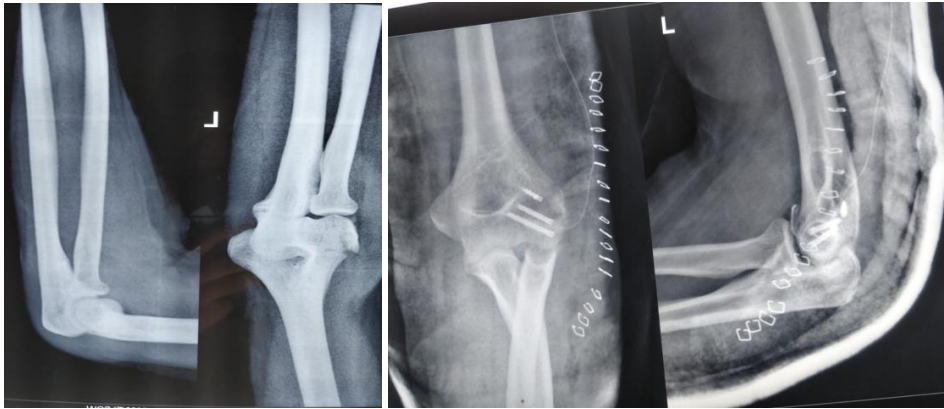
Fig 1: Mechanism of injury causing fractures of capitellum.

Table 1: Demographics and clinical outcomes of study participants

Patient	Age in years	Gender	Modified Bryan–Morrey Classification	ROM in flexion / extension (degree)	ROM in supination / pronation (degree)	MEPI Score
1	26	F	IV	130	160	85
2	67	F	IV	120	155	75
3	51	M	I	130	175	95
4	33	F	I	135	180	100
5	24	M	I	145	180	100
6	43	F	III	90	160	85
7	39	F	II	130	180	95
8	60	M	I	125	160	90



F -female, M -male, ROM -range of motion, MEPI -Mayo Elbow Performance Index.



Patient no. 6- 3D-CT scan with sagittal and axial cut sections showing capitellum fracture type 3.



Follow up pictures of patient no. 4

**Patient 4:** Pre-operative and post-operative x-ray showing capitellum fracture and fixation done with Herbert screws and suture anchor.

## Discussion

Based on fracture type and complexity, comfort of the orthopedic surgeon and protection of the blood supply, various methods for management of capitellum fractures have been described. These include closed reduction, excision and open reduction with or without internal fixation. Open reduction and internal fixation is a suitable method for maintaining joint congruity while allowing early mobilization. Herbert screws have been used with varying degrees of success. Present study included eight patients of capitellum fracture operated during study duration and they were followed-up for a period of twelve months to assess their clinical outcome. 50% patients were below 40 years of age with mean age  $42.8 \pm 14.55$  years and capitellum fracture was predominantly found in females (62.5%). Right hand was involved in 75% of cases and most common mechanism of injury was road traffic accident (62.5%). Mean duration of injury and surgery was 5 days (range 1 to 9 days).

Amr S. Elgazzar *et al.* [20] done a study at Egypt on 10 patients of capitellum fractures found mean age of patients was 37 years with range of 20 to 48 years which is lower than present study. In this study male to female ratio was 1.5:1 which shows male predominance while present study shows female predominance with ratio of 1:1.67. Study done by Valentin Rausch *et al.* [21] on 27 patients of capitellum fractures was found median age of 57 years with range of 4 to 78 years. Male were 40.75% and female were 59.25% which is similar to present study (M 37.5%, F 62.5%). Falling on an outstretched hand was most common cause of injury in study of Amr S. Elgazzar *et al.* [20] while direct blow to their elbow

during a fall was found in 70.37% of patients in study of Valentin Rausch *et al.* [21] Similar to present study, mean age at operation was 47 (18–65) years in study done by Giuseppe Giannicola *et al.* [22] and all had occurred following a fall onto the elbow or the outstretched hand or in motor vehicle accidents. Study done by Tengbo Yu *et al.* [23] found mean age  $42 \pm 13$  years (range, 19 to 64 years). Ten patients occurred after a fall, and 5 occurred in road traffic accidents. The mean time from presentation to surgical treatment was  $4 \pm 1$  days (range, 1 to 7 days).

In present study, according to Modified Bryan–Morrey Classification of capitellar fractures, 25% were in class IV, 12.5% in class II and III each, 50% were type I. Mean operating time was 72 minutes with range of 55 to 130 minutes. No intraoperative or postoperative complication was encountered. The average loss of ROM of the affected elbows was  $12^\circ$  of flexion-extension and  $6^\circ$  of supination-pronation compared with the unaffected elbows. The average MEPI Score was  $91.8 \pm 7.88$  (range, 75 to 100) with 06 excellent and 02 good. They had good stability although 2 reported mild pain during activity without restriction of movement.

Ajay Pal Singh *et al.* [24] did a study on 10 patients of capitellar fractures class IV. Author reveals that mean age was 32 years (range 18-36 years). There were 7 male and 3 females. Right extremity was involved in 8 and left in 2 patients. Four patients had a fall on outstretched hand and 6 had direct fall on elbow in road traffic accidents. The mean time of operative procedure was 82 minutes (60-108 minutes). There were no intra-operative complications. There was no case of postoperative neural involvement. Mean flexion was  $117.5^\circ$  (range  $124^\circ$ - $144^\circ$ ) and mean extension was  $6^\circ$  (range  $0^\circ$ - $30^\circ$ ). Mean pronation and supination were 76 degrees and 86 degrees respectively. By Mayo Elbow Performance Score evaluation, 7 patients got excellent, 2 good, and 1 fair result.

Based on radiological findings, 6 type-I and 9 type-IV fractures according to the Bryan–Morrey classification were identified in study done by Giuseppe Giannicola *et al.* [22] Out of 15 patients, 14 patients recovered or exceeded the functional range of motion in 3 weeks while 01 did not recover normal motion due to delay in operation. At final evaluation no patients complained of pain, except for one who had moderate discomfort during physical effort and one patient had moderate instability at the time of removal of the fixator and at the final evaluation. The average score on the MEPS was 98 (75–100), corresponding to an excellent outcome.

Valentin Rausch *et al.* [21] find that out of 27 fractures, 33% could be classified as a type I, 07% as class II, 07% as class III and 52% as class IV fracture according to the modified

Bryan–Morrey classification. Of the fractures, 26 healed in a timely manner. However, in one case, a comminuted fracture (Bryan–Morrey type III) resulted in necrosis of the capitellum.

Amr S. Elgazzar *et al.* [20] find that out of 10 capitellar fractures, six fractures were classified as type I, two as type II, and three as type IV. The mean extension of the elbow was 7.5° (range 0–20°) and the mean flexion Overall, six results were found to be excellent and four to be good according to Mayo elbow performance score.

### Conclusion

Capitellum fractures are rare and complex articular injuries. Capitellum fractures are more common in females due to some underlying causes. Road traffic accidents are most common mechanism responsible for such injuries. Open reduction and internal fixation with Herbert screws, biodegradable screw, K-wire, suture anchor according to fracture pattern and associated injuries is recommended, because this procedure leads to minimal articular damage and able to achieve stable fixation and restoration of a functional range of motion. Some patients might have decreased range of motion which is more with type 3 fracture.

### Limitation

Due to rare fracture, small number of patients could be included in study. Follow-up period was short as many complication required longer duration to develop which may be missed in present study. The larger numbers of patients and longer follow-up period is necessary to determine true incidence of complication and outcome.

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