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The study of early results of internal fixation of capitellar fractures by anterolateral approach

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Abstract
Fracture of the Capitellum is a relatively uncommon injury around elbow. Being an intra-articular fracture it requires accurate reduction and stable internal fixation to allow early movements and to expect a good result. Most of the time the fracture occurs in a coronal plane, which warrants antero-posterior Screw fixation for better reduction and desired compression. However by the conventional laterally based approaches it is difficult to obtain the proper reduction as well as fixation. Recently anterior approaches have gained wider acceptance because of direct access to the fracture and the ability to pass screws perpendicular to the fracture plane. They utilise a plane between the Biceps and the Brachioradialis superficially and then between Brachialis and the Brachioradialis in deeper plane.
We are presenting a case series of 14 cases of Capitellar fractures, which were fixed by Herbert Screws via anterolateral approach. They were followed up for a minimum period of six months and maximum up to three years and assessed in terms of fracture union, elbow range of movements, any complication and Mayo Elbow Performance Score. Out of 14 cases the outcome of 12 cases were excellent and two were good. We found that the Anteriolateral approach for fixation of Capitellar fracture of Distal Humerus is a useful approach. Proper identification of the plane and direct visualisation of the nerves is mandatory to avoid any untoward injuries. This approach provides passage of screws perpendicular to the fracture plane and good compression at fracture site.

Keywords: capitellar fracture, herbert screw fixation, anterolateral approach elbow, distal humerus fracture, articular fracture elbow

Introduction
Fracture of the Capitellum is a relatively rare fracture around the Elbow. The incidence is about 1% of all fractures of Elbow and 6% of all the fractures of distal humerus [1]. The usual mechanism for this fracture is fall on outstretched hand with Elbow slightly flexed. Direct landing on the Elbow can also cause such fractures [2]. In case of minimally displaced fracture, the fracture can be missed which results in a stiff elbow later on. It is a split fracture of the Capitellum in coronal plane. Sometimes it also involves the part of the Trochlea [3]. Diagnosis is mostly depends on clinical suspicion and radiological evaluation. Plain X-ray is usually enough for detection of the fracture, however CT scan is required for detailed assessment of the fracture fragments especially if associated with comminution [4].
There are many classification systems to describe the fracture of the capitellum. Most commonly the classification of Bryan and Morrey with modification of McKee is used [2]. Originally there were three fracture types described by Bryan and Morrey and later McKee added the fourth type. Another widely used classification is that of Dubberley [4].
Treatment of the Capitellar fracture comprises both the conservative and operative methods. In case of undisplaced or minimally displaced fractures in elderly person cast immobilization of the elbow done for 3-4 weeks followed by guided mobilization. Few reports of closed reduction of the displaced fractures are also there in the literature [5]. However, the results of the closed reduction methods are not encouraging especially in the younger age group.
The operative methods ranges from excision of the fractured fragment to open reduction and internal fixation with Headless screws [6, 7, 8]. Similarly, there are various approaches to the fractured area for fixation, like anterolateral, lateral and posterior approach. Lateral approaches utilize either the Kaplan or the Kocher plane to reach the fracture. There are pros and cons associated with each approach [9, 10, 11]. In the lateral approaches to get the proper screw trajectory perpendicular to the coronal fracture plane is difficult to obtain. The visualization of the medial margin of the fracture is limited. Also it requires detachment of the common extensor tendons origin

as well as chances of injury to Lateral Collateral ligament are very high. The Antero-lateral approach has the advantage of inter-muscular plane without detaching any muscle and a perpendicular direction of the screws in relation to the fracture [12, 13]. Direct visualization of the reduction is another plus point of this approach. Only drawback of this approach is its inability to address the posterior comminution if present.

Materials and Methods

This study was performed in a tertiary care hospital from 2015 to 2021. A total of 16 patients fulfilled the inclusion criteria and enrolled for the study. However, two of them were lost in subsequent follow up leaving 14 patients for the detailed analysis. Out of them 11 were male and 3 were female; age range of the patients were from 20 years to 48 years. Inclusion criteria were; adult patient from 18 to 65 years sustaining capitellum fracture, no associated fracture in the same limb, no old fracture around elbow, willing to carry out postoperative physiotherapy protocol. Open fractures and grossly comminuted fractures were excluded from the study. Majority of the fractures were resulted from Road Traffic Accidents (9 nos), followed by Fall (5 nos). Detail history with emphasis on the mechanism of injury were taken and clinically examined to rule out any other associated injury and morbid conditions. Radiological evaluations were done with plain x-rays initially and subsequently by CT scan [Picture 1]. We used the classification of Bryan and Morrey with McKee modification. The 'Double Arc sign' was looked for in the lateral view x-ray. Accordingly, we found 12 cases of type 1 and 2 cases of type 4 fractures. After written consent, the patients were prepared for surgical fixation. All of them were fixed by Herbert screws from anterior to posterior utilizing the Antero-lateral approach [Picture 2]. After the surgery, they were regularly followed up on 3,6,12,16 weeks and then 3 monthly. On follow up visits the elbow is assessed and scored according to Mayo Elbow Performance Score. Radiological evaluation was done to see the progress of union or non-union, articular step off, implant position/backout, avascular necrosis of the capitellum and post-traumatic arthritis.

Fig 1: X-ray and 3D CT

Fig 2: Immediate Post-op X-ray

Surgical Steps: Anterio-lateral Approach to the Capitellum fracture

The Elbow is prepared and drapped in a standard manner and a side table is used. The limb is exsanguinated and the tourniquet is inflated. A lazy S shaped incision is made in front of the Elbow starting about 5-6 cm above the Elbow crease along the lateral margin of Biceps muscle and crossing the Elbow and going along the medial margin of Brachioradialis for about 3-4 cm. It utilises the interval between the Brachioradialis and Biceps superficially and between the Brachioradialis and the Brachialis in deeper layer [Picture 3]. The lateral cutaneous nerve of forearm is encountered in superficial dissection. In deeper layer the Radial Nerve is seen crossing the Elbow deep to Brachioradialis. Upon retracting the Brachioradialis laterally and the Brachialis medially, the anterior capsule of the Elbow Joint is reached. Slight flexion of the Elbow is helpful at this stage. Often the Capitellar fragment forms a palpable bulge. Careful palpation and pronation-supination movement of the forearm ascertain the position of the Radial head. The anterior capsule is incised longitudinally and the fracture as well as the joint is exposed. The fracture fragment and comminution is assessed and correlated with preoperative radiological findings. The fracture haematoma is cleared and the receptor area is gently curetted. The coronal split fracture is reduced by gently pushing the fragment to its proper area keeping the Elbow slightly flexed. The reduction is held by 1.5mm K wire putting from anterior to posterior. Next the guidewire for the Herbert Screw is put from anterior to posterior and it's position as well as the reduction is checked under image intensifier [Picture 4]. Length of the Screw is measured by equal size second guide wire and one mm less sized Screw is inserted after drilling by a cannulated drill bit of appropriate diameter so that the Screw is well buried under the cartilage. A second Herbert Screw is inserted using similar technique. Sometimes a third screw may be required if there is involvement of the trochlea. Range of movement of the Elbow is checked and also the stability of the fragment after fixation. After a good lavage with normal saline, the capsule is closed with No 1 Vicryl sutures. The wound is then closed in layers after obtaining a good hemostasis.

Fig 3: Surgical Steps

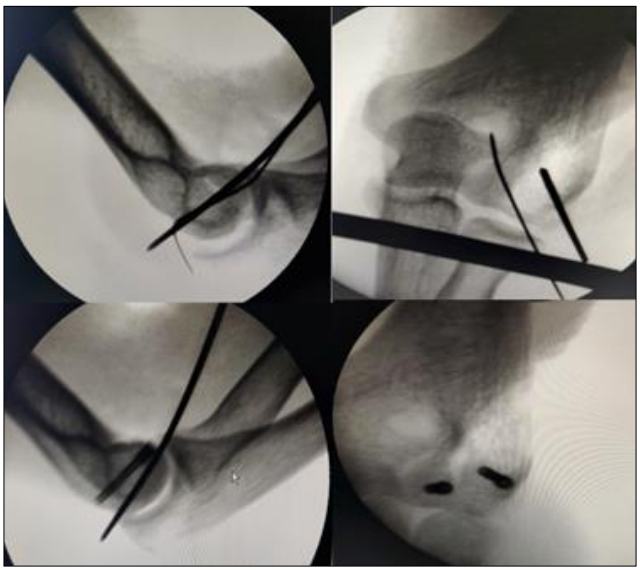

Fig 4: Per-op C-Arm images

Results

All the 14 fractures were united within 12 weeks. We did not encounter any delayed or non-union. In one case, a mild articular step off (<1mm) was noted, however the fracture united on time. The Mayo Elbow Performance Score was used to observe the final outcome after bony union [11]. It has four components namely Pain, Range of motion, Stability and Activity of daily living and has a maximum score of 100. We found excellent results in 7 cases, good in 6 cases and poor in one case.

The demography and the functional outcome are shown in **Table 1**.

Table 1: Demography and Mayo Elbow Performance Score

Sl No	Age/Sex	Pain	ROM	Stability	ADL	Total Score
		No Pain=45 Mild=30 Moderate=15 Severe=0	>100 degree=20 100-50=15 <50=5	Stable=10 Mildly Unstable=5 Unstable=0	Combing/ Hygiene/ Eating/Shirts/ Shoes: 5x5	
1	32/M	45	20	10	25	100
2	40/F	30	15	10	20	75
3	26/M	45	20	10	25	100
4	38/M	30	15	10	20	75
5	24/M	45	15	10	20	90
6	36/M	30	20	10	25	85
7	28/F	30	15	10	25	80
8	25/M	45	20	10	25	100
9	42/M	30	15	10	25	80
10	20/M	45	20	10	25	100
11	48/F	15	15	5	20	55
12	25/M	45	15	10	25	95
13	32/M	45	15	10	25	95
14	40/M	30	15	10	20	80
	Male=11 Female=3	Mayo Elbow Performance Score Poor: 1,Fair: 0, Good: 6, Excellent: 7				Average=84.43 Range:55-100

We did not find any cases of neurovascular injury. Peroperative breakage of guide wire was noted in one case. The broken part was retrieved by a separate posterior incision.

Fig 5: Range of Motion

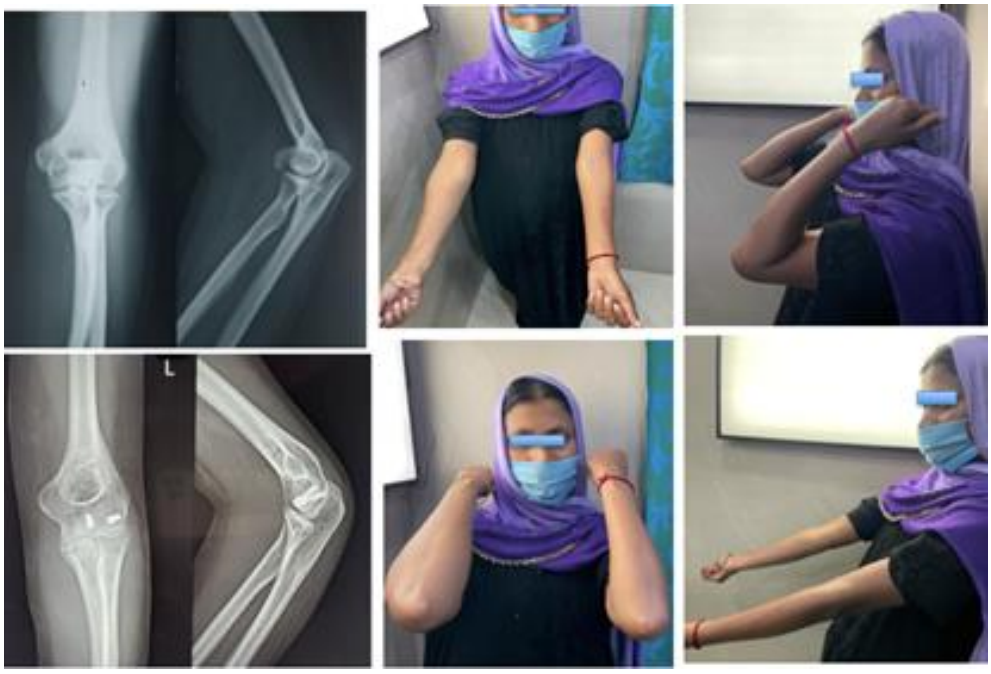

Fig 6: Function of the Elbow

Discussion

The capitellum takes an active part in the stability of the elbow joint especially the lateral column. Accurate anatomical restoration of the capitellum is therefore warranted for smooth functioning of the elbow. Surgical treatment of the Capitellar fractures restores the anatomy better than the conservative treatment [14, 15]. Previously, excision of the Capitellar fragment was also performed but at present it has only of historical importance. Now, almost all displaced fractures are anatomically reduced and fixed by different implants which ranges from cancellous screws, cannulated screws, headless screws, Herbert screws, to bio absorbable screws. Different investigator found good to excellent results after surgical fixation [16, 17, 18].

The fracture of the Capitellum is mostly the result of shear force and the fracture plane is coronal. This orientation of the fracture plane necessitates antero-posterior placement of the screws for proper compression. Posterior to anterior screws in a lag manner can also compress the fracture, however holding the fracture in reduced position while inserting screws would be a problem. Also the fragment is not large to be held from posterior aspect by the screws. Therefore, anterior to posterior screws are now preferred. In this current study, we are using Herbert screws from anterior to posterior direction to achieve compression across the fracture plane.

In any fracture, selection of the surgical approach has got utmost importance in reduction of the fracture as well as the final outcome. This fracture is usually approached laterally which is relatively safe and there are no neuro-vascular structures nearby. Either the classical Kocher's plane between the Anconeus and Extensor Carpi Ulnaris or the Kaplan's plane between the Extensor Digitorum Communis and Extensor Carpi Radialis Brevis is utilized to expose the fracture. Main disadvantages of these approaches are injury to the extensor muscles and the Lateral Collateral ligament and inability to visualize the medial aspect of the fracture fragment. Also it is relatively difficult to obtain the proper antero-posterior screw trajectory.

The Antero-lateral approach utilizes the plane between the Biceps brachi and the Brachioradialis and either retracts or splits the Brachialis along the fibers to expose the fracture site. The whole fracture extent can be visualized extending from the lateral margin up to the trochlear groove. Another major advantage of this approach is that it allows placement of the screws from anterior to posterior direction under direct vision perpendicular to the fracture plane thereby compressing it. Retraction should be gentle as the median neurovascular bundle as well as the Radial nerve is nearby. Injury to the Radial nerve is reported using this approach [12]. We however, did not encounter any nerve palsy in our series.

Implant selection for this fracture also merits importance, as this is an intra-articular fracture and the implant must be buried under the cartilage. In the past, various implants were tried such as Cancellous screws, Cannulated screws, Headless screws, Bio-absorbable screws, Herberts screws etc. In this study, we used titanium Herbert screws which were buried well under the cartilages and which are confirmed both visually and under image intensifier. Implant back out and loosening were very unwanted complications, which were reported in various studies [17, 18, 19]. We did not encounter any such implant related complications in our present study.

Associated ligamentous injury of the elbow should always be ruled out. Most of the times where there was associated elbow dislocation, either the Medial Collateral ligament or the Lateral Collateral ligament or in rare event both of them could be torn [20]. Examination under anaesthesia before the surgery should always be performed to detect such injuries. Ligamentous injuries should be addressed accordingly. In our study, we

routinely examined the elbow under anaesthesia before proceeding to surgery. However, there was no such associated ligamentous injuries in our series.

Union is usually not a problem in a well-fixed and timely intervened fracture. However, there are reports of non-union as well as avascular necrosis [13]. Stiffness of the elbow along with myositis ossificans and posttraumatic arthritis are late complications. In our study we did not encounter any cases of myositis and posttraumatic arthritis. Our results are encouraging but the less number of cases and relatively shorter follow up period are major concerns.

Conclusion

Adequate surgical fixation of displaced Capitellar fractures is mandatory to regain good functional outcome of the elbow. Anterolateral approach provides better exposure as well as good compression by antero-posterior screws.

Declaration

All Authors contributed equally to the study. No funding was received from any source. Written consent was taken from the patients for the study.

Conflict of Interest

None.

References

1. Suenghwan J. Distal humerus fractures: isolated fracture of the capitellum. In: Morrey B, Sotelo JS, Morrey M, eds. Morrey's Elb Its Disord. Philadelphia, PA: Elsevier; 2018:458–465.
2. McKee MD, Jupiter JB, Bamberger HB. Coronal shear fractures of the distal end of the humerus. J Bone Joint Surg Am,1996:78:49–54.
3. Ring D, Jupiter JB, Gulotta L. Articular fractures of the distal part of the humerus. J Bone Joint Surg Am. 2003;85–A:232–238.
4. Dubberley JH, Faber KJ, Macdermid JC, et al. Outcome after open reduction and internal fixation of capitellar and trochlear fractures. J Bone Joint Surg. Am,2006:88:46–54.
5. Dushuttle RP, Coyle MP, Zawadsky JP, et al. Fractures of the capitellum. J Trauma,1985:25:317–321.
6. Root CG, Meyers K, Wright T, et al. Capitellum excision: mechanical implications and clinical consequences. J Orthop Res,2014:32:346–350.
7. Sen MK, Sama N, Helfet DL. Open reduction and internal fixation of coronal fractures of the capitellum. J Hand Surg Am,2007:32:1462– 1465.
8. Ruchelsman DE, Tejwani NC, Kwon YW, et al. Open reduction and internal fixation of capitellar fractures with headless screws. J Bone Joint Surg Am,2008:90:1321–1329.
9. Ring D. Open reduction and internal fixation of an apparent capitellar fracture using an extended lateral exposure. J Hand Surg Am,2009:34:739–744.
10. Ravishankar MR, Kumar MN, Raut R. Choice of surgical approach for capitellar fractures based on pathoanatomy of fractures: outcomes of surgical management. Eur J Orthop Surg Traumatol,2017:27:233-42.
11. Trinh TQ, Harris JD, Kolovich GP, Griesser MJ, Schickendantz MS, Jones GL. Operative management of capitellar fractures: a systematic review. J Shoulder Elbow Surg,2012:21:1613-22.
12. Imatani J, Morito Y, Hashizume H, Inoue H. Internal fixation for coronal shear fracture of the distal end of the humerus by the anterolateral approach. J Shoulder Elbow Surg,2001:10(6):554–556.
13. Tanwar YS, Kharbanda Y, Jaiswal A, Birla V, Pandit R. Retrospective analysis of open reduction and internal fixation of coronal plane fractures of the capitellum and trochlea using the anterolateral approach. SICOT-J, 2018, 4, 8.
14. Bryan RS, Morrey BF. Fractures of the distal humerus, in The elbow and its disorders. Morrey BF, Editor. Philadelphia, PA, WB Saunders, 1985, 302–339.
15. Ochner RS, Bloom H, Palumbo RC, Coyle MP. Closed reduction of coronal fractures of the capitellum. J Trauma,1996:40: 199-203.
16. Kramer M, Pamnani A, Strauch RJ. Internal fixation of a capitellum fracture using a biodegradable screw. Orthopedics,2002:25(7):765–766.
17. Hirvensalo E, Bostman O, Partio E, Tormala P, Rokkanen P. Fracture of the Humeral Capitellum Fixed with Absorbable Polyglycoide Pins. Acta Ortho Scand,1993:64:85-86.
18. Lambert SM, Pike J, Railton GT. Fractures of the humeral capitellum: Herbert screw fixation. J R Coll Surg Edinb 1994:39:321-3.
19. Mighell M, Virani N, Shannon R, Echols E, Badman B, Keating C. Large Coronal Shear Fractures of the Capitellum and Trochlea treated with Headless Compression Screws. J Shoulder Elbow Surg,2010:19:38-45.
20. Trinh TQ, Harris JD, Kolovich GP, Griesser MJ, Schickendantz MS, Jones GL. Operative management of capitellar fractures: a systematic review. J Shoulder Elbow Surg,2012:21:1613-22.