

## Fixation of fracture capitellum humerus

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### Abstract

Fracture of capitellum is a rare fracture of distal humerus mostly seen in young adult. At present time there are different method of treatment and fixation of capitellum are available and described in literature. In this article we present diagnosis and management of different types of capitellar fracture in rural medical college with available instruments and implants.

Between 2007 to Sept 2015 eight patient of capitellum were treated in our hospital. There were five male age 16 to 30 years and three female patient age 22 years and 45 years. In two cases the fracture was missed by private hospital and managed there conservatively by above elbow POP cast for 6 and 8 weeks marked stiffness of elbow present in both cases. Six cases came directly to our hospital. In these eight cases six cases were type one (Hahn steinthal fracture), one was Mc kee type four type and one case was associated with fracture of lateral condyle. All cases were treated under general anaesthesia and tourniquet by open reduction through modified Kochers approach and internally fixed by 4mm partially threaded cancellous screws inserted from posterior part of lateral condyle avoiding the penetration of anterior articular surface. All the fractures united uneventfully except one with loss of 15 degree in flexion and extension. Radiologically no signs of AVN and arthritis were present in seven cases but mild arthritis was present in one case. Screws were removed after 12 to 18 months of surgery. We got good result by using modified Kochers approach and fixation by partially threaded cancellous screws. We use Mayo elbow performance score to evaluate the result of surgery which was excellent in seven cases and good in one case.

**Keywords:** Capitellum fracture, Hahn- steinthal fracture, Internal fixation, Mc. Kee type IV fracture.

### Introduction

The distal articular unit of humerus made by capitellum and trochlea they project anteriorly at an angle of 40 to 45 degree and act as tie arch between medial and lateral column. The capitellum is a smooth rounded knob like projection of lateral condyle completely covered by articular cartilage. The head of radius articulate with anterior portion of capitellum during flexion of elbow and loses its contact with capitellum in full extension as it fall away from distal end of humerus. Isolated fractures of capitellum are rare and represent only 0.5-1% of all fractures around elbow and 6% of distal humeral fractures.<sup>1-3</sup> This fracture is rare in children below age of 12 years due to cartilaginous nature of capitellum make it resistant to stress.<sup>4</sup> According to some reports in literature it is more common in females with M/F ratio of 1:4. The more carrying angle, cubitus valgus and hyperextension at elbow increase chances of this fracture as reflected by female predominance.<sup>5-9</sup> The mechanism of injury is fall on out stretched hand with elbow in varying degree of flexion or direct blow to fully flexed elbow. The force which leads to fractures of capitellum transmitted through head of radius. The maximum amount of force transmitted during 0 to 30 degrees of flexion and it decreases with increasing flexion and the magnitude of force transmission is more when the forearm is in pronation than the supination.<sup>10</sup> The fracture of capitellum is an osteochondral fracture which is entirely intrarticular there is no involvement of epicondyle, growth plate and the metaphysis with intact posterior part of lateral condyle.<sup>11,12</sup> Most of the accepted

classification systems are descriptive not treatment oriented.<sup>13</sup> According to classification of Bryan and Morrey capitellar fractures are classified as type 1, 2 and 3. Type 1: (Hahn steinthal fracture) coronal shear fracture of capitellum with or without fragment of lateral part of trochlea, type 2: (Kocher-Lorenz fracture) decapping of articular cartilage with minimal subchondral bone, type 3: it is comminuted compression fracture of capitellum. A type 4 fracture described by Mc. Kee and colleagues coronal shear fracture of capitellum and most of trochlea.<sup>14</sup>

Radiographic diagnosis is difficult in children below age of 9 to 10 years because the capitellum is not fully ossified and fused.<sup>15,16</sup> A true lateral view of the elbow is essential for the diagnosis a slightly oblique projection can easily miss the fracture<sup>17</sup> but some time oblique radiograph may be very helpful for diagnosis of small fragment and unusual capitellar fracture.<sup>18</sup> CT may be good option for comminuted and associated fracture. The characteristic radiologic feature double arc sign as seen in lateral view of elbow is due to lateral part of trochlea and subchondral bone of capitellum.<sup>14</sup>

The goal of treatment is anatomic reduction and fixation to maintain normal elbow and forearm biomechanics<sup>19</sup> and to prevent post traumatic arthritis, stiffness, cubitus valgus, proximal migration of radius, disruption of triangular fibrocartilage complex or wrist osteoarthritis and rarely AVN of capitellum. The treatment modalities are close reduction and immobilization,<sup>20</sup> excision of fragment, open reduction and internal fixation with K wire/4mm partially threaded cancellous screws in PA direction/headless

Herbert screw in PA and AP direction, arthroscopic reduction and fixation,<sup>21</sup> use of biodegradable pins and screws for fixation and fixation by small plate and screws but the choice of treatment depends on type of fracture, age of patient, quality of bone and available implants and expertise.

The purpose of this study is to discuss different modalities of treatment and the best result can be achieved by simpler technique and easily available implants.

### Materials and Methods

Eight patients were treated in or hospital between 2007 to September 2015 for fractures of capitellum. Six of them were male age between 16 to 30 year, two of them were female one of 22 years and another of 45 years. The mechanism of injury was fall from different height and landed on outstretched hand, the 6 fractures involve right elbow and two left elbow.

Two patients came to us after 6 to 8 weeks of injury managed elsewhere conservatively and present with marked stiffness of elbow with gross restriction of movement six cases directly came to us after injury. True AP and Lateral view of elbow done in all cases to make the diagnosis out of the eight patients one is Mc kee type four, one is associated with fracture lateral condyle of humerus and six fractures were type1 (Hahn steinthal fracture).

All patients were operated under general anaesthesia and tourniquet using modified Kochers approach. After exposing the fracture site and fragment the fracture surface were cleaned and the cases which presented late freshening of fracture end done. The fracture reduced in full vision and held with k wires. The reduction was checked in AP and Lat view under image intensifier. The final fixation was done with two 4mm partially threaded cancellous screws from posterior to anterior direction from posterior surface of lateral condyle. The screw length roughly measured 2mm less than the distance between posterior surface of lateral condyle and anterior surface of capitellum to prevent the penetration of anterior articular surface of capitellum. In two cases which presented us late with stiffness of elbow and restriction of movements passive mobilization of elbow to full range of flexion and extension was done before closer. An above elbow POP splint was applied in midpron position of forearm for 2-3 weeks. After 2-3 week patient were send for physiotherapy which include active and active assisted range of movement. Clinical and radiological evaluation was done during follow-up period of 12 to 18 months for range of movements and instability. The clinical assessment of elbow was done as per Mayo elbow performance score. There were no evidence of stiffness, arthritis, hetrotopic ossification and AVN in five cases but in one case which presented very late to us mild stiffness and arthritis present.

**Case 1:** (Mc Kee type 4) A 16 year male sustained injury due to fall on outstretched hand present with pain, swelling and limitation of movement of right elbow. Bony tenderness present over lateral condyle and a bony mass palpable antero-superiorly. True lat view shows displaced fracture of capitellum with a large lateral part of trochlea. Patient treated surgically under general anaesthesia and tourniquet through modified Kochers approach and the fracture fragment was fixed with two 4mm partially threaded cancellous screws in PA direction. At last follow up there was full range of movement without any radiological signs of arthritis, AVN and hetrotopic ossification. The Mayo elbow performance score was excellent. The screws were removed at 18 month through a stab wound just above the screw head under image intensifier (Fig. 1-4).



**Fig. 1:**



**Fig. 2:**



Fig. 3:



Fig. 4:

**Case 2:** A 45 year female present with a history of fall from stairs with pain and swelling over right elbow. On examination tenderness presents over lateral condyle of humerus. Radiologically there was fracture of lateral condyle associated with fracture of capitellum. Patient underwent open reduction through modified Kocher approach. First we fixed lateral condyle through a lag screw than the capitellar fragment was fixed by a single 4 mm partially threaded cancellous screw. The fixation was quite stable when on table stability was checked in full extension and full flexion. An above elbow POP splint was applied for a period of three weeks followed by active and active assisted elbow mobilization physiotherapy and limb was kept in arm pouch for next three weeks. After 3 months there were full ranges of painless movement present. In successive follow up to 12 months there were no radiological sign of arthritis and AVN were present, the Mayo elbow performance was excellent (Fig. 5-7).



Fig. 5:



Fig. 6:



Fig. 7:

**Case 3:** A 22 years male patient presented to us with above elbow POP cast and asked for removal of cast. There was history of fall followed by pain and swelling in left elbow, for these complaints patient went to a private clinic where close manipulation and an above elbow POP cast applied for one and half month. Patient had AP and lateral view of pre-reduction radiograph showing type 1 (Hahn Steinthal fracture) of capitellum. After removing the cast true AP and lateral view of elbow done the capitellar fragment was still displaced antero-superiorly. Clinically marked stiffness present, elbow fixed at 90 degree and loss of further flexion and extension with loss of pronation and supination was present. Patient underwent open

reduction and internal fixation through modified Kochers approach under general anaesthesia and tourniquet. The fractured fragment and fractured surface were cleaned thoroughly and freshening of fracture surface done before reduction and temporary fixation by K wires. The elbow was mobilized to full range of flexion-extension and supination-pronation before fixation by two partially threaded cancellous screw in posterior to anterior direction. We kept an above elbow POP splint for only 2 weeks and started active and active assisted range of movement physiotherapy for next 2 weeks and elbow was kept in arm pouch during this period. At the end of 6 weeks there was 10 degree loss of flexion and 15 degree loss of extension present. Patient was advised to continue physiotherapy. At 9 months follow up patient gain full range of elbow movement except 15 degree loss of flexion and extension, radiologically there was no sign of arthritis, heterotropic ossification and AVN.

**Case 4:** An eighteen year female patient was presented to our hospital with stiff left elbow fixed at 30 degree flexion and restriction of further movements, supination and pronation. There was a history of fall two and half month back managed elsewhere by close manipulation and above elbow POP cast for one and half month and advised for elbow mobilization exercises after that. Patient had no records of previous treatment a true AP and lateral view of elbow was done which shows type 1 (Hahn-Steinthal fracture) fracture of capitellum displaced antero-superiorly. Patient underwent open reduction and internal fixation under general anaesthesia and tourniquet through modified Kochers approach. In this case we also mobilized elbow to full range of flexion, extension and supination, pronation before final fixation by partially threaded 4mm cancellous screws in posterior to anterior direction. The elbow was kept in above elbow POP splint for 2 weeks followed by removal of splint and active and active assisted range of movement physiotherapy for 2 weeks and elbow was kept in arm pouch during this. At the end of 8 weeks last 10 degree loss of full flexion and extension was present and patient was advised to continue physiotherapy. In last follow up at 14 month no improvement in range of movement was there and radiologically there were signs of mild arthritis without any signs of hetrotropic ossification and AVN.

At the time of last follow up we evaluate every elbow as per Mayo elbow performance score and the result were excellent in fresh cases and good to excellent in two cases those presented late to us.

## Result and Discussion

Mazel in 1935 describe fracture capitellum as a layer of bone with a portion of trochlea attached to it,<sup>18,22</sup> Hahn in 1853 first give the description of isolated capitellum fracture in medical literature followed by Kocher 1896, Steinthal in 1898, Lorenz in 1905 and Mc Kee describe a coronal shear fracture in 1996.<sup>14,19,23,24</sup>

Capitellum fracture was classified by Bryan and Morrey as type -1(Hahn Steinthal fracture), type-2 (Kocher-Lorenz fracture) and type-3 (Browberg and Morrey) proposed by Grantham et al. in 1981.<sup>6</sup> Mc Kee describes type-4 as coronal shear fracture.<sup>14</sup> According to AO classification B 3.1 is capitellum fracture, B 3.2 fracture of trochlea and B3.3 is fracture of capitellum and trochlea.<sup>13</sup> Dubberley also classified the fracture of capitellum into three types, type-1 mainly fracture of capitellum with or without lateral part of trochlea, type-2 single fragment fracture of capitellum and trochlea and type-3 fracture of both capitellum and trochlea as separate fragments. These type are further classified as A (absence), B (presence) of posterior condylar comminution.<sup>13</sup>

As concern to the mechanism of injury in most of the cases it take places due to fall on out stretched hand with varying degree of flexion or direct strike on elbow. The clinical finding are pain and swelling around elbow with bony tenderness over lateral condyle. The elbow movements were painfull with restriction of flexion and extention. The cases which presented late there were minimal swelling around elbow but gross restriction of movements and marked stiffness of joint were prominent features. In clinical examination always examine shoulder an wrist joint for any associated injury and stiffness.

Radiographic diagnosis was made by standard anterior-posterior and lateral view of the injured elbow, the lateral view is more helpful to assess the amount of displacement and type of fragment. Fowels and Kassab states that a slight obliquity of lateral view can miss the fracture fragment due to rotation of humerus<sup>17</sup> but Ben B. Pradhan et al. states that sometimes oblique view may be very helpful for identification of small fragment and other unusual capitellum fractures.<sup>18</sup> CT scan only advised in complex and comminuted fractures.

Associated injury as reported in various literatures were supracondylar fracture of humerus, fracture of lateral condyle, fracture of radial head, posterior dislocation of elbow joint, disruption of ulnar collateral ligament and interosseous membrane and distal radioulnar joint. In our cases one case was associated with fracture of lateral condyle.

The various treatment methods are close reduction and immobilization, open reduction and internal fixation with K-wires, partially threaded cancellous screws, Herbert screws, biodegradable pins, small plates, excision of fragment and arthroscopic reduction and fixation. Ochner RS et al. treated coronal shear fractures of the capitellum by fully extending the elbow under general anaesthesia followed by gradual flexion of elbow while distracting the elbow joint which allow the radial head to capture the capitellar fragment in the joint rather than pushing it proximally. After reduction 3 week immobilization in elbow at 90 degree flexion followed by gentle active mobilization but advised open reduction an internal fixation for irreducible fracture.<sup>20</sup>

Eduardo Alvarez, MD et al. in 1975 after analysis of various treatment methods close reduction, open reduction internal fixation, excision and splintage conclude that excision of fragments was best method of treatment with advantages as it is a simple and definitive procedure with early return to function without any complication such as redisplacement imperfect reduction and AVN.<sup>25</sup> Most of author advice open reduction and internal fixation of type-1 and type -2 fractures to provide stability and congruity to elbow joint and proper biomechanics of forearm. Excision of fragment may leads to instability, osteoarthritis and cubitus valgus deformity<sup>3,6</sup> the type-2 and type-3 fracture can be treated conservatively or by excision of fragments.

We use modified Kocher approach to all our cases without any difficulty in visualization of fracture, fracture fragment and reduction and fixation of fragment. Other approaches are posterior with olecranon osteotomy<sup>26</sup> and anterolateral approach.

The choice of treatment should be selective and individualized according to age of patient, quality and character of bone and the type of fracture.<sup>29</sup> The treatment also depends on the availability of implants and expert.

In our all cases we use 4mm partially threaded cancellous screws for fixation of type I and Type IV fracture from posterior to anterior direction because they are easily available and provide same stability as Herbert screw and not violate the anterior articular cartilage, easily removed by a stab incision, there is no chances of radial head erosion in cases of AVN and chondrolysis.

In a biomechanical study of three fixation method cancellous lag screw in AP and PA direction and Herbert screw in AP direction the PA direction of the screws is more stable than the AP direction. The Herbert screw fixation had a higher failure load than PA directed cancellous screws but statistically not very significant thus the decision of method depends on operating surgeon and the technique with which he is comfortable.<sup>27</sup> The K-wires provide less stability for early mobilization and chances of migration and articular cartilage damage are high. For arthroscopic fixation of capitellar fracture with minimum damage to periarticular soft tissue demands experts and sophisticated instrumentation.

The performance of every treated elbow were assessed by mayo elbow performance score at last follow up it includes four parameter. 1-Pain intensity (none-45, mild-30, moderate-15, severe-0), 2-Motion-(arch of motion->100deg-20, 50-100deg-15,<50deg-5), 3-Stability (stable-10, moderate instability-5, grossly unstable-0), 4- Function-score of 5 for each function (can comb hair, can eat, can perform hygiene, can don shirt, can don shoe). The result are interpreted according to the score achieved as excellent (91-100), good (81-90), fair (71-80), poor (below 70).<sup>26</sup>

We got excellent result in 6 cases and good result in two cases which present late to us with our method of treatment.

## Conclusion

Type I and type IV fractures of capitellum give excellent results after ORIF with partially threaded cancellous screw inserted in posterior to anterior direction in fresh and even those cases which present late. Good fixation, early active assisted mobilization and physiotherapy play an important role in good functional outcome.

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