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Antero-lateral approach to capitellum fractures fixation: A retrospective study

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Abstract

Introduction: The understanding of the anatomical configuration of the fractures of the capitellum has enhanced in the last few years and the classification of these fractures continues to evolve. It is essential to tailor the surgical approaches to these fractures based on the state of the art classifications.

Materials and methods: 33 patients with fractures of the capitellum were included in this retrospective study conducted at Bidar Institute of Medical Sciences, Bidar. The mean age of the patients was 37.5 years and the mean follow-up period was 24.6 months. Seventeen patients had Bryan-Morrey type I fracture, three had type II fracture, two had type III fracture and eleven had type IV fracture. Of the 11 patients with Bryan-Morrey type 4 fracture, 5 patients belonged to Dubberley 2A and 3A category and 6 patients belonged to Dubberley 2B and 3B category. Bryan-Morrey type 1 fractures were approached via extended lateral approach. Bryan-Morrey type 2 and type 3 fractures were approached via anterolateral approach. Dubberley 2A and 3A fractures were approached via the anterolateral approach and Dubberley 2B and 3B fractures were approached via the posterior trans-olecranon approach.

Results: Fracture united in all except two patients who showed slight delay in union. Two patients had avascular necrosis of the capitellar fragment. The mean range of flexion/extension was 135.3° and pronation/supination was 168.8°. The mean Mayo Elbow Performance Index at final follow-up was 92.5 (S.D±5.8). Based on the MEPI score, 14 patients had excellent, 10 patients had good, 6 patients had fair and 3 patients had poor results.

Conclusion: Correct choice of surgical approach facilitates accuracy of reduction and fixation of these difficult fractures. Poor results were seen mainly in fractures belonging to Dubberley type 3B category.

Keywords: Capitellum fractures, distal humeral fractures, Herbert screw fixation, anterolateral approach to elbow

Introduction

Fractures of the humeral capitellum account for less than 1% of all the elbow fractures [1]. Capitellum fractures usually occur due to axial loading of the distal humerus by forces transmitted across the joint producing a coronal shear fracture of the capitellum or the trochlea [2]. Many capitellum fractures extend into the trochlea, with frequent association of fractures of the lateral epicondyle, impaction of the posterolateral aspect of the humerus and the trochlea, fragmentation of the articular surface, and even involvement of the medial epicondyle [2]. Internal fixation is the best modality to restore articular congruity in these fractures and biomechanical analysis has shown that head-less variable pitch screws are the most stable constructs [3]. Bryan and Morrey classification has been used widely to classify capitellar fractures and provide therapeutic guidelines [2]. Type 1 is the commonest and includes coronal shear fractures resulting in a 'thick' hemispheric fragment (Hahn-Steinthal fracture). Type 2 fracture results in a predominantly cartilaginous 'thin' fragment (Kocher-Lorenz fracture). Type 3 fractures are comminuted, multi fragmentary and often impacted. Type 4 category was added by McKee *et al.* to describe shear fractures of the capitellum that extend medially to involve most of the trochlea and are also referred to as "apparent capitellar fractures" [4, 5]. The Dubberley classification is useful in further categorizing the trochlear involvement. It recognizes 3 types of injuries – type 1 - fracture of the capitellum with or without the lateral trochlear ridge; type 2– capitellum and trochlea are fractured as single fragment; type 3 – capitellum and trochlea are fractured into separate fragments. Each type is further sub classified into A and B types depending on the presence of posterior comminution [6].

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Most surgeons prefer internal fixation of Bryan and Morrey type 1 and type 4 fractures using headless variable pitch screws. Internal fixation can be performed in type 2 and type 3 fractures provided the capitellar fragment is amenable to screw fixation. When internal fixation is not possible due to the small size and comminuted nature of the fragments, type 2 and type 3 fractures are often managed with excision of the fragments.

The extended lateral approach is preferred in the fixation of type 1 fractures and is adequate for this purpose^[5, 7, 8]. Type 4 fractures with extension to trochlea have been traditionally approached via the posterior approach with olecranon osteotomy. Excision of type 2 and type 3 fracture fragments can also be achieved without much difficulty via the lateral approach. In this study, *anterolateral approach* has been employed for internal fixation of type 2 and type 4 fractures without posterior comminution. This approach provides better visualization and direct access to the fragments and facilitates internal fixation of these difficult fracture types. It obviates the need for olecranon osteotomy in type 4 fractures that are limited to the trochlea alone (without involvement of lateral condyle and without significant posterior comminution i.e. Dubberley type 2A and 3A fractures).

Materials and Methods

33 Patients Are Included With Capitellum fracture which underwent internal fixation of the fracture between January 2019 and August 2020 at Bidar Institute of Medical Sciences, Bidar. All patients were treated surgically with open reduction and internal fixation of the humeral capitellar fracture using one or two Herbert screws. The average age of the patients at the time of injury was 37.5 years (range 20-70 years). Causes of fracture included road traffic accident (22 patients), slip and fall (9 patients), fall from height (1 patient) and direct injury to elbow (1 patient). Modified Bryan and Morrey's classification and the classification of Dubberley *et al.* were employed in this study^[2, 4]. The Dubberley classification is especially useful in sub classification of Bryan and Morrey type 4 fractures. Seventeen patients had Bryan-Morrey type I fracture, three patients had type II fracture, two patients had type III fracture and eleven patients had type IV fracture. Of the 11 patients with Bryan-Morrey type 4 fracture, 5 patients belonged to Dubberley 2A and 3A category and 6 patients belonged to Dubberley 2B and 3B category. Two patients had associated radial head fracture and one patient had concomitant olecranon fracture.

Prior to operation, all patients underwent antero-posterior, lateral and oblique radiographs of the elbow and CT (computerized tomography) scans including 3-D reconstruction of the distal humeral anatomy. Bryan and Morrey type I fractures (17 patients) were approached via the *extended lateral approach (Kaplan's interval)* and fixed using Herbert screws passed from the anterior to posterior aspect. Bryan and Morrey type II fractures (3 patients) were approached via the *anterolateral approach* and fixed with Herbert screws passed from anterior to posterior aspect. Two patients with Bryan and Morrey type III fracture were managed with excision of the comminuted fragments through the *anterolateral approach*. When three-dimensional CT confirmed a Bryan and Morrey type IV fracture with extension of the fracture to involve the part of trochlea and the lateral condyle, comminution of the posterior part of the articular surface determined the surgical approach. In the presence of posterior comminution (Dubberley type 2B and 3B), *posterior approach with olecranon osteotomy* was

employed (6 patients) since it provides better exposure for reduction and internal fixation. Type IV fractures without posterior comminution (Dubberley type 2A and 3A) were exposed using the *anterolateral approach* (5 patients) and fixed with Herbert screws passed from the anterior to the posterior aspect.

Anterolateral approach^[9]—The extended lateral approach and the posterior trans-olecranon approach have previously been described in detail by numerous authors. Hence, we have limited the description to anterolateral approach which has been reported infrequently. This approach is useful to expose the lateral half of the elbow joint and the proximal third of the radius. The patient was placed supine on the operating table, with the arm resting on an arm-board. Tourniquet was inflated following exsanguination of the limb. The incision was made along the lateral border of the biceps on the anterior aspect of the elbow joint, beginning 5 cm above the flexion crease. The incision was curved slightly medially at the level of the elbow joint to avoid crossing perpendicular to the flexion crease. The incision was continued inferiorly, along the medial border of the mobile wad of Henry. The approach is made through the inter-nervous plane (proximally, between the brachialis muscle supplied by the musculocutaneous nerve and the brachioradialis muscle supplied by the radial nerve; and distally, between the brachioradialis muscle and the pronator teres muscle supplied by the median nerve).

The lateral cutaneous nerve of the forearm (the sensory branch of the musculocutaneous nerve) is identified lateral to the biceps muscle in the proximal part of the incision and protected. The radial nerve is identified at the level of the elbow joint between the brachialis and the brachioradialis. The recurrent branches of the radial artery and the muscular branches to the brachialis just below the elbow are ligated. The radial nerve is retracted laterally. This exposes the distended anterior capsule of the elbow and a longitudinal incision is made in the capsule to expose the capitellum. Medial retraction of the capsule exposes the trochlea. To increase the exposure of the trochlea, the capsular incision may be extended upwards by 1 to 2 centimetres. Inferior extension of the capsular incision is not advisable due to the risk of injury to the posterior interosseous branch of the radial nerve.

Fracture fixation—The osteoperiosteal sleeve over fractured fragment was dissected and the fracture was reduced. The fragment was provisionally fixed with 2 K-wires. The lateral K-wire was drilled with cannulated drill for Herbert screw fixation while medial K-wire prevents the rotation of fracture fragment during drilling. Herbert screw is used to fix the fracture & buried beneath the articular surface. A second Herbert screw may be inserted if the fragment is large enough to accommodate two screws. In the smaller fragments of type 2 fracture, single screw is preferable to avoid comminution of the fragment. In type 4 fractures, a second Herbert screw is inserted into the trochlear fragment. The trochlear Herbert screw is inserted obliquely whenever possible – this ensures that longer screws can be inserted with minimal risk of screw penetration of the ulno-humeral joint.

Postoperatively, the elbow was immobilized in a splint at 90 degrees of flexion in neutral rotation. The slab support was removed after suture removal at 14 days and physiotherapy was commenced. Clinical outcomes were evaluated postoperatively at 4 weeks, 8 weeks, 3 months, 6 months, and at yearly intervals thereafter. The mean follow-up interval was 24.6 months (range: 12 to 47 months). The minimum follow-up period was 12 months. At each follow up visit,

range of motion (ROM) in flexion/extension and pronation/supination was recorded. The Mayo Elbow Performance Index (MEPI), which is a functional rating based on a 100-point index was used (MEPI score >90 – excellent outcome, 75-89 – good outcome, 60-74 – fair outcome, and <60 poor outcome) ^[10].

Antero-posterior and lateral radiographs of the patient's elbow were taken at each follow-up clinic visit. The radiographs were evaluated for the presence of union (or nonunion), avascular necrosis, joint line step-off (none/<1-mm/ >1-mm), hardware failure and arthritis. Arthritis was evaluated using the system described by Broberg and Morrey as: grade 0 (no signs of arthritis); grade 1 (slight joint-space narrowing and minimal osteophyte formation); grade 2 (moderate joint-space narrowing and osteophyte formation); grade 3 (severe joint-space narrowing with gross destruction) ^[11]. Heterotopic ossification (HO) was classified using the Brooker classification applied to the elbow: Class I (islands of bone within the soft tissues); Class II (presence of ectopic bone from the humerus, radius, or ulna, leaving at least 1 cm between opposing surfaces); Class III (ectopic bone from the humerus, radius, or ulna, reducing the space between opposing bone surfaces to less than 1 cm); Class IV (bone ankylosis of the elbow joint) ^[12].

Results

The study group consisted of 33 patients, out of which 21 patients were male and 12 patients were females. The average age of patients was 37.5 years (range: 20-70 years). Average duration for radiological evidence of fracture union was 10.8 weeks. Fracture united in all patients although two patients had showed slight delay in union (one Type II fracture united after 20 weeks and one Type IV fracture united after 18 weeks). None of the patients showed evidence of nonunion or instability of the elbow. Heterotopic ossification was noted in one patient. Two patients showed evidence of avascular necrosis of the capitellar fragment. Degenerative joint disease (grade I arthritis) was noted in one patient. Two patients had superficial infection which was treated with local dressings and oral antibiotics. The mean range of flexion/extension was 135.3° and average range of pronation/supination was 168.8°. The mean fixed flexion deformity in type I fractures was 7.9° in contrast to the mean flexion deformity of 16.4° in type 4 fractures. The mean Mayo Elbow Performance Index at final follow up was 92.5 (S.D.±5.8). Based on the MEPI score, 14 patients had excellent results, 10 patients had good results, 6 patients had fair results and 3 patients had poor results. The poor results were mainly in fractures belonging to Dubberley type 3B category which required additional plate osteosynthesis of the lateral condyle.

Discussion

While excision of the fragments and conservative management with cast immobilization are available as alternative management modalities for capitellar fractures, anatomic reduction and internal fixation is the most suitable option whenever feasible. Malunion, elbow instability and arthrosis are more likely when the capitellar fragment has been removed or healed incongruently ^[13, 14].

The extended lateral approach is useful for internal fixation of Bryan and Morrey type 1 fractures. The capitellum can be approached through the Kocher's interval or the Kaplan's interval. A disadvantage of the lateral approach is inadequate visualization of the trochlear extension of the fracture. Approaches recommended to deal with medial extensions of

capitellar fractures include posterior trans-olecranon approach or an additional anteromedial approach through the flexor-pronator interval. These procedures are likely to increase the complexity and duration of the operation. Posterior trans-olecranon approach may be unavoidable in the presence of marked posterior comminution of the capitellum and trochlea and extension of fracture to involve the lateral condyle (Dubberley type 2B and 3B fractures). The lateral condyle may require plate osteosynthesis in addition to capitellar fixation. In the absence of significant posterior comminution (Dubberley 2A and 3A fractures), anterolateral approach is useful in providing access to both capitellar and trochlear components of the fracture.

We have used anterolateral approach and Herbert screw placement from anterior to posterior aspect of the Bryan and Morrey type 2 and type 4 capitellar fractures. Type 2 fractures are often excised due to their small size and difficulty in fixation via the lateral approach. The anterolateral approach is useful in improving the access to type 2 fractures so that internal fixation can be performed using a single Herbert screw passes from anterior to posterior aspect. Thus, excision of the fragment can be avoided unless the fragment is extremely thin. In type 4 fractures, Dubberley classification is useful in guiding further management. Dubberley type 2A and 3A fractures are most suitable for internal fixation via the anterolateral approach. Anterolateral approach gives direct visualisation of fracture fragment, and facilitates anatomical reduction of the fragment. It carries no risk of injuring blood supply to capitellum which originates from the posterior aspect. Anterolateral exposure is potentially useful in type 3 Bryan and Morrey fractures if the fragments are large enough to allow fixation.

Imatani *et al.* reported acceptable functional outcomes in 6 adult patients with capitellar fractures which were approached through the anterolateral approach and fixed with Herbert screws ^[15]. Cornelius *et al.* have discussed the utility of the anterolateral approach in one paediatric patient with capitellar fracture. They claimed that it facilitates screw placement at right angles to the plane of the fracture and to avoid the physis in children ^[16]. Our series also included one paediatric patient aged 12 years in whom anterolateral approach was employed to similar effect.

Conclusion

In conclusion, it can be said that surgical approach to fractures of the capitellum need to be chosen carefully based on the fracture configuration on the pre-operative imaging studies. The anterolateral approach has been used infrequently and it has the potential to be employed more often with beneficial outcomes. Olecranon osteotomy may be avoided in Dubberley 2A and 3A categories of fractures (Bryan-Morrey type 4). On the basis of our findings, we suggest the following algorithm in the management of capitellar fractures.

References

1. Cheung EV. Fractures of the capitellum, *Hand Clin* 2007;23:481-486
2. Bryan R, Morrey B. Fractures of the distal humerus. In: Morrey B (Ed): *The elbow and its disorders*. Philadelphia: WB Saunders 1985;325-33.
3. Elkowitz SJ, Polatsch DB, Egol KA, Kummer FJ, Koval KJ. Capitellar fractures: A biomechanical evaluation of three fixation methods, *J Orthop Trauma* 2002;16:503-6.
4. McKee MD, Jupiter J, Bamberger H. Coronal shear fractures of the distal end of the humerus, *J Bone Joint*

- Surg 1996;78:49-54.
5. Ring D. Open reduction and internal fixation of an apparent capitellar fracture using an extended lateral exposure, J Hand Surg 34-A, 2009,739-744.
 6. Dubberley JH, Faber RJ, MacDermaid JC, Patterson SD, King GJ. Outcome after open reduction and internal fixation of capitellar and trochlear fractures. J Bone Joint Surg (Am) 2006;88:46-54.
 7. Ruchelsman DE, Tejwani NC, Kwon YW, Egol KA. Open reduction and internal fixation of capitellar fractures with headless screws. J Bone Joint Surg 2009;91(2-1):38-49.
 8. Mighell M, Virani NA, Shannon R, Echols Jr EL, Badman BL, Keating CJ. Large coronal shear fractures of the capitellum and trochlea treated with headless compression screws. J Shoulder Elbow Surg 2010;19:38-45.
 9. Hoppenfield S, DeBoer P, Buckley R. The Elbow: In: Surgical exposures in orthopaedics. Philadelphia, Wolters Kluwer/Lippincott Williams and Wilkins 2009,122-27.
 10. Morrey BF, An KN, Chao EYS. Functional evaluation of the elbow. In: Morrey BF (Ed). The elbow and its disorders. Philadelphia; WB Saunders 1985,73-91.
 11. Broberg MA, Morrey BF. Results of delayed excision of radial head after fracture. J Bone Joint Surg Am 1986;68:669-74.
 12. Brooker AF, Bowerman JW, Robinson RA, Riley LH. Ectopic ossification following total hip replacement. Incidence and method of classification. J Bone Joint Surg Am 1973;55:1629-32.
 13. Alvarez E, Patel MR, Nimberg G, Pearlman HS. Fracture of the capitulum humeri. J Bone Joint Surg Am 1975;57:1093-6.
 14. Guitton TG, Doornberg JN, Raaymakers EL, Ring D, Kloen P. Fractures of the capitellum and trochlea. J Bone Joint Surg Am 2009;91:390-7.
 15. Imatani J, Yoshiaki M, Hiroyuki H, Hajimi I. Internal fixation for coronal shear fractures of the distal end of the humerus by anterolateral approach. J Shoulder Elbow Surg 2001;10(6):554-556.
 16. Cornelius AL, Bowen TR, Mirenda WM. Anterolateral approach for an unusual paediatric capitellar fracture: A case report and review of literature. The Iowa Orthopaedic Journal 2012;32:215-219.