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Research Article

Use of Headless Screws for the Treatment of Type IV Capitellum Fractures in Adults

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Abstract

Objective: The fractures of the capitellum constitute about 1% of the elbow fractures and usually accompanied by fracture trochlea and extend medially or shared by lateral column fracture. There are many controversies about the x-ray appearance and surgical management.

The purpose: our aim was the clinical, radiological and functional outcome of open reduction and internal fixation by headless screws with simultaneous repair of associated injuries in type IV capitellar fracture through extensile lateral Kocher approach.

Patients and Methods: A prospective study of eighteen patients all with Bryan and Morrey type IV fractures capitellum started from March 2012 to May 2018 in our university hospital. There were 13 male (72.2%) and 5 female (27.8). there were 13 Right sided (72.2%) and five left sided (27.8%). All were treated by open reduction and internal fixation using headless screws with simultaneous repair of associated osseous and ligamentous injuries in type IV capitellar fracture through lateral Kocher approach. The mechanism of trauma, the clinical and radiological examination information was recorded. The Double arc sign present in six elbows. The patients below 12 years and compound fractures were excluded.

Results: The Bryan and Morrey classification system was used for the identification of the eighteen elbows with Type IV fractures. Twelve elbows were Isolated and six elbows were associated with ipsilateral radial head fractures occurred in association with Type-IV fracture. The lateral collateral ligament was injured in five elbows. Eleven elbows recorded with association of Metaphyseal comminution. We had no elbow instability or weakness and the all the fractures healed. All patients received follow-ups averaging at 18.1 months (ranging from 12 to 24 months). The mean ulnohumeral motion was 126±21.14 (range, 75° to 150°). The functional arc of elbow motion was gained by thirteen patients and three elbows with radial head had mean flexion contracture 13±5.8 degrees, and all patients had full forearm rotation. The mean Mayo Elbow Performance index Score (MEPS) was 91 ± 10 points, with thirteen (72.2%) excellent results, four (22.2%) good result, and one (5.6%) fair results. The ipsilateral radial head fracture did not affect the ulnohumeral motion and the functional outcome.

Conclusion: The associated complex injuries of type IV increase the incidence of flexion contracture and reduce the clinical outcome. The controversy of the approach for open reduction and fixation still need more studies with much more number of elbows.

Keywords: Capitellum; Headless screws; Fracture

Introduction

Fracture of the capitellum represent 1% of the elbow fractures and May occurs in isolation, extends medially to the trochlea or associated with complex osseous or ligamentous injuries that extend beyond the lateral column [1]. There are controversies about the classification, the surgical approach and the fixation methods, all depend on the type of the fracture and the extent of the articular involvement [2]. The capitellar fractures complexity has been better estimate, the management options had been changed from conservative with closed reduction and/or immobilization and excision of the fragment to open reduction and internal fixation to got good and stable anatomic reduction for starting the motion as early as possible [3,4]. The use of the lateral Kocher approach become more popular for open reduction and fixation by cannulated headless screws for complex fracture types.

Fracture capitellum with associated osseous or ligamentous injury become more common than we thought before [5]. Those injuries characterized by the presence of the metaphyseal comminution and associated by fracture of the ipsilateral head radius and supplemental fixation is needed [6]. Some authors in their studies demonstrate that the outcome of the open reduction and internal fixation of the capitellar fractures that either isolated or associated by involvement of the trochlea, the radial head and the ligamento-osseous complex are limited. But they concluded in their studies a satisfactory functional outcome in the patients with limited injury of the radiocapitellar compartment [7,8].

Patients and Methods

From March 2012 to May 2018, eighteen patients were classified type IV by Bryan and Morry classification system. There were 13 (72.2%) right side lesions and 5 (27.8%) with left side lesions; and there were 13 (72.2%) males and 5 (27.8%) females, the mean age 26.55±4.47 years (range 19-34), 15 injuries were caused by falls and 3 by falls from a height. There were no neurovascular symptoms and 4 cases had medial collateral ligament injury. The mean preoperative time was 4.67±1.65 days (ranging from 2 to 7 days).

Surgical Technique

All our patients were operated on in supine position on radiolucent table with side support. Intraoperative radiology (c-arm) was used during the procedure to chick reduction of the fracture and the screws length. The pneumatic tourniquet aws applied around the arm of the affected limb. After induction of the anesthesia the injured elbow was examined clinically for ligamentous instability. Extensile lateral Kocher approach was used for open reduction of the capitellotrochlear fractures. Lateral skin incision at the elbow is centered over the lateral epicondyle and extended from the anterior aspect of the lateral column of the distal end of the humerus to approximately 2 cm distal to the radial head and then dissecting the subcutaneous tissue layers and then palpation of the lateral column [1,2]. The radial nerve was protected by pronation of the forearm to make the nerve away from the surgical field; the common origin extensor in conjunction with the anterior capsule is elevated sharply as a full-thickness flap from the lateral supracondylar ridge anteriorly. Distally, the Kocher interval is identified and connected to the proximal exposure to develop a continuous full-thickness anterior soft tissue flap. The retractors are placed intracapsular with the elbow flexed; deep to the brachial and the anterior capsule and over the medial column for the exposure of the anterior part of the distal humeral articular fracture fragments and the radial head. The fracture site is debrided of hematoma and soft-tissue debris for good visualization of the fracture fragments. The retractors must not be placed anterior to the radial neck for the reduction of the risk of posterior interosseous nerve injury.

As there was posterior metaphyseal comminution, the lateral part of the triceps elevated from the lateral column and the proximal ulnar metaphysis. Meticulous dissection to preserve the lateral ulnar collateral ligament origin at the lateral epicondyle and the vascular supply to the capitellum. Release of the lateral ulnar collateral ligament is not always necessary even when there is trochlear extension of the coronal shear capitellar fracture. In patients with a lateral epicondylar fracture fragment, the epicondylar fragment with the lateral collateral ligamentous complex origin can be reflected distally to enhance exposure. The lateral extensile exposure does not increase the risk of osteonecrosis of the capitellum or trochlea [3,9]. Anatomic reduction was done under direct vision; as the articular segment is reduced along the proximal metaphyseal margin and trochlea, the capitellar fracture is provisionally fixed with a minimum of two 1.14 or 1.5-mm K-wires. C-arm was used to confirm anatomic reduction. When there is sufficient subchondral bone on the articular segment, buried headless cannulated screws are inserted over the guide wires in an anterior-to-posterior direction. Herbert screws and fully threaded mini-headless screw provide fracture site compression through variable thread pitch designs. A minimum of two screws are used in larger fragments to ensure control of rotation. Care is taken to spread the screws sufficiently to avoid iatrogenic fracture of the capitellum. The common extensors are repaired to the soft-tissue cuff on the lateral supracondylar ridge, and the Kocher interval is closed in continuity with the proximal exposure of the lateral column. When rigid fixation has been achieved, a long arm posterior plaster splint and compressive dressing is applied with the elbow at approximately 90° of flexion. At the first outpatient clinic visit (seven to ten days postoperatively), the sutures are removed and active and active-assisted range of motion of the elbow and forearm is initiated. Delayed or protected mobilization with a hinged functional elbow brace may be necessary when there is concern about the stability of fixation.

Result

The mean follow up period was 18±9.56 months (ranging from 12 to 24 months).The mean age was 26.55 years (range 19-34 years) (Table 1). There were 13 (72.2%) male and 5 (27.8%) female (Table 2). Right extremity was involved in 13 (72.2%) elbows and left in 5 (27.8%) elbows (Table 3). Four patients had a fall on outstretched hand and 6 had direct fall on the elbow in road traffic accidents. The mean preoperative delay was 4.67 days (2-7 days). Associated injuries included posterolateral elbow dislocation in two cases, lateral condyle fracture in three elbows, radial head fracture in two elbows and medial epicondyle in one elbow. The mean time of operative procedure was 82±4.35 minutes (60-108 minutes). The mean ulnohumeral motion was 126±21.14 (range, 75° to 150°). The functional arc of elbow motion was gained by 16 patients and two elbows with radial head fractures had mean flexion contracture 8±5.8 degrees, and all patients had full forearm

rotation. The mean Mayo Elbow Performance index Score (MEPS) was 91±10 points, with thirteen (72.2%) excellent results, four (22.2%) good result, and one (5.6%) fair results. The ipsilateral radial head fracture did not affect the ulnohumeral motion and the functional outcome (Table 4) (Figure 1).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Right	13	72.2	72.2	72.2
	Left	5	27.8	27.8	100.0
	Total	18	100.0	100.0	

Table 1: Statistics (demographic state of all patients about age and time of surgery, and ROM).

	N	Minimum	Maximum	Mean	Std. Deviation
Age	18	19.00	34.00	26.5556	4.47506
Time to surgery	18	2.00	7.00	4.6667	1.64496
ROM Flexion-Extension	18	75.00	150.00	126.1111	21.41276
ROM of Pronation &Supination	18	75.00	90.00	87.0000	4.15862
Healing time	18	6.00	10.00	8.1667	1.20049
Valid N (list wise)	18				

Table 2: Sex distribution of all patients.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	13	72.2	72.2	72.2
	Female	5	27.8	27.8	100.0
	Total	18	100.0	100.0	

Table 3: Side affected by trauma.

		Count	Percent
MEPS	Excellent	13	72.2%
	good	4	22.2%
	fair	1	5.6%
Overall		18	100.0%
Excluded		0	
Total		18	

Table 4: clinical results (Mayo Elbow Performance Score).

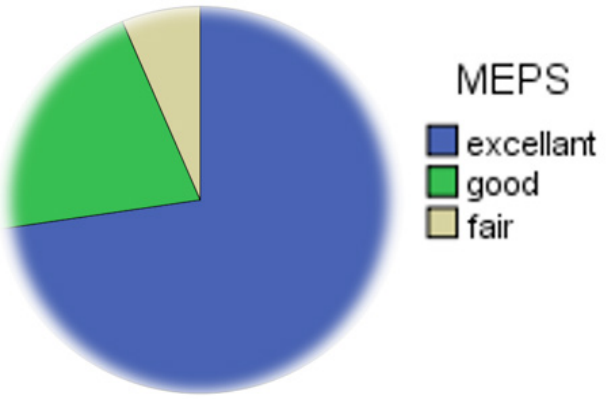

Figure 1: Histogram of the Mayo Elbow Performance Score.

There were no intraoperative complications. The mean healing time was 8.16±1.2 with range 6-10 weeks. Cases associated with fractures of lateral condyle were treated by K-wire. Cases associated by radial head fracture all show small fragments and treated by partial excision of these fragments. The case with fracture medial epicondyle fixed by k-wire and cases with dislocation elbow were treated by closed reduction and hinged elbow brace after fixation of the capitellum for the stability postoperative. There was no postoperative neural affection. From the first outpatient clinic visit the sutures removed and active assisted flexion and extension of the elbow was initiated. Immediate pronation and supination movements in flexion were allowed and in cases with dislocation of the elbow, hinged elbow brace was used to initiate mobility after one week. Lifting weight was initiated after the six week and full activity was initiated after 14 weeks. There was no evidence of avascular necrosis or elbow instability was seen till the last follow-up visit. All elbows were pain free and there was no heterotopic ossification during our follow-up.

Discussion

The radial head-capitellum view good delineates the fracture feature and the double arc sign on the lateral view of the elbow has to be pathognomonic for Type IV capitellum fractures1. As type IV capitellar fractures are very rare and proper visualization of the capitellar fragment may not be possible in the routine views of the elbow7. However, this sign is not always present [2]. In our study, six patients did not show this sign. A simple capitellum fracture on radiographs turns out to be a complex fracture intraoperatively with most of them having part of trochlea involved [1]. Therefore a 3-D CT scan should be done to identify the fracture geometry for the proper approach and the implant selection. In our study, we had used lateral extensile kocher approach in all cases for fixation of these complex fractures. This approach can be used for capitellotrochlear fractures with lesser degree of comminution. The large articular fragments can be fixed by mini-screws on table and comminuted part can be excised [8,3].

The direction of the fixating screws of the capitellum can be passed either anteroposterior or posteroanterior [4,5]. *In vitro* comparison studies have found that posteroanterior construct is more stable than anteroposterior one [10]. However if the screws inserted anteriorly, countersinking is needed and also increases the risk of comminution of the fragment. In our study we used anterior to posterior directed Herbert screws in thirteen cases but we found that posterior to anterior Herbert screws were easier and more stable and did not affect the articular cartilage. We had used cannulated cancellous screws posterior to anterior in two cases and it was easy to insert and we considered intraoperative stability rather than the direction of screws was the key to a good functional outcome. (Figures 2,3) The forearm rotations and flexion and extension Limitation and residual pain are the most common complications of capitellar fracture were rarely affected [1,3]. Intraarticular or extraarticular adhesions, articular damage and articular deformity, and postoperative immobilization are the major factors causing loss of elbow motion [11]. The accurate reduction of fracture, stable fixation and immediate mobilization are the keys to achieve optimum functional results8. The capitellar fracture has no clinical reports of significant heterotopic ossification [5]. In our study associated with elbow dislocation, patients were given indomethacin for six weeks postoperative for prophylaxis. The timing of the procedure may be a critical factor in the development of heterotopic bone formation as the sooner these fractures are managed the less likely they seem to progress to the development of heterotopic ossification [12]. Osteoarthritis was not yet seen in any case during the follow-up. These injuries involve the articular surface and are extremely traumatic to the elbow joint. Osteoarthritis can be developed secondary to the chondral damage sustained during the time of injury [13].

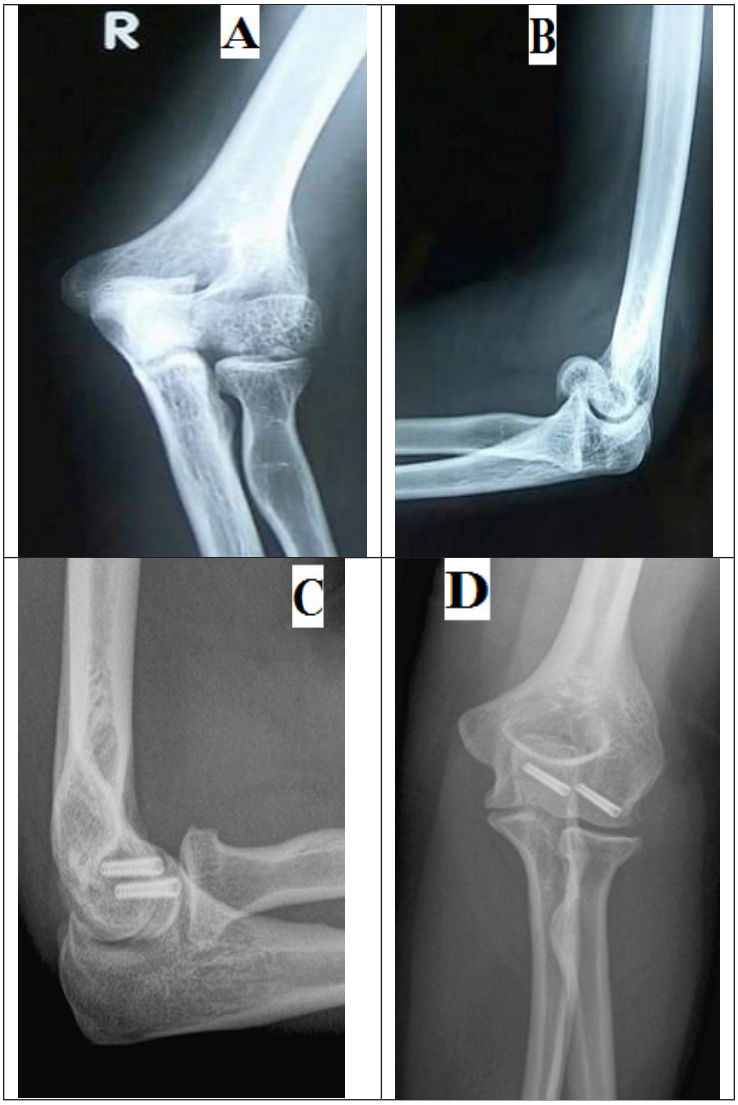

Figure 2: Case 1 show A&B preoperative x-ray and C&D final after union.

Figure 3: Case 2 show A&B preoperative x-ray and C&D final x-ray.

As the fact that the fractured fragments of the capitellum has no soft tissue attachment, avascular necrosis is suspected as one of the major nightmare complications after surgical management. Rapid revascularization of the fractured fragments may be admired to make the clinical and radiological features of the avascular necrosis apparent [14]. All these patients have stable pain free elbows with excellent functional outcome and no signs of avascular necrosis so far. Patients with avascular necrosis of capitellum undergo collapse and slow degeneration of the articular surface with subsequent pain and limited range of motion, and usually patients have experienced minimal dysfunction in the elbow. Because of this low incidence of avascular necrosis, encountering a free capitellar fragment should not discourage the use of internal fixation [15].

Conclusion

Fracture of the capitellum is a challenging orthopedic problem either the radiological appearance or the surgical management. The early diagnosis and stable fixation are mandatory for the early mobility for reduction of the complications. The posterior to anterior direction of the fixing screws is easier and more stable and preserve the articular cartilage.

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