

Open Reduction and Internal Fixation of Capitellar Fracture through Anterolateral Approach with Headless Double Threaded Compression Screws

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Abstract

Background: Injuries to the humeral 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 due to falling on an outstretched hand or flexed elbow. The aim of this study to evaluate the results of patients suffering from capitellar fracture treated by open reduction and internal fixation through anterolateral approach with headless double threaded compression screws. **Patients and Methods:** This study included 12 capitellar fractures; the radiological x-ray was done for planning the fixation technique. All fractures were treated with headless double threaded compression screws using anterolateral approach, over the period from March 2020 to February 2021 at Zagazig university hospital, with the mean follow up period 8 months \pm 1.95 ranged from six to 11 months. **Results:** The present study showed the pain score was 45 points. At end of the follow up period 9 patient had no pain (75 %) and 3 patient had mild pain (25 %). Eight patients had active flexion above 100° (66.7 %) and 4 patients had active flexion from 50° to 100° (33.3 %). Eight cases were excellent score with (66.7 %), three cases good score (25%), and only one was satisfactory score with (8.3%). **Conclusion:** Headless double threaded compression screws has a good clinical result in Capitellar fracture because these screws have the advantage of excellent compression at the small fracture fragments, stable fixation, and non-prominence of the implants intraarticular.

Keywords: Capitellar Fracture; Internal Fixation ; Double Threaded Compression Screws

INTRODUCTION:

The capitellum is the smooth rounded ball situated on the lateral aspect of the lower end of the humerus. It presents anterior and inferior articular surface, but does not extend posteriorly. The head of the radius rotates on its anterior surface when the elbow is in flexion and on its inferior surface when the elbow is in extension (1). Fractures of the humeral capitellum are rare and account for 1% of elbow fractures. 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 due to falling on an outstretched hand or flexed elbow (2).

Brayan and Morrey classified fractures of the capitellum into: Type I Coronal shear fracture through the capitellum, resulting in a hemispheric fracture fragment (Hahn-Steinthal fracture), Type II: Involves a shell of articular cartilage with a thin layer of subchondral bone and appears as though the capitellum has become “uncapped” (Kocher-Lorenz fracture). Type III: Comminuted, often impacted fracture, McKee et al described a type IV, which is a shear fracture involving the capitellum and extending medially into most of the trochlea (3). The capitellum fracture may be associated with ligamentous injury. Medial collateral ligament or lateral collateral ligament tear (4). Imperfectly treated fracture may lead to a severe loss of function due to the restricted range of motion (ROM)(5).

Various modalities of treatment and fixation of the fracture have been described. These range from conservative treatment with closed reduction and immobilization to open reduction and fixation. Open reduction and fixation can be done with Kirschner (K) wires, partially threaded cancellous screws, headless double-threaded compression screws (HC screws), 3.5 mm lag screws, horizontal mattress cross stitched suture technique (6). The traditional approach for capitellum fracture is lateral (also known as Kocher approach), but the disadvantages of this approach are an indirect visualization of the fracture fragment, and the relative difficulty of putting the screws perpendicular to the fracture site, These difficulties can be avoided by the use of the anterolateral approach (7).

The intra-articular nature of the fracture makes it necessary that the head of the implant should not be prominent. The HC screws, with its property of differential pitch and countersunk head, is a good option for fracture fixation. The advantages offered by these screws include excellent compression at the fracture site, stable fixation, and non-prominence of the implant intra-articularly, thus allowing early mobilization of the elbow (8).

Therefore, the present study aimed to evaluate the results of patients suffering from capitellar fracture treated by open reduction and internal fixation through anterolateral approach with headless double threaded compression screws.

PATIENTS AND METHODS:

This study included 12 patients with capitellar fractures; the radiological x-ray was done for planning the fixation technique. All fractures were treated with headless double threaded compression screws using anterolateral approach, over the period from March 2020 to February 2021 at Zagazig university hospital.

Approval was obtained from Institutional Review Board (IRB) Zagazig University. Written informed consents were obtained from all patients. The work has been carried out in accordance World Medical Association (Declaration of Helsinki) for studies involving humans before prospective collection of patient’s data and after informed consent was obtained from patients.

Inclusion criteria:

Patients of both sex in age ranged from 18 to 60 years old with capitellum fracture type I, III, and IV according to modified Brayon and Morrey classification.

Exclusion criteria:

Patients with capitellum fracture type ii according to modified brayan and morrey classification. age below 18 years old. Presence of fracture dislocation, failed previous fixation, rheumatological diseases, infection, poly-traumatized patients and compound fractures and pathological fractures.

Clinical examination:

A comprehensive general examination of each patient was performed. After stabilizing the patient's general condition, local clinical examination was performed.

Routine investigations:

- Complete Blood Count (CBC).
- Bleeding profile (PT, PTT).

Radiological evaluation:

The radiological evaluation is the cornerstone for the proper management of fractures of capitellum.

Radiological evaluation consisted mainly of (AP/ lateral and Greenspan view) plain radiography and CT- scan in all patients.

Preoperative preparation of the patient:

The fractures were temporarily put in an above elbow slab till the time of operation, the limb was elevated, analgesics were prescribed and the patients were kept under observation in the hospital till the time of surgery.

Surgical technique:

After anesthetic assessment, all patients with a capitellum fracture were consented and listed for ORIF with headless double threaded compressed screws in the operating theatre. A single dose of intravenous prophylactic antibiotics was administered at the anesthetic induction. The patient was supine position on table surgery with arm supination on radiolucent arm board. A pneumatic tourniquet applied to the proximal arm, inflated after draping. After identified the nerve, Retraction of muscles bring into view the radial nerve with its division into the superficial and deep branches. Ligation and transected the radial recurrent artery with its branches.

After the fracture was exposed, irrigated, and reduced. The fragment is reduced under direct visualisation and provisionally K wire is fixed from anterior to posterior, the K-wire used as joystick to manipulation them into anatomical reduction. Once definitive fixation was confirmed by C-arm in all planes, Elbow motion and stability were assessed clinically. In addition, deflated a pneumatic tourniquet before the closure of the wound to check blood hemostasis and insert a drainage tube. After that; proper skin closure and above elbow slab applied to immobilize the elbow.

Post-operative care:

The patients were observed for neurovascular status after operation immediately. By examination the pulse and radial nerve. All patients received parenteral broad-

spectrum antibiotics during their hospital stay in a dose of 1 gram every 12 hours and continued postoperatively for 1 day. All patient advice to do active range of motion to wrist joints (flexion and extension) and gripping exercises.

Follow up:

The patients were following up both clinically and radiologically from one week till 8th week after operation. At the end of follow up: elbow function was assessed by The Mayo elbow performance index.

Statistical analysis:

Data were checked, entered and analyzed using SPSS version 23 for data processing. The following statistical methods were used for analysis of results of the present study. Data were expressed as number and percentage for qualitative variables and mean + standard deviation (SD) for quantitative one.

RESULTS:

The attainable results showed the age of the patients in this study ranged from 23 to 59 years with the mean of 39.25 years \pm 10.48 years. There was 3 males (25%) and 9 females (75%) with male to female ratio (1:3). The right hand is a dominant extremity in all patient in this study and it represent (42%), however the injury more in the left (non-dominant extremity) as it represent (58%). The mechanism of injury was fall on out stretched hand (FOOSH) in seven cases (58%), road traffic accident (RTA) in five cases (42%). According to modified Braynan and Morrey classification, 8 patients had grade I (66.7%), one patient had grade III (8.3%), and 3 patients had grade IV (25%) (**Table 1**).

Regarding Mayo elbow performance index score, the present study showed the pain score was 45 points. At end of the follow up period 9 patient had no pain (75 %) and 3 patient had mild pain (25 %). the mean range of motion of elbow joint was 118.8° ranged from 95° to 140°. Eight patients had active flexion above 100° (66.7 %) and 4 patients had active flexion from 50° to 100° (33.3 %). The stability score 10 points. All patients had stable elbow. Nine patients had the ability to fulfill all the activities (75%) and three patients showed some restricted activity (25%), while none of the patients had difficulty with shirts, hygiene, and feed. Eight cases were excellent score with (66.7 %), three cases good score (25%), and only one was satisfactory score with (8.3%) (**Table 2**).

Concerning correlation of time of union and type of trauma, our study showed statistically significant correlation (P = 0.04) between the type of trauma and time of union (**Table 3**).

There was statistically significant correlation (P= 0.002) between the type of fracture according modified Braynan and Morrey classification and time of union (**Table 4**).

There was statistically significant correlation ($P = 0.002$) between the type of fracture and complication (Table 5).

Table (1): Demographic and clinical data of the studied patients:

		N	%
AGE	Mean \pm S.D 39.25 \pm 10.48	20 – 30 years (2)	16.7%
		30 – 40 years (5)	41.6%
		40 – 50 years (3)	25%
		50 – 60 years (2)	16.7%
SEX	Male	3	25%
	Female	9	75%
	Total	12	100%
Side of trauma	Right	5	42%
	Left	7	58%
	Total	12	100%
M.O.I	FFH	7	58%
	RTA	5	42%
	Total	12	100%
Brayan and Murry	Grade I	8	66.7%
	Grade III	1	8.3 %
	Grade IV	3	25 %
	Total	12	100%

Table (2): Distributions of Mayo elbow performance index score:

		N	%
Pain	No pain	9	75%
	Mild pain	3	25%
Range Of Motion	Arc $> 100^\circ$	8	66.7 %
	Arc 50° to 100°	4	33.3 %
Stability	Stabile	12	100%
Comb Of Hair	Yes	9	75 %
	No	3	25 %
Feed	Yes	12	100 %
Hygiene	Yes	12	100%
Shirt	Yes	12	100 %
Shoe	Yes	10	83.3 %
	No	2	16.7 %
Total Mepis	Excellent (> 90)	8	66.7 %
	Good (75 – 89)	3	25 %
	Satisfactory (60 – 74)	1	8.3 %
	Poor (< 60)	0	0
	Total	12	100 %

Table (3): Correlation of time of union and type of trauma:

			FOOSH (7)	RTA (5)	X^2	<i>P</i>
Time of union	8 WKS	N	5 (71.4%)	0	7.8	0.04*
		%	100%	0		
	10 WKS	N	2 (28.6%)	2 (40%)		
		%	50%	50%		
	12 WKS	N	0	2 (40%)		
		%	0	100%		
	14 WKS	N	0	1 (20%)		
		%	0	100%		

Table (4): Correlation of time of union to modified Brayn and Morrey classification.

			Type I (8)	Type III (1)	Type IV (3)	X^2	<i>P</i>
Time of union	8 WKS	N	5 (62.5%)	0	0	19.88	0.002**
		%	100%	0	0		
	10 WKS	N	3 (37.5)	0	1 (25%)		
		%	75%	0	25%		
	12 WKS	N	0	0	2 (50%)		
		%	0	0	100%		
	14 WKS	N	0	1 (25%)	0		
		%	0	100%	0		

Table (5): Correlation of complications according to type of fracture:

		Non (8)	Complicated (4)	X^2	<i>p</i>
Type I	N	8 (100%)	0	12	0.002**
	%	100%	0		
Type III	N	0	1 (100)		
	%	0	(100%)		
Type IV	N	0	3 (100%)		
	%	0	100%		

DISCUSSION:

Careful assessment of the fracture should be done to rule out the involvement of other anatomic structures and associated radial head and neck fractures. CT scan is recommended to visualize the entire fracture line, relationship to the trochlea, metaphyseal comminution, and posterior condylar comminution (3).

Open reduction can be done by anterolateral approach, lateral (Kocher) approach, or lateral approaches, and fixation can be done by Kirschner (K) wires, partially threaded cancellous screws, headless double-threaded compression screws (9). Hence, the posterior approach is best avoided for fixation of these fractures. The

most commonly used approach is the Kocher lateral approach, which allows exposure of the joint by elevation of the common extensor origin from the lateralepicondyle (4).

In the current study, twelve patients with capitellar fracture were treated with headless double threaded compression screws using an anterolateral approach, during the period from March 2020 to February 2021 at Zagazig university hospital, with the mean follow up period 8 ± 1.95 months (ranged 6 - 11 months). In this study, the outcome according to Mayo elbow performance index was excellent in (66.7%) of patients, good in (25 %) of patients, and (8.3%) of patients had satisfactory results. The mean range of flexion was 118.8° (range, $95^\circ - 140^\circ$). The average time of bone union was 9.83 ± 1.9 weeks (range, 8 weeks – 14 weeks), with no mal-union or non-union. Our findings were comparable with several studies:

Bhat et al., (10) who reported the outcome was excellent in (85 %) of patients, good in (10 %), and satisfactory in (5 %) of patients. The mean range of motion in flexion/extension arc was from 5° to 130° . The average time of bone union was 18 weeks (range 12–30 weeks) there was one case with delayed union.

Vaishya et al., (11) who stated the outcome was excellent in (62.5%) of patients, and (37.5%) of patients had a good result. The mean range of flexion was 132° (range, $125^\circ - 135^\circ$). The average time to bony union was 3.5 months (range, 2.5 - 5 months) with no mal-union or nonunion.

Moreover, **Yu et al., (12)** who revealed the outcome was excellent in (73.3 %) of patients, and good in (26.7 %) of patients. The mean range of motion was 134° (range, 120° to 145°) during flexion-extension. Non-union was not detected in any patients.

In addition, **Singh et al. (13)** who reports the outcome of 14 patients with capitellum fractures who managed with an open reduction and internal fixation and all patients had good functional outcome with no degenerative changes and avascular necrosis

Mighell et al. (14) who underwent an open reduction and internal fixation using headless compression screws in 18 patients with fractures of capitellum and 17 patients had good functional outcome but only 3 patients developed avascular necrosis while 5 patients developed arthrosis post-operatively.

Imatani et al. (15) who managed six patients with fractures of humerus with open reduction and internal fixation and concluded that patients had good post-operative functional outcome.

Mahirogullali et al. (16) who concluded the outcome of 11 patients with capitellum fractures treated by open reduction and internal fixation postoperatively. They showed an excellent outcome in 8 patients and good outcome in 3 patients. However, they used superior posterior approach to anterolateral approach and concluded that early mobility helps in improving functional outcome of these patients

Stamatis et al. (17) who managed six patients with type IV fractures using open reduction and internal fixation. The complications include mild degenerative joint disease in one patient, osteonecrosis of coronal shear fragment in one patient. All patients had good functional outcome with Mayo elbow performance scale scores

between 98-100. Hence we can conclude that anterolateral approach offers promising results and good functional outcomes with minimal complications.

CONCLUSION:

Headless double threaded compression screws has a good clinical result in Capitellar fracture because these screws have the advantage of excellent compression at the small fracture fragments, stable fixation, and non-prominence of the implants intraarticular.

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