

## Case Report

# Treatment of the coronoid process fractures with anteromedial approach: a case report

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Received April 21, 2015; Accepted September 28, 2015; Epub October 15, 2015; Published October 30, 2015

**Abstract:** This study aimed to explore the clinical effect of the coronoid process fractures with anteromedial approach. 18 cases of coronoid process fractures treated with the anteromedial approach were enrolled. Causes of injury included traffic injuries in 3 cases and fall on the ground in 15 cases. There were 6 cases of type I, 10 cases of type II, and 2 cases of type III according to the O'Driscoll classification. The time from injury to operation was 2-10 days (mean, 3.9 days). Fractures were fixed by using mini-plate or screws. All cases were followed-up for 12-24 months (average 14.9 months). The bony union time was 8-14 weeks with an average of 10.6 weeks. The mean flexion at last follow-up was 122° (range, 90°-140°), the mean extension loss was 20° (range, 0°-50°), and the mean pronation was 67° (range, 22°-90°), while the mean supination was 61° (range, 30°-88°). Elbows were stable in the flexion-extension and varus-valgus in all cases. According to the MEPS elbow performance score, results were excellent in 14 cases, good in 3 cases and fair in 1 case. According to the Broberg and Morrey elbow performance score, results were excellent in 9 cases, good in 4 cases, and fair in 1 case. In conclusion, the anteromedial approach facilitates the reduction and fixation of the coronoid process fractures and has advantages of clear exposure, convenient placement of internal fixation, small invasion and good clinical results.

**Keywords:** Unlar fracture, fracture fixation, internal, anteromedial approach

## Introduction

Recent biomechanical and clinical studies have demonstrated that coronoid process is an important structure for stable elbow joint [1-15]. Coronoid process is anterior support that prevents the ulna from posterior displacement. The anterior fascicles of medial collateral ligament are attached to the protruding node of the coronoid process, which supports the elbow joint to prevent extroversion. Therefore, the integrity of the coronoid process plays a key role in stability of the elbow joint. The fracture should be fixed through operation. For the surgical treatment of coronoid process fracture, the option of approaches remains to be debated due to its special and complicated anatomy. The optimum exposure approach of coronoid process fracture has been controversial all the time. To explore the clinical effectiveness of the coronoid process fractures with anteromedial approach, the study retrospectively reviewed 18 cases of coronoid process fractures treated

with anteromedial approach from January 2010 to October 2013.

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18 cases with coronoid process fractures were enrolled in this study (shown in **Table 1**). There were including 11 males and 7 females, with age ranging from 21 to 55 years (mean age of 33.6 years). Causes of injury included fall on the ground in 15 cases and traffic injuries in 3 cases. 6 cases had left side injuries and 12 cases had right side injuries. All were closing injury. There were 6 cases of type I, 10 cases of type II and 2 cases of type III according to O'Driscoll classification. Time from injury to operation was 2-10 days (mean time of 3.9 days).

The patients underwent a range of imagiological examinations including anteroposterior and lateral X-ray film of the elbow, CT scan and 3-D or multiplanar reconstruction (MPR) to determine the displacement and types of fractures.

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**Table 1.** Base information, treatment and outcome details (at final follow-up)

Patient	Age	Sex	Cause of injury	O'Driscoll type	Lateral collateral ligament injury	Fixation method	Complication	Follow-up time (month)	MEPS	Broberg & Morrey score
1	21	Male	Fall	I	No	Mini-plate	No	12	100	100
2	38	Female	Fall	I	Yes	Screw & rivet	No	14	98	95
3	27	Male	Fall	I	Yes	Mini-plate	Heterotopic ossification	18	89	88
4	28	Male	Fall	II	Yes	Plate & screw assisted fixation	No	12	98	95
5	26	Female	Fall	II	No	Mini-plate	Retropgression	24	72	75
6	37	Female	Fall	I	Yes	Mini-plate	No	17	97	94
7	33	Male	Fall	II	Yes	Plate & screw assisted fixation	No	18	98	92
8	30	Male	Car accident	II	No	Mini-plate	No	12	89	89
9	35	Male	Fall	II	No	Plate & screw assisted fixation	No	12	100	95
10	55	Male	Fall	III	No	Mini-plate	No	12	98	93
11	43	Male	Fall	II	Yes	Mini-plate	Heterotopic ossification	14	89	78
12	29	Female	Fall	II	No	Mini-plate	No	14	99	99
13	34	Female	Fall	I	Yes	Mini-plate	No	16	100	100
14	37	Male	Fall	II	No	Mini-plate	No	20	98	98
15	35	Female	Fall	II	No	Mini-plate	No	13	88	90
16	28	Male	Car accident	II	Yes	Plate & screw assisted fixation	No	12	99	98
17	26	Male	Fall	I	Yes	Mini-plate	No	16	98	96
18	43	Female	Car accident	III	No	Plate & screw assisted fixation	No	12	89	90

It is hard to tell the radial head fracture from the coronoid process fracture by anteroposterior and lateral X-ray film of the affected elbow. CT 3-D or MPR can accurately detect the position, severity and displacement of the fracture. The affected elbow was extended on see-through surgical table with brachial plexus block anesthesia or general anesthesia. The pneumatic tourniquet was used on proximal upper arm.

An incision of 6-8 cm was made at 1-3 cm proximal to medial epicondyle of humerus and 5 cm distal from the ulnar coronoid process extended from the center of the elbow joint. The skin and subcutaneous tissues were dissected. The medial antebrachial cutaneous nerve and basilic vein were found and protected by blunt incision of subcutaneous tissues. The nerve was inclined along the surgical view and easy to recognize at the medial epicondyle level. The vein that interfered with the exposure was ligatured. The bicipital aponeurosis was longitudinally dissected. The intermuscular septum between the pronator teres and the flexor carpi radialis were separated longitudinally along the muscle fiber and unbound at the proximal side. The ridge of medial epicondyle was found. Part of anterior structure of distal humerus was subperiosteally retracted. The pronator teres was retracted at the radial side. The flexors such as

flexor carpi radialis was retracted at the ulnar side. So the brachialis was exposed and retracted at the radial side or longitudinally dissected. Part of the end point of the brachialis was subperiosteally retracted. The anterior fascicles of medial collateral ligament attached to the interior protruding node of the coronoid process should be protected. The joint capsule was dissected at the anterior elbow joint.

For great coronoid process fracture, the ulnar recurrent artery at the lower segment of the incision should be noted. The ulnar recurrent artery could be ligatured for better exposure and fixation. The coronoid process was exposed. The articular surface of the coronoid process was more easily exposed when the elbow joint completely stretched. The open anatomical reduction of the fracture was performed. The Kirschner wires were used for temporary fixation. Prior to reduction and fixation of coronoid process, it was important that the distal humerus was completely located at the incisura trochlearis of the olecranon. 12 cases were supported and fixed using mini metacarpal plate. 5 cases were fixed using plate plus screw. 1 case was fixed using screw plus rivet. 9 cases with lateral collateral ligament injury were repaired with rivet (as shown in **Figure 1**).

After repairing of bone and ligament structure, the elbow joint was observed for stability under

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**Figure 1.** Ulnar Coronoid Process Fracture. A, B. Ulnar coronoid process fracture on the anteroposterior and lateral position X-ray film prior to operation. C, D. Obvious dislocation of ulnar coronoid process fracture on the CT scan. E, F. The ulnar coronoid process fracture on the anteroposterior and lateral position X-ray film after fixation operation. G. Favorable reduction of ulnar coronoid process fracture on the CT scan after operation.

fluoroscopy. The consistency of the humeroulnar joint should be carefully examined at the flexion range of 30-130°.

The orthosis or plaster was used to immobilize the elbow joint at flexion 90° and neutral position of the forearm following operation. The routine treatments such as anti-inflammation, detumescence and analgesia were administered. The indometacin was orally administered to prevent myositis ossificans. 1 week after operation, patients could do limited activities starting from flexion to rotation of the forearm at the flexion of the elbow of 90°. The maximum extension was limited at 30° till the sixth week. The activities were not limited and the patients returned to normal work 8 weeks after operation. Based on individual activity strength, they were generally able to do heavy physical activities 3 months after operation. The concentric reduction of humeroulnar joint was guaranteed by double-examination with monthly film within 3 months.

The Mayo elbow performance score (MEPS) [16] and Broberg & Morrey score [17] were used to assess the function of the elbow joint. Assessment of effectiveness by MEPS: pain (45 points), range of flexion (20 points), stability of elbow joint (10 points), daily activity function (25 points); excellent ( $\geq 90$  points), good (75-89 points), fair (60-74 points), poor ( $< 60$  points). Broberg & Morrey score: function activity (40 points), strength (20 points), stability (5 points), pain (35 points); excellent ( $\geq 95$  points), good (80-94 points), fair (60-79 points), poor ( $< 60$  points).

All cases were followed-up for 12-24 months (average 14.9 months). The healing time was 8~14 weeks with an average of 10.6 weeks. At last follow-up, 16 cases had no pain, and 2 cases had mild pain. No cases had severe pain. Mean flexion at last follow-up was 122° (range, 90°-140°), mean extension loss was 20° (range, 0°-50°), mean pronation was 67° (range, 22°-88°) while mean supination was

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61° (range, 30°-86°). Elbows were stable in flexion-extension and varus-valgus in all cases. 2 cases developed mild ectopic ossification (Brooker class 1) in the elbow joint 3 months after operation and no special treatment was applied. 1 case developed mild degenerative change in the elbow joint and no progression was observed after rehabilitation and exercise. The mean score was 95.5 (ranged from 82-100) according to MEPS, excellent in 14 cases, good in 3 cases and fair in 1 case. The mean score was 92.5 according to Broberg and Morrey, excellent in 9 cases, good in 7 cases and fair in 2 cases.

### Discussion

#### *Option of approach for the ulnar coronoid process fracture*

The treatment of ulnar coronoid process fracture is the same as that of the intra-articular fracture. Best result can be achieved through anatomical reduction, stable fixation and early activity. The current recommendation for coronoid process fracture is to repair all unstable bones of the elbow joint in spite of the size of the fracture [3, 4]. The optimum approach for the coronoid process fracture was controversial. There are lateral [5, 6], interior [7-9], posterior [10, 11] and anterior [12, 13] approaches for the coronoid process fracture. The lateral approach is often recommended for terrible triad elbow injury.

Gupta et al [5] used standard lateral approach to treat 52 cases with terrible triad elbow injury. The majority of patients reliably attained functional ROM arcs with this treatment protocol. The rate of recurrent instability was extremely low. Dodds et al [6] used lateral Kocher approach (intermuscular septum between ulnar extensor muscle and elbow muscle) to treat coronoid process fracture. They believed the lateral approach could better expose the coronoid process because it was located at the anterior side. Some researchers used posterior median approach [10, 11]. This approach has several advantages. It enables both interior and lateral access, which avoids interior approach when necessary during operation. The posterior approach is at lower risk to damage cutaneous nerve than the interior and lateral approach. Moreover, the posterior approach is more cosmetic and less visible compared with interior and lateral approach.

The disadvantages of the posterior approach include increased possibility of exudation and hematoma, and potential complication of cutaneous necrosis. The anterior approach of the elbow joint is to make an S-shape incision from the anterior region to the lateral region. The arc goes along the skinfold of fossa cubital and extends to the interior forearm, thereby exposing the structure of the anterior elbow joint. Han et al [12] believed that the advantage of anterior approach was extensive exposure of the joint to enable the surgeon to examine the elbow joint injury during reduction of the fractured bone in the joint and mild flexion of the elbow joint. Moreover, the approach can avoid damage of normal anatomical structures such as medial collateral ligament, flexor pronator teres and the ulnar nerve of the elbow joint. They also supported that the anterior approach of the elbow joint was alternative approach for the type III coronoid process fracture, which could expose the fracture fragment with minor soft tissue injury. However, we hold that the anterior approach has bigger risk of neurovascular iatrogenic injury than other approaches. It is hard to repair the accompanied ligament injury within the same incision. The combination of interior or lateral approach has some impact [14].

Recently, the interior approach to treat coronoid process fracture has gained more attention from orthopedists. Taylor and Scham [7] described the coronoid process was exposed by elevation of the whole flexor pronator teres of the interior ulna though it needed extensive dissection. Huh J [9] suggested the approach that required dissection of flexor carpi ulnaris between two heads. This approach requires adequate decompression and dissociation of ulnar nerve. In most elbow joints, the bundle branches should be cut off. Hotchkiss et al [8] used more anterior "Over the top" approach to expose the coronoid process. The pronator teres, flexor carpi radialis and palmaris longus were retracted at the radial side. The flexor carpi radialis was retracted at the ulnar side. We selected anteromedial approach. The pronator teres was retracted at the radial side. The flexors such as flexor carpi radialis was retracted at the ulnar side, thereby exposing the inferior coronoid process. It is suggested that there existed a safe region between the ulnar nerve and median nerve if anteromedial approach was used. The exposure was smaller and safer.

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No cases developed neurovascular injury in 18 cases with coronoid process fracture who had been treated.

### *Advantages and precautions of refined antero-medial approach*

First, the injury caused by the anteromedial approach is smaller due to operation in the intermuscular spatium. Second, the fracture fragment can be directly reduced and fixed using plate or screw. Compared with suturing technology, the plate and screw for fixation are biomechanically better in resist axial load, especially for the corrupted coronoid process fracture [15]. They are helpful for early activities. Third, the anterior fascicles of ulnar collateral ligament can also be detected and repaired using the same incision in case of any fracture. Fourth, the coronoid fracture is adequately exposed, including the anterior side and the protruding node. Fifth, the forearm medial cutaneous nerve is protected during operation. There is no need for separation of important structures such as ulnar nerve, median nerve and brachial artery. Sixth, the point attached by the brachial artery impacts the exposure and fixation of the coronoid process. Part dissection of the end point is necessary [18]. Seventh, the anterior fascicles of ulnar collateral ligament should be protected during the operation. Eighth, the stability and consistency of the joint should be assessed after restoration.

It is concluded that the anteromedial approach is a safer approach for reduction and fixation of ulnar coronoid process fracture. This approach causes less injury and is better to expose the coronoid process fracture.

### **Disclosure of conflict of interest**

None.

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