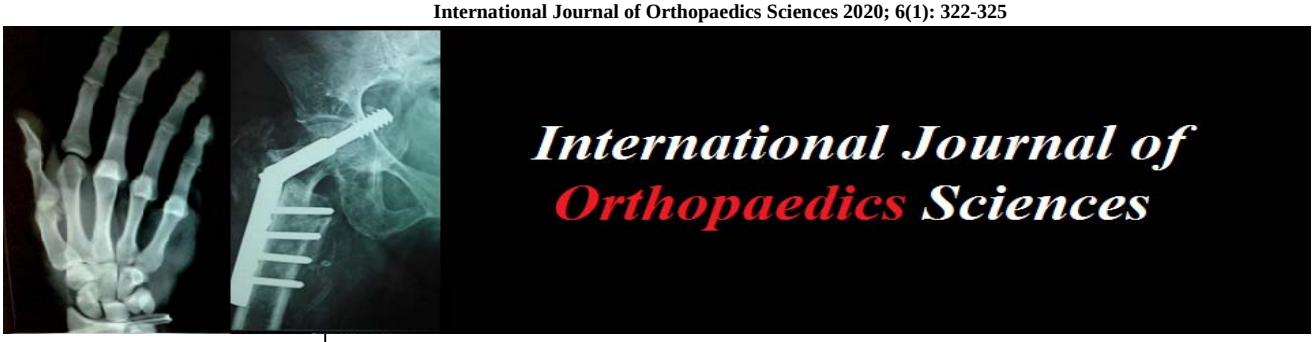

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Outcome of buttress plate fixation of coronoid process fracture via a modified anteromedial approach

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Abstract
Fractures of Coronoid process of ulna are rare and difficult injury to treat with pain and instability to elbow. The aim is to study outcomes of buttress plate fixation of coronoid via modified anteromedial approach. We evaluated 15 patients from august 2017 to September 2019 with 9 (60%) of type II & 6(40%) of type III Regan-Morrey fractures. At final follow up all patient were have solid osseous union with mean elbow flexion & extension movement was 0 to129 degrees,4 patients have extension lag of 5 degrees,12 patients had full flexion of elbow while 3 patients have flexion upto 120 degrees. Mean supination movement was 79 degrees & mean pronation movement was 80 degrees. The mean MEPS score was 95 with 12 (80%) excellent and 3 (20%) good results. Coronoid factors can be treated with modified anteromedial approach and Buttress plating with excellent outcomes.

Keywords: Modified Anteromedial approach, Coronoid Process, Buttress Plate Fixation

Introduction
The coronoid process of ulna helps to restrict excessive forward movement of the humeral trochlea and to resist introversion stress when extending the elbow; thus it has an important role in anatomy and stability of elbow joint [1, 2]. Isolated fractures of the coronoid are uncommon with the majority having associated fractures of the radial head or proximal ulna or collateral ligament injuries or concomitant dislocations. Fractures of the coronoid occur in 2 to 15% of patients with ulno-humeral dislocations [3]. Coronoid fractures have traditionally been classified using the Regan–Morrey classification system and O'Driscoll System [4, 5]. Type l Regan-Morrey having avulsion fracture can be treated conservatively while Type II & III fractures having large fragments should be operated to maintain elbow stability & mobility [4].
Fractures of coronoid can be fixed with various approach including Anterior, Anteromedial, Lateral and Medial. A good exposure to fracture site with ability to fix fracture preventing damage to vital structure should be provided by a good approach. Our aim of this study is to evalute clinical outcome of coronoid process fractures of Regan-Morrey type II & III fixed with Open Reduction & Internal Fixation by Modified Anteromedial Approach [6-8].

Materials & Methods
A prospective study of 15 patients with unilateral fracture coronoid process of ulna was carried out during the period of August 2017 to September 2019 at Medical College and S.S.G. Hospital, Vadodara, Gujarat. All Patients with Regan-Morrey type II& III Fractures treated with Open Reduction & Internal Fixation by Modified Anteromedial Approach without any other elbow fractures are included in this study. Patients with Regan-Morrey type I& having other elbow injuries & with open grade II & III injuries are excluded from our study.
Preoperative Xray & CT scan were done to get additional information on fracture comminution and fragment location. After adequate surgical fitness, all patients were given Brachial Block or Supraclavicular Block in supine position with upper limb on side arm table under tourniquet. The skin incision commenced 3 cm proximal to the cubital crease, along the medial border of biceps, and curved across the cubital crease, extending 3 cm distally along the midline of the forearm. The bicipital aponeurosis was exposed underneath the subcutaneous tissue and incised perpendicular to the aponeurotic fibers. The neurovascular bundle in front of the elbow joint, which consists of the median nerve and brachial artery, were identified.

The coronoid process was exposed through the brachial artery-median nerve interval (B-M Interval) [9]. While dissecting via the B-M interval, the brachial artery and concomitant veins were retracted laterally, and the median nerve was retracted medially. Brachialis muscle insertion was exposed between those retracted structures, and it was longitudinally split. The fracture of coronoid process exposed was assessed through the split brachialis tendon.(Figure 1)

Fig 1: Coronoid process fracture exposed

Gentle pressure was applied against the coronoid fracture with appropriate surgical tools to get fracture reduction. Before reduction and buttress plating, we ensured that the distal humerus was fully seated in the trochlear notch of the olecranon. We used 1.5-mm Kirschner wires to temporarily fix the fragments in the anteroposterior direction and maintain pressure against the fragment. 2.7-mm buttress plate and screws were fixed. Post operatively x rays were taken. Intravenous antibiotics were given for 2 days post operatively. Patients were discharged on 3rd postoperative day with oral antibiotics & followed up on 2 weeks for suture removal.

All patients were given above elbow splint for 4 weeks postoperative with elbow in 90 degree flexion & forearm in supination. Supervised rehabilitation, including active elbow flexion and extension was commenced on the second day after surgery, and when pain and swelling had subsided, the frequency of exercises and the range of motion (ROM) were gradually increased. Isometric upper extremity muscle contraction was also encouraged. At 6 weeks splint is removed & muscle strengthening exercise started. At 6,12 & 16 weeks follow up x rays were taken and clinical outcome was measured using Mayo Elbow Performance Score (MEPS)[10].Final follow up was done at 16 weeks.

Observations & Results

The study represents 15 patients (11Males & 4Females) of fracture of coronoid process of ulna with 9(60%) having Regan-Morrey type II and 6(40%) having Regan-Morrey type III fractures treated at Medical College & S.S.G. Hospital, Vadodara, Gujarat during August 2017 to September 2019. The mean age was 28.6 years & 12(80%) having right side & 3(20%) having left sided injury. The mechanism of injury included fall on flat surface while walking (8cases) & road traffic accidents (7cases). 9(60%) patients were having ulno-humeral dislocations were reduced in emergency department at the time of injury & splinting done after analysis of flexion extension arc. All patients were operated within 4 days of injury. Functional range of motion at 6, 12 & 16 weeks follow up were assessed & were improved after each follow up (Figure 3). The mean elbow flexion &extension movement was 0 to129 degrees, 4 patients have extension lag of 5 degrees, 12 patients had full flexion of elbow while 3 patients have flexion up to 120 degrees. Mean supination movement was 79 degrees & mean pronation movement was 80 degrees. All patients having union at 16 weeks follow up & mean union time was 13.4 weeks (Figure 2). At final follow up MEPS score [11] showing excellent results in 12(80%) patients & 3(20%) good result with mean MEPS SCORE of 95. All patients were returned to their work till final follow up.

There were no intraoperative & immediate postoperative complications. All patients have suture removal at 2 weeks follow up without wound complications. At the time of final follow up no heterotopic calcification or flexion contracture was noted in all patients. One patient had mild pain which was reduced with oral analgesics.

Fig 2 Preoperative, Postoperative & 16 weeks follow up Xray

Fig 3: Clinical outcome at 16 weeks follow up

Discussion

The ulnar coronoid process acts as an anterior buttress that resists posterior translation of the ulna and angular rotation of humerus [11]. Axial loading is considered to be the main fracture mechanism of the coronoid process, which is especially vulnerable when the elbow is flexed at 80 degree.(12)Fracture fragments which are interposed within the articulation and the presence of residual instability are contraindications to non-operative treatment [3]. It is well known that the larger the fragment of the coronoid process, the greater the resultant joint instability, and thus the more likely the need for surgical stabilization [11].

Ulnar coronoid process fractures can be addressed through several approaches. When a coronoid process fracture is associated with a radial head fracture, a lateral approach is very useful for fracture reduction and fixation, repair of the lateral joint capsule and the lateral collateral ligament [5, 8]. However, the coronoid process cannot be exposed and fixed directly through this approach [7]. In contrast, the medial approach is recommended for treatment of comminuted and/or anteromedial coronoid fractures and patients with an isolated coronoid fracture [13]. However it is difficult to expose entire coronoid through this approach.

The anterior approach provides excellent visualization and the most direct access to a coronoid fracture. However, the anterior approach is avoided generally because of the risk of iatrogenic injury to the neurovascular structures in the anterior of elbow. During dissection of the neurovascular structures near coronoid process found that there was a natural interval (B-M interval) between the brachial artery and median nerve. Above the cubital crease, the median nerve and brachial artery were superficial at the medial side of biceps, so the B-M interval was easy to identify. Below the cubital crease, the median nerve and brachial artery were covered by the flexor-pronator mass; thus it was difficult to identify the B-M interval. Therefore, it was suggested that the B-M interval is initially identified at the medial side of biceps, above the cubital crease, and then was dissected along the neurovascular bundle to the coronoid process. In comparison to B-B interval (between biceps tendon & brachial artery), B-M interval provide better exposure to coronoid [9].

Antero medial approach provides excellent visualization of the entire articular surface of the fractured coronoid process, thereby allowing the surgeon to widely expose the joint and the coronoid process to directly reduce and fix the coronoid process fragment. Second, with the large interval, stable anatomic fixation with compression of coronoid segments can be obtained by placing anterior to posterior screws perpendicular to the fracture line. Theoretically, the coronoid fragment can be fixed to the main dorsal stock in an easier and firmer way using this approach, and, based on the specific pattern of the fragment the surgeon can choose what type of instrumentation achieves more stability. Moreover, the surgeon may repair the anterior capsule after implantation, which could increase elbow stability. Fourth, this approach avoids damage to the normal anatomic structure of the elbow joint, such as the medial collateral ligament, the flexor-pronator muscle mass, and the ulnar nerve. And, finally, this approach allows the surgeon to fix the coronoid process through intervals between muscles without requiring wide dissection; this may help reduce the possibility of heterotrophic ossification [14, 15].

In our study we have fixed coronoid process fractures with open reduction and buttress plating with modified Anteromedial approach, having good final outcome. Even for comminuted fractures, the coronoid fragments can be fixed to the main dorsal stock easier and firmer using a plate and, moreover, this definitive fixation permits early functional exercise and early joint motion, presumably by recruiting muscle groups that act as dynamic stabilizers of the elbow [4]. There may be also drawbacks like inability to repair brachialis leading to reduced flexion strength & risk to injury to neurovascular structures which can be prevented by keeping elbow in flexion & careful dissection.

The limitations of our study are small sample size, the short duration of study, inclusion of limited variety of fractures and not referencing our outcomes with confounding factors like age, sex, quality of bone and other concomitant ligament injuries.

Conclusion

In this study, we found that coronoid process fractures can be treated successfully through a modified anteromedial approach using buttress plate fixation, which allows for accurate reduction and rigid internal fixation even for small bony fragments. Furthermore, buttress plate fixation through an anteromedial approach facilitates early functional exercise and a reasonable outcome. However, an anterior approach calls for a well-trained surgeon to avoid damage to the neurovascular structures.

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