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## Fixation of Isolated Fracture of the Humeral Trochlea Through Posterior Trans-Olecranon Approach

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### ABSTRACT

An isolated coronal plane fracture of the humeral trochlea is very rare. We report a study of 5 patients with isolated fracture of the humeral trochlea in coronal plane operated through posterior approach including olecranon osteotomy followed by herbert screw fixation. 5 patients sustaining isolated fracture of the humeral trochlea were included in the study. The patients were operated through a posterior approach involving olecranon osteotomy and osteosynthesis was achieved via Herbert screws. The patients were followed up at regular intervals and functional ability was assessed through the Mayo Elbow Performance Index (MEPI). The mean time of injury to surgery was  $3.4 \pm 1.14$  days. 4 out of the 5 patients had excellent outcome as per the MEPI scores and 1 patient had good outcome. Isolated fractures of humeral trochlea in coronal plane can be effectively treated with posterior approach and Herbert screw fixation.

**Keywords:** Isolated trochlea fracture, Distal humerus fractures, Posterior Transolecranon approach, Herbert screw.

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## INTRODUCTION

Fractures that occur around the distal humerus usually involve the capitellum along with variable parts of trochlea<sup>1</sup>. Although, the first description of an isolated trochlea fracture was given by Laugier in 1853, the injury is extremely rare<sup>2</sup>. Isolated trochlea fracture, also known as Laugier's fracture is often associated with fractures of capitellum, radial head, olecranon and elbow dislocations<sup>3</sup>. The lack of muscular and ligamentous attachments along with a deep location in elbow joint makes the trochlea inaccessible to direct trauma<sup>4</sup>. A consensus on the management of isolated trochlea fracture is lacking. Undisplaced fractures can be managed by immobilization in an above elbow slab for 3 weeks<sup>5</sup>. Unamenable and small osteochondral fragments should be excised and early elbow mobilization should be instituted<sup>1,6</sup>. Anatomical reduction of displaced fragment followed by fixation using headless Herbert screws or bioabsorbable screws is the treatment of choice for displaced fractures<sup>1,7,8</sup>. Our study was undertaken with the objective of determining the efficacy of posterior trans-olecranon approach and Herbert screw fixation for the management of isolated fractures of humeral trochlea in coronal plane.

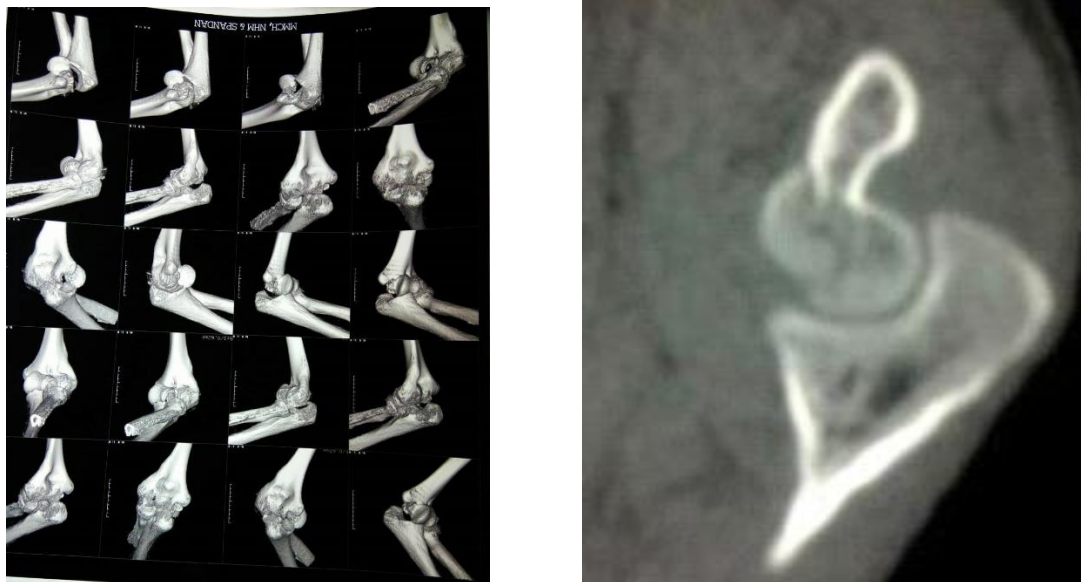
## MATERIALS AND METHOD

### Patients included in the study

Five patients with isolated fracture of humeral trochlea, confirmed by CT scan of the elbow joint, between March 2014 to December 2019 were included in the study (Table-1) after obtaining informed and written consent. The patient presented to our OPD with pain and swelling of the elbow joint and restricted movement of flexion and extension. The distal neurovascular status was normal in all the patients. The patients gave a history of sustaining a fall on either a flexed or extended elbow. As a routine procedure, an antero-posterior and lateral radiograph of the involved elbow was obtained (figure 1) followed by CT scan (figure 2) which confirmed the diagnosis along with ruling out any associated fractures around the elbow.



**Figure 1: Anteroposterior and lateral radiograph of the elbow in a 14 year old girl (double arc sign on lateral radiograph showing trochlea fracture)**



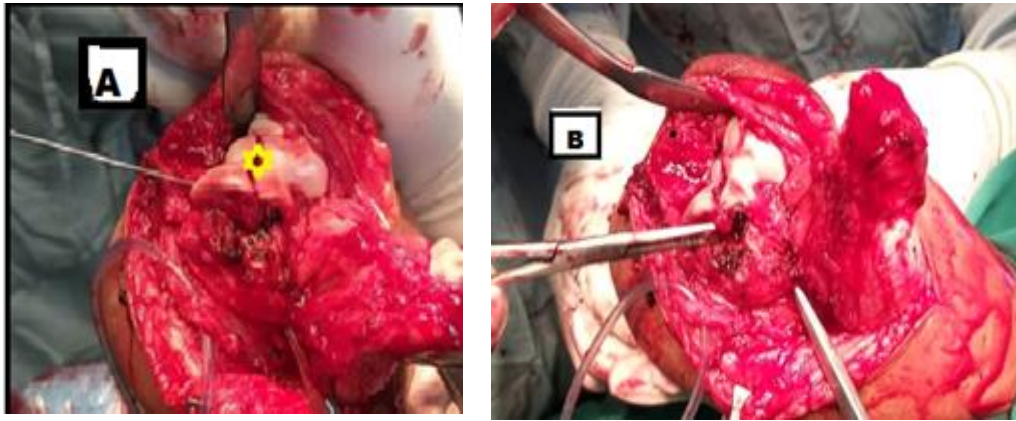
**Figure 2: CT scan of the elbow joint of the same patient**

**Table 1: Patients included in the study**

Case number	Age (years)	Sex	Day of operation since injury	Mechanism of injury	Position of elbow at the time of injury
1	28	Male	3	High energy trauma	Flexed
2	21	Female	3	Low energy trauma	Extended
3	14	female	4	High energy trauma	Extended
4	34	male	5	Low energy trauma	extended
5	30	male	2	High energy trauma	Flexed
Mean	25.4±7.088		3.4±1.14		

### Operative technique

Open reduction and internal fixation was planned for our patients and everyone was operated within 5 days of trauma. The written and informed consents for operation were taken in all patients. Under the regional block/General anaesthesia, the patients were placed in lateral recumbent position with the involved elbow up in flexion (90 degrees) and the arm placed over an arm rest. The joint was opened through a posterior trans-olecranon approach with chevron osteotomy of the olecranon. The ulnar nerve was dissected and protected. The trochlea was found to be fractured in coronal plane which was seen displaced, with persistence of the posterior wall in continuity with the distal humerus. The reduction was facilitated by flexing the elbow further and held provisionally by passing guide wires and fixation was obtained by inserting two Herbert screws into the cartilage from anterior to posterior direction perpendicular to the fracture line (Figure 3). The guide wires were then removed. The olecranon osteotomy was reduced and tension band wiring done. After thorough lavage, wound was closed in layers with a negative suction drainage tube applied. The sterile dressings were applied and the elbow was then immobilized in long arm posterior slab. An immediate postoperative x-ray was done (Figure 4).



**Figure 3: Intra-operative pictures after reduction and fixation.(reduction marked by a star)**



**Figure 4: Immediate post-operative X-Ray**

#### **Follow up and rehabilitation protocol**

All the patients were followed up at 2 weeks, 6weeks, 3 months, 4months, 5months, 6months and 1 year. At the end of the second week of follow up, the long arm slab was removed followed by suture removal. Passive and active assisted exercises were allowed in the ensuing period.

#### **Assessment**

The patients were assessed for pain, range of motion and return to work (figure 4). The Mayo Elbow Performance Index (MEPI) based on pain, arc of motion, stability, and functional disability was used for functional evaluation of the patients. A score of >90 was considered excellent, 75 to 89 as good, 60 to 74 as fair, and <60 as poor. (Table -2)

**Table 2: Mayo Elbow Performance Index<sup>9</sup>**

<b>Function</b>	<b>Definition</b>	<b>Points</b>
Pain(maximum 45 points)	None	45
	Mild	30
	Moderate	15
	Severe	0
Motion(maximum 20 points)	Arc>100	20
	Arc 50-100	15
	Arc< 50	5
Stability(maximum 10 points)	Stable	10

	Moderately unstable	5
	Gross instability	0
Function(maximum 25 points)	Able to comb hair	5
	Able to feed oneself	5
	Able to perform personal hygiene tasks	5
	Able to put on shirt	5
	Able to put on shoes	5
Total		100

## RESULTS

A total of 5 patients were included in the study (3 males and 2 females). The mean time of surgical intervention from the time of injury was  $3.4 \pm 1.14$  days and all the patients were followed up for a period of 1 year (table 3).

The mean time of radiological union was  $12.8 \pm 0.979$  weeks. On follow up, none of the patients developed any wound related complications, neurovascular compromise or signs of trochlear osteonecrosis (figure 5). As per the Mayo Elbow Performance Index (MEPI), 4 patients had excellent outcome and one patient had good outcome. The mean MEPI was  $94 \pm 4.898$ . All the patients were pain free and returned to normal activities within a period of 4 months.



**Figure 5: AP and lateral radiographs at 1 year follow up**



**Figure 6: Recovery of flexion (A) and Extension (B) (follow up at 6 months: operated on left elbow)**



**Table 3: Outcome of patients following Surgery (at 6 months follow up)**

Case number	Range of motion(flexion extension arc)	Time radiological union(weeks)	Mayo Performance score(MEPI)	Elbow Index
1	10°-135°	12	95	
2	5°-130°	14	95	
3	5°-140°	12	100	
4	15°-115°	14	85	
5	5°-135°	12	95	

## DISCUSSION

Isolated fracture of the humeral trochlea is a very rare entity as the trochlea lacks any muscular or ligamentous attachment and is deep seated within the elbow joint which protects it from any direct or indirect trauma. Also, the ulno-humeral joint when compared to the radio-capitellar joint is subjected to less shear forces which explains the higher frequency of occurrence of capitellar fractures when compared to trochlear fractures<sup>5, 10</sup>. Isolated fractures of trochlea lacks any specific characteristics as the injury can result from both high energy and low energy trauma with the elbow in either flexion or extension<sup>11</sup>. Tetsuya et al emphasized the role of varus stress that transfers the compressive forces generated on the radio-humeral compartment to the ulno-humeral compartment<sup>12</sup>. Axial loading with elbow in extension and axial loading on anterior part of trochlea with elbow in flexion best explains the mechanisms generating complete and anterior coronal trochlear fractures(with osteochondral fragments) respectively<sup>13,14</sup>.

As far as the diagnosis of isolated coronal fractures of the humeral trochlea is concerned, a CT scan is imperative as the anteroposterior radiographs can be interpreted as normal in most of the cases and the lateral radiographs may show a half moon shaped osteochondral fragment which may be difficult to differentiate from capitellar fractures<sup>11</sup>. CT scan also rules out any associated bony injuries along with determining the size and displacement of fragments thereby guiding the surgical technique<sup>15</sup>.

Open reduction and internal fixation is the treatment of choice for displaced fracture<sup>1,5,7,8,11</sup>. A medial or anterior approach is most often used, as both the approaches provide good exposure of the fracture<sup>11</sup>. A lateral approach often limits the amount of surgical exposure and should only be considered in case of associated fractures of capitellum<sup>5</sup>. In our study, we opted for the posterior approach combined with olecranon osteotomy. A posterior trans-olecranon approach for isolated fractures of humeral trochlea has not been reported in literature so far. This approach provided us with good exposure of the fracture site and also aided in intra operative reduction of the displaced fracture fragments by mere flexing of the elbow. The means of achieving osteosynthesis can vary and may include Herbert screw, cancellous screws and kirschner wires<sup>11</sup>. We opted for Herbert screws in our study and the screws were inserted

perpendicular to the fracture line after reduction of the fracture fragment securing the fracture fragment to posterior wall with maximum compression. This mode of osteosynthesis is stable and offers rigid stability that facilitates early mobilization of the elbow joint. However, kirschner wires can be opted for the fixation of the small fragments not amenable to screw fixation and the postoperative mobilization should be delayed in that cases<sup>5, 11</sup>. Damage of the articular cartilage of the trochlea, posterior comminution in trans-articular fractures, inability to achieve rigid fixation and a delayed rehabilitation is associated with poor outcome in the patients<sup>5,16</sup>. The rarity of the isolated fracture of the trochlea was responsible for the paucity of the number of patients in our study. A large scale study with the posterior transolecranon approach is required to further validate the efficacy of the approach and mode of osteosynthesis.

## CONCLUSION

Isolated coronal plane fracture of the humeral trochlea is a rare entity. We recommend an open reduction via posterior trans-olecranon approach for better exposure and facilitation of reduction of the fracture and internal fixation with Herbert screws at the earliest after the injury for good functional outcome.

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