Case report

Surgical management of isolated humeral trochlear fracture: A rare case report

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\textbf{Abstract}

Introduction: Isolated humeral trochlea fracture is a rarely reported entity, because theoretically it inaccessible to direct trauma. The mechanism of this injury is still under speculation, also consistent with the limited information available, and a medical consensus on the management does not exist. We report the case of a patient with an isolated trochlea fracture and discuss the underlying mechanisms and the clinical, radiological and therapeutic features of this injury. This work will significantly advance our understanding of this particular fracture.

Case presentation: A 19-year-old man received an elbow injury after a fall. An anteroposterior radiograph showed an irregularity of the medial joint space, and an intra-articular half-moon-shaped fragment that had moved up and forward at lateral view radiograph. A computed tomography scan confirmed an isolated fracture of the trochlea. Open reduction and internal fixation were performed, resulting the good outcome.

Discussion: Isolated trochlear fracture in adults is rare and usually associated with capitellar fracture and/or elbow dislocation. The mechanism of injury behind distal humeral fractures is under speculation with reported in the literature the are the result of both high-energy and low-energy traumas. Radiographs and CT scan can be used as the modality for imaging studies, but diagnosis is based on the results of a CT scan.

Conclusion: An isolated fracture of the trochlea is rare. The mechanisms that generate this fracture are complex. As with other front-line fractures of the humeral distal end, we recommend open reduction and internal fixation for displaced fracture.

1. Introduction

Isolated trochlear fracture is also known as Laugier’s fracture, was first described by Laugier in 1853 \cite{1,2}. An isolated humeral trochlear fracture rarely occurs as compared to its capitellar counterpart \cite{3,4} since there is no musculor or ligamentous attachments, and due to its location within the olecranon fossa, which makes it inaccessible to direct trauma \cite{3,5}. In addition, the humeral trochlea is not subjected to the shear force endured by the radio-capitellar joint because it resides within the ulno-humeral joint \cite{5,6}. Therefore, whenever a trochlear fracture is present it is usually accompanied by other injuries such as elbow dislocation, capitellum fracture, radial head fracture, olecranon fracture, and/or ligamentous injury of the elbow \cite{3,5–7}. Currently, the mechanism of injury behind an isolated trochlear fracture is still under speculation \cite{5,7,8}.

The trochlea’s anatomical position is consistent with the limited information available about this injury, appearing occasionally in the literature as a case report. Because of the literature paucity on their treatment, a medical consensus on the management of trochlear shear fractures does not exist \cite{8}.

In this report, we present a rare and unique case of an isolated coronal trochlear shear fracture, sustained during a fall, in an adolescent patient who managed surgically. The purpose of this study is to discuss the mechanisms and the diagnostic - therapeutic issues relating to this entity. Surgery was performed by Orthopaedic hand surgeon with 9 years experiences. Significant improvement of range of movement and no neurological disturbance were used to assess outcome of the surgery. The SCARE criteria was used for reporting this case report \cite{9}.

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2. Case presentation

A 19-year-old male came to the outpatient clinic with history 2 months ago he fell while playing futsal. A sharp persistent pain on his left elbow was reported, which aggravated by flexion - extension the elbow and pronation - supination of the forearm.

Physical examination revealed moderate swelling, tenderness to palpation of his elbow medial part, and decreased flexion range of motion (0–30°) but pronation - supination were free (Fig. 1). The distal neurovascular examinations were unremarkable.

An AP view radiograph showed an irregularity of the medial joint space, and an intra articular half-moon-shaped fragment at lateral view that had moved up and forward, with suspicious a capitellar fracture. But a computed tomography (CT) scan confirmed an isolated front-line fracture of the trochlea without participation of capitellar fracture (Fig. 2).

Surgical treatment was performed by open reduction and internal fixation. The patient was transferred to a supine position and a medial approach for the elbow was used. The joint was opened through a medial approach, passing between the triceps muscle in the posterior side and brachialis muscle in the anterior. Ulnar nerve was explored and protected. Accessing the joint capsule required disinsertion of the humeral part of the pronator teres, without interrupting the intact medial collateral ligament. The trochlea fracture was found across the front line, with persistence of the posterior wall (Fig. 3). The fragment had moved up and forward without any compaction or loss of cartilage substance. Reduction was achieved and held in place with a pin. Two headless Herbert screws were then placed just below the articular surface. After evaluation the stability of reduction and fixation, Pronator Teres was re-attached to Flexor Group tendon. Suturing the subcutaneous layer by single interrupted and followed by subcuticular suture skin closure.

Postoperative radiograph examination was performed in anteroposterior and lateral views. Trochlea was well reduced with two headless Herbert screws were in place (Fig. 4).

The motion of the left elbow was evaluated after the surgery and full range of motion in flexion and extension were confirmed from 0° to 135° (Fig. 5).

3. Discussion

The trochlea has no muscular or ligamentous attachments and its position is deep within the trochlear notch cavity, within the olecranon process of the ulna, make it protected against direct and indirect trauma, so the humeral trochlear fracture is rare in isolation [3,5–7,10]. The ulno-humeral joint is subjected to very light compressive and shear forces compared to those experienced by the radio-humeral joint which explains the high frequency of capitellar fractures compared to trochlear fractures [3,5–7,11]. Trochlear fractures are usually accompanied by other elbow injuries such as dislocation and/or fracture of the capitellum, radial head, or olecranon [3,7].

3.1. Mechanism of injury

As reported in the literature trochlear fractures were the result of both high-energy (for instance a road traffic accident) and low-energy (falls) traumas [2]. The mechanism of injury behind distal humeral fractures is under speculation [5–7]. A fall with the elbow is in an extended position, the radial head and coronoid impact the distal articular surface and may shear off variable osteochondral fragments [5,8]. A tangential force produced by axial loads along the radial shaft may cause an isolated fracture at the capitellum [5,7]. Trochlear fractures may also occur when falling on an outstretched hand because of the force transmitted through the palm and along the ulna [5,7,8]. Coronal shear fractures tend to involve the capitellum and a variable portion of the trochlea [5,8]. Six cases of distal humeral shear fractures that extended medially from the capitellum to include the lateral trochlear ridge were reported by McKee et al. in 1996. Every patient recalled falling on their outstretched hand [8]. In extension, an axial load from the coronoid process combined with the varus stress could impact the lip of the trochlea, resulting in an isolated trochlear fracture [5,7].

The force may have been transmitted axially through the wedge-shaped trochlear ridge on falling with the flexed elbow. It is unclear what caused this isolated trochlear fracture, as opposed to a fracture of the entire capitello-trochlear block. It has been suggested that the intact capitellum is either spared or subjected to a lesser force [5,6]. Jupiter
Fig. 2. Initial radiograph. (A) Plain radiograph lateral and AP view. (B) Computed Tomography (CT) scan view 2D and 3D.

Fig. 3. Fracture of the trochlea with intact ulnar nerve.
et al. posed the possibility that the coronoid may act as a fulcrum when a force is directed in a flexed elbow [8].

3.2. Imaging

An irregularity at the ulno-humeral joint in the anteroposterior view and the appearance of an articular half-moon-shaped fragment moved up and forward in a lateral view of the radiographs evaluation could suggest a capitellar fracture [1,2,5,11]. But the image can be interpreted ‘normal’, for this reason, diagnosis is based on the results of a CT scan [2,4–6,11]. CT scan allows to determine the size of the fragment and its displacement, thus guiding the surgical procedure for the treating physician [2].

3.3. Fixation

ORIF is the most commonly used surgical treatment for displaced trochlear fracture [8,11]. Using a standard medial approach allows for direct access to the trochlear fragment [5,6,11]. It may also preserve the blood supply to the trochlea by avoiding the vasculature at the posterior surface [3,5]. Sen et al. [5] offer an alternative posterior approach combined with olecranon osteotomy, but may increase the risk for avascular necrosis in the future. It is unlikely to occur if osteonecrosis is not apparent after 1 year [8,11]. Giannicola et al. advocated the using of a hinged fixator to allow early elbow mobilization while preserving joint stability when stable fixation cannot be achieved by ORIF. Giannicola et al. reported in their study, that 14 among 15 patients involving displaced fractures of the capitellum and trochlea, had a stable, pain-free elbow with an active range of motion at final follow-up [8].

The choice of fixation is depend on the size of fragment and the comminution [7]. In this case we managed the displaced trochlear fracture using two headless Herbert screws. Herbert and Fischer in 1984 introduced the double-threaded design of screws that allows them to sink below the articular cartilage level and provide necessary compression for early mobilization [8,11]. The using of Kirschner wires and compression screws with the combination early range of motion exercise, have also brought successful result [5,8]. Sen et al. [5] suggested that wire fixation can secure smaller osteochondral fragments that were not amenable to screw fixation. In prior studies, a variety of fixation methods have been utilized, and given the paucity of literature, so no one can say which one can provide the best results.

4. Conclusion

Isolated trochlear fractures have a low incidence of occurrence and appear rarely in the literature. The mechanisms generating this fracture are complex. Because of the paucity of information and the absence of high-level studies on this injury, a standard treatment protocol has not been established. We recommend open reduction and internal fixation for displaced fractures, where it has been shown in previous reports that patients experienced positive outcome following ORIF. Reports of isolated trochlear fractures have described successful results.

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Ethical approval

The patient provided informed consent, and the study design was approved by ethics review board of Prof. Dr. R. Soeharso Orthopaedic Hospital (Ethical Clearance No: LB.02.01/XXX.3/6456/2021) and followed local and international laws and the 1964 Declaration of Helsinki.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Guarantor

Tito Sumarwoto, MD

Provenance and peer review

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Credit authorship contribution statement

All the authors have been actively involved in the planning and performance of the study and have also assisted with the preparation of the submitted article.

Registration of research studies

No need registration for research study since the surgery in this case report was not the first performed in human.

Declaration of competing interest

None.

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