

## Case Report

## Isolated Avulsion Fracture of the Lesser Tuberosity of the Humerus: Case Report and Literature Review

## 單純的肱骨小結節撕脫骨折- 病例報告及文獻回顧

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## ABSTRACT

Isolated avulsion fracture of the lesser tuberosity of the humerus is a rare injury. It is easily missed because the fracture is difficult to visualize in routine plain radiographs of the shoulder. This article reports a man who sustained a right shoulder injury after a fall. Physical examination found local tenderness over the anterior aspect of his right humerus. The initial plain radiographs of shoulder showed no fracture. However, the axillary view demonstrated a rare isolated avulsion fracture of the lesser tuberosity. He was treated nonoperatively with good clinical outcome.

## 中文摘要

肱骨小結節撕脫骨折是一個罕見的創傷,並常有漏診的情況出現,因為常規的肩部x光片是很難看到骨折部份。本文報告一名男子因跌倒而引致右肩受創傷,臨床身體檢查發現局限性壓痛集中在肱骨前面位置。最初常規的肩部x光片中顯示沒有骨折,然而腋位x線檢查診斷出一個罕見的肱骨小結節撕脫骨折。我們應用了非手術方法去治療這位病人並獲得良好之臨床果效。

## Introduction

Isolated fracture of the lesser tuberosity of the humerus is an uncommon injury. Two-thirds of these injuries occur in adults and one-third of the cases are pediatric.<sup>1</sup> Most of the cases reported in the literature were treated operatively with great success. We present a case of isolated lesser tuberosity avulsion fracture that was treated nonoperatively with good clinical outcome.

## Case report

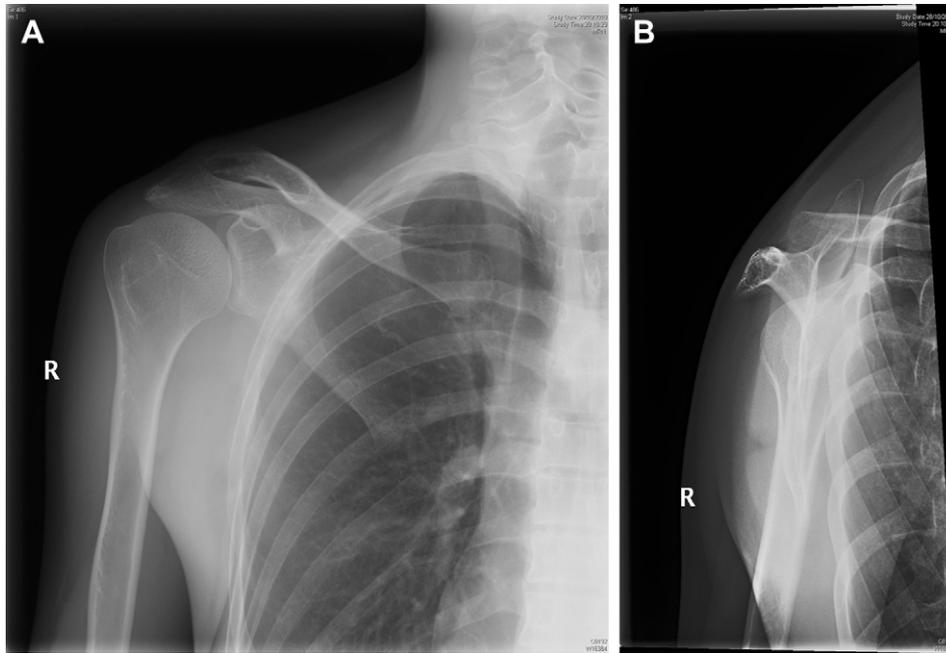
A 37-year-old decoration worker was admitted after falling from height of 2 m. While he was performing overhead duty, he lost his balance and fell down with his right arm forcefully abducted and externally rotated upon landing. He then experienced severe right anterior shoulder pain with limited range of motion of his right shoulder. Physical examination revealed a large area of ecchymosis and swelling over the anterior right shoulder and arm regions. Tenderness localized on the anterior right shoulder. The active range of motions of right shoulder were 80° forward flexion and 80° abduction. The active range of external rotation was normal

while the active range of internal rotation was decreased to 30° only. Active extension and adduction was limited by pain to 20°. The passive range of motion of right shoulder was 140° forward flexion and 140° abduction, while the passive extension and adduction was 20° and 40°, respectively.

The antero-posterior and lateral plain radiographs of the right shoulder did not reveal any obvious fractures (Figure 1). However, the axillary view revealed an isolated avulsion fracture of lesser tuberosity of the right humerus (Figure 2). Computed tomography of the right shoulder confirmed an isolated avulsion fracture of the lesser tuberosity of his right humerus (Figure 3A). The avulsed fragment was 20 mm in length and 10 mm in width (Figure 3B). The fragment displaced medially of 3.6 mm (Figure 3C). The residual part of the lesser tuberosity was intact and contributed to the medial buttress of the bicipital groove. Ultrasound scan of right shoulder showed intact long head of the bicep tendon within the bicipital groove. There was no associated rotator cuff tear. As the avulsed fragment was minimally displaced and the long head of bicep tendon was not subluxed, we decided to treat this man nonoperatively.

In order to prevent fracture displacement, we relaxed the deforming muscular force (i.e. the *subscapularis* muscle) by putting him on a shoulder immobilizer with the shoulder in internal rotation for 6 weeks. Pendulum exercise of the right shoulder was

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**Figure 1.** (A) Antero-posterior and (B) scapular Y radiographs of the right shoulder showed no obvious fracture.

started at the third week. Free mobilization of his right shoulder was allowed from the seventh week onwards when the focal tenderness resolved and the plain radiograph revealed no further fracture displacement. Plain radiographs confirmed the healing of the fracture with good alignment at the 10th week (Figure 4).

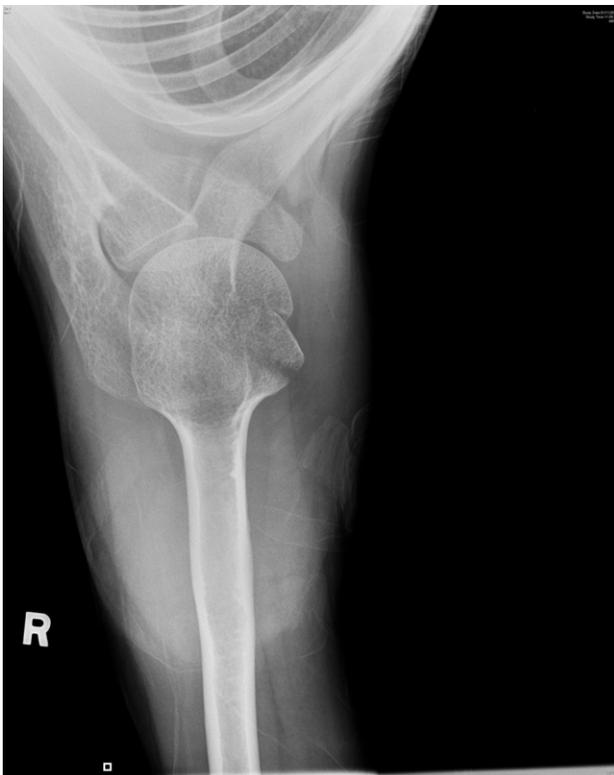
At the 16th week after the injury, the motion of his right shoulder was full in all directions. There was no tenderness. The *subscapularis* muscle power was full. There was no evidence of biceps tendinitis, nor subluxation of the long head of biceps tendon. The glenohumeral joint was stable. The Constant score<sup>2</sup> was 94. He could return to his original work requiring frequent overhead activities.

### Discussion

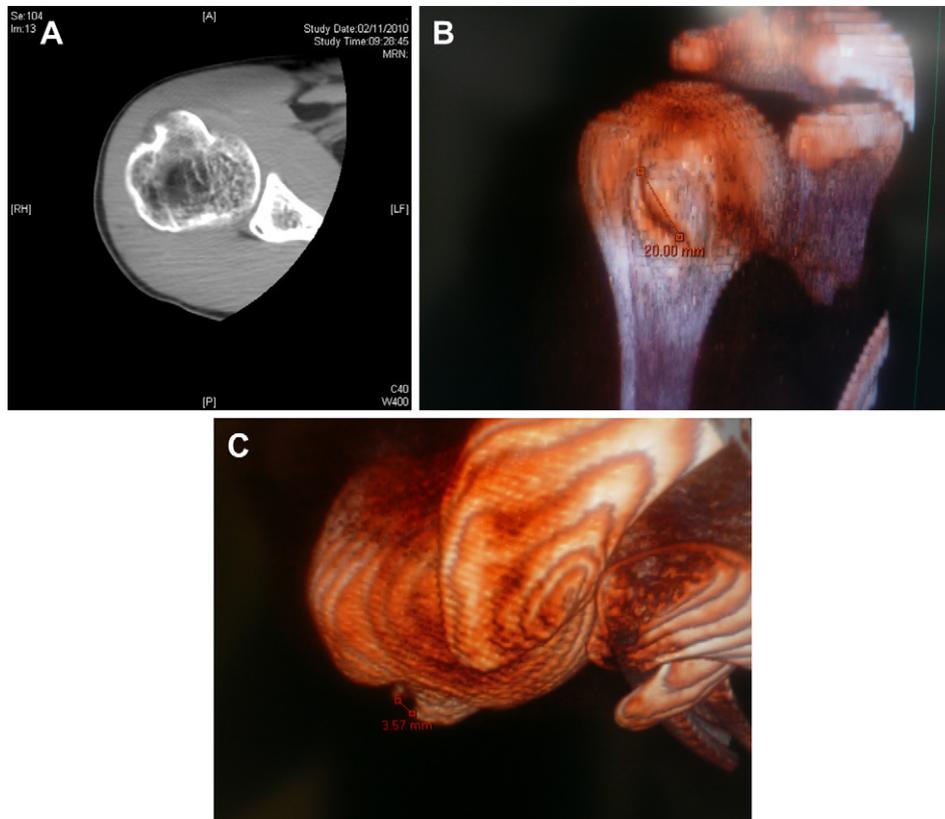
The mechanism of this rare indirect injury is commonly caused by the pulling forces of the upper gleno-humeral ligament and the *subscapularis* muscle in hyperextension with increased abduction and external rotation of the shoulder.<sup>3</sup> With the shoulder in 90° abduction, the *subscapularis* muscle is in a relaxed status. Further forced abduction and external rotation of the humerus, together with contraction of the muscle avulse the bony insertion in the lesser tuberosity.<sup>4</sup> Because of the lesser tuberosity located at the medial side of the humerus, direct trauma causing the fracture is less likely. Other less common mechanisms such as postepilepsy and in psychiatric patients after receiving electroconvulsive shock therapy have also been reported.

Clinically, the diagnosis of isolated avulsion lesser tuberosity fracture requires a high index of suspicion. The typical physical examination findings included tenderness at the lesser tuberosity, increased passive external rotational range in compared with the contralateral shoulder. Weakness in internal rotation can be demonstrated by the lift-off test. One should also palpate for any subluxed long head of biceps tendon and test for the gleno-humeral joint stability to rule out concomitant shoulder dislocation.

The diagnosis is easily missed with routine antero-posterior and scapular views of the radiographs of the shoulder, especially if the avulsed fragment is small and minimally displaced. Axillary view of the shoulder should be taken to confirm or rule out the diagnosis.<sup>4</sup> Large avulsed fragment with gross displacement, though easily seen on the routine radiograph of shoulder, it does pose another diagnostic difficulty. Most of these fragments were displaced to the sub-glenoid position, which can mimic other pathologies such as calcified tendonitis or even a bony Bankart fragment after shoulder



**Figure 2.** The axillary view of right shoulder showed avulsion fracture of lesser tuberosity.



**Figure 3.** (A) The axial cut of computer tomography of right shoulder showed the avulsed fragment of lesser tuberosity. (B,C) 3D reconstruction of computer tomography of right shoulder better defines the size and displacement of fragment with more accurate measurements.

dislocation.<sup>3</sup> For children, one must also consider the possibility of fracture from the previous osteochondroma in the proximal humeral metaphysis region.<sup>6</sup> Computed tomography allows better delineation of the size and the displacement of the avulsed fragment, which aids the plan of management. The role of ultrasound

scan is to give extra information on the associated rotator cuff injury, and biceps tendon dislocation or subluxation. Magnetic resonance imaging is more sensitive in delineation of the associated shoulder dislocation with defect on the glenoid or humerus, or diagnosis of neoplastic related fracture in children.<sup>6</sup>

Delayed diagnosis can cause shoulder instability, biceps tendon complications, and even impingement problems. The avulsion of the lesser humeral tuberosity is more commonly associated with dislocation of the shoulder,<sup>7</sup> while an isolated injury is quite rare. Lengthening of the *subscapularis* muscle after trauma weakens the muscle and this is the prime factor in producing instability of the shoulder.<sup>8</sup> The *subscapularis* tendon is the weakest part of the anterior capsular mechanism in the elderly, thus predisposing the recurrent dislocation of shoulder.<sup>9</sup>

In addition, the superior gleno-humeral ligament/coraco-humeral ligament complex (pulley system for the long head of biceps) are in close proximity with the fibres of humeral insertions of the *subscapularis* to the lesser tuberosity, thus fracture in this region is definitely associated with both acute and chronic biceps subluxation or even dislocation with secondary tear. It will cause bicipital tendinitis, chronic shoulder pain and stiffness. The higher the level of avulsion, the greater the chance that this pulley system will have secondary tendon instability problem.

Theoretically, medially displaced avulsion fragment of the lesser tuberosity will narrow the functional space of coraco-humeral interval, which may cause subcoracoid impingement problem presented with chronic shoulder pain problem. To the authors' knowledge, there has been no reported case of subcoracoid impingement in this condition.

Management of this fracture was still controversial. Most of the cases are delayed in diagnosis presenting with chronic shoulder



**Figure 4.** The axillary view of the right shoulder showed a healed fracture of lesser tuberosity at 16th week.

**Table 1**  
Summary of treatment guidelines in the literature

Severity	Displacement	Associated complication*	Suggested treatment option
Mild	Incomplete avulsion ≤5 mm	Presence of favourable factors†	Conservative management if uncomplicated
Moderate	Incomplete avulsion >5 mm	Increased chance	Operative fixation if complicated
Severe	Complete avulsion with gross displacement	More common	Operative fixation/excision

\* Associated complications: bicep tendon instability (from subluxation to dislocation); gleno-humeral instability.

† Favourable factors for retained stability of bicep tendon: intact superior part of lesser tuberosity fragment; intact medial wall of intertubercular groove.

pain problem.<sup>3,9</sup> After reviewing all the case reports in the literature, conservative management is an acceptable option for all those uncomplicated cases with incomplete avulsed fragment displaced <5 mm. Complicated cases included injury associated with biceps tendon rupture/instability or gleno-humeral instability will need operative reduction and fixation. Other indications for operative treatment included mechanical block to internal rotation, persistent pain despite conservative management, and weakness of terminal internal rotation.<sup>7</sup> Most of the cases reported in the literature were complete avulsion with gross displacement; open reduction and internal fixation were performed for the high demand active patients, and excision of the fragment was done for the elderly. The integrity of intertubercular groove and level of lesser tuberosity avulsion were also crucial to predict the risk of biceps tendon dislocation, which required operative treatment.

Ogawa and Takahashi suggested fixing all lesser tuberosity fracture regardless of the size and displacement of the fragment<sup>10</sup> so as to avoid future fracture displacement and potential biceps tendon subluxation. Van Laarhoven et al believed that conservative management<sup>5</sup> is good enough if the avulsion fragment is small, incomplete, and without gleno-humeral joint instability and biceps tendon displacement. Canigga et al also reported good clinical outcome in two patients treated nonoperatively.<sup>11</sup> The clinical result of our patient was comparable to the result of patients treated with operations by Robinson et al.<sup>12</sup> After reviewing of the case reports in the literature, a management guideline can be concluded and is summarized in Table 1.

Open reduction and internal fixation of the fracture fragment by using either cannulated screws with or without washers, heavy suture, and cerclage wire had been described.<sup>11</sup> The deltoid-pectoral approach is the most common surgical approach to be used. For those cases of isolated lesser tuberosity fracture without bicep tendon subluxation, Scheibel et al<sup>13</sup> reported an arthroscopic approach using suture anchors for fracture fixation with good functional outcome. Regardless of fixation type, most reports in the literature got satisfactory results functional recovery 3 to 6 months<sup>6</sup> after operation.

In summary, isolated lesser tuberosity fracture, although an uncommon injury, carries a great clinical implication if the diagnosis is missed and improperly treated initially. Axillary view and computed tomography of the shoulder is helpful to make the diagnosis. If the size and displacement of fragment is small, conservative management is a reasonable treatment option that can achieve a good clinical outcome.

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