Case report

Isolated lesser tuberosity fracture of the humerus literature review and case report

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Abstract

Background: Isolated fractures of the lesser tuberosity of the humerus are exceptionally rare and often challenging to diagnose due to non-specific symptoms and their infrequent occurrence. The accurate diagnosis and timely treatment of such fractures are critical to prevent complications such as chronic shoulder pain and functional impairment.

Objective: This study aims to review the clinical presentation, diagnostic challenges, and treatment outcomes associated with isolated lesser tuberosity fractures of the humerus. Additionally, we present two case reports that highlight the surgical management of these injuries and their outcomes.

Methods: Both male patients, aged 31 and 35 sustained their injuries from falls and presented with acute shoulder pain and limited motion. Initial X-rays were inconclusive, leading to further imaging with CT scans, which confirmed the diagnosis. Both patients underwent open reduction and internal fixation (ORIF). Postoperative follow-up included serial radiographs and clinical assessment of shoulder motion**.**

Results: ORIF restored the lesser tuberosity to its anatomical position in both cases. Follow-up radiographs demonstrated maintained reduction and progressive union, while clinical examination showed marked improvement in pain and shoulder function. At 3 months, case 1 had mild residual limitation of abduction and extension, whereas case 2 recovered near-full shoulder motion after rehabilitation.

Conclusion: Isolated lesser tuberosity fractures, though rare, require careful clinical evaluation and imaging for accurate diagnosis. Early and accurate diagnosis of isolated lesser tuberosity fractures is crucial to prevent long-term complications. Surgical management, particularly ORIF, appears to be a reliable approach in treating these fractures, resulting in favorable outcomes. Further research is needed to establish standardized treatment protocols for these uncommon injuries.

Keywords: *Isolated lesser tuberosity fracture, humerus, shoulder injury, open reduction internal fixation (ORIF), clinical diagnosis, fracture management.*

1. INTRODUCTION

Isolated lesser tuberosity fractures of the humerus are rare injuries often missed during clinical diagnosis due to non-specific symptoms and the difficulty of detection through imaging [1]. Statistics indicate that lesser tuberosity fractures occur in about 0,6 out of 100,000 cases of posterior shoulder dislocation each year [2], limiting research and understanding of this injury. Difficulty in diagnosis, especially in the acute phase, can lead to complications such as chronic shoulder pain and loss of shoulder function if not promptly detected and treated [3].

In medical literature, lesser tuberosity fractures are often associated with more complex injuries, including two- or three-part fractures of the proximal humerus, making isolated lesser tuberosity fractures even more unique and rare [4]. The first case of isolated lesser tuberosity fracture was reported by Hartigan et al. in 1985 [5], opening new avenues for research on the mechanism and treatment of this injury. These fractures are categorized into two primary types based on the mechanism: direct trauma, which is uncommon due to the tuberosity's small size and internal location, and indirect trauma, often resulting from muscle tension. Most injuries occur due to sudden subscapularis muscle contraction opposing shoulder abduction and external rotation, commonly seen in high-impact falls or seizures. Athletes and adolescents are at higher risk due to incomplete skeletal maturation and repetitive shoulder use. Clinical diagnosis is often delayed, leading to complications like shoulder instability and muscle atrophy. Imaging, particularly CT and MRI, is essential for accurate diagnosis and treatment planning. The treatment strategy for isolated fractures of the lesser tuberosity depends mainly on the degree of displacement and the stability of the

glenohumeral joint. Conservative treatment may be considered for nondisplaced or minimally displaced fractures. However, surgical intervention is generally recommended when the fragment is significantly displaced, commonly defined as displacement greater than 5 mm or angular deformity exceeding 45 degrees, particularly when associated with subscapularis tendon dysfunction, mechanical block to shoulder motion, or shoulder instability. Recent advancements include arthroscopic techniques, offering less invasive solutions with favorable outcomes [6].

This study aims to clarify the clinical and radiological features of isolated lesser tuberosity fractures of the humerus and evaluate the effectiveness of ORIF in restoring shoulder function. Understanding the diagnosis and treatment of this injury has scientific significance and practical value in improving patient quality of life. Continued research is necessary to refine treatment protocols and improve patient outcomes.

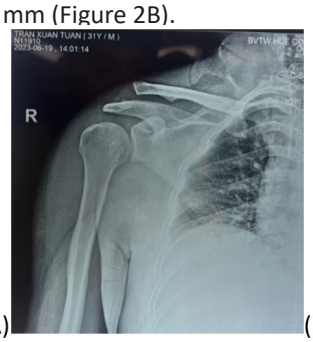
2. CASE REPORTS

2.1. Case report 1

A 31-year-old male patient was admitted with right shoulder pain after falling from a height of 1,5 meters, landing with his right arm abducted and externally rotated. Clinical examination revealed right shoulder pain, tenderness at the proximal humerus, bruising on the medial aspect of the proximal right humerus, a prominent deformity at the acromioclavicular joint, and a positive piano key sign. Range of motion examination showed restricted movements, including 90° forward flexion, 80° abduction, normal external rotation, and 40° internal rotation.

Figure 1. Limited shoulder joint range of motion (R) after injury

X-ray imaging revealed a clear acromioclavicular dislocation, but an abnormal bright spot at the lesser tuberosity was difficult to detect (Figure 2A). The patient was indicated for a CT scan of the right shoulder, which confirmed a fracture at the lesser tuberosity with a fragment measuring 15 x 13 mm and a displacement of 8 mm (Figure 2B).

(A) 

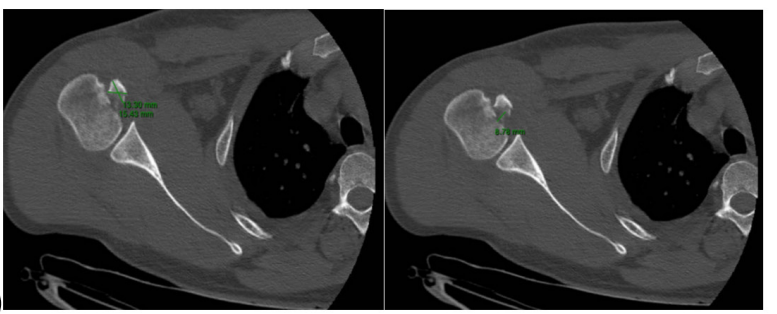
(B) 

Figure 2 (A). Abnormal bright spot at the lesser tuberosity on X-ray;
(B). Fracture at the lesser tuberosity on shoulder CT

The patient underwent open surgery in the "beach chair" position (under 45 degrees). Two separate surgical approaches were used in this case. The distal clavicle fracture was addressed through a superior clavicular incision, while the lesser tuberosity fracture of the proximal humerus was managed through a deltopectoral approach. These injuries were located in anatomically distinct regions, requiring different exposures to allow adequate visualization, accurate reduction, and stable fixation. A single surgical approach would likely have provided limited access and might have compromised the quality of fracture reduction. The first incision over the acromioclavicular joint for acromioclavicular joint fixation with hook plates and ligament reconstruction; the second incision approached the fracture at the lesser tuberosity via the deltopectoral approach (Figure 3).

Figure 3. Patient positioning

During surgery, it was observed that the fractured fragment had been avulsed from its anatomical position. Further dissection revealed the long head of the biceps tendon had dislocated from the bicipital groove and was entrapped at the fracture site. The surgeon repositioned the biceps tendon into the bicipital groove and fixed the lesser tuberosity fragment back to its anatomical position using cancellous screws (Figure 4).

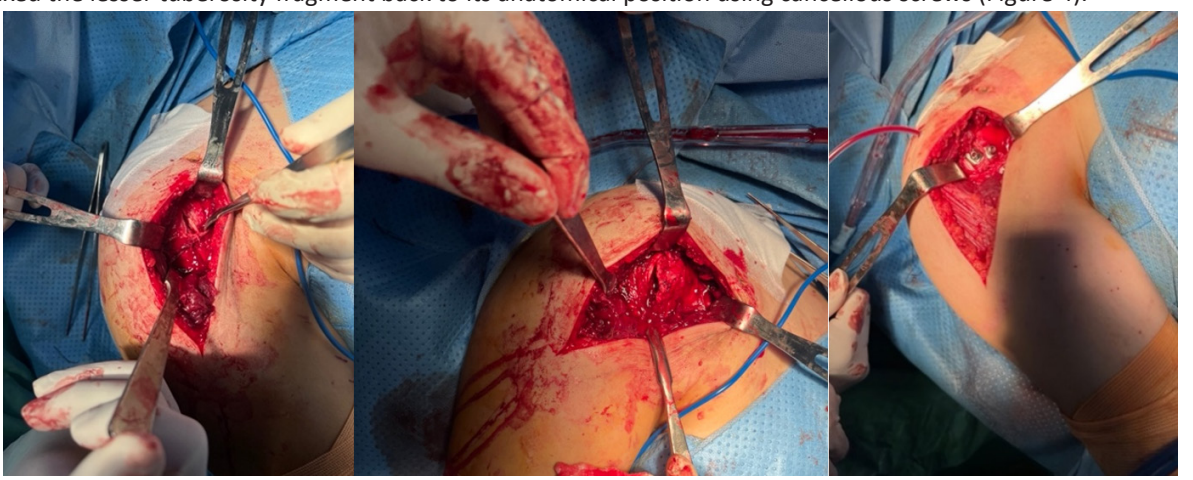


Figure 4. Exposure of the fracture site and fixation of the lesser tuberosity

Postoperative X-rays showed the fracture had been well-fixed in its anatomical position (Figure 5A). The patient was immobilized for 3 weeks and began physical therapy in the 4th week. At the 3-month follow-up, radiographs demonstrated satisfactory bone healing (Figure 5B). Clinically, the patient showed significant improvement in shoulder motion, although mild limitation in extension and abduction was still observed (Figure 6)

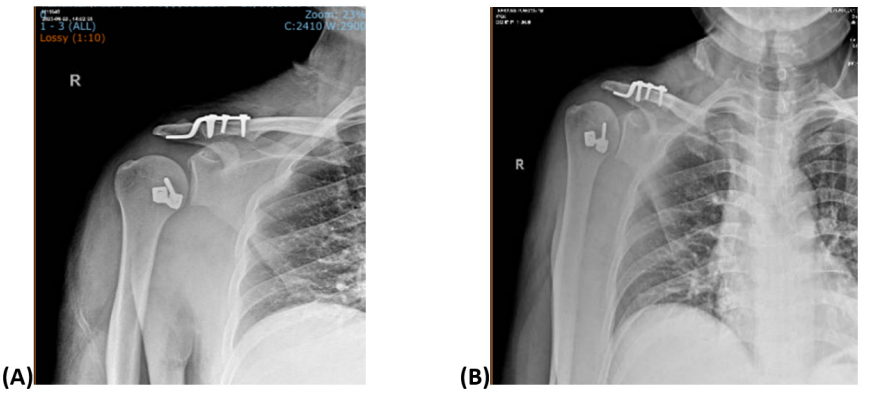


Figure 5. Postoperative X-rays of the shoulder joint (A); after 3 months follow-up (B)

Figure 6. Shoulder's range of motion after 3 months

2.2. Case report 2

A 35-year-old male patient was admitted following a work-related accident, falling and landing with his arm outstretched. Upon admission, the patient was alert and communicative but exhibited severe pain and complete limitation of left shoulder motion. There were no signs of neurovascular injury. X-rays of the left shoulder revealed posterior shoulder dislocation with an unusual bright line at the proximal humerus (Figure 7).

Initial diagnosis confirmed posterior shoulder dislocation, and the patient was indicated for a CT scan of the left shoulder. The CT scan revealed posterior shoulder dislocation with an avulsion fracture of the lesser tuberosity at the proximal humerus. The lesser tuberosity fragment measured 15x20 mm with a displacement of 21 mm (Figure 8).

Figure 7. Shoulder dislocation with fracture displacement on X ray

The patient underwent closed reduction of the shoulder dislocation, followed by X-ray imaging. Post-reduction X-rays showed the shoulder remained dislocated, and the joint appeared unstable during the reduction maneuver (Figure 9).

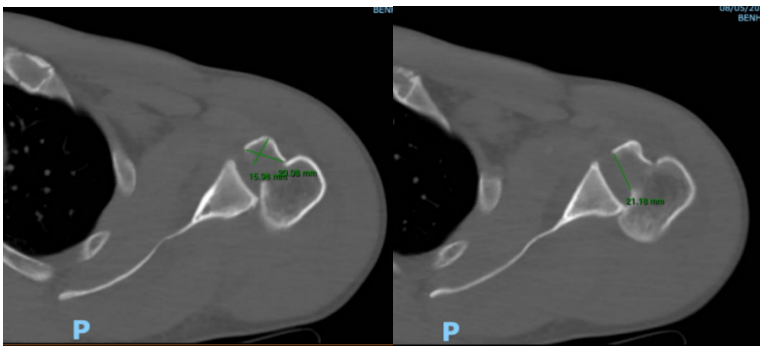


Figure 8. Difficult detection of lesser tuberosity fracture on CTScan

Figure 9. Unsuccessful shoulder reduction on left shoulder X-ray

The patient was indicated for open surgery using the deltopectoral approach to access the lesser tuberosity fracture. The fragment was fixed with cancellous screws, and the shoulder was reduced. Postoperative X-rays showed the fracture and shoulder joint had been returned to their anatomical positions (Figure 10). The patient was immobilized for 4 weeks before beginning physical therapy. By the third month post-surgery, the patient had fully regained shoulder motion (Figure 11).

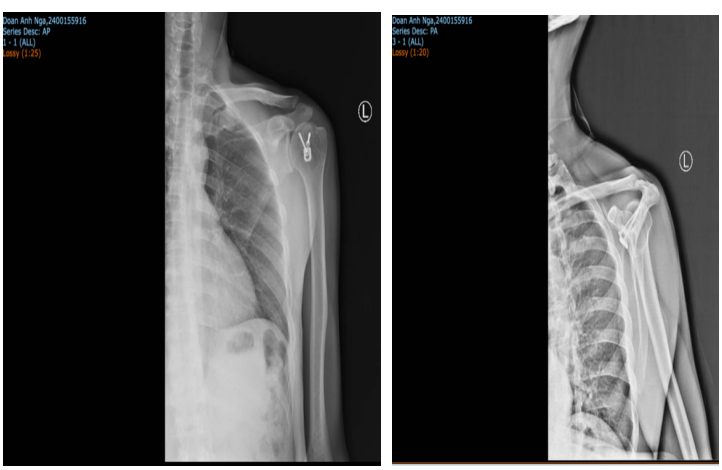


Figure 10. Postoperative X-rays showing the left shoulder joint in its anatomical position

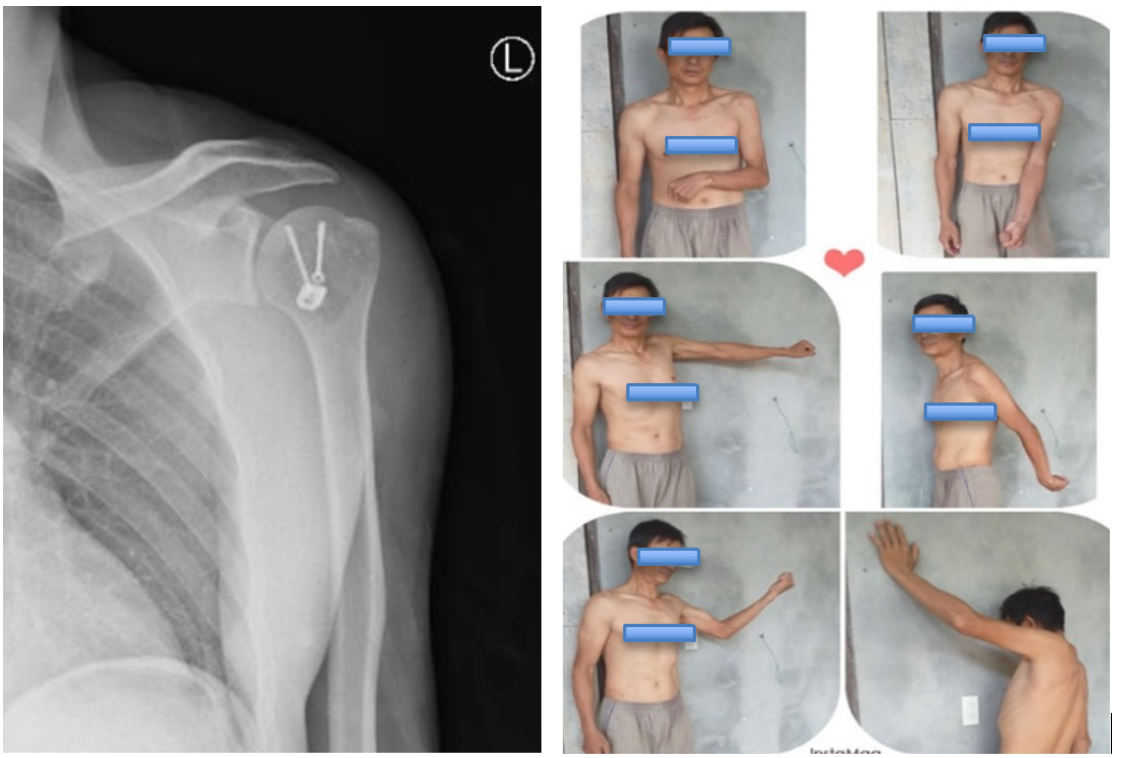


Figure 11. Postoperative X-rays and shoulder range of motion at 3 months

3. DISCUSSION

Isolated lesser tuberosity fractures of the humerus are rare, with an incidence of approximately 0.6 cases per 100,000 population [1]. Due to the rarity of this injury, clinical experience in managing it is limited. A literature review reveals no large case series, only small case series or single case reports.

Morphologically, lesser tuberosity fractures can be classified into two main types based on injury mechanism: direct force trauma and indirect force trauma. Due to the small size and internal location of the lesser tuberosity, isolated fractures caused by direct force are rare. Therefore, most authors believe the primary injury mechanism is muscle tension [7] [8]. The common mechanism is strong contraction of the subscapularis muscle in opposition to abduction and external rotation of the shoulder, as seen in falls from a height, violent backward falls, or being thrown to the ground as in wrestling or motorcycle accidents [1]. Other less common mechanisms include sudden, involuntary muscle contractions following a seizure or in psychiatric patients undergoing electroconvulsive therapy; posterior shoulder dislocation has also been reported [8]. High-risk groups for this injury include athletes and adolescents who have not fully developed their skeletal system, particularly those who frequently engage in shoulder-related activities [1].

Clinically, acute fractures of the lesser tuberosity typically present with classic symptoms such as pain at the lesser tuberosity, limited active external rotation, and pain with internal rotation. Clinical tests such as the lift-off test, belly-press test, and Napoleon sign can help accurately identify the injury site. During examination, physicians should check for abnormalities in the long head of the biceps tendon and assess the stability of the glenohumeral joint to rule out associated shoulder dislocations.

As previously mentioned, isolated lesser tuberosity fractures are rare and easily overlooked, leading to delayed diagnosis, which can cause shoulder instability, muscle atrophy due to inactivity, and impingement symptoms years after the injury [8]. In some cases, patients may not experience pain but may lose active shoulder rotation and subscapularis muscle strength, while others may show increased strength in the external rotator muscles. Lesser tuberosity fractures can be missed if only standard anteroposterior or scapular Y views are used, especially with small fragments and minimal displacement. More accurate diagnosis requires axillary view X-rays. In cases where the

fragment is large and significantly displaced, it may be easily recognized on standard X-rays but could be mistaken for other injuries, such as a Bankart lesion following shoulder dislocation. If the fragment is displaced beneath the glenoid, it may be mistaken for calcific tendinitis [7]. The axillary view is considered an important radiographic projection for detecting posterior shoulder dislocation. However, in acute traumatic settings, this view may be difficult to obtain due to severe pain and limited shoulder mobility. In such cases, CT imaging can provide more detailed information about the fracture pattern and associated joint dislocation. CT scans provide detailed images of the fracture size and displacement, aiding in precise treatment planning. Ultrasound can supplement by providing information on associated rotator cuff injuries and dislocation or subluxation of the biceps tendon. MRI has higher sensitivity in detecting shoulder dislocations related to glenoid or humeral head defects or diagnosing fractures associated with tumors in children. In chronic fractures, diagnostic imaging may reveal bone healing and callus formation. In our report, most patients presented with limited external rotation and shoulder abduction following injury, accompanied by anterior shoulder pain exacerbated by movement. These patients often had tenderness at the lesser tuberosity and a positive subscapularis muscle test. CT scans showed significant displacement of the lesser tuberosity relative to the humerus.

In terms of treatment, there is still debate over the management of isolated lesser tuberosity fractures of the humerus, including choosing between conservative and surgical treatment and the optimal surgical approach. Primary treatment methods include sling immobilization, open reduction and internal fixation (ORIF), arthroscopic fixation, and percutaneous closed reduction and internal fixation [9].

In cases of acute, non-displaced lesser tuberosity fractures, non-surgical treatment may yield favorable outcomes. Using an arm sling for 6 to 8 weeks followed by rehabilitation exercises after sling removal usually results in good prognosis.

Surgical indications include displacement of the fracture fragment > 5 mm or angulation > 45°, significant clinical limitations in movement or strength, or persistent pain [10],[11]. Ogawa et al. have conducted extensive research and recommend ORIF for most cases regardless of the fragment size and displacement to achieve optimal outcomes [7]. Other recommendations suggest ORIF for multi-fragment fractures of the lesser tuberosity (Neer V) or fractures associated with shoulder dislocation or biceps tendon entrapment [12]. The deltopectoral approach is the standard surgical approach for lesser tuberosity fractures of the humerus [13]. During surgery, the subscapularis muscle often requires mobilization, and the torn attachment must be managed to remove fibrous tissue. Careful assessment of the medial wall of the bicipital groove is essential to preserve the long head of the biceps tendon attachment [9]. The patients in our study were treated with ORIF. After one month of surgery, they began physical therapy, and after three months, they reported no pain, indicating that this treatment method helped patients quickly return to daily activities, thereby improving their quality of life. Recently, arthroscopy has been used for isolated lesser tuberosity fractures with a two-step procedure: closed reduction and internal fixation [1]. This method allows for pain-free movement and rapid return to sports requiring shoulder flexibility, such as volleyball and tennis [9]. This technique can be indicated for isolated, displaced avulsion fractures of the lesser tuberosity, providing excellent clinical and radiological outcomes [12].

A recent report focusing on the treatment of lesser tuberosity avulsion fractures in adolescents demonstrated good results with both open surgery and arthroscopy, with no significant difference in clinical outcomes between the two methods [14]. The advantages of arthroscopic techniques over ORIF include no hardware passing through the avulsion fragment, reducing the risk of fragment breakage and loss of fixation. Arthroscopy is also less invasive, leading to smaller postoperative scars and theoretically less postoperative pain with a shorter rehabilitation time [15]. Some authors suggest that the treatment of lesser tuberosity fractures should be based on the fracture's timing, dividing it into acute and chronic categories. Ogawa recommends intervention in acute fractures, while in chronic cases, conservative treatment may yield favorable results without surgical intervention [1],[7].

4. CONCLUSION

Though isolated lesser tuberosity fractures of the humerus are rare, they require accurate and timely diagnosis, especially when patients present with symptoms similar to other proximal humerus fractures. Accurate diagnosis should be based on thorough assessment of shoulder range of motion, including abduction, internal, and external rotation,

and supported by X-ray and CT imaging. There is still debate over the optimal treatment method for lesser tuberosity fractures, but it should be tailored to the patient's specific condition. In acute cases, surgical intervention with open reduction and internal fixation (ORIF) is usually preferred to ensure optimal recovery. Conversely, in chronic cases, conservative treatment may achieve satisfactory outcomes without surgical intervention.

In conclusion, understanding and choosing the appropriate treatment method for isolated lesser tuberosity fractures is crucial. Continued research and updates to clinical guidelines are necessary to optimize patient outcomes.

Limitations of the paper:

+ The absence of axillary view radiographs in this case represents a limitation of the present report. When patient condition allows, this projection should be considered to reduce the risk of missed posterior shoulder dislocation.

+ The lack of ultrasound assessment is a limitation of the present report, and we mention its potential value in the diagnostic work-up of similar cases in future practice.

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