Proximal humerus fractures are common injuries of the upper extremity. These injuries are frequent in the elderly population due to low-energy trauma and in the younger patient secondary to high-energy trauma that is associated with shoulder dislocations. Proximal humerus fractures are frequently categorized according to the Neer classification which is defined by the number of segments and the amount of displacement required to define the fracture as displaced. Segments include the greater tuberosity (GT), the lesser tuberosity, the humeral head, and the humeral shaft. Fractures are considered displaced if there is at least 45° of angulation or 1 cm of displacement.

Case Report: We present a case of a 42-year-old Caucasian patient with a displaced and incarcerated GT avulsion fracture following a motorcycle accident. In this report, we describe the patient positioning, technique using open reduction internal fixation utilizing multiple anchors and suture to treat this injury and the successful outcome of our patient 1 year from the injury.

Conclusion: While standard open reduction internal fixation techniques using plates and screws are appropriate for treating these injuries, we chose to pursue a method that involved only bio-absorbable suture anchors. Using these anchors, we were able to achieve an anatomic reduction of the GT fragment that ultimately went on to achieve full healing.

Keywords: Proximal humerus fracture, motorcycle, greater tuberosity avulsion, suture anchors, trauma evidence: Level V.
This is a case report of a 42-year-old male who presented to our ED after being involved in a motorcycle accident. He sustained a left GT avulsion fracture. The fracture fragment was retracted to the level of the glenohumeral joint which indicated intact and functional rotator cuff musculature (Fig. 1).

After non-operative versus operative treatment options were discussed with the patient, it was decided to proceed with open reduction internal fixation to give the patient the greatest chance of range of motion recovery. A standard deltopectoral approach was utilized. The avulsed GT fracture with attached rotator cuff was identified. Two 4.75 mm Arthrex anchors with associated FiberWire (Arthrex) were placed in the footprint of the GT (Fig. 2). The sutures from the anchors are sequentially passed through the tendinous portion of the supraspinatus muscle-bone interface from inferior to superior. The FiberWires (Arthrex) are then tied in a horizontal fashion to secure the lesser tuberosity to its anatomic location medially. Next, the FiberWires were placed laterally into two separate anchors for further compression (Fig. 3). Postoperatively, the patient was placed in a shoulder immobilizer. He underwent early pendulum exercises followed by rotator cuff repair protocol. At the last follow-up, 8 months postoperatively, he had 140° of active forward flexion and 20° of external rotation and radiographs showed fully healed fracture fragments (Fig. 4).

Our report presents a case of an isolated GT fracture with an intact rotator cuff, incarcerated in the glenohumeral joint following a motor vehicle accident. Proximal humerus fractures...
are common orthopedic injuries. Within this, GT fractures make up a small portion [4]. Roughly, 19% of all proximal humerus fractures are isolated GT fractures [9]. Typically, fractures in this region occur through the physeal lines and 5% to 57% can be associated with dislocation [10]. As there are many muscles that can act as deforming forces on the proximal humerus, displacement of these fractures is common. Most notably for the GT, the rotator cuff, namely, the supraspinatus and infraspinatus, act as the primary deformers. These muscles will typically pull the fragment superior and posterior. It is believed that a forceful contraction of the rotator cuff against a distracted humeral head from the glenoid is what leads to these avulsion type fractures [10].

As these GT fractures occur, their degree of displacement can lead to impingement. Most authors cite that 5 mm of displacement is enough to provide unsatisfactory results if left alone. For example, superior displacement can lead to impingement of the subacromial space [4]. The treatment of these injuries is sought to achieve anatomical reduction, prevent impingement, and restore rotator cuff function [9]. Incarcerated GT fragments in the glenohumeral joint can be detrimental to the cartilage and lead to early onset arthritis if not treated in a timely manner.

Many treatment options exist for GT fractures. Depending on the injury pattern and degree of displacement, arthroscopic versus open techniques can be utilized. Most commonly, heavy suture fixation, isolated screws, or a combination of plates and screws are utilized to secure the displaced fragment [4, 10]. In addition, factors such as degree of comminution, inadequate reduction, size of fragments, and lower bone quality can lead to bone loss at presentation and an increased risk of GT resorption after fixation [11]. To mitigate these risks, bone grafting may be used at times to aid in achieving appropriate reduction and allowing the bone the greatest potential to fully heal.

While standard open reduction internal fixation techniques using plates and screws are appropriate for treating these injuries, we chose to pursue a method that involved only bioabsorbable suture anchors. Using these anchors, we were able to achieve an anatomic reduction of the GT fragment that ultimately went on to achieve full healing. While many options exist for surgically treating these injury patterns, successful outcomes have been noted in 80–100% of cases when these fractures are treated operatively [10]. It is important to treat all displaced fractures with surgical intervention to allow these patients to optimize their chances of regaining full use of their shoulder.

**Conclusion**

Proximal humerus fractures are common injuries of the upper extremity. There are several described treatment techniques. This article is a case report of a patient with a displaced GT avulsion fracture treated with open reduction internal fixation utilizing multiple anchors and suture.

**Clinical Message**

Isolated GT fractures can be detrimental to a patient's function and range of motion. With the attachments of the rotator cuff, notably the supraspinatus and infraspinatus, at the GT, these fragments may become incarcerated in the glenohumeral joint. Operative treatment of these injuries is imperative to prevent accelerated osteoarthritis of the glenoid and humeral head and to restore optimal function of the joint.
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