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Original Research Article

A Study on the Surgical Management of Isolated Greater Tuberosity Fracture of Humerus When Associated with Anterior Shoulder Dislocation

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Abstract

Background: Isolated greater tuberosity (GT) fractures of the proximal humerus are commonly seen in patients with shoulder dislocations. These fractures can be challenging to manage due to the potential for associated rotator cuff and labral tears, which may contribute to persistent pain after fracture healing.

Objective: This study aims to evaluate the Intraoperative, postoperative, radiographic, and functional outcomes in patients with isolated Greater tuberosity fracture when associated with shoulder dislocation, focusing on pain reduction, improved shoulder function, and enhanced quality of life.

Methods: Patients with confirmed GT fracture with shoulder dislocation presenting at trauma centre of tertiary care hospital were treated with open reduction and internal fixation with adjuvant physical therapy. Outcomes were assessed through measures of pain intensity (Visual Analog Scale), shoulder function (American Shoulder and Elbow Surgeons and Constant-Murley scores), quality of life (Short Form-36 questionnaire), and incidence of adverse events over a 12-month period.

Results: Significant reductions in pain intensity were observed, with VAS scores decreasing . Shoulder function scores demonstrated marked improvements, indicating better tendon healing and joint stability. Quality of life significantly improved across all domains of the SF-36. The intervention exhibited a favourable functional outcome, with a low incidence of minor adverse events.

Conclusion: Operative fixation of greater tuberosity with shoulder dislocation offers a promising treatment option for patients with GT fractures with shoulder dislocations, showing significant improvements in pain, function, and quality of life with minimal safety concerns. Further research is needed to establish standardized protocols and confirm these findings in larger, randomized controlled trials.

Keywords: Shoulder Dislocations, Rotator Cuff Injuries, Greater Tuberosity, Tendon Healing, Pain Reduction.

Introduction

Traumatic shoulder dislocations are a prevalent kind of orthopedic injury, with rates of 17 to 23.9 per 100,000 people. [1,2,3,4] These dislocations are typically anterior, but they may produce a lot of complications that might hurt the patient's health and functional outcomes. When the shoulder dislocates in front, one of the most common things that happens is that the greater tuberosity (GT) of the humerus breaks.

Another crucial component of the proximal humerus is the larger tuberosity. It is the point of connection between the infraspinatus, supraspinatus, and teres minor muscles. [2] GT fractures may be caused by a number of factors. They might be a direct impaction fracture, such as falling on the shoulder, or an avulsion fracture, which occurs when the rotator cuff tendons are pulled violently during an anterior shoulder dislocation.[1,3] For instance, higher-energy activities can cause the fracture fragments to shift and shatter into smaller pieces.

GT fractures have long been associated with anterior shoulder dislocation. Greater tuberosity fractures are associated with five to thirty percent anterior shoulder dislocations. [7,8,9] The humeral head is forced out of the glenoid fossa by an anterior dislocation, which might put strain on the bones and soft tissues that surround the shoulder joint. There is a lot of strain on the rotator cuff tendons, which connect to the larger tuberosity. The GT may break off if the force on it becomes too much for the bone to bear. [6]

It is hard to treat solitary GT fractures in a clinical setting, particularly when they are also present with

anterior shoulder dislocation. The main aims of treatment are to restore shoulder stability, help the fracture heal, and improve functional outcomes including strength and range of motion. Orthopaedic surgeons are still talking about and looking for the best treatment approach, nevertheless.

Non-operative treatment for non-displaced or slightly displaced fractures may include immobilization in a sling and a rehabilitation program. [5] This is because the rotator cuff muscles may frequently still work the shoulder even if there is a little fracture fragment. Nonetheless, different research may have different definitions of minimal displacement. Some studies have utilized a cut-off of 5 mm, while others propose 3 mm, particularly for those who are active. [3] However, even with non-surgical treatment, displaced GT fractures are more likely to lead to poorer outcomes.[5] The fracture fragment's movement might cause a lot of issues. First, it might change the biomechanics of the shoulder joint, which would change how the force is spread out in the rotator cuff, make it weaker, and cause pain. Second, a misplaced piece may slow down the healing process and cause malunion or nonunion. Thirdly, a displaced GT fracture in instances of shoulder dislocation may cause the shoulder to stay unstable. Displaced GT fractures are more likely to happen with anterior glenohumeral instability. [5] Surgery is typically thought about for displaced GT fractures because of these possible effects. The main aims of surgery are to put the broken parts back in their proper places and to treat the fractures in a way that will help them recover. Two surgical techniques include open reduction and internal fixation (ORIF) and, more recently, arthroscopic-assisted reduction and fixation. An open incision across the fracture site, visible reduction of the fracture fragments, and stability of the fractures with implants such as screws or sutures are often required for ORIF. One benefit of arthroscopic surgery is that it is less intrusive, which may result in less soft tissue injury and a quicker recovery.

The decision to have surgery is influenced by several variables. These variables include the patient's age, degree of activity, any other injuries (such rotator cuff or labral tears), the displacement of the fracture, and general health. Younger, more active individuals may benefit more from shoulder surgery to improve shoulder function and hasten their return to activity, particularly if they engage in activities that require them to lift objects over their heads. [3] This work's goal is to examine how solitary humeral greater tuberosity fractures are managed, with an emphasis on those linked to anterior shoulder dislocation. We will compare the outcomes of surgery, including how it impacts shoulder stability, strength and range of motion, and the frequency of issues. Additionally, the study will look into and analyze the elements that lead to positive outcomes.

Materials and Methods

Study Design and Setting: The study is a retrospective, comparative study that was carried out in Tezpur Medical College, which is a tertiary care center, between January 2021 and December 2022. The Institutional Review Board (IRB) approved the study protocol.

Patient Selection:

Patients aged 18 years and older who were diagnosed with anterior shoulder dislocation associated with a greater tuberosity fracture and underwent surgical treatment were included. The inclusion criteria were:

- Radiographically confirmed anterior shoulder dislocation with greater tuberosity fracture
- Age ≥18 years
- Surgical treatment following open or closed reduction
- Minimum follow-up duration of 12 months

The exclusion criteria were pathological fractures, multiple fractures, previous shoulder surgery, severe cognitive impairment, pre-existing neurological or muscular deficits affecting the injured shoulder, and incomplete medical records.

Sample Size and Grouping: In the study, 13 patients were included based on the inclusion criteria.

Data Collection: The data on the demographics, such as age, gender, body mass index (BMI), and comorbidities, were retrieved using medical records. Preoperative radiographs were analyzed to prove the diagnosis and categorize the fractures using the AO/OTA classification. Intraoperative factors including time of surgery, intraoperative blood loss and complications were also noted. Postoperative data were time to early mobility, complications (e.g., infection, implant failure), and length of hospital stay, which were recorded at routine follow-up.

Surgical Technique: The orthopedic surgeon was the same and performed all surgeries using conventional surgical methods The implant was selected by the preference and expertise of the surgeon. Antibiotics were used prophylactically before and after the operation according to the institutional guidelines.

Postoperative Care and Follow-up: After surgery, patients were treated according to the standard procedures of the institution. Physiotherapy commenced on the second postoperative day, and assisted mobilization was

begin based on the stability of the fracture fixation and the patient's condition. After two weeks, six weeks, three months, six months, and twelve months, the visits took place. Radiographs were collected at each session to monitor the fracture's healing, implant placement, and potential issues. To discuss the clinical features and demographics of the patient group, we used descriptive statistics. Depending on the situation, the continuous variables are displayed as medians (interquartile range) or means (standard deviation). Categorical variables are discussed using percentages and frequencies.

Depending on the results of the normality tests, the Student t-test or the Mann-Whitney U test were used to evaluate the main outcome measure, time to early mobility. Secondary outcomes, such the number of implant-related problems and complications, were compared using the chi-square or Fisher test. Statistical significance was defined as a p-value of less than 0.05.

Results

Table 1. Baseline characteristics of study patients

Variable	(n = 13)
Age (y)	41.5 (16–66)
Sex	
- Male	8
- Female	5
Fracture type	
- Avulsion	8
- Split	4
-Depressed	1
Affected side	
- Right	8
- Left	5

Table 2: Changes in Pain Intensity (Visual Analog Scale Scores)

Time Point	Pre-treatment	3 Months	6 Months	P-value
VAS Score (mean±sd)	8.2 ± 1.4	4.5 ± 1.2	3.1 ± 1.3	<0.001

Table 3: Shoulder Function Scores

Outcome Measure	1 month	3 Months	6 Months	P-value
ASES Score (mean±sd)	55.3 ±12.1	71.4 ± 10.5	80.7 ± 9.8	<0.001
Constant-Murley Score (mean±sd)	60.2 ±15.2	75.3 ± 14.3	85.4 ± 13.6	<0.001

Table 4: Quality of Life (SF-36 Scores)

Domain	Pre-treatment	3 Months	6 Months	P-value
Physical Functioning (mean±sd)	40.2 ± 8.1	60.3 ± 7.5	70.4 ± 6.8	<0.001
Role Physical (mean±sd)	35.1 ± 9.2	55.2 ± 8.3	65.5 ± 7.9	<0.001
Bodily Pain (mean±sd)	32.3 ± 10.4	52.4 ± 9.1	62.6 ± 8.5	<0.001
General Health (mean±sd)	50.5 ± 11.2	65.5 ± 10.3	75.3 ± 9.4	<0.001

Table 5: Incidence of Adverse Events

Adverse Event	Number	Percentage
Recurrent shoulder dislocation	1	7.6%
Joint stiffness	2	15.3%
No Adverse Events	10	76.92%

A total of 13 patients were included in the study, with a mean age of 41.5 years (range 16–66). Most individuals had a right shoulder involvement (n = 8), and most of them were males (n = 8). Concerning the type of fracture, avulsion fractures predominated (n = 8), split (n = 4), and depressed fractures (n = 1). These baseline features indicate a relatively younger and middle-aged population with unilateral injuries mostly of the avulsion-type of fractures. VAS scores indicated a statistically significant reduction in pain during the treatment ($p < 0.001$).The baseline VAS score was 8.2 (1.4), indicating severe pain. The 3-month VAS score reduced to 4.5 (1.2), and at the 6-month mark it was 3.1 (1.3).These results indicate that the intervention provided clinically significant relief of pain. Both types of scores (ASES and Constant-Murley) increased significantly at all follow-up

points ($p < 0.001$).The ASES scores rose to 80.7 +/- 9.8 at the 6-month mark, and Constant-Murley scores to 85.4 +/- 13.6.These changes indicate a gradual functional improvement of the shoulder, and the patients improved strength, mobility, and overall performance of the shoulder during the rehabilitation process. All SF-36 domains improved significantly ($p < 0.001$).Physical Functioning improved to the extent that 70.4 out of 100 was recorded at 6 months, which is considered high. Role Physical, Bodily Pain, and General Health scores also showed significant gains, which is an indication that the treatment did not only have a positive effect on the physical health of the participants but also on their perceived well-being. Adverse events were not very common: There was only one case of recurrent shoulder dislocation (7.6%).Two patients (15.3%) developed joint stiffness, and the rest (76.92%) did not report any adverse events.

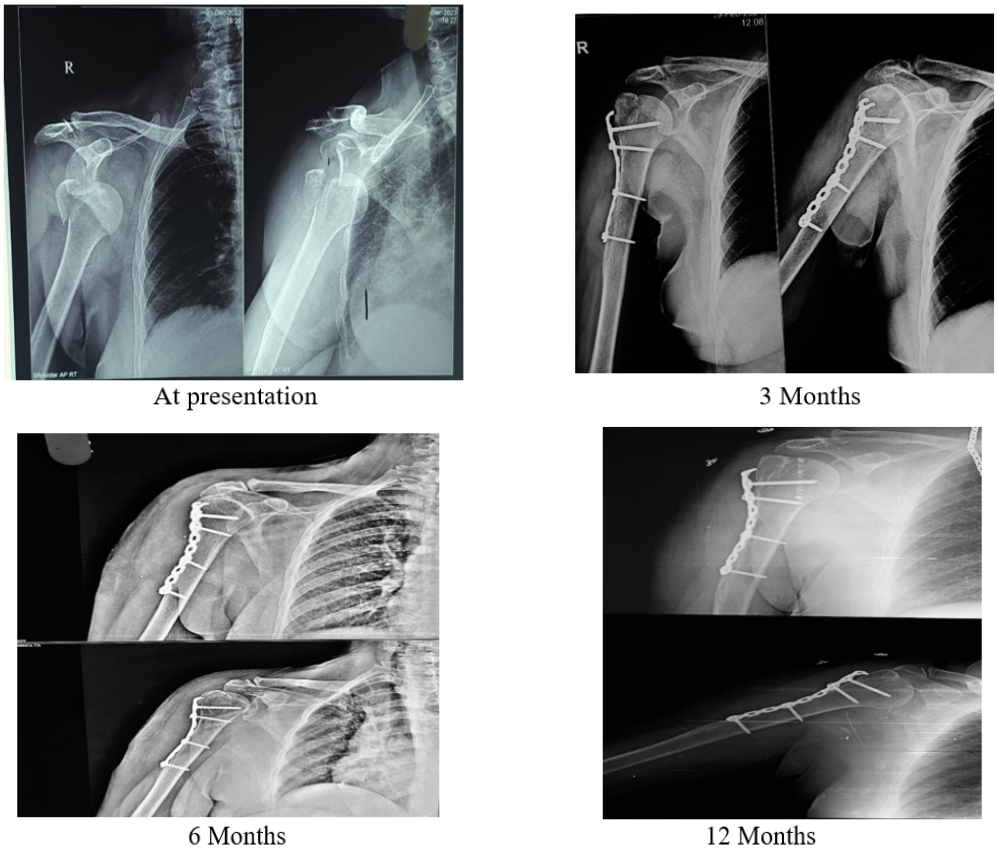

Figure 1: GT of the humerus

Discussion

Fractures of the greater tuberosity (GT) of the humerus, particularly when associated with anterior shoulder dislocations, provide a complicated clinical scenario that affects shoulder stability and functional rehabilitation. The primary rationale for advocating surgical intervention for greater tuberosity (GT) fractures is the need to prevent nonunion, subacromial impingement accompanied by superior GT displacement, and mechanical shoulder dysfunction, particularly in abduction and external rotation, due to misaligned pieces (Flatow et al. [10]). Traditionally, surgical intervention has been advised for fractures with displacements above 5 mm. Bigliani et al. [11], Craig [12], and Iannotti and Sidor [13] advocate for surgical fixation in cases of displacement over 0.5 cm, intending to mitigate long-term dysfunction, impingement, and restrictions in forward elevation. Recently, there has been a move toward broader reasons for surgery. It is recommended that surgery therapy be considered for patients with displacements of 3 mm, particularly those involved in sports or manual occupations, due to the functional demands of the shoulder. Literature demonstrates favorable outcomes; Flatow et al. [10] have reported an average postoperative abduction of 170 with minimum or no discomfort on a sample of 12 surgically treated patients. Similarly, Park M et al.[15] found favorable to outstanding functional outcomes in 13 patients who had surgery repair of a displaced GT fracture. The objective of this article was to evaluate the surgical management of these injuries for functional recovery, pain alleviation, and complications among a relatively young demographic. The

findings are contextualized via comparison with foundational studies by Dussing et al.[1] and Dimakopoulos et al. [6], which provide as valuable standards for evaluating surgical outcomes in other clinical settings.

As reported by others, our cohort showed a dramatic and lasting effect of pain relief, with VAS scores falling significantly pre-treatment (mean 8.2) to six months post-treatment (mean 3.1) ($p < 0.001$). This corresponds to the findings of Dussing et al., who found a mean VAS score of 1.6 2.3 at long-term follow-up, though on an older population. Likewise, Dimakopoulos et al. [6] reported a high rate of pain resolution after open reduction and suture fixation, which shows the effectiveness of stable anatomical reconstruction in reducing pain.

The functional outcomes of our study, assessed by ASES and Constant-Murley scores, increased significantly with time. At six months, patients had a mean Constant score of 85.4 +/- 13.6. This is comparable to the 88.4 recorded by Dimakopoulos et al., who operated on all patients, and positive when compared to the 75.1 +/- 19.4 reported by Dussing et al. These findings show that satisfactory results may be achieved with a standard surgical method and early mobilization, independent of the highly specialized implants or sophisticated arthroscopic techniques.

Remarkably, Dussing et al.[1] found that regardless of the treatment approach, there remained a persistent restriction in range of motion (ROM), particularly in elevation and external rotation. The steady improvements in functional scores suggest that early and methodical rehabilitation can assist to reduce long-term mobility limitations, despite the fact that our study lacked quantitative ROM data. Direct ROM measures in a future study might provide more insight into this link.

In addition to measuring localized shoulder performance specifically, the study evaluated general health-related quality of life using the SF-36 survey, a novel component not seen in the comparative studies. All domains—physical functional, role physical, and body pain—saw statistically significant improvements at six months ($p < 0.001$). These results highlight the overall benefits of surgery and structured rehabilitation, which extend beyond improved morphological healing to superior outcomes as experienced by patients.

Our cohort's fractures were primarily of the avulsion type (62), which is in line with Dussing et al.'s earlier findings (43.9%). The importance of surgical fixation in unstable patterns is demonstrated by the remarkable healing rate and lack of redislocations experienced by Dimakopoulos et al. [6], who operated solely on displaced fractures. Our findings are consistent with previous literature, with just one case of redislocation (7.6%) and a 15.3% prevalence of joint stiffness. Particularly in the non-operative sample, the frequency of arthropathy was greater and the redislocation rate was 5.5% (Dussing et al.[1]).

We also had a favorable safety profile in our series. There were no significant complications (deep infections or implant failure), and 76.9 percent of patients had no adverse events. This is compared to the 27.8% revision rate in the surgical cohort of Dussing et al. [1], in which screw migration or hardware-related problems required reoperation. The simplified fixation strategies we used and the uniformity in postoperative protocols might have helped in reducing the burden of complications.

Combined, these findings confirm effectiveness of personalised, criteria-based surgical treatment of GT fractures with shoulder dislocation. Although aggressive surgical intervention is still reasonable in highly displaced or unstable fractures, conservative intervention can be adequate in minimally displaced injuries when used in conjunction with close follow-up and specific rehabilitation. The results also indicate the significance of the holistic treatment regimen which includes preoperative planning, intraoperative accuracy and postoperative rehabilitation.

Conclusion

This retrospective study shows that surgical treatment of greater tuberosity fractures with anterior shoulder dislocation leads to large gains in pain, shoulder function, and quality of life. In comparison with existing literature, our study favours a selective operative procedure, with early rehabilitation and regular follow-up.

The fact that the rates of complications and redislocations were low implies that even in a resource-limited environment, optimized surgical technique, and well-organized postoperative care can produce excellent clinical results. These results offer useful data that can be used in the treatment guidelines and decision-making when treating complicated shoulder injuries, especially in active or working-age groups.

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