



Comparative Study between Operative and Conservative Treatment of Un-Displaced Isolated Greater Tuberosity Fracture of the Humerus

TA Al-Sadek^{1*} and AAI-Sadek²

¹Trakia University, Department of Orthopedics and Traumatology- Stara Zagora, Bulgatria

²UMHAT Tsaritsa Joanna- ISUL, Department of Orthopedics and Traumatology- Sofia, Bulgaria

*Corresponding Author: TA Al-Sadek, Trakia University, Department of Orthopedics and Traumatology- Stara Zagora, Bulgatria.

Received: February 20, 2023

Published: March 27, 2023

© All rights are reserved by TA Al-Sadek and AAI-Sadek.

Abstract

Background and Purpose: Fractures of the greater tuberosity of humerus account for one fifth of all fractures affecting the proximal $\frac{1}{3}$ of humerus. Although a displacement of 3-5 mm in fractured greater tuberosity indicates surgical intervention, less displaced tuberosities can be managed nonoperatively in young athletes as well as more displacement in older groups. Surgical modalities include ORIF using plate and screws, fragment excision, and percutaneous fixation.

Patients and Methods: We performed a prospective interventional study involved 20 patients with isolated greater tuberosity fractures of the humerus. Divided equally into 10 in each group, conservative and operative management. The follow-up images were assessed for radiographic healing.

For the objective assessment, the DASH score was used.

Results: We have twenty patients with un-displaced isolated greater tuberosity fracture; divided equally into ten in each group; conservative and operative. The mean age in conservative group 37.7 and in operative 36.9 with statistically non-significant difference. Male patients represented 60% and 70% within conservative and operative groups respectively. There is statistically non-significant difference between studied groups regarding range of motion. Four patient (40%) had anterior shoulder dislocation within operative group. The median DASH score of operative group 13.49, while it was 20.83 within conservative group.

Conclusion: Un-displaced greater tuberosity fractures can be treated without surgery with good outcome; however there are indications for surgical interventional with benefit of provides early return to life activity as it enhance early union.

Keywords: Greater Tuberosity; Fractures; Humerus

Introduction

Greater tuberosity fractures are common injuries seen in the emergency setting typically involving older patients with osteoporotic bone after low velocity trauma. They may also occur in younger men with normal bone following high-velocity trauma and make up one fifth of all proximal humerus fractures [1].

The diagnosis of greater tuberosity fractures is based on history, physical examination, and imaging. Important information to obtain includes the position of the arm at the time of the injury, the occurrence of a dislocation, and symptoms of numbness, tingling, or weakness, which could indicate neurovascular injury [2].

The treatment of these fractures depends on many clinical factors, such as the presence of shoulder instability, other associated shoulder injuries, and individual patient comorbidities, functional demands, and patient expectations [2].

Many greater tuberosity fractures that are minimally displaced may be treated conservatively. Non-operative treatment of greater tuberosity fractures with a 3-4 weeks of immobilization by pouch arm sling, followed by early passive motion. active motion and strength training initiated after signs of radiographic union [3].

Greater tuberosity fractures that are displaced posteriorly and superiorly by the rotator cuff more than 5 mm generally require ana-

tomic reduction and internal fixation. If not reduced, the fragment may heal with significant superior displacement which narrows the subacromial space and may result in impingement on elevation of the arm [4].

Multiple surgical techniques have been described to treat greater tuberosity fractures with the ultimate goal of anatomic reduction. These include both open and arthroscopic surgical techniques depending on the fracture type, pattern, and preference of the surgeon [5].

Surgical management may include an arthroscopic or open surgical technique. Avulsion fractures may be treated with arthroscopic fixation, similar to full thickness rotator cuff tears with a double row suture anchor technique. Isolated screw fixation of the fracture has been described; however, it is not feasible if the fragment is comminuted. A split-type fracture may be fixed with a laterally applied plate and screws [6].

Patients and Methods

This prospective interventional study involved 20 patients with isolated greater tuberosity fractures of the humerus; divided into two groups:

- **Group A:** Ten patients were managed conservatively and immobilized in arm slings for 2-3 weeks followed by gradual range of motion.
- **Group B:** Ten patients were managed surgically and immobilized in arm slings temporarily till they can be operated upon as soon as possible.

Inclusion criteria

- Skeletal maturity.
- Normally active individuals aged between 18 and 70 years old.
- Isolated greater tuberosity fracture.
- Patients without comorbidities.
- Patients with traumatic fractures.
- Bilateral and unilateral fractures.

Exclusion criteria

- Patients younger than 18 years old and patients older than 70 years old.
- Proximal humeral fractures, 3 parts and 4 parts fractures.
- Skeletal with bone deformity or diseases.
- Un fit for surgery patients.
- Pathological fractures.
- Patients with dementia or other mental health illness prevented the ability to adequately complete questionnaires.

Methods

Clinical evaluation

History is taking, examination of the shoulder, neurovascular examination and any other associated injury.

General functions of the shoulder and rotator cuff function were determined clinically by standard tests, with measurements of motion using a goniometer. Impingement syndrome was diagnosed by history and physical exam using Neer's clinical test.

For the objective assessment, the DASH score was used. DASH score was graded as excellent (0-24), good (25-49), moderate (50-74), or poor (75-100).

Laboratory

Routine preoperative investigations.

Informed consent

Informed consent for all patient undergoes surgery, include all operative details, possible risks, complications and follow up protocol had clearly explained.

Radiological evaluation

Primary standard plain radiographs with true glenoid anteroposterior (AP) and trans-scapular lateral view (Y-view) of the shoulder were evaluated, CT scan, or MRI were interpreted in subtle fractures on plain radiograph.

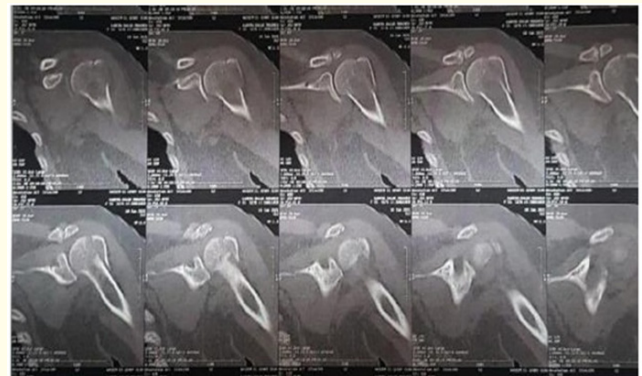


Figure 1: CT of shoulder: Coronal view.

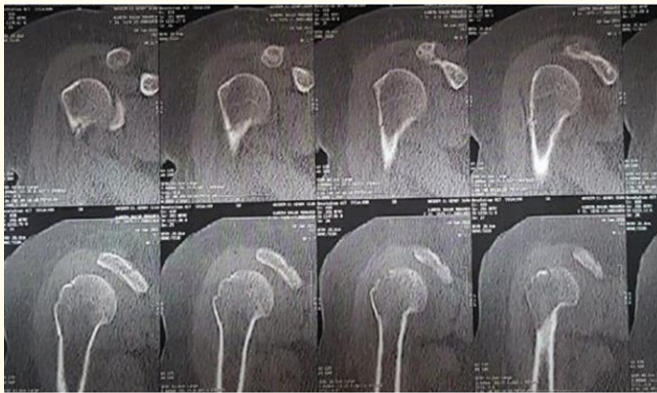


Figure 2: CT of shoulder

Techniques

Operative group: Patients were immobilized in arm slings temporarily till they can be operated. Six patient treated with screw fixation and four with plate in our study.

Treatment using plate

General anaesthesia may be with a regional block was used and a beach chair position was given to all the patients. A deltopectoral approach was utilized and the necessary surgical steps were followed. An 8 cm to 10 cm incision starting from corocoid process was taken along the line of deltopectoral groove, the internervous plane was identified and separated, the fracture fragments were identified, and the haematoma was cleared off completely. Tag sutures were taken through the rotator cuff muscles for later repair.

Preliminary reduction was done with the help of K wires and checked in both the orthogonal views. plate was applied about 5-8 mm distal to the greater tuberosity and around 2-4 mm posterior to the bicepital groove. Meticulous closure was done in all the cases. All the patients were kept in arm pouch postoperatively. Mobilization was started from postoperative day one. Similar pain management protocols were followed in all the cases.

Screw fixation

- Patient preparation: This procedure is normally performed with the patient in a beach chair position.
- Safe zones for screw insertion: Inserting percutaneous instrumentation through the safe zones reduces the risk of damage to neurovascular structures.
- Reduction of the greater tuberosity: One can try to reduce the greater tuberosity closed, a manipulative reduction with a threaded pin through a stab incision under image intensification often works. If not, open reduction is required.
- Temporary fixation of the greater tuberosity.

- Fixation of the greater tuberosity: It is the surgeons preference whether to use 3.5 mm cannulated lag screws or small fragment screws. Washers might be advisable with osteoporosis or fragmentations. Generally, they are not preferable as they make the screw heads more prominent and may result in shoulder impingement, If the greater tuberosity fragment is large, two screws may be used for better fixation. Make sure to avoid the axillary nerve by placing the second screw rather proximal.
- Completed osteosynthesis: Once osteosynthesis is completed remove all K-wires. Check fixation by image intensification.

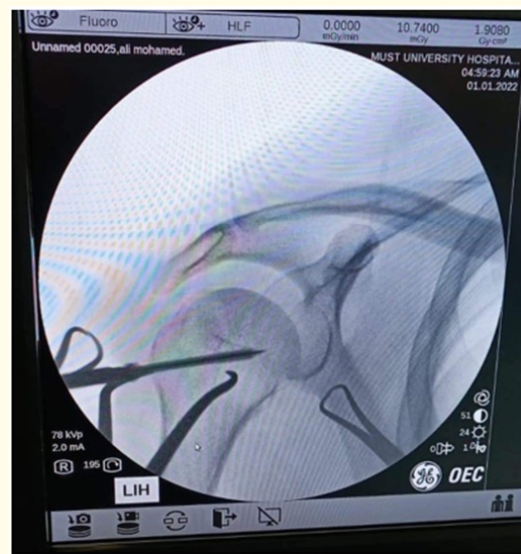


Figure 3: Fixation of the greater tuberosity.

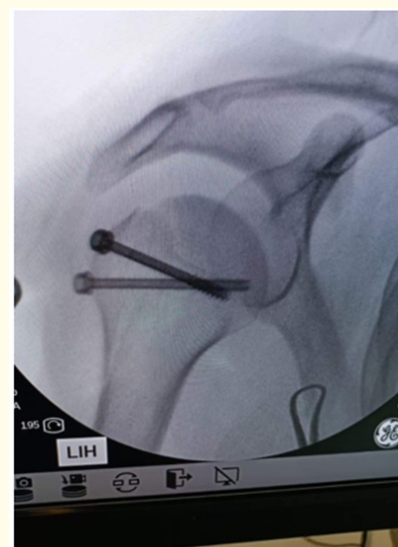


Figure 4: Completed osteosynthesis.

Postoperative care

A six-month postoperative follow-up plan was adopted starting at day zero postoperatively, then in 3 weeks, 6 weeks, 3 months, and lastly 6 months. Clinical and radiological assessment was done each visit in the form of pain, function and range of movements. Antero-posterior and axial X-rays were performed for all the patients at each follow up to assess the fracture union.

Conservative group: immobilization was done for 3-4 weeks, followed by gentle range of motion exercises. Isometric exercises may begin early, depending upon the injury and its repair.

Follow up

General health, physical examination, skin and wound conditions, radiological evaluation to determine the rate of union, clinical assessment of the muscle bulk and tone, and finally the functional assessment using DASH score was graded as excellent (0-24), good (25-49), moderate (50-74), or poor (75-100). True antero-posterior radiographs of the glenohumeral joint were assessed to determine union and the relation between the tuberosity and the head.

Results

We have twenty patient with un-displaced isolated greater tuberosity fracture; divided equally into ten in each group; conservative and operative. The mean age in conservative group 37.7 and in operative 36.9 with statistically non-significant difference. Male patients represented 60% and 70% within conservative and operative groups respectively. There is statistically non-significant difference between studied groups regarding range of motion. Four patient (40%) had anterior shoulder dislocation within operative group. The median DASH score of operative group 13.49, while it was 20.83 within conservative group. The mean DASH score of complicated cases 39.3. One patient within conservative group need MRI that has been shown impingement syndrome, while two patient (20%) within operative group one of them associated with rotator cuff tear.

Discussion

Proximal humeral fractures (PHFs) is the third common fractures in the elderly, followed by the proximal femur and distal radius, accounting for 5% of the total body. Isolated greater tuberosity fractures are well described and frequently discussed [7]. Non-operative treatment of greater tuberosity fractures has a poor outcome and observed that even slight displacement of the greater tuberosity can result in disability [8].

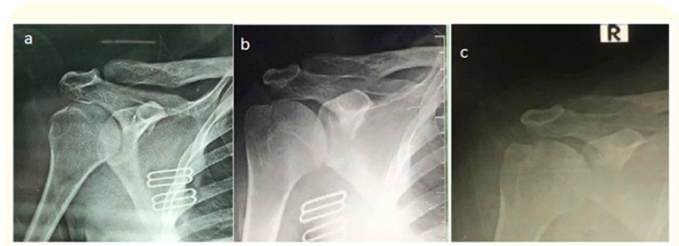


Figure 5: A 40-year-old woman presenting after a fall on the right shoulder, plain x-ray AP shows greater tuberosity un-displaced fracture (a) at presentation and (b) after 3 weeks of follow up and (c) with complete healing of the fracture.



Figure 6: Patient examination on the follow up for the range of motion for right shoulder.

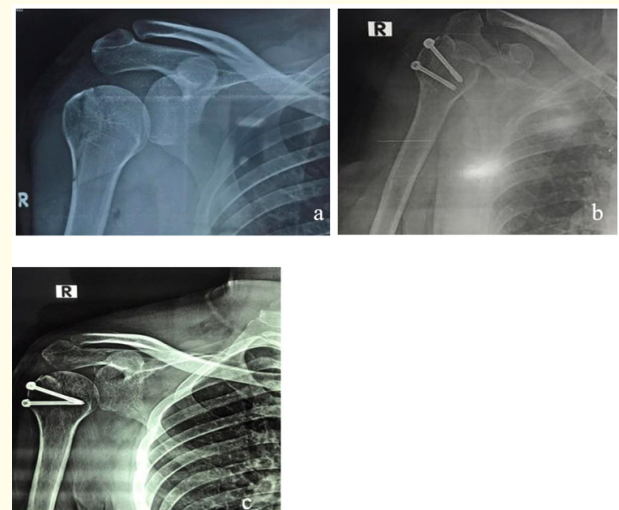


Figure 7: A 41-year-old male porter presenting after a fall on right hand with hyper abduction of the right shoulder, plain x-ray AP shows greater tuberosity un-displaced fracture (a) at presentation and (b) after 3 weeks of operation with fixation by 2 cannulated screws (c) with complete healing of the fracture after 4 months.



Figure 8: Patient examined for range of motion of the shoulder.

In our study there is four patient (20%) with anterior shoulder dislocation underwent operative management.

The greater tuberosity fracture after glenohumeral dislocation even the anatomically reduced should be considered highly unstable and at risk of secondary displacement, and the recent studies insists on the necessity of operative treatment for these fractures when associated with glenohumeral dislocation [9].

Schliemann B [10]. Evaluate 102 patient with isolated greater tuberosity fracture un-displaced, 76.5% of the patient underwent surgery due to secondary displacement on the follow up. the concomitant soft tissue lesions were found frequently after shoulder dislocation which cause recurrent dislocation in patient with greater tuberosity fractures need to surgical intervention.

Since the greater tuberosity is an important component of subacromial gliding mechanism and serves a major insertion of rotator cuff which is a dynamic stabilizer of the joint should be addressed if present [11].

Furthermore, The Rotator cuff tear leave a vascularized area affect the bone healing [12].

Comminuted fractures of greater tuberosity are essentially rotator cuff tears with an attached bony fragment, so recent studies recommending sutures as part of the fixation technique [13]. We have two patient with rotator cuff tear interfere with the improvement of the patient with limited range of motion underwent operative management.

The recommendation of Neer (2006) to treat the tuberosity of less than 1 cm non operatively has been revised, and in current literature it is recommended that surgical fixation be used regardless Neer recommendation for fractures in active patient with frequent overhead activity [14].

Although it is often stated in the literature that 60% to 80% of nondisplaced or mildly displaced fractures can be treated conservatively, certainly most such fractures are now treated surgically, and the threshold values for a surgical indication are now being set lower than in the past [15].

We have four young active patients underwent operative management by screws. Younger patients tend to require secondary interventions more frequently than older patients. The mean age of the patients who underwent surgical intervention was 46 years (25-62 years), whereas the mean age of the cohort without secondary intervention was 56 years (18-94 years). However, this difference was not statistically significant ($p = 0.148$) [10]. These fractures in young patient better to treat operatively with better outcome and early return to activities.

Most current literature have lower set the criteria for surgical management of isolated greater tuberosity in active patient who involved in an over head activity [9].

One patient in our study had previous proximal femur with DEXA showing osteoporosis, the most affected site by decrease bone mass and osteoporosis of proximal humerus is the greater tuberosity, which affect the outcome with poor healing [16].

One of the indications for operative treatment of un-displaced greater tuberosity fracture is secondary displacement in the follow up, as it is known that as little as 2-5mm of displacement can cause impingement and requires increased forces for abduction [16].

Similarly Schliemann [10]. found that 50 to 60% of un-displaced isolated greater tuberosity fractures show further displacement over the time. our study had displacement on the follow up which need for reduction and fixation.

Some of the limitations of this study are its relatively of small number of patients, and thus, some bias of evaluation could not be avoided completely.

Conclusion

Isolated un-displaced greater tuberosity fractures may have subtle finding on imaging and may be not detected on radiograph, so additional views are needed and should be performed.

Conservative treatment for un-displaced greater tuberosity fractures is the best choice, however surgical interventional necessary in Secondary displacement on the follow up to avoid mal-union, osteoporotic patient, young active athletes, shoulder dislocation, epileptic patient, non union at six weeks after trauma and Rotator cuff tear as it affect the healing.

Complications such as intraoperative or post-operative like infection occur with operative treatment, while nonunion and sub acromial impingement occurred with conservative-treatment.

Bibliography

1. Fakler JK., et al. "Current concepts in the treatment of proximal humeral fractures". *Orthopedics* 31.1 (2008): 42-51.
2. George MS. "Fractures of the greater tuberosity of the humerus". *Journal of the American Academy of Orthopaedic Surgeons* 15.10 (2007): 607-613.
3. Hebert-Davies J., et al. "Delayed migration of greater tuberosity fractures associated with anterior shoulder dislocation". *Journal of Orthopaedic Trauma* 29.10 (2015): e396-e400.
4. Volpin G., et al. "Impingement syndrome following direct injuries of the shoulder joint". *Harefuah* 130.4 (1996): 244-247.
5. Bogdan Y., et al. "An alternative technique for greater tuberosity fractures: use of the mesh plate". *Archives of Orthopaedic and Trauma Surgery* 137 (2017): 1067-1070.
6. Lizzio VA., et al. "Clinical evaluation and physical exam findings in patients with anterior shoulder instability". *Current Reviews in Musculoskeletal Medicine* 10 (2017): 434-441.
7. Anon MG., et al. "Operative repair of proximal humerus fractures in septuagenarians and octogenarians: Does chronologic age matter?" *Journal of Clinical Orthopaedics and Trauma* 8.1 (2017): 50-53.
8. Anon EA., et al. "Isolated greater tuberosity fractures of the proximal humerus: anatomy, injury patterns, multimodality imaging, and approach to management". *Emergency Radiology* 25.3 (2018): 235-246.
9. Darweash A and Abou Ouf A. "Hybrid fixation of late presenting greater tuberosity fracture following shoulder dislocation". *The Egyptian Orthopedic Journal* 55 (2020): 1-6.
10. Schliemann B., et al. "Isolated fractures of the greater tuberosity: When are they treated conservatively?" *Obere Extremität* 13 (2018): 106-111.
11. Bh B., et al. "Osteotomy and re-fixation for treatment of mal-united greater tuberosity of humerus". *Journal of Orthopaedic Case Reports* 2.1 (2012): 18-20.
12. Wilcox III RB., et al. "Management of a patient with an isolated greater tuberosity fracture and rotator cuff tear". *Journal of Orthopaedic and Sports Physical Therapy* 35.8 (2005): 521-530.
13. Gruson KI., et al. "Isolated tuberosity fractures of the proximal humeral: current concepts". *Injury* 39.3 (2008): 284-298.
14. Neer CS. "The classic: displaced proximal humeral fractures: part i. classification and evaluation". *Clinical Orthopaedics and Related Research*® 442 (2006): 77-82.
15. Helfen SR., et al. "Outcomes of surgical fixation of greater tuberosity fractures: A systematic review". *Orthopaedics and Traumatology: Surgery and Research* 106.6 (2020): 1119-1126.
16. Patel AH., et al. "How age and gender influence proximal humerus fracture management in patients older than fifty years". *JSES International* 6.2 (2022): 253-258.