

# Hybrid fixation of late presenting greater tuberosity fracture following shoulder dislocation

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## Abstract

### Background

Malunion and nonunion of greater tuberosity fractures (GTF) is a terrible complication of the conservative treatment of the associated GTF with shoulder dislocation which leads to pain and limitation of range of shoulder movement. Management of late presenting GTF before malunion is a big challenging as regard to decision making and surgical technique.

### Patient and Method

13 patients, presented to outpatient clinic presented to the outpatient clinic in Aswan University Hospital in the period from October 2015 to March 2018; complaining of pain and limitation of the shoulder motions after acute post-traumatic shoulder dislocation with concomitant fracture greater tuberosity, which were treated conservatively over months following injury, and proved to have GT displacement more than 5 mm in x-ray and CT scan.

Those patients were treated surgically by open reduction and hybrid fixation with 2 suture anchors and single cannulated lag screw. All cases were evaluated pre and post operatively according to visual analogue (VAS), constant and the University of California Los Angeles shoulder (UCLA ) score.

### Results

outcome was excellent in 61.5% (8 patients), good in 38.5 % ( 5 patients) according to Constant score and all patients were Satisfied and better according to UCLA score.

### Conclusion

our study represented an easy, safe and reliable method to tackle those patients with late presenting displaced GT fractures associated with acute post-traumatic shoulder dislocation.

### Keywords

Late presentations, greater tuberosity fracture, shoulder dislocation.

## Introduction

A concomitant fracture the greater tuberosity(GT) is seen in approximately 20% of patients presenting with anterior shoulder dislocation.[1] A simple closed reduction of the glenohumeral dislocation will indirectly reduce the GT fracture [2,3], The degree of GT fragment displacement after reduction has been suggested to be a prognostic factor regarding restitution of shoulder function. While non-displaced and minimally displaced fractures can be treated conservatively, most current literature supports and recommends surgical intervention for fractures with 5–10 mm of displacement in the general population or even less than 5 mm of displacement in active patients who are involved in an overhead activity.[1, 3]

In general, isolated GT fracture necessitating operative intervention are uncommon. However, a recent study insists on the necessity of operative treatment for these

fractures when associated with a glenohumeral dislocation. Other studies reported that the conservative treatment of the GT fracture after traumatic anterior shoulder dislocation may result in stiffness and functional disability[3].

Our study represents the outcome of using hybrid fixation in surgical treatment of the patients presented late with displaced GT fracture that was associated with acute shoulder dislocation and were conservatively managed before.

## Patients and material

Our study included 13male patients were treated in Aswan university hospital in the period from October 2015 to March 2018 with mean age of 36.2 y (25-52),11 right shoulders and 2 left, 69% (9 patients) had injured dominant side. Inclusion criteria

were: (1) an episode of acute post-traumatic shoulder dislocation with concomitant fracture greater tuberosity, (2) Treated conservatively (closed reduction, immobilization, and physiotherapy) over a minimum of 3 months following injury, (3) still complaining of pain and limitation of movement, (4) GT displacement in x-ray and/ or CT 5mm or more. A detailed history of the mechanism of injury, details of treatment including the period of immobilization, compliance with physiotherapy, and availability of X-rays post reduction and follow-ups. A thorough clinical examination of the shoulders, assessment of the active and passive range of movement, neurovascular examination, and pain assessment. All patients were evaluated both preoperative & postoperative by; pain intensity using the visual analog scale (VAS score)[6], assessment of active ROM of both shoulders, and final outcome assessment using Constant score [7] and The University of California Los Angeles shoulder score[8] (UCLA score). New AP and lateral scapular x-ray at the first visit to our clinic, CT scan as well to measure the exact displacement of GT at the widest displacement part of the fracture. (Figure 1; A, B, C, and D) (Table 1)

## Patient and Method

After obtaining consent, the 13 patients were operated under general anesthesia, shoulder manipulation was done first before draping in the supine position, then patient shifted to beach chair position, using lateral trans-deltoid approach[5], fracture site debrided, then 2 corkscrew double-loaded fiber wire suture anchors inserted in the bed of the fracture, then one sutures of each anchor passed through the rotator cuff just medial to the fragment and the other passed transosseous through the fragment and then tightened (medial row), fixation augmented with 4 mm cannulated lag screw and washer distal to the anchors (lateral row) using intra-operative fluoroscopy (Figure 1; E and Figure 2).

Patients shoulders were immobilized in 30-degree shoulder abduction pillow, for 6 weeks, with active mobilization of wrist & elbow from day one and passive abduction and pendulum movement of the shoulder when pain permits, active use, then active ROM, and passive stretches in all directions is encouraged, at 12 weeks; strengthening exercises of rotator cuff muscles against resistance started. All patients were evaluated both preoperative & follow up by; pain intensity using the visual analog scale (VAS score)[6], assessment of active ROM of both shoulders, and final outcome assessment using Constant score [7] and The University of California Los Angeles shoulder

score[8] (UCLA score). Constant score graded according to the difference between injured and sound shoulder into; <11 excellent, 11-20 good, 21-30 fair and >30 poor [9], while UCLA score; the maximum score is 35 points. Excellent/good (>27) indicates satisfactory results, whereas fair/poor (<27) indicates unsatisfactory results. [10]

## Results

The duration of conservative treatment before our surgical treatment ranged from 15 to 24 weeks (mean 17.4). Preoperatively, CT scan showed mean displacement of GT fragment 7.2 mm (range 5mm to 12mm), all patients showed pain score improvement on VAS from 8 to 0.6 and improvement of ROM (table.1). All fractures were united with no local infection, no nerve injury or heterotrophic ossification.

GT osteotomy was not needed (0%). The rate of second surgery and recurrent dislocation happened were 0% during follow up period (mean follow up 17.9 months, range 14 to 24 months). Pain-free active ROM was 54% (7 patients), while 46% (6 patients) showed minimal pain on VAS during active ROM, active forward elevation range (145 to 160 degrees) with improved strength of forward elevation on UCLA score grade 5 in 69% of patients (9 patients) and grade 4 in 21% of patients (5 patients), active external rotation range (20 to 30 degrees), lateral elevation range (145 to 160 degrees), with improved strength of abduction (range 21 to 24 points) at Constant score. The final outcome was excellent in 61.5% (8 patients), good in 38.5% (5 patients) according to constant score and all patients were Satisfied and better according to UCLA score. (table.2)

## Discussion

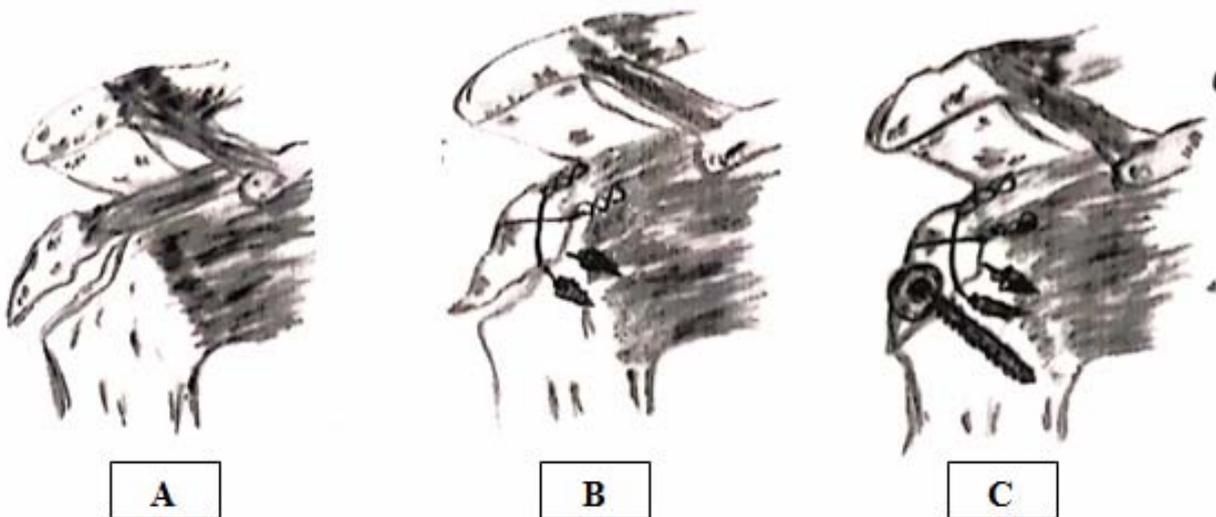
Greater tuberosity malunion and nonunion occur as a result of an initial error in diagnosis either from inadequate imaging or under-appreciation of the extent of the injury. Pain is the primary indicator of the treatment of greater tuberosity fracture malunion or nonunion. [11] in our study all included patients presented after a variable duration of conservative treatment; range 15 to 24 weeks delay; however persistence of pain and limitation of the shoulder was the trigger to take another opinion. All x-rays at the time of presentation showed reduced shoulder joint with varying degrees of GT displacement (5 to 12 mm); Which may be accounted to more migration of GT, this has been also shown in the study done by Hébert et al. 2015[12]; included 55 patients received initial closed reduction, with accepted closed reduction of the tuberosity in

85%., migration of the GT was later seen in 9 cases (16%) and Displacement of the GT was 5.6 times more in GT fracture with dislocation than without. 33% of cases of migration operated, mostly due to late presentation ( range 1 to 6 Months), Measurements of GT displacement after glenohumeral reduction are misleading and should not be compared with isolated GT fractures with minimal displacement. Even the ana-

tomically reduced GT should be considered highly unstable and at risk of secondary displacement.[2, 12] Ogawa et al. (2003)[13] reported that two-thirds of these fractures were missed on initial evaluation; this triggered us to go through CT evaluation of injured shoulder to all cases[14] CT gave us more details about, morphology, size, presence of comminution, and healing process.



**Figure 1:** A; initial x-ray at the time of injury. B, C, and D; preoperative X-ray and CT. E; postoperative X-ray.



**Figure 2:** An illustration showing Fixation Steps; showing distal gaping of the fragment with suture anchors only (B), complete reduction & compression with adding 4mm cannulated screw & washer distal to the anchors (C).

**Table 1:** Demographic, preoperative, and postoperative data of patients. (No; number, VAS; visual analog scale., F. Elev.; Forward Elevation., Ex. Rot.; External Rotation., Lat. Rot.; Lateral Rotation., GT Displ.; Greater Tuberosity Displacement., mm; millimeter., W; weeks., FU; Follow up., M; months.

No	age	Dominant side	preoperative					Time until surgery in W	FU in M	Preoperative at 12 M			
			Pain VAS	F. Elev.	Ex. Rot	Lat. Elev.	GT. Displ. in mm			Pain VAS	F. Elev.	Ex. Rot	Lat. Elev.
1	31	yes	8	30	5	40	5	15	18	1	155	25	150
2	25	No	8	30	0	40	7	17	17	2	150	30	155
3	41	Yes	7	30	5	60	9	19	15	0	150	30	150
4	38	Yes	8	30	5	30	5	16	14	0	150	30	150
5	28	Yes	8	35	5	50	6	17	19	0	160	30	160
6	37	No	8	40	0	40	6	16	24	0	150	30	160
7	39	Yes	9	30	0	30	9	19	23	0	145	25	155
8	51	Yes	7	25	0	40	7	15	17	2	160	30	165
9	30	No	8	30	5	30	8	16	14	0	150	30	155
10	43	Yes	9	40	5	50	5	16	15	0	155	30	160
11	35	Yes	9	35	5	30	9	17	20	1	155	25	160
12	44	No	8	30	0	30	10	24	21	2	145	20	145
13	29	yes	7	25	0	20	12	20	16	2	155	25	150

**Table 2:** final outcome o surgery. (No; Number. UCLA Score; University of California Los Anglos shoulder Score)

	Fracture union	Final outcome					
		Constant Score				UCLA Score	
		excellent	good	Fair	poor	Satisfactory (good/Excellent)	Unsatisfactory (fair/poor)
<b>preoperative</b>	0%	0%	0%	2 (15.4%)	11 (84.6%)	13 (100%)	0%
<b>postoperative</b>	13 100%	8 61.5%	5 38.5%	0 0%	0 0%	13 100%	0 0%

Although the non-operative treatment of non displaced GT is highly accepted [3,15], surgical treatment of displaced GT fractures is debatable[2], regarding the magnitude of displacement indicating surgical management is controversial, the consensus is that displacement of more than 5 mm suggests that impingement of the GT is more likely to occur. [3, 16, 17, 18]

Several surgical methods of GT fixation are reported including cannulated lag screw fixation, plate fixation, and open or arthroscopic suture anchor fixation [19,20,21,22]. The cannulated lag screw fixation method alone is not sufficient for adequate reduction and fixation, especially in osteoporotic patients[19]. The plate fixation method is sufficient for fixation, but an avulsion fracture may occur through the screw hole if bone quality is poor[19], arthroscopic treatment using suture anchors reported in acute cases of GT fractures, when large fragment[20, 21], as well as

in highly comminuted fragments[22] in acute presenting cases. comparing to our patients we used open reduction & anatomical fixation of GT fragments using suture anchors (two 5 mm corkscrews double-loaded suture anchors with fiber wires) due to bone softening after a period of immobilization and augmented by 4 mm cannulated cancellous screws and washer distal to anchors to achieve better compression at the distal part of fracture and reduce tension over the anchors., also the use of hybrid anchor and screw fixation take the benefit of double row of anchors with reduced cost. All fragments showed partial fibrous healing and partially mobile in displaced position, no single GT osteotomy needed. Manipulation was done for all Cases in the study to overcome stiffness present as a result of pain & immobilization.

Our results with delayed surgical treatment were superior to the reported outcome of conservative treatment of GT fractures; Conservative treatment was far

less successful in GT fractures displaced >5 mm.[18, 23, 24] Keene and colleagues[23] reported unsatisfactory results in all 4 patients with fractures displaced >1.5 cm. Platzer and colleagues in 2008 [24] evaluated displaced fractures and found function and patient satisfaction were inferior after non-operative treatment than after surgery. Those studies[23, 24] support the finding of an overall low patient satisfaction rate in non-operative patients. Platzer and colleagues[24] also found non-significantly worse shoulder scores with superior displacement of 3 mm to 5 mm and recommended surgery for overhead athletes in this group.

Meanwhile our results were comparable to results of acute fixation of GT fractures associated with acute shoulder dislocation reported by Elkady and Fouda.,(2017)[25] using percutaneous screw fixation in 12 patients, with an excellent outcome in 67% of patients compared to 61.5% excellent results in our study at Constant Score.

GT osteotomy, Acromioplasty[26,27], and arthroscopic tubero-plasty[28] are described in the literature for the Treatment of malunited fractures of GT, Beredjiklian et.al.(1998)[26] reported outcome of Eleven patients had malposition of the greater tuberosity but a congruent joint surface preoperatively. Ten patients in this group were managed with either osteotomy of the tuberosity or acromioplasty, and nine of them had a satisfactory. Martinez et al. (2010)[28] treated 8 patients with malunited GT by arthroscopic tubero-plasty, they reported one excellent, 6 good & one poor final outcomes, they concluded that arthroscopic tubero-plasty is a valuable treatment method, however, the technique involves detachment & repair of the rotator cuff with the possibility of failure of repair, and adding complexity to rehabilitation, and delay mobilization.

Most literature reported the outcome of surgical treatments of similar cases acutely after trauma, as well as after established malunion of GT; we aimed in this case series to present the outcome of tackling such fracture in the middle stage before full picture & sequellae of malunion which could be the outcome of poor initial reduction, underestimation of displacement, or further migration of the fragment after initially accepted displacement. an approach which is accepted to us in many aspects including proper evaluation of fracture, cut short the suffering of those young active patients in our study, avoiding sequellae of malunion, as well as avoiding different kinds of demanding surgeries for malunion, like GT osteotomy, Tubero-plasty, and avoiding complications of prolonged pain & stiffness, and finally taking the benefit of straight forward surgery, rehabilitation & recovery of activity as shown in our results which

appear comparable to those of early fixation with good patient satisfaction regarding pain & ROM. [25]

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## Conclusion

Our take-home message is; fixation of displaced GT fractures 5mm or more associated with acute post-traumatic shoulder dislocation is mandatory, and those patients presented late after trauma, or after a period of conservative treatment better to be treated surgically otherwise will need salvage operations if left to malunion. Also, we represented a good method to tackle those fractures using anchors and screw with washer for fixation to overcome; bone softening, and bone loss secondary to debridement and refreshing of the fracture site.

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