

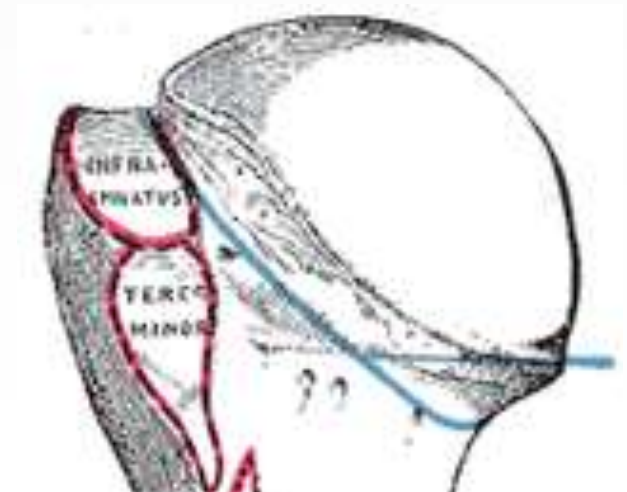
Anterior Shoulder Dislocation associated with Greater Tuberosity Fracture – Current Concepts



Andreas Panagopoulos, MD, PhD

Anatomy

- The greater tuberosity is situated lateral to the head and lesser tuberosity
- Its upper surface is rounded and marked by three flat impressions (RC insertion)



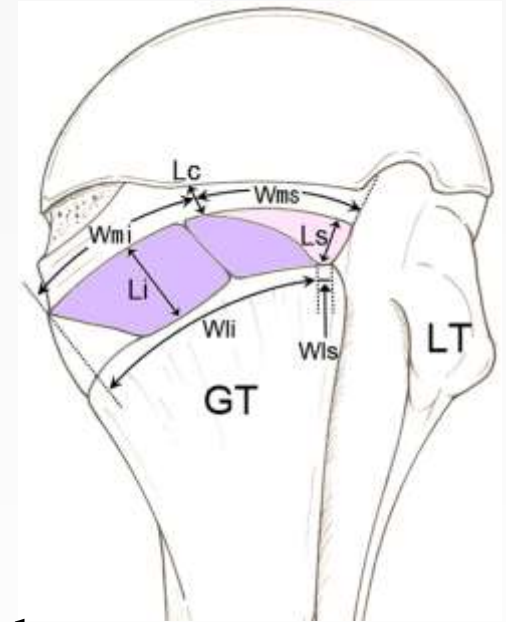
Anatomy

- Anterior facet = Supraspinatus
- Middle facet = Infraspinatus
- Inferior facet = Teres minor



Humeral Insertion of the Supraspinatus and Infraspinatus. New Anatomical Findings Regarding the Footprint of the Rotator Cuff

Tomoyuki Mochizuki, Hiroyuki Sugaya, Mari Uomizu, Kazuhiko Maeda, Keisuke Matsuki, Ichiro Sekiya, Takeshi Muneta and Keiichi Akita
J Bone Joint Surg Am. 2008;90:962-969. doi:10.2106/JBJS.G.00427

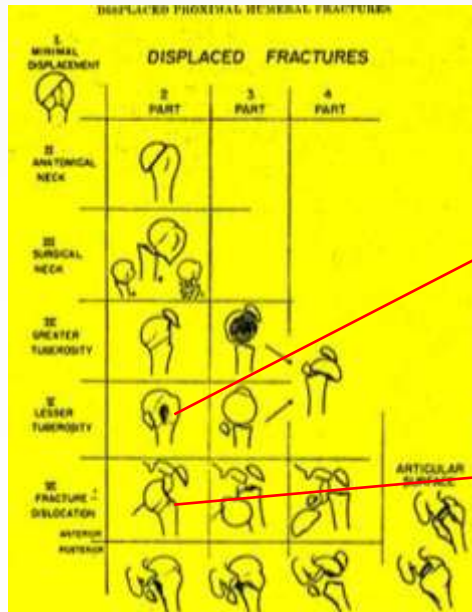


.....our findings that the infraspinatus occupied about **half** of the highest impression on the greater tuberosity, which has been believed to be the footprint of the supraspinatus, support the concept that the infraspinatus may contribute more to shoulder abduction than previously believed

Classification

Neer CS II, JBSJ Am 1970

Neer CS II, JESS 2001



- Part instead of segment
- Displacement > 1 cm?
- Angulation > 45°

Epidemiology

- Isolated GT = **17% - 21%** of proximal humeral fractures
- **15%-30%** are associated with anterior dislocation
- More common in men than in women (ratio 2:1)



Epidemiology

The Journal of Bone and Joint Surgery
J B J S

Redislocation of the Shoulder During the First Six Weeks After a Primary Anterior Dislocation: Risk Factors and Results of Treatment

C. M. Robinson, M. Kelly and A. E. Wakefield
J Bone Joint Surg Am. 84:1552-1559, 2002.

TABLE I Demographic Data on the Cohort of Patients with Anterior Dislocation, Stratified According to Associated Soft-Tissue Injuries and Fractures

Injury	Number of First-Time Dislocations (Number of and Prevalence of Redislocations)	Age (yr)*	Male:Female Ratio	Mechanism of Injury			
				Simple Fall	Fall from Height	Sports Injury	Other
No associated fractures	430 (7, 1.6%)	47.5 (13-97)	267:163	241	19	128	42
• No rotator cuff tear	358 (1, 0.3%)	43.2 (13-84)	240:118	185	9	125	39
• Rotator cuff tear	72 (6, 8.3%)	66.2 (42-97)	27:45	56	10	3	3
Greater tuberosity fracture only	81 (0, 0%)	63 (16-78)	46:35	59	3	10	9
Glenoid rim fracture only	16 (3, 18.8%)	65 (35-69)	7:9	8	3	2	3
Combined greater tuberosity and glenoid rim fractures	11 (7, 63.6%)	62 (36-80)	6:5	3	7	0	1
Total	538 (17, 3.2%)	51.4 (13-97)	326:212	311	32	140	55

- GT fractures in 15%
- Increased risk of re-dislocation in patients with both glenoid rim and GT fracture



Epidemiology



Nonoperative Treatment of Primary Anterior Shoulder Dislocation in Patients Forty Years of Age and Younger

A Prospective Twenty-five-Year Follow-up

By Lennart Hovelius, MD, PhD, Anders Olofsson, MD, Björn Sandström, MD, Bengt-Göran Augustini, MD, Lars Krantz, MD, Hans Fredin, MD, PhD, Bo Tillander, MD, PhD, Ulf Skoglund, MD, Björn Salomonsson, MD, Jan Nowak, MD, PhD, and Ulf Sennerby, MD

- GT fractures 10% (257 patients)
- ... fracture of the GT when the primary dislocation occurred was associated with a better prognosis with respect to recurrence ($p < 0.001$).

Biomechanics

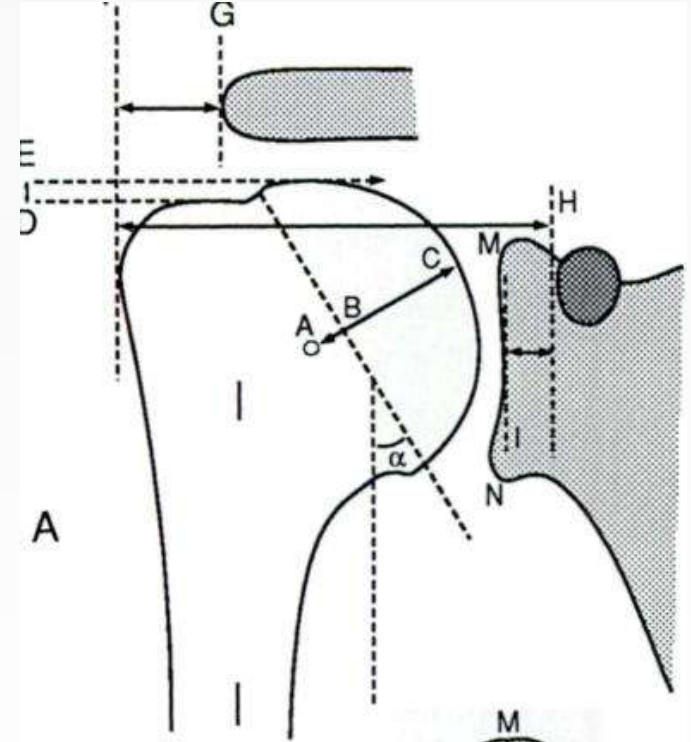


The normal glenohumeral relationships. An anatomical study of one hundred and forty shoulders

JP Iannotti, JP Gabriel, SL Schneck, BG Evans and S Misra
J Bone Joint Surg Am. 1992;74:491-500.

The greater tuberosity is on average **8 ± 3.2 mm** below the top of the articular segment

..... even small amounts of displacement can affect shoulder function¹



¹Green A et al, JSES 2003

Biomechanics

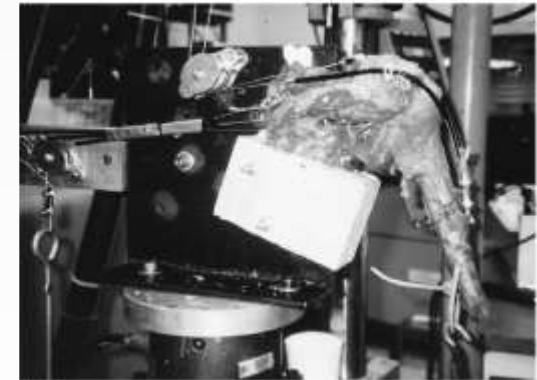
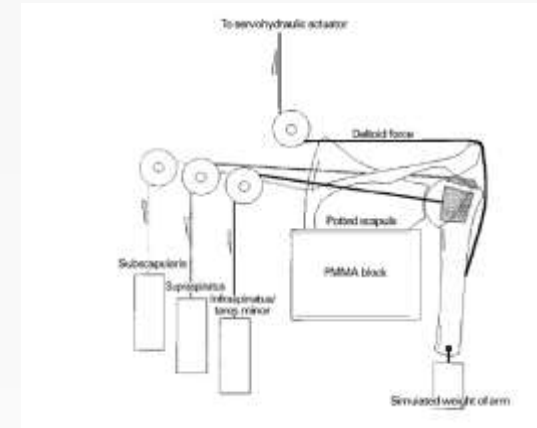


Effect of displacement of fractures of the greater tuberosity on the mechanics of the shoulder

C. M. Bono, R. Renard, R. G. Levine, A. S. Levy
From New Jersey Medical School, Newark, USA

J Bone Joint Surg [Br] 2001;83-B:1056-62.

- The GT was osteotomised and stabilised to represent malunion with combinations of superior and posterior displacements of 1 cm or less
- The abduction deltoid force was significantly increased by **16%** and **27%** by superior displacements of 0.5 cm and 1 cm, respectively, while combined superior and posterior displacement of 1 cm gave an increase in force of **29%**



Mechanism of injury

Isolated fractures of the greater tuberosity of the proximal humerus

Andrew Green, MD, and Joseph Izzi, Jr, MD, Providence, RI

J Shoulder Elbow Surg
November/December 2003

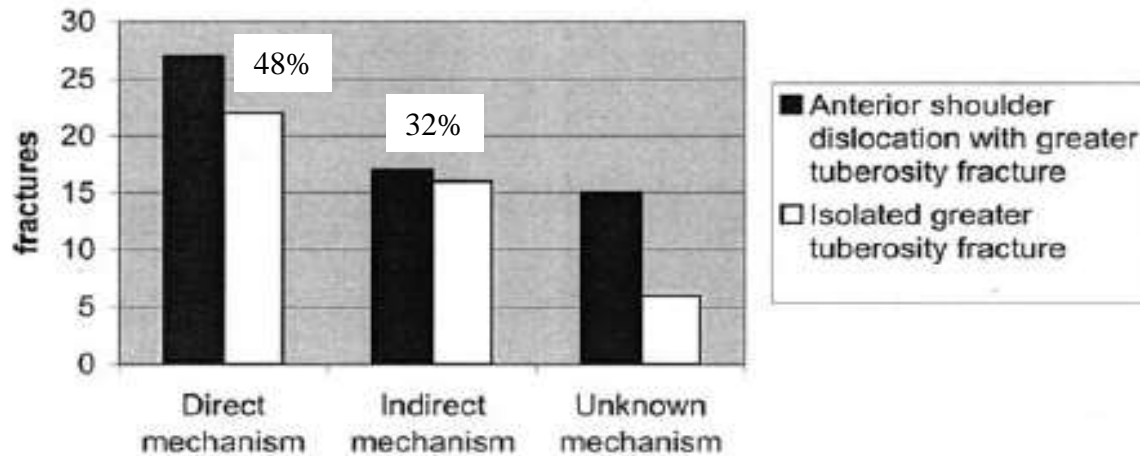
- Direct **impaction** as might occur during a fall directly on the shoulder or with hyperabduction and impaction of the greater tuberosity against the acromion or superior glenoid.
- **Avulsion** injuries commonly occur in association with anterior dislocation
- **Forceful pull** by the rotator cuff can also avulse the GT

Mechanism of injury

Mechanism of injury and morphology of the greater tuberosity fracture

JSES 2006

Christian Bahrs, MD,^a Erich Lingenfelter, MD,^b Franziska Fischer, MD,^a Eduard M. Walters, MD,^c and Michael Schnabel, MD,^a Marburg, Germany, and Clinton, MO



- 103 patients, 59 with anterior dislocation, 25% inferior displacement of the GT.
- ...shearing against the glenoid rim with concomitant **impression or depression** seems to be a more convincing mechanism

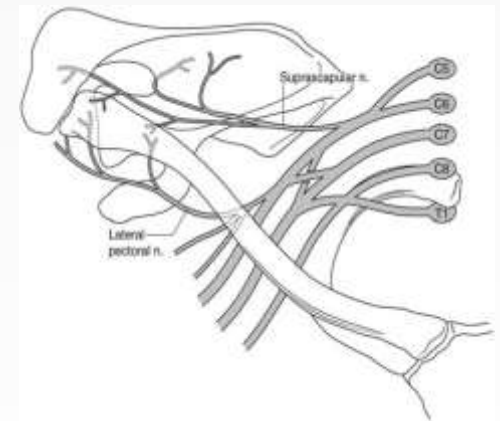
Clinical examination

- Arm in slight abduction and external rotation
- Shoulder is "squared off" (loss of deltoid contour)
- Humeral head is palpable anteriorly
- Patient resists abduction and internal rotation



Associated injuries

- Axillary neuropathy is the most common nerve injury
- Infraclavicular brachial plexus injuries
Among the 31 cases of infraclavicular brachial plexus injury that were reviewed by Leffert and Seddon, 14 involved greater tuberosity fracture; 12 of these were anterior fracture-dislocations.
- Vascular injuries



Associated injuries



Volume 14(2) February 2000

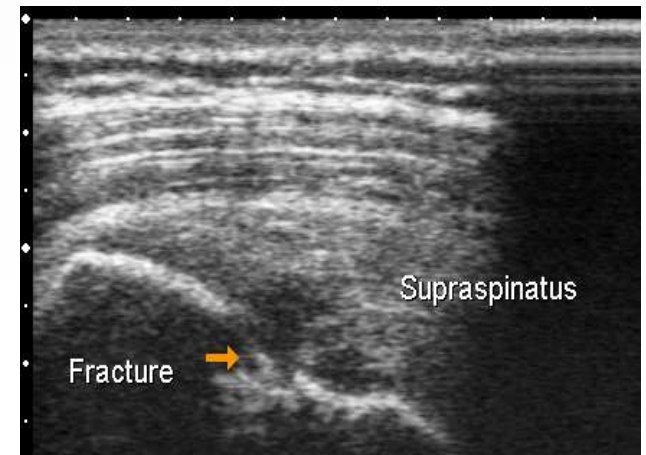
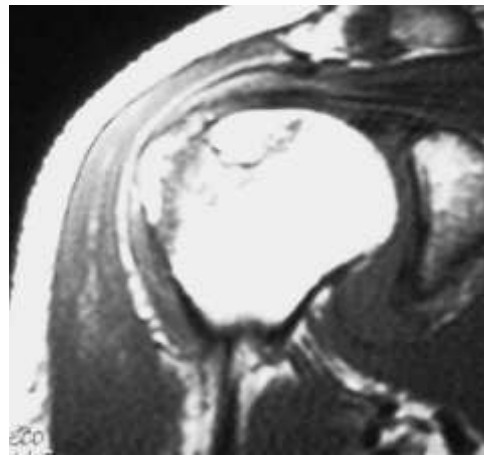
Nerve injury after greater tuberosity fracture dislocation

Garg, Ashima; McQueen, Margaret M.; Court-Brown, Charles M.

- Looking at all **47 fractures**, the maximum pre-reduction GT fracture displacement varied from 20 to 32 mm and averaged 11 mm, and after reduction the displacement varied from 1 to 20 mm for an average of 3 mm.
- There were **16 nerve injuries**: 10 axillary, 3 brachial plexus, 1 median, and 1 ulnar. Three injuries did not recover. **34% risk of nerve injury with only a 81.2% recovery rate.**

Radiological examination

- **AP view**
- **Axillary view**
- **CT, MRI, US**



Radiological examination

Reliability and Reproducibility of Radiographs of Greater Tuberosity Displacement. A Cadaveric Study

Bradford O. Parsons, Steven J. Klepps, Suzanne Miller, Justin Bird, James Gladstone and Evan Flatow
J Bone Joint Surg Am. 87:58-65, 2005. doi:10.2106/JBJS.C.01576

- AP views in external and internal rotation, AP views in neutral rotation with 15° of cephalic or caudal tilt, lateral outlet view, axillary view
- Increased accuracy of minimally displaced (≤ 5 mm) GT fractures with the AP view in external rotation.
- The AP view in external rotation, evaluated last, altered treatment in 15% of cases



Radiological examination



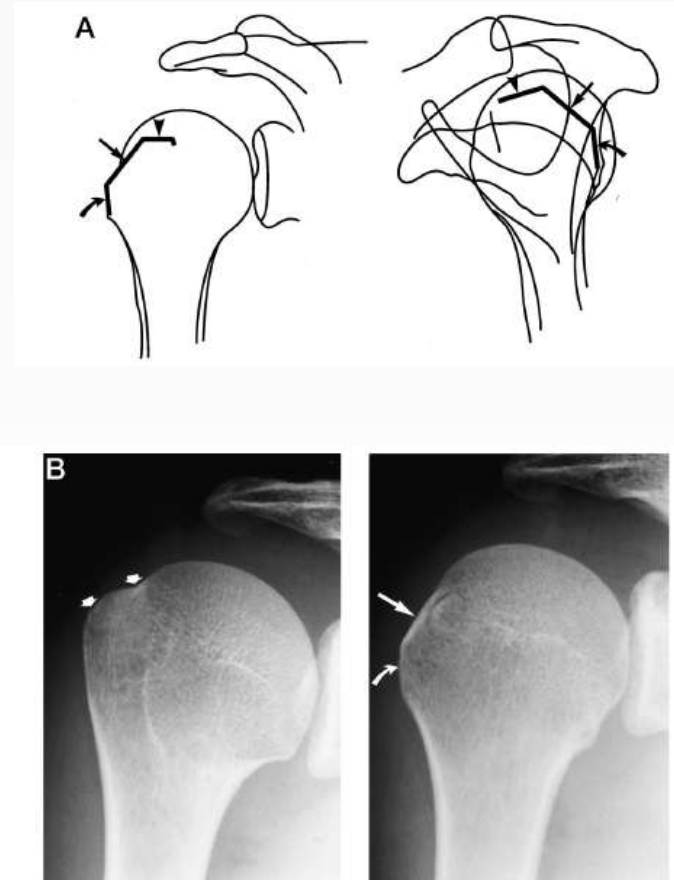
Radiological examination

The Journal of TRAUMA® Injury, Infection, and Critical Care

Isolated Fractures of the Greater Tuberosity of the Humerus: Solutions to Recognizing a Frequently Overlooked Fracture

Kiyohisa Ogawa, MD, Atsushi Yoshida, MD, and Hiroyasu Ikegami, MD

- Fractures were overlooked in 58 of the 99 shoulders (59%) that had been initially examined at other clinics
- The smaller the fragment, the higher the rate of missed diagnosis ($p < 0.05$).



Treatment

REVIEW ARTICLE

Isolated fractures of the greater tuberosity of the proximal humerus

Andrew Green, MD, and Joseph Izzi, Jr, MD, Providence, RI

- Nondisplaced greater tuberosity fractures are treated **nonoperatively**. The majority of impacted fractures have no displacement and, after a short period of immobilization, can be treated with rehabilitation that includes early range-of-motion exercises.
- Impacted non-displaced greater tuberosity fractures are more stable than a reduced greater tuberosity fracture-dislocation.

Treatment

INJURY
INTERNATIONAL JOURNAL OF THE CARE OF THE INJURED

www.elsevier.com/locate/injury

The influence of displacement on shoulder function in patients with minimally displaced fractures of the greater tuberosity

Patrick Platzer^{a,*}, Florian Kutscha-Lissberg^a, Stephan Lehr^b, Vilmos Vecsei^a, Christian Gaebler^a

- We evaluated the radiographs and function in 135 patients after non-operative treatment of minimally displaced (1—5 mm) fractures of the greater tuberosity
- 97% of the evaluated patients had good or excellent results. Patients with a displacement of more than 3 mm had slightly worse results
- **Conclusion:** We recommend non-operative treatment in all patients with minimally displaced fractures of the greater tuberosity, as most obtain very good results.

Treatment

Displaced Fractures of the Greater Tuberosity: a Comparison of Operative and Nonoperative Treatment.

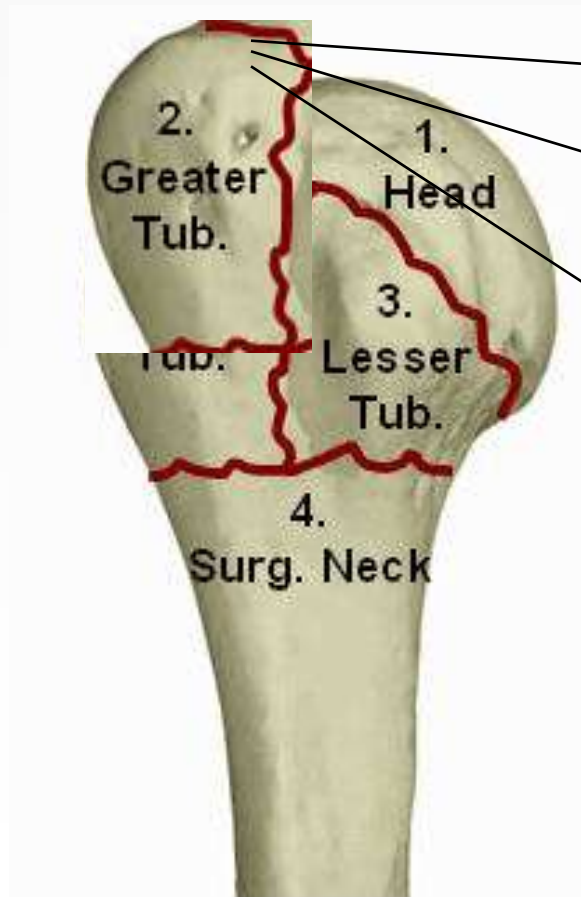
Journal of Trauma-Injury Infection & Critical Care. POST AUTHOR CORRECTIONS, 17 March 2008

Platzer, Patrick MD; Thalhammer, Gerhild MD; Oberleitner, Gerhard MD; Kutscha-Lissberg, Florian MD; Wieland, Thomas MD; Vecsei, Vilmos MD; Gaebler, Christian MD

- In nine patients (17%) we had a minimal loss of reduction (<5 mm) to superior, but there was no significant influence on shoulder function.
- In comparison of the results of the surgical study group and the nonoperative control group, patients with reduction and fixation of greater tuberosity fractures had significantly better results on shoulder function than did those with conservative treatment ($p < 0.05$).
- **CONCLUSION.....**Reduction and fixation of those fractures is recommended because patients with nonoperative treatment showed significantly worse results.

Treatment

Small series of **13-17 patients** with good to excellent results after operative treatment



1 cm Neer, Flatow

0.5 cm Bigliani, Iannotti

0.3 cm Park

Neer CS 2nd. JBJS Am. 1970;53-A:1077–89.

Iannotti J, Sidor M. 1997:245–264.

Bigliani LU, Flatow EL, Pollock RG. 1998:337–390

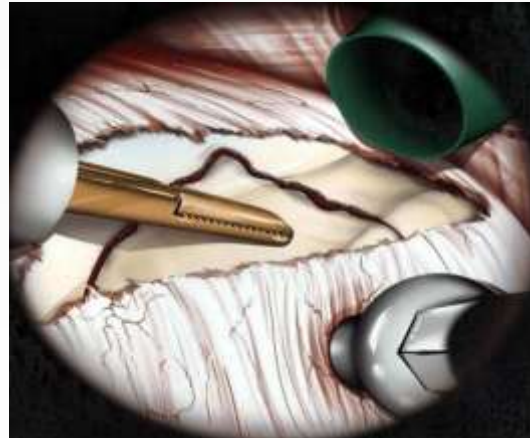
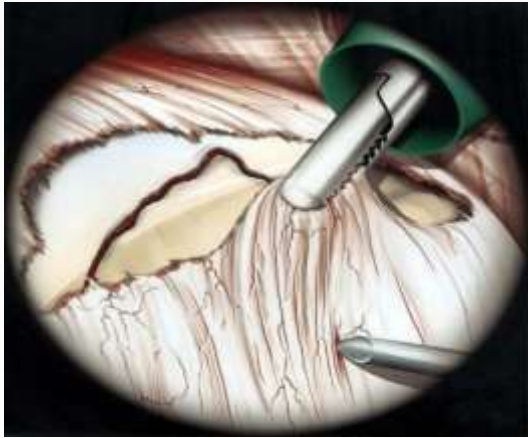
Park T, Choi I, Kim Y, et al. A 1997;56:171–176.

Treatment

Technical Note

Arthroscopic Treatment for Greater Tuberosity Fractures: Rationale and Surgical Technique

Ettore Taverna, M.D., Valerio Sansone, M.D., and Ferdinando Battistella, M.D.



GT fractures associated with glenohumeral dislocation show a much higher frequency of labral lesions than those with verified nondislocation

Schai PA, Hintermann B, Korris MJ. Preoperative arthroscopic assessment of fractures about the shoulder. *Arthroscopy* 1999;15:827-835.

Treatment

Anterior Traumatic Shoulder Dislocation Associated With Displaced Greater Tuberosity Fracture: The Necessity of Operative Treatment

Panayiotis Dimakopoulos, MD, Andreas Panagopoulos, MD, PhD, George Kasimatis, MD, Spiros A. Syggelos, MD, and Elias Lambiris, MD

J Orthop Trauma • Volume 21, Number 2, February 2007

- **34 patients** with a GT fracture and anterior shoulder dislocation
- Average age was 52.8 years
 - young men (n = 19; average age, 44.7 years)
 - old women (n = 15; average age, 62.3 years)
- Mean follow-up period was 4.8 years (range, 2.0 to 10 years).

66 y old



26 y old



Treatment

The mean postreduction displacement of the GT was 1.6 cm (range, 1.3–2.9 cm)



In 16 of 36 (44%) cases, there was a rotator cuff tear

Treatment

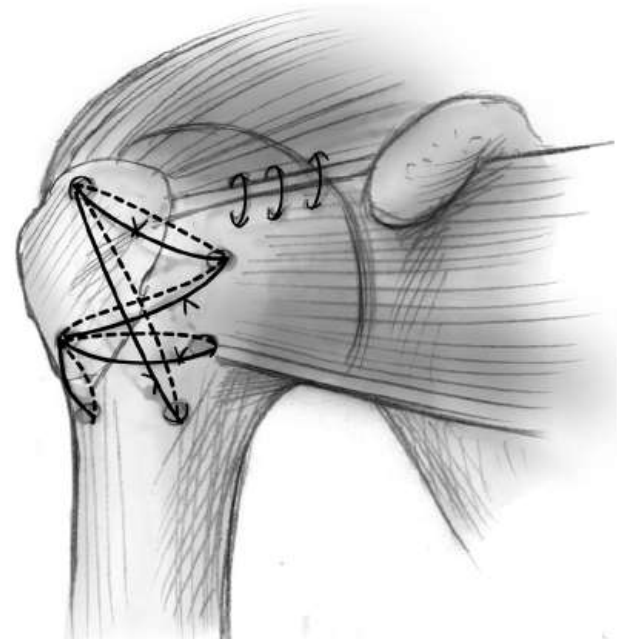
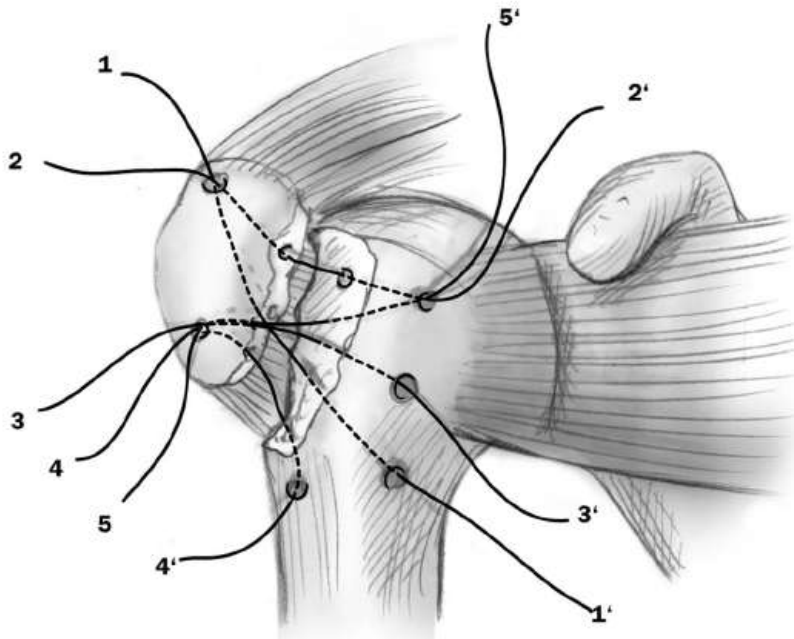
THE JOURNAL OF BONE & JOINT SURGERY
J B & J S

Transosseous Suture Fixation of Proximal Humeral Fractures

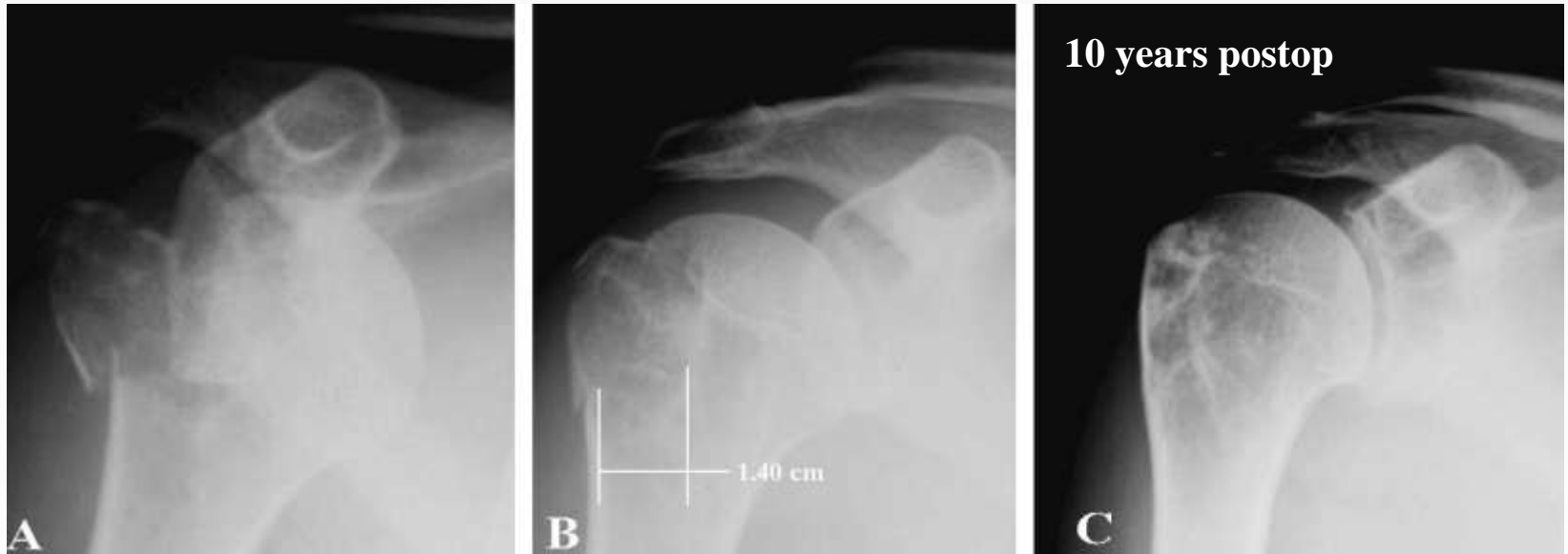
By Panayiotis Dimakopoulos, MD, Andreas Panagopoulos, MD, PhD, and Georgios Kasimatis, MD

Investigation performed at the Shoulder and Elbow Unit, Orthopaedic Department, Patras University Hospital, Patras, Greece

Surgical technique for 2-part GT fractures



Treatment



- There was no case of recurrent dislocation of the shoulder.
- The average **Constant-Murley** score of the affected shoulder was **88.4 points** (range, 40.0 to 100.0 points), whereas the functional score, unadjusted for age or sex as a percentage of the unaffected shoulder, was **93.2%**.

Treatment

- 17 neglected cases [5 from our area and 12 referrals] were treated nonoperatively with sling and physiotherapy
- During surgical exploration, 12 (70.5%) of these patients had moderate or large rotator cuff tears



Conclusions

- Different philosophy due to the nature of the injury
- Radiological control with x-rays in external rotation
- Transosseous suturing (avoidance of metal fixation)
- Evaluation and repair of the RC tear
- Supervised rehabilitation program