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TRAUMA SURGERY

A simple and effective implant for displaced fractures of the greater tuberosity: the "Bamberg" plate

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Abstract Displaced fractures of the greater tuberosity are common findings in trauma surgical patients. Nevertheless, osteosynthesis of these fractures impairs the risk of secondary dislocation or secondary impingement due to the implant (e.g., 4.5 mm cancellous screws with spiked washers). We present an easy and simple technique/implant to perform an osteosynthesis of multiple-fractured greater tuberosity fractures. We use a self-adjusted calcaneus titanium plate (Litos®) which is cut into a 6 or more holed small plate. In ten patients we had excellent postoperative outcomes with no complications and no secondary loss of reduction. The surgical technique is easy and efficient.

Keywords Shoulder · Greater tuberosity fracture

Introduction

Proximal humerus fractures are common findings in trauma surgical patients [1, 2]. Most of these fractures are minimally displaced or nondisplaced and can be managed conservatively with immobilization and early motion. However, 15–20% are displaced and therefore represent a challenge to the orthopedic surgeon [2]. These fractures of the proximal humerus produce a combination of four segments: the articular surface, the humeral shaft, the greater and the lesser tuberosity, which leads to the two-, three- or four-part fracture classification according to Neer [3].

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The classical two-part fractures can include displaced fractures of the greater tuberosity, surgical neck displaced fractures, or lesser tuberosity displaced fractures. In fractures of the greater tuberosity the supraspinatus and infraspinatus pull the greater tuberosity superiorly, which can lead to secondary dislocation and impingement. Greater tuberosity fractures do result in rotator cuff avulsion as well as a loss of dynamic stability.

The AO and Neer [3] classification are the most commonly used scores. Displacement greater than 1 cm or angulation of greater than 45° is required for classification as one part [2]. Nevertheless, nowadays most authors agree that even 5 mm of posterosuperior displacement can lead to clinically significant impingement, therefore a displacement of more than 5 mm is considered as indication for surgery [2, 4, 5].

Although a great variety of implants for three- and four-part fractures do exist, the surgical management of more "simple" two-part fractures with dislocated greater tuberosity can be demanding. Most of these fractures require and open retention and internal fixation (ORIF) [2]. Nonabsorbable interfragmentary sutures, Kirschner wires or tension band sutures can be used for fixation, incorporating the rotator cuff combined with repair of a rotator cuff injury, if present [2, 4–6]. Newer techniques involve an open refixation onto absorbable or nonabsorbable suture anchors or cork-screws (e.g., Arthrex®, Naples, FL) or even an arthroscopic suture bridge technique [2, 7]. If the greater tuberosity is in one fragment an osteosynthesis with 4.5-mm cancellous screws and spiked washers is a simple and effective procedure. Nevertheless, if the greater tuberosity is multiple fragmented within itself, screws will not lead to a sufficient functional result. In these cases retention with an increased contact area or broader footprint, as performed in double-row rotator cuff repair, is necessary. The concept of arthroscopic suture bridge repair was also described by Song and Williams [7]. Thus, the necessary strength of retention is distributed over a larger area. ORIF with t-plate, cloverleaf plate, small condylar plate or even an internal locked system plate (e.g., PHILOS, Synthes®, Switzerland) may be necessary [6]. Nevertheless, the bigger the implant the higher is the possibility of a secondary impingement [8, 9]. We present an easy and simple technique/implant to perform an osteosynthesis of multiple-fractured greater tuberosity fractures which demonstrated good functional results and did not lead to a secondary impingement.

Surgical technique

We use a self-adjusted Litos® (Hamburg, Germany) calcaneus titanium plate. With a wire-cutter the calcaneus plate is cut into either a 6-hole rectangular or 8- or 9-hole round plate which is secondarily bent manually to fit smoothly to the tuberosity area (Fig. 1). The surgical procedure is performed through an anterior deltoid split approach. After reduction of the displaced greater tuberosity it can temporarily be fixed with a Kirschner wire. The custom-made implant is then placed onto the greater tuberosity and fixed with variable screws. Both types of screws, cancellous and cortical screws can be used according to the surgeons demand. While the straight force of the screws is transferred laterally to the plate a more indirect and thus less blood flow decreasing fixation is performed. The fence structure of the implant allows suturing between the bridges. Postoperatively a 2-week immobilization with a Gilchrist bandage is performed, early passive motion is allowed. A removal of the implant is optional and can be performed after 6 months. Radiographic results were assessed based on accurate radiographs in two planes (anteroposterior and axillary).

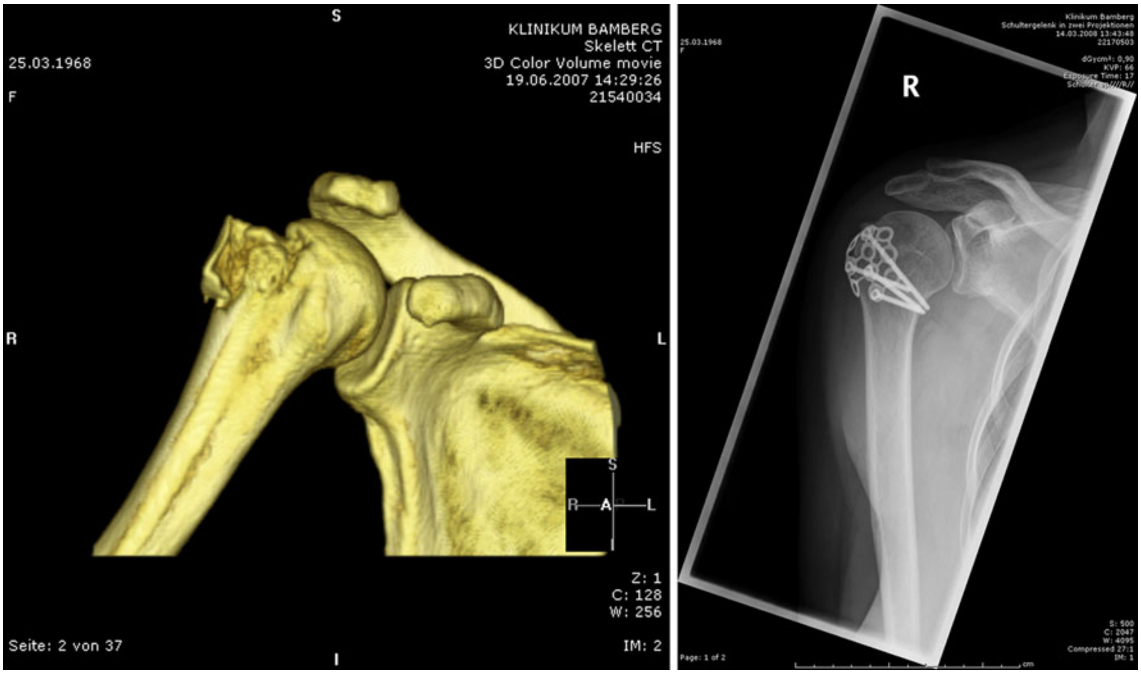
Fig. 1 The “Bamberg” plate, a self-adjusted Litos® (Hamburg, Germany) calcaneus titanium plate

Results

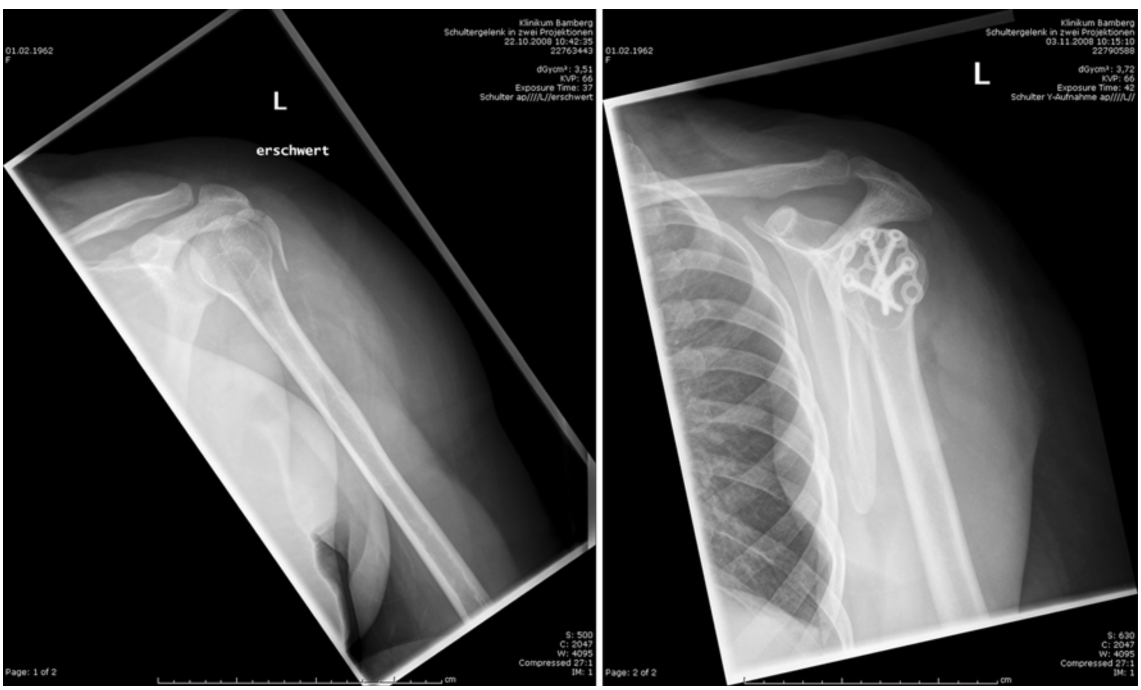
Ten patients (five male, five female) (age mean 45.6 years, range 29–68) with displaced fractures of the greater tuberosity (AO-classification: A1.2, 9 patients; A1.3, one patient; Neer, Group 4 two-part in all patients) were treated surgically with open reduction and internal fixation using the self-made “Bamberg” plate. Displacement was defined as displacement in any plane of more than 5 mm [2, 4]. In 8 cases the dominant side was affected, in two the non-dominant side. Seven fractures were on the right side, three on the left. In three cases the demonstrated procedure was performed together with rotator cuff repair, biceps tenodesis or arthroscopic Bankart repair. In these three patients also sutures in between the bridges of the fence-structured implant were applied. Three patients had multiple trauma, 7 a single shoulder trauma. All fractures healed without complications, there were no intraoperative complications. A secondary loss of reduction did not occur. The Constant–Murley Score (CS) [10] (>6 month postoperatively) proved the excellent functional results (CS excellent, 91–100%) (mean 94.2, range 91–98) in all cases. The therapy course and postoperative course was uneventful in all patients. In one case, a 39-year-old woman after a multiple trauma injury (polytraumatic), the implant was removed together with the other implants on her demand. The CS was 98 and she had no complaints. One male patient [fractured greater tuberosity (AO 1.3) and glenohumeral dislocation] who had the ORIF together with an arthroscopic Bankart repair (Fastak, Arthrex®, Naples, FL) received an implant removal after 8 months on his demand. During arthroscopic control minor scaring was removed in the subacromial area. An arthroscopic removal of the implant, as intended, was technically not possible, and was performed by open procedure (Figs. 2, 3).

Discussion

Displaced two-part fractures of the greater tuberosity requiring surgical intervention are rare and the literature gives only few data of functional results after operative treatment [4]. An open reduction and internal fixation is recommended because patients with nonoperative treatment showed significantly worse results on shoulder function [4]. These fractures of the greater tuberosity involve several problems. As often the tuberosity is displaced and multiple fractured within itself; it is difficult to replace and retain the fragile parts at their origin. Simple screwing may lead to further harm of the fragments and commonly used screws with spiked washers are prominent and can lead to secondary impingement [5, 8, 11]. Locking plates are known to possibly trigger secondary impingement [9].



Figs. 2, 3 39-year-old female patient with multiple trauma and multiple fragmented greater tuberosity (AO A1.2). Result after ORIF with "Bamberg" plate



Figs. 4, 5 46-year-old female patient with fracture of the greater tuberosity (AO A1.2) and ORIF with "Bamberg" plate

A secondary loss of reduction, which can be found in 17% of the patients [4] does also increase the risk of subacromial impingement. The above demonstrated plate is not prominent and therefore does only marginal minor the subacromial space. It distributes the pressure over a wide area without affecting the blood supply of the rotator cuff which is in general partly underneath the implant. The fence structure of the implant allows suturing between the bridges, which was additionally used in the three cases with additional rotator cuff ruptures. With its pressure distribution over a larger area the implant creates a wide footprint and thus excellent fracture healing conditions. The 6 or more holed plate allows a great variability of screw positioning without further fragmentation of a multiple-fractured greater tuberosity (Figs. 4, 5).

Dimakopoulos et al. [5] evaluated the long-term functional and radiographic results of transosseous suture fixation in a series of selected displaced fractures of the proximal part of the humerus on 188 patients. 34% (56 patients) of these had two-part fractures of the greater tuberosity. All fractures were fixed with transosseous, non-absorbable, number-5 Ethibond sutures. Associated rotator cuff tears detected in 57 patients (35%) were also repaired. All two-part fractures involving the greater tuberosity showed bony union within 4 months. At the time of the final evaluation, the mean Constant Score was 91 points, the mean Constant Score as a percentage of the score for the unaffected shoulder, unadjusted for age and gender, was 94%. The clinical and radiographic results of this transosseous suture technique were found to be satisfactory. Gruson et al. [2] state that the choice of fixation and approach depends not only on fracture type and characteristics, but also on a multitude of patient-related factors. Even if the above-described suture fixation gives good results, it can be difficult if the tuberosity is multiple fractured and suturing would further diminish the stability of the fragments. At this place the described implant proves its advantage in distributing its vector of strength from single points, as in suturing or screwing, over the wide area of the plates' contact surface. In addition, thanks to its fence structure, the blood supply is compromised to a lesser extent compared to a full surface contact plate.

Our patients showed a minimal better outcome as those of Szyszkowitz et al. [6] or Dimakopoulos et al. [5]. Nevertheless, these studies also included three- and four-part fractures, which are more complex and do present less good results than two-part fractures [2]. Platzer et al. [4] analyzed functional and radiographic long-term results in patients with surgical treatment of displaced greater tuberosity fractures and compared it to nonoperatively treated patients. In comparison to the operative techniques, patients with open reduction and internal fixation had slightly better functional results than patients with closed reduction and percutaneous internal fixation, but this was statistically not significant ($p \geq 0.05$). In comparison to the nonoperative control group, patients with reduction and fixation of greater tuberosity fractures had significantly better results on shoulder function ($p \leq 0.05$). Concerning the Constant Score our patients demonstrated slightly better results although we only present short-term follow-up (6–12 months) and a small number of cases.

In our opinion, the described technique and implant is a simple, effective, accurate and inexpensive method, which has basically no existing learning curve.

References

1. Resch H (2003) Fractures of the humeral head. Unfallchirurg 106:602–617
2. Gruson KI, Ruchelsman DE, Tejwani NC (2008) Isolated tuberosity fractures of the proximal humeral: current concepts. Injury 39:284–298
3. Neer CS (1970) Displaced proximal humeral fractures. Classification and evaluation. J Bone Jt Surg 52:1077–1089
4. Platzer P, Thalhammer G, Oberleitner G et al (2008) Displaced fractures of the greater tuberosity: a comparison of operative and nonoperative treatment. J Trauma 65:843–848
5. Dimakopoulos P, Panagopoulos A, Kasimatis G (2007) Transosseous suture fixation of proximal humeral fractures. J Bone Jt Surg Am 89:1700–1709
6. Szyszkowitz R, Seggl W, Schleifer P et al (1993) Proximal humeral fractures. Management techniques and expected results. Clin Orthop Relat Res (292):13–25
7. Song HS, Williams GR Jr (2008) Arthroscopic reduction and fixation with suture-bridge technique for displaced or comminuted greater tuberosity fractures. Arthroscopy 24:956–960
8. Niall DM, O'Mahony J, McElwain JP (2004) Plating of humeral shaft fractures—has the pendulum swung back? Injury 35:580–586
9. Handschin AE, Cardell M, Contaldo C et al (2008) Functional results of angular-stable plate fixation in displaced proximal humeral fractures. Injury 39:306–313
10. Constant CR, Murley AH (1987) A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res (214)160–164
11. Scheibel M, Lichtenberg S, Habermeyer P (2004) Reversed arthroscopic subacromial decompression for massive rotator cuff tears. J Shoulder Elbow Surg 13:272–278