

Clinical case

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Fixation of the rotator cuff tendons for the greater tuberosity fracture of the humerus

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Abstract

Introduction Strategic approaches to managing patients with a greater tuberosity fracture of the humerus are controversial and there are discussions about surgical treatment options. Nondisplaced fractures require no surgical management. Shoulder replacement can be indicated for the surgical treatment of proximal humeral fractures with limited function of the upper limb and difficulties in refixation of the rotator cuff tendons due to the peculiar anatomical location of the tendon fixation. Solution to this problem can improve the quality of life of patients with greater tuberosity fracture of the humerus.

The **objective** was to evaluate the treatment outcome of a patient with a greater tuberosity fracture of the humerus repaired with open refixation of the rotator cuff tendons and medialization of the border of the articular surface of the humerus.

Material and methods A 46-year-old patient presented with limited movements and severe pain in the left shoulder after humerus dislocation and a greater tuberosity fracture.

Results The condition was repaired with an open repair of the rotator cuff tendons and medialization of the border of the articular surface of the humerus. The patient reported neither pain nor limited movements in the left shoulder at the one-year follow-up.

Discussion Treatment options for patients with a greater tuberosity injury remains controversial. The effectiveness and results of organ-saving surgery have not been explored and require scientific evaluation using a larger cohort of patients.

Conclusion Excellent functional results were achieved in a patient with injury to the greater tuberosity using surgical refixation of the rotator cuff tendons and medialization of the cartilaginous surface.

Keywords: humerus fracture, rotator cuff tear, rotator cuff repair

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INTRODUCTION

Proximal humerus fractures are a common injury with the greater tuberosity fracture of the humerus accounting for approximately 16.5 % of all proximal humerus fractures [1, 2]. About 30 % of greater tuberosity fractures are caused by dislocation of the humerus [3]. Shoulder dislocation can be accompanied by a characteristic set of injuries including fracture of the glenoid cavity of the scapula, impression fracture of the humeral head, damage to the capsule, ligaments and cartilaginous lip of the joint, damage to the rotator cuff, as well as fractures of the proximal humerus [3].

Satisfactory reduction can occur with the tendons of the rotator cuff attaching to the tubercle. According to the literature, non-displaced fractures of the greater tubercle of the humerus can be treated conservatively using immobilization, rehabilitation and physical therapy, and bone displacement of 3–5 mm and greater requires surgical intervention with bone reduction and fixation of the greater tubercle of the humerus including arthroscopic techniques [4–10].

The site of tendon fixation is important with the bone injury [11–13]. The bone at the fracture site is susceptible to osteoporotic changes and does not have a cortical plate for anchors, and fixation to the articular surface does not have adequate biological capabilities for fusion [11, 12]. Therefore, the patients can be treated with reverse shoulder arthroplasty to restore function and reduce pain [14, 15]. Joint replacement can be postponed for as long as possible with preserved shoulder joint, the cartilaginous surface of the scapula and humerus in the attempts to restore the shoulder functions, in younger patients, in particular. Solution of the problem will help improve outcomes for patients with injury to the greater tuberosity without the use of reverse arthroplasty.

The objective was to evaluate the treatment outcome of a patient with a greater tuberosity fracture of the humerus repaired with open refixation of the rotator cuff tendons and medialization of the border of the articular surface of the humerus.

MATERIAL AND METHODS

A 46-year-old patient was seen at the consultative and diagnostic department of the Moscow Loginov Scientific Research Center in September 2022. She sustained an injury from a fall off the motorcycle in June 2022 and was admitted to a 24-hour emergency hospital in Moscow. She was diagnosed with a closed displaced fracture of the plateau of the right tibia and fracture dislocation of the left humerus. The shoulder dislocation was eliminated and a tibial plateau fracture was surgically treated in the hospital. The fracture of the left upper limb was immobilized with a scarf bandage for 6 weeks. Then the patient was referred to a rehabilitation center for a 4-week rehabilitation course. Rehabilitation resulted in no improvement in the upper limb function with the pain increased, and the patient was referred to the Moscow Loginov Scientific Research Center for consultation. The patient reported severe pain during the day and at night, significantly limited movements in the left shoulder joint.

Local status: no signs of inflammation at the shoulder joint, no deformity observed. Movements are limited: abduction 20°, adduction 25°, internal rotation 40°, external rotation 0°. Movements are also limited because of severe pain. Passive abduction 120°. There are no neurocirculatory disorders in the upper limb.

Results of X-ray examination methods Radiographs showed the absence of anatomical contours of the greater tubercle of the humerus, rarefied bone tissue in its projection, the atypical position of the bone fragment, presumably a fragment of the greater tubercle (Fig. 1). Conclusion: non-united displaced fracture of the greater tubercle of the humerus with. MRI of the shoulder joint showed injury to the greater tubercle of the humerus, absence of anatomical attachment of the rotator cuff tendons, greater tubercle bones dislocated posteriorly and upward and aseptic necrosis of the greater tubercle bone (Fig. 1).

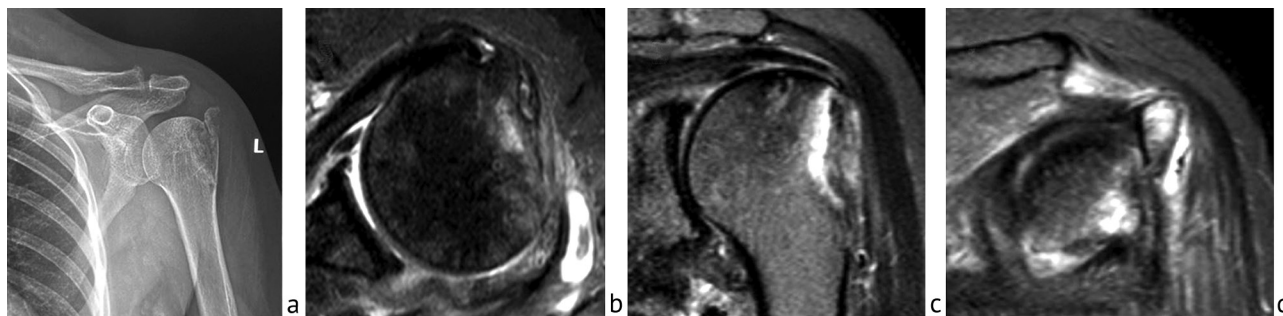


Fig. 1 (a) anteroposterior view of the shoulder joint at 3 months of a traumatic shoulder dislocation; (b) axial T2 MRI of the shoulder joint with fat suppression demonstrating the absence of the greater tubercle of the humerus; (c) coronal T2 MRI of the shoulder joint with fat suppression showing the absence of the greater tubercle and the loose-lying supraspinatus tendon; (d) coronal T2 MRI of the shoulder joint with fat suppression showing the greater tubercle remnants dislocated into the subacromial space with signs of avascular necrosis

The beach chair position was used for surgical intervention. The patient was positioned at the edge of the operating table with the shoulder joint hanging down to allow manipulation of the limb. A direct incision was made according to a standard technique using an anterolateral transdeltoid approach extending 1 cm onto the acromial process of the scapula. The deltoid muscle was cut off from the acromial process of the scapula using an electric knife, and the muscle was separated along the fibers in a blunt manner. The absence of the greater tubercle of the humerus was detected during repair of the subdeltoid, subacromial space and joint, a bone fragment as the remnant of the greater tubercle, which was located in the subacromial space, was mobile and limited movement in the shoulder joint positioned in extreme abduction (Fig. 2). The rotator cuff tendons and a bone fragment, the remnant of the greater tubercle of the humerus, were isolated from the scars. The tendons were mobilized using a blunt levator. Tendon mobility was checked using traction with a capsular clamp (Fig. 2).

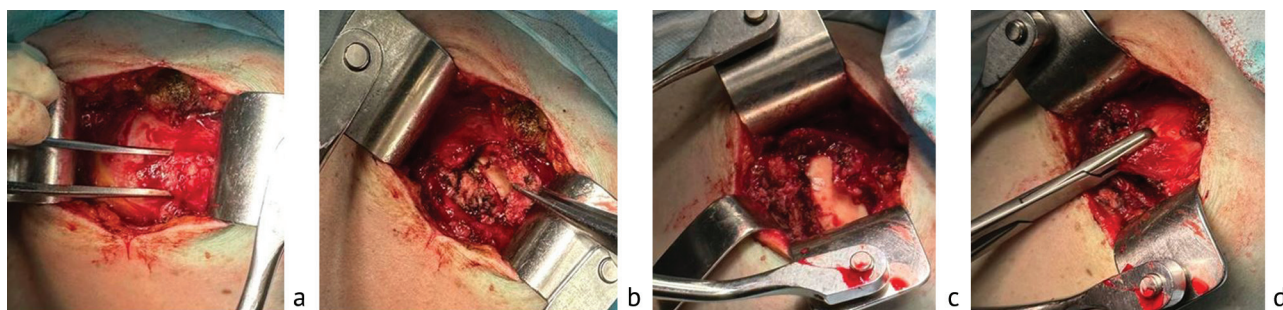


Fig. 2 Appearance of surgical wound: (a) the remnant of the greater tubercle of the humerus fixed to the rotator cuff tendons after access to the proximal humerus with jaws of tweezers; (b) a bone fragment of the greater tubercle of the humerus seen between the branches of the tweezers; (c) cartilaginous surface of the humerus and the absence of the greater tubercle of the humerus seen in the wound; (d) the rotator cuff tendons released from the scars; checking tendon mobility with traction

With scars removed and the rotator cuff tendons released, markings in the form of a 1 cm strip were made on the articular surface along the cartilage line using an electric knife [10]. The cartilage was removed using a sharp rasp with the subchondral bone trimmed until honeycomb appeared (Fig. 3). Three canals were then formed in the humerus, similar to those formed in the greater tubercle of the humerus during transosseous fixation of the rotator cuff tendons. Shuttle threads were inserted into the channels (Fig. 3). Rip-stop suturing of the rotator cuff tendons was performed using the Mason-Allen technique; ligatures coming out of the tendons at the site of the articular surface passed through the humerus along the channels using shuttle threads. The threads were tied with tension on the tendons. A double-row suture was applied with crossed threads to ensure a strong and reliable fixation, pressing a large tendon area to the bone (Fig. 3), and the wound was sutured layer-by-layer.

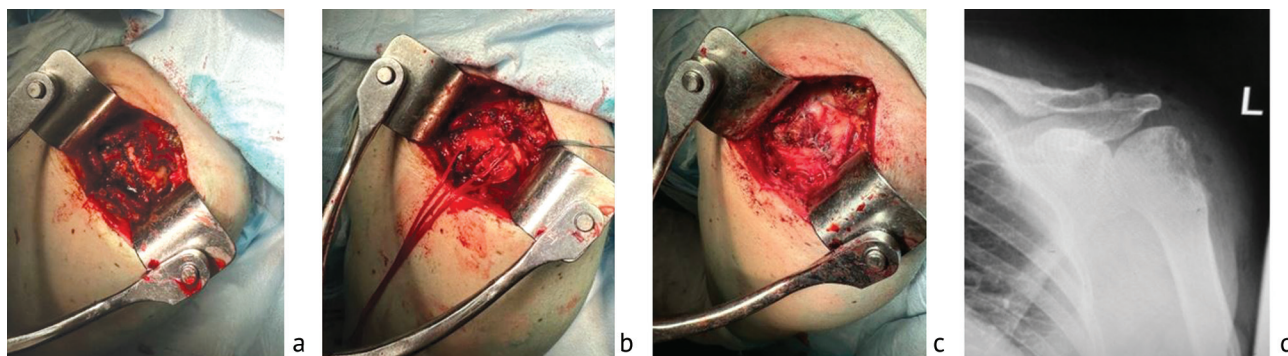


Fig. 3 Appearance of surgical wound: (a) the cartilage removed from the lateral edge of the articular surface of the proximal humerus; (b) the shuttle threads passed through the humeral head; (c) the threads tightened and tied to fix the rotator cuff tendons to the humeral head; (d) postoperative AP view

The patient was recommended to use scarf bandage for 3 weeks post op to be followed by a course of standard rehabilitation for patients after repair of the rotator cuff tendons.

RESULTS

The patient reported no complaints for the left upper limb at one-year follow-up. She had no pain in the shoulder joint or limitations in its movements. Local status: no signs of inflammation at the shoulder joint, no deformity observed. Range of motion measured 170° flexion, 40° extension, 180° abduction, 25° adduction, 70° internal rotation, 60° external rotation (Fig. 4). No neurocirculatory disorders were registered.

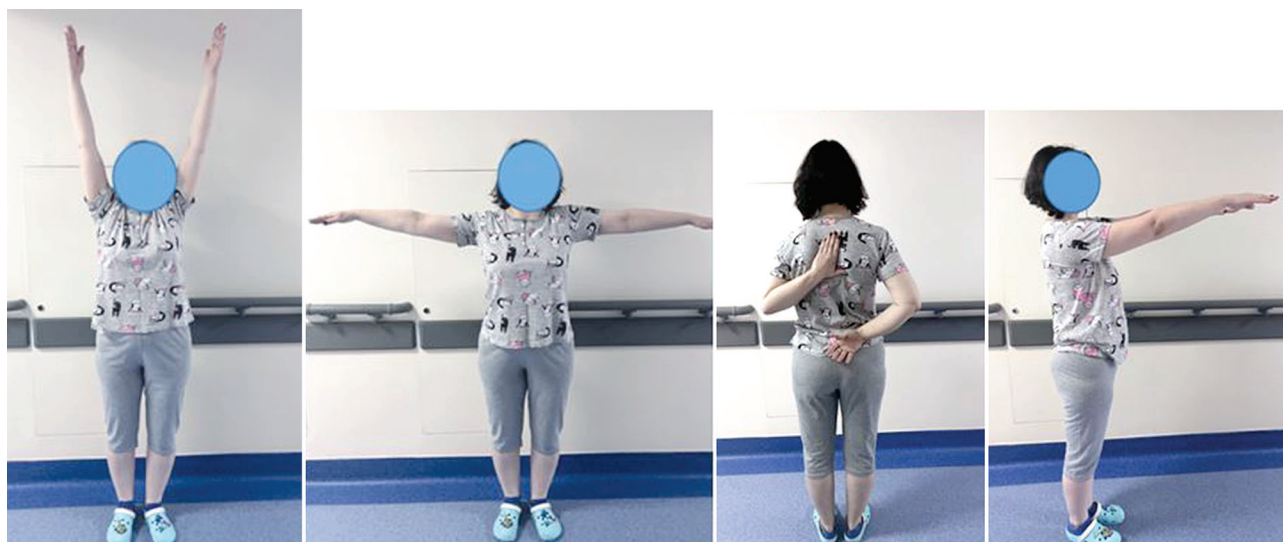


Fig. 4 Range of motion in the shoulder joints at one-year follow-up

DISCUSSION

The clinical instance demonstrated an alternative surgical strategy for the management of patients with injury to the greater tuberosity of the shoulder. The pain could be caused by injured tendons of the shoulder joint, by capsulitis and inflammation. The limited movements were caused by the lack of fixation of the rotator cuff muscles, and a bone fragment of the humerus tubercle displaced into the subacromial space limiting abduction in the extreme position only. The articular cartilage was preserved. Reverse shoulder arthroplasty was offered for the patient with fractured greater tubercle in other medical organizations with the impossibility of fixing the tendons to the humerus. The young patient refused the treatment offered. The intervention suggested the articular medialization by removing cartilage from the humeral head to form an analogue of the greater tubercle of the humerus and ensure fixation of the tendons to the humeral head. Tendons at the site of the native tubercle could not be fixed in the fracture zone due to the lack of good quality bone tissue for suturing the tendons transosseously and using anchors. Considering that the articular surface of the shoulder is approximately 160° with the center displaced medially of about 6 mm, the strategy chosen allowed us to preserve the main part of the articular surface. With the tip of the greater tuberosity being distally located 8 mm, the force lever changed slightly due to the medialization of the tendon insertion point [16, 17]. Medialization can reduce the area of the articular surface and the range of movements in the shoulder joint, but the residual range of movements is sufficient for everyday loads [16, 17]. The intervention facilitated delayed shoulder arthroplasty in a 46-year-old patient.

Despite a significant number of studies devoted to this topic, establishing indications for surgical treatment and determining surgical strategy in patients with shoulder dislocation and a fracture of the greater tuberosity remains challenging, which makes it difficult to choose the correct algorithm for the management of such patients [18–20].

Reduction and blood supply are major problems in the conservative management of patients with a fracture of the greater tubercle of the humerus. Bone displacement is noted in 50–60 % during conservative treatment [13, 15, 20] which can be associated with a decrease in soft tissue swelling. Inaccurate reduction of the displaced tubercle can result in limited ROM in the shoulder joint, disturbed movement of the rotator cuff muscles with and in impingement syndrome with the acromion process of the scapula at the time of shoulder abduction [13].

Clinicians can control complications due to accurate reduction and reliable fixation, which is not the case with blood supply of the broken humeral fragment. The issue remains unexplored and uncontrollable. The extent of impaired blood supply cannot be identified in the broken humerus at diagnosis to determine an appropriate strategy for managing this cohort of patients.

The existing evidence suggests that adequate reduction and reliable fixation can influence the blood supply to a bone fragment, reducing the risks of a bone lesion or fracture nonunion [2, 4, 6, 10, 13]. But lesion of the greater tubercle has also been described in the conservative treatment of non-displaced fractures [12].

Three surgical interventions using the method were produced for patients with similar clinical manifestations at our hospital. The patients aged 28, 46 and 53 years. The technique facilitated excellent functional results in all patients. The question of whether all fractures of the greater tubercle of the humerus should be fixed to avoid lesion of the fragment remains unexplored. The difficulties with the treatment described above can occur even in young

patients. There are many minimally invasive techniques that are not a technically complex intervention to fix the tubercle. This topic requires further study and synthesis of clinical material for scientific evaluation.

CONCLUSION

Medialization of the articular line, removal of a strip of the articular cartilage allowed us to create a place for fixation of the rotator cuff tendons in a patient with lesion of the greater tuberosity of the humerus. The surgical fixation of the rotator cuff tendons offered in the clinical case was shown to be a good alternative to reverse arthroplasty with excellent functional results achieved.

Conflict of interest None of the authors has any potential conflict of interest.

Informed consent The patient gave informed consent for publication of the findings without identification.

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