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SHOULDER

Arthroscopic tuberoplasty for subacromial impingement secondary to proximal humeral malunion

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Abstract Subacromial impingement secondary to malunion of proximally displaced greater tuberosity fractures may be treated with arthroscopic acromioplasty in patients with slight displacements, but open anatomical repositioning of the malunited fragment is recommended when more severe deformities exist. This deformity may also be addressed by abrading the protruding proximal portion of the greater tuberosity (tuberoplasty). However, this procedure would require full elevation of the rotator cuff insertion if performed with open surgery. This article reports a technique of arthroscopic tuberoplasty based on combined intra- and extra-articular transtendinous abrasion of the proximal end of the greater tuberosity for malunions with severe upward displacement of the greater tuberosity. This procedure allows for major preservation of the rotator cuff insertion.

Keywords Proximal humerus · Greater tuberosity · Malunion · Tuberoplasty · Arthroscopy

Introduction

Malunion of displaced fractures of the greater tuberosity may result in subacromial impingement, usually due to malposition of greater tuberosity in relation to the humeral head [2, 4, 5, 9]. Symptomatic malunion of greater tuberosity fractures may be treated with arthroscopic acromioplasty in patients with slight displacements, but open surgery by osteotomy and anatomical reduction of the malunited fragment is recommended in cases with more severe deformities when the room created by acromioplasty is considered insufficient to relieve subacromial impingement [1, 3] (Fig. 1). This deformity may also be addressed by abrading the protruding proximal portion of the greater tuberosity (tuberoplasty). However, if this procedure is performed with open surgery, it would require full elevation of the rotator cuff insertion because the area to be abraded corresponds to the footprint.

This paper reports a surgical technique based on combined arthroscopic intra- and extra-articular transtendinous abrasion of the proximal end of the greater tuberosity (tuberoplasty), which allows for major preservation of the rotator cuff insertion, for malunions with severe upward deformity.

Technical note

The patient may be placed either in a lateral decubitus or in a beach chair position. Joint surface should be inspected to rule out any incongruities, especially in the anterior and posterior compartments, where tuberosity malposition may interfere with shoulder rotation. If any impinging edge of the tuberosity is found, it will be abraded as reported by Hinov et al. [6] and Porcellini et al. [10]. The articular side of the rotator cuff should be carefully assessed searching for partial thickness tears, which are commonly associated to greater tuberosity malunions [7]. The articular surface of the rotator cuff tendon is followed laterally with a probe, and the greater tuberosity may be easily palpated under the tendon insertion protruding higher than the humeral head (Fig. 2). The camera is then inserted into the subacromial space from the posterior portal. Once cleared, the

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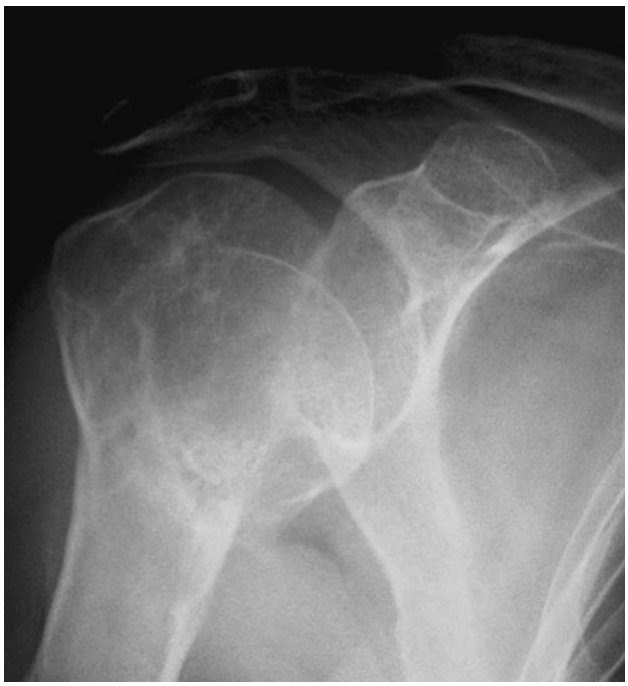

Fig. 1 Preoperative AP radiographs of patient with a three-part proximal humeral fracture malunion. The greater tuberosity healed in a superior position in relation to the humeral head

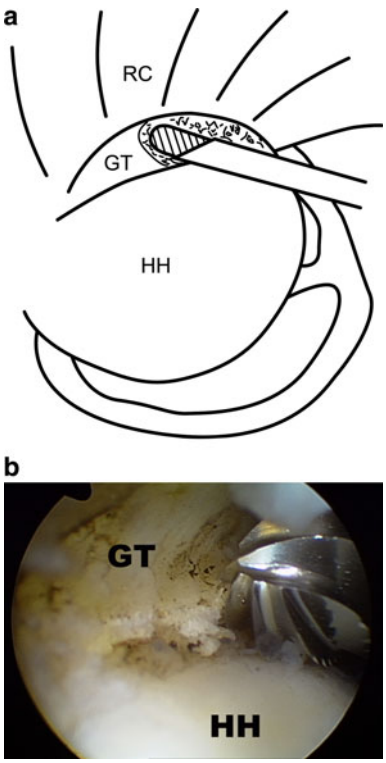

Fig. 2 **a** Illustration showing the intra-articular tuberoplasty. A burr is inserted through the rotator interval to abrade the protruding portion of the greater tuberosity medial to lateral and anterior to posterior. **b** Intraoperative image showing abrasion of the proximal portion of the greater tuberosity under the rotator cuff up to the most lateral tendon insertion. *RC* rotator cuff, *GT* greater tuberosity, *HH* humeral head

dynamic arthroscopic view shows that the malunited greater tuberosity fracture impinges on the inferior surface of the coracoacromial arch, obstructing normal shoulder movement, especially during shoulder abduction and flexion. A two-step tuberoplasty is then started. In the first step, the camera is reintroduced posteriorly into the joint for visualization, and the proximal portion of the greater tuberosity is abraded using a motorized burr under the rotator cuff until the most lateral tendon insertion is reached (Fig. 3). Instruments are switched anterior to posteriorly to reach the most posterior and anterior margins of the protruding bone, respectively. The intra-articular part of the long head of the biceps tendon is preserved. In the second step, the subacromial space is entered again and a longitudinal 10-mm window is opened in the supraspinatus tendon along with its fibers using a Mitek Hooked VAPR (DePuy Mitek, Ryanham, MA) inserted through the lateral conventional portal. The remaining lateral protruding bone of the proximal greater tuberosity may be palpated through the window. The camera is then switched to the lateral portal, and anterior and posterior portals are used to alternatively insert a periosteal elevator (DePuy Mitek, Ryanham, MA) into the subacromial space and through the window opened at the supraspinatus to detach the posterior

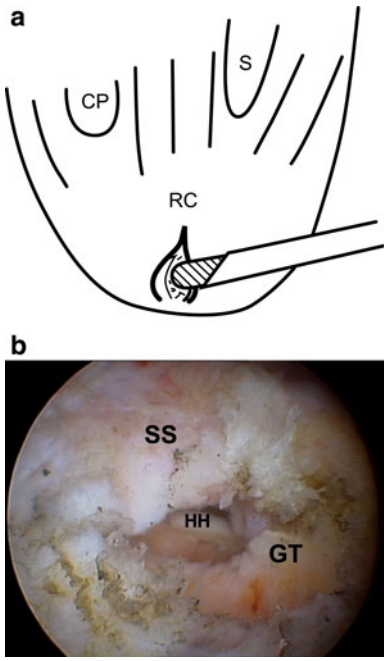

Fig. 3 **a** Illustration showing the subacromial tuberoplasty. A burr is inserted into the subacromial space from the posterior portal, and the remaining proximal portion of the greater tuberosity is abraded through a window opened in the supraspinatus tendon. **b** Arthroscopic view from the lateral portal of the subacromial space. The malunited greater tuberosity is partially removed. *RC* rotator cuff, *CP* coracoid process, *S* spine of the scapula, *SS* supraspinatus, *GT* greater tuberosity, *HH* humeral head

and anterior rotator cuff insertions, respectively. Once the upper portion of the greater tuberosity is freed from tendon insertions, a burr is alternatively inserted from the anterior and posterior portals using the same window to abrade the remaining proximal portion of the greater tuberosity following a similar sequence (Fig. 4). After tuberoplasty is completed, observation from the posterior portal shows free shoulder abduction and flexion, without signs of subacromial impingement. The window opened through the supraspinatus tendon is finally sutured in a conventional manner.

Discussion

The most important finding in this study was that malunion of proximal humeral fractures with upward displacement of the greater tuberosity may be successfully treated by intra- and extra-articular arthroscopic tuberoplasty, without elevating the rotator cuff insertion.

Malunion of proximal humeral fractures is difficult to treat debilitating condition. A few reports have described a successful arthroscopic approach consisting of intra-articular fragment abrasion in patients with malunited greater and lesser tuberosity fractures which blocked humeral head rotation [6, 8, 10]. Conversely, the procedure reported here is indicated for patients with severe malunion of the greater tuberosity in the coronal plane that causes subacromial impingement during shoulder abduction and flexion. In addition to clinical exam and preoperative imaging, dynamic arthroscopic evaluation of the subacromial space may be very useful to show the malunited greater tuberosity obstructing normal shoulder movement due to impingement on the inferior surface of the coracoacromial arch.

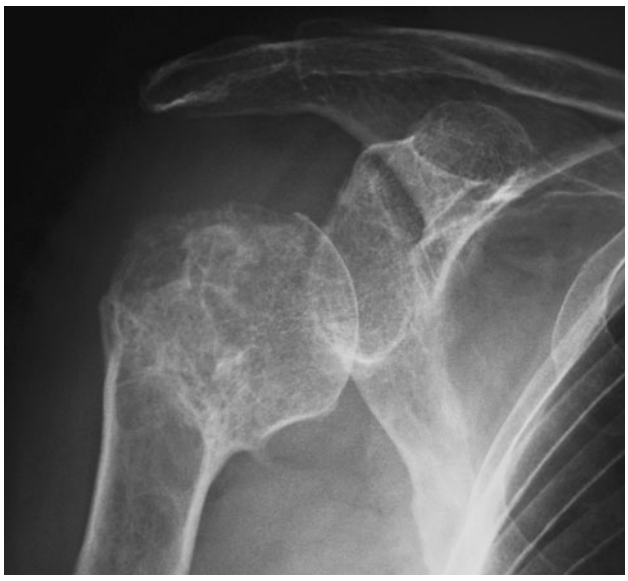

Fig. 4 Postoperative AP X-rays corresponding to the case are shown in Fig. 1. Complete removal of the impinging proximal portion of the greater tuberosity may be seen

Beredjiklian et al. reported satisfactory results in two patients with malunion of the greater tuberosity managed with acromioplasty. Based on this experience, authors recommended the procedure in patients with small tuberosity malposition [1]. However, acromioplasty alone may be inadequate for relieving impingement in severely malunited greater tuberosity fractures. Open repositioning and internal fixation is considered the best treatment option for these cases, but requires major anatomic aggression [1, 3].

Since the rotator cuff inserts at the greater tuberosity, abrasion of the proximal portion that includes the footprint is the most challenging part of the procedure from a technical viewpoint. In order to preserve tendon insertion, tuberoplasty is performed in two steps, from the articular and subacromial spaces. The first intra-articular step is usually facilitated by the presence of a partial thickness tear in the articular side of the rotator cuff, which has been regarded as a constant finding in patients with chronic shoulder pain after minimally displaced fractures of the greater tuberosity [7]. Once the partial thickness tear is debrided, the medial part of the proximal greater tuberosity may easily be abraded with a burr. In the second step of the procedure, a minimal window created in line with the fibers of the supraspinatus tendon allows for cuff insertion release and for abrasion of the lateral part of the tuberosity working from anterior and posterior portals.

The technique reported here (arthroscopic tuberoplasty), consisting of abrasion of the proximal part of the greater tuberosity using a double intra-articular and subacromial transtendinous approach, should be considered for patients with symptoms due to malunion with upward displacement of the greater tuberosity.

Conclusion

In proximal humeral fracture malunions with severe upward displacement of the greater tuberosity causing subacromial impingement, the technique of arthroscopic tuberoplasty based on sequential intra- and extra-articular transtendinous abrasion of the proximal end of the greater tuberosity allows for successfully relieving subacromial impingement with major preservation of the rotator cuff insertion.

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