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Surgical techniques

Reverse shoulder arthroplasty in recent proximal humerus fractures

Jean-David Werthel[a,*], François Sirveaux[b], Damien Block[b]

[a] Service de chirurgie orthopédique et traumatologique, hôpital Ambroise-Paré, 9, avenue Charles-de-Gaulle, 92100 Boulogne-Billancourt, France
[b] Service de chirurgie orthopédique et traumatologique, centre chirurgical Émile-Gallé, CHRU, 49, rue Hermite, 54000 Nancy, France

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ABSTRACT

Reverse shoulder arthroplasty is now the standard treatment for displaced, three- or four-part, proximal humeral fractures in patients older than 70 years. Inadequate tuberosity repair or inappropriate humeral stem position are associated with poorer outcomes, notably regarding rotation and stability. Strict operative technique during prosthesis implantation is therefore crucial to obtain reliable and reproducible outcomes. The objective of this article is to describe the surgical technique for reverse shoulder arthroplasty used to treat recent proximal humerus fractures.

1. Introduction

Changes in the treatment of proximal humerus fractures in recent years include both the growing popularity of internal fixation and the declining use of hemiarthroplasty due to a preference for reverse shoulder arthroplasty (RSA) for displaced, three- or four-part fractures in patients older than 70 years [1]. In these patients, hemiarthroplasty fails to produce reproducible and reliable outcomes in the event of tuberosity non-union or migration [2–5]. In contrast, RSA medialises the centre of rotation of the shoulder and lowers the humerus, thereby increasing the lever arm of the deltoid muscle, which then ensures good forward elevation, even when the rotator cuff is deficient [6]. Tuberosity non-union and/or migration are associated with poorer outcomes after RSA, notably regarding rotations [7–12] and stability [13–15]. One of the leading reasons for revision surgery after RSA is instability [10,16], which may be related to errors in height and/or version of the humeral stem [8,13,17]. Rigorous surgical technique must therefore be applied when implanting reverse shoulder prostheses in order to ensure reliable and reproducible outcomes.

2. Indications/contraindications

In recent proximal humerus fractures, the decision to perform RSA is based on patient age and comorbidities and on the characteristics of the fracture including tuberosity displacement and comminution, the condition of the cuff and calcar, the extent of the displacement, and the risk of avascular necrosis.

RSA is indicated in patients older than 70 years who have a three- or four-part displaced fracture with a high risk of avascular necrosis of the humeral head and/or poor-quality comminuted tuberosities and/or a pre-existing rotator cuff tear [5]. RSA should not be used as the first-line treatment in young active patients. Contraindications of RSA include pre-existing or concomitant axillary nerve injury, concomitant fracture of the scapular spine or acromion that might be displaced by increased tension of the deltoid muscle and concomitant glenoid fracture that might preclude the implantation of a glenoid baseplate.

3. Pre-operative work-up

This procedure is not urgent and should be carried out after proper planning. The imaging work-up consists of standard anteroposterior and lateral radiographs and of computed tomography (CT) with 3D reconstruction to provide an accurate analysis of the condition and displacement of the tuberosities [18] and of the characteristics of the glenoid (bone stock, version and glenoid type) [19]). Soft tissue windows supply information on pre-operative cuff trophicity and fatty degeneration. Metaphyseal bone loss should be assessed with care, and pre-operative planning of the humeral height to be restored is essential. In the event of substantial metaphyseal bone loss, a radiograph of the entire contralateral humerus can be obtained to accurately assess the height of the implant [20–22].

* Corresponding author.
E-mail address: jdwerthel@gmail.com (J.-D. Werthel).

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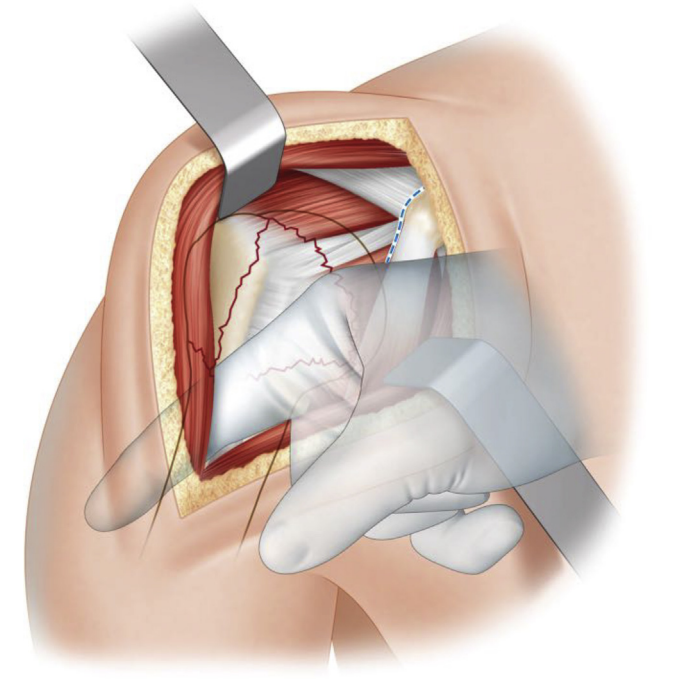

Fig. 1. Delto-pectoral approach: long (8–10 cm) and lateralised. The deep aspect of the deltoid muscle must be fully released to allow posterior mobilisation of the muscle.

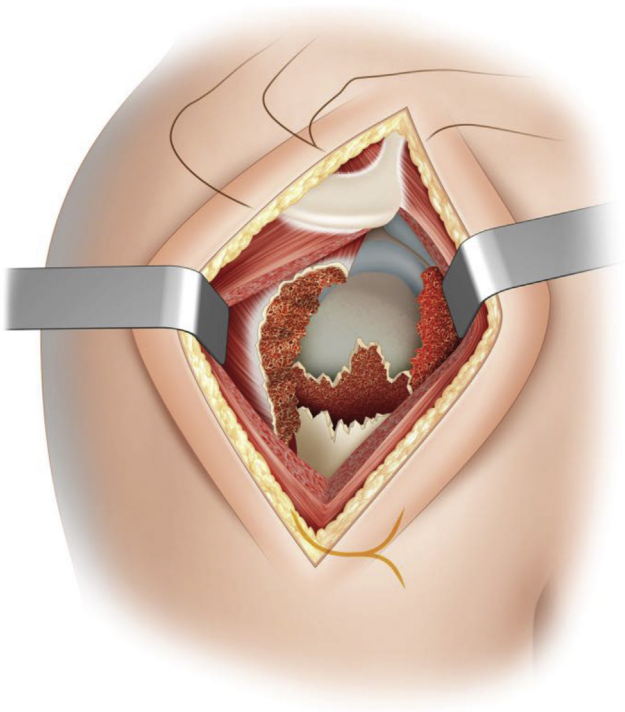

Fig. 2. Supero-lateral approach: incision along the anterior edge of the acromion without going beyond 38 mm under the lateral edge of the acromion to avoid injuring the axillary nerve.

4. Operative technique

4.1. Anaesthesia and installation

The procedure is performed under general anaesthesia with or without an interscalene block to ensure post-operative pain control.

The patient is in the beach-chair position tilted at 30– to 60–, on the edge of the table. The position should allow free anterior and posterior shoulder movements, as well as retropulsion of the humerus. The arm is placed on a rest.

4.2. Surgical approach

Either the delto-pectoral or the supero-lateral approach may be used. With the delto-pectoral approach, reduction of the greater tuberosity is more difficult to control and access to the glenoid is less direct. Nevertheless, this approach deserves preference in patients with a fracture-dislocation injury or a fracture line extending into the metaphysis. It also has the theoretical advantages of sparing the anterior deltoid and of avoiding axillary nerve exposure. When using the delto-pectoral approach, the upper edge of the pectoralis major tendon can serve as a landmark for the height of the prosthesis and the reduction of the tuberosities.

The delto-pectoral approach is a lateralised 8-to-10 cm approach that starts at the acromio-clavicular joint and extends to the tip of the deltoid V to ensure that access to the glenoid is as direct as possible. The deep surface of the deltoid must be fully released to allow posterior mobilisation of the muscle. The clavi-pectoral fascia is opened at the lateral edge of the conjoined tendon and the coraco-acromial and coraco-humeral ligaments are cut flush with the coracoid process (Fig. 1).

The incision is made along the anterior edge of the acromion, from the acromio-clavicular joint to 38 mm under the lateral edge of the acromion. This limit is important, as extending the incision further carries a risk of axillary nerve injury. The fibres of the anterior and middle deltoid are separated. A suture can be placed at the distal part of the separation between the two deltoid bundles to protect the axillary nerve. The anterior deltoid and coraco-acromial ligament are detached en-bloc, sub-periosteally, from the acromion. Acromioplasty can be performed to improve exposure (Fig. 2).

4.3. Identification of the tuberosities and rotator cuff

The haemorrhagic sub-acromial bursa is excised. The long head of biceps tendon is identified and the bicipital groove is opened. Tenotomy of the biceps tendon is performed routinely. Tenodesis at the distal part of the groove is an option, although no effect of this procedure has been demonstrated. The fracture is usually located immediately lateral to the groove. The tuberosities are separated at the fracture line. The rotator interval is identified and opened down to the glenoid. The supra-spinatus tendon is excised down to the glenoid. Although this tendon can be spared, it may then place excessive traction on the greater tuberosity after the reduction (Fig. 3). The greater tuberosity is identified and mobilised, taking care to preserve the periosteal attachments to the extent possible. Four suture loops are run through the postero-superior cuff (Fig. 3) flush with the tendon attachments on the greater tuberosity (two loops in the medial-to-lateral direction in the intra-spinatus and teres minor tendons, after which the needles are removed and two in the lateral-to-medial direction through the same tendons). The humeral head is released from its capsular adhesions and removed to expose the medial aspect of the lesser tuberosity. It is kept as a graft source during reconstruction. The lesser tuberosity is identified and reclined forwards with the sub-scapularis. Two tag sutures

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