Enlarged transacromial superior approach with reverse shoulder arthroplasty for fractures

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Abstract

The authors describe a step-by-step technique for reverse total shoulder arthroplasty using arthroscopy via the enlarged transacromial superior approach. This technique seems ideal for reinsertion of the tuberosities and to ensure adequate postoperative tensile balance of the infraspinatus and the subscapularis, which is critical for the rotator cuffs to function properly and to achieve optimal arthroplasty stability. Reviewing these different steps helps understanding each rotator cuff individual component’s contribution to achieve optimal arthroplasty stability and external rotation with a reverse shoulder arthroplasty.

Introduction

Replacement of the head of the humerus appears to be justified for the treatment of complex fractures of the proximal humerus in elderly patients (three- or four-part fractures). However, the results are often compromised by displacement of the tuberosities. The reverse shoulder arthroplasty, which was initially described by Grammont and Baulet, allows correct antepulsion and abduction without rotator cuff and has been proposed to treat these fractures without reinsertion of the tuberosities. With the usual deltopectoral approach the main difficulty encountered with reverse arthroplasty is the fixation of the tuberosities particularly the greater posterior tuberosity in an anatomical position. This is possible via the transacromial approach as described by Debeyre et al. and enlarged by acromio clavicular dislocation of the acromial anterior part.

This study investigates if the reverse design of a shoulder prosthesis implanted with this approach and with reinsertion of the tuberosities is associated with a better functional outcome in traumatic proximal humerus fractures as compared with results in the literature for reverse arthroplasty without reinsertion of the tuberosities. The objective of this article is to describe the operative technique and discuss the expected benefits.

Materials and Methods

Between January 2000 and January 2007 we treated 23 consecutive patients with a recent fracture of the proximal humerus using a Delta reversed shoulder prosthesis (Deputy, Saint Priest, France). All were over 75 years of age. Two had sustained a displaced three-part fracture and 21, of whom 2 had a dislocation, a four-part fracture of the proximal humerus as described by Neer. There were 11 women and 12 men with a mean age of 82 years (75 to 97). The dominant arm was involved in 14 patients. All the operations were carried out within 10 days of the injury.

Operative technique

The patient is placed in a seated or semi-seated position and operated on under general anaesthesia. The patient’s torso is stabilized on the operating table with adhesives. The forearm of the operated limb is supported so that it maintains the elbow flexed at a right angle and the shoulder in neutral rotation. The operative field leaves the entire shoulder and the entire upper extremity free and sterile to ensure freedom of movement.

The transacromial approach

The skin is incised approximately 12 cm, beginning at the tubercle of the spine of scapula, parallel to the spine of scapula, located 1 cm above it. The incision (Figure 1) directs slightly above the acromion, passing 1 cm forward from its posterior angle. Then the incision curves, moving forward so that it is perpendicular with the middle fibers of the deltoid. It should remain two fingerwidths under the external edge of the acromion to prevent damage to the axillary nerve.

The upper trapezius muscle is incised using the electrocautery knife 1 cm above the spine of scapula. The middle fibers of the deltoid are spread apart vertically 1 cm forward from the acromial angle. The deep fascia of the deltoid is incised vertically and its deep side is detached forward and backward of the subdeltoid bursa. The acromioplasty is performed using the oscillating saw after having made the intra-acromial guides for the two parallel posterior screws with a 2.5-mm drill bit for compression osteosynthesis at the end of the procedure. The osteotomy is located 1 cm in front of the acromial angle. The anterior acromion is released from its adhesions with the bursa roof. It is tilted around the acromioclavicular joint using a powerful Beckmann retractor. The retractor’s prongs are supported on the posterior acromion and the deep side of the anterior acromion. The usual transacromial approach described by Debeyre is too narrow to implant the glenoid component and also the humeral component without rotating it in relation to the humerus. The anteroposterior space of the transacromial approach is widened by doing an acromio clavicular dislocation of the acromioclavicular joint (or a clavicule osteotomy) which allows to return and push forward the anterior part of the acromion (Figure 2). The acromial clavicular zone is released minimally from the deltoid and trapezius muscle insertions. The acromion clavicular joint is opened and the piece comprising the anterior acromion is pushed toward the front with the Beckmann retractor, which is displaced so that its anterior branch takes leverage on the inferior side of the acromioclavicular joint. The coracoacromial ligament is resected. The greater and lesser tuberosities are retracted allowing removal of the head of the humerus and wide exposure of the glenoid. The supraspinatus tendon and the long head of the biceps, if present, were divided. The joint capsule was incised. Then the limb was externally rotated to expose the head. The osteotomy was done as proximal to the anatomic neck as possible to save metaphyseal bone stock allowed by the fracture level. The tuberosities were not removed to allow reattachment of the rotator cuff muscles in all 23 patients.

Exposing the glenoid

Exposing the glenoid requires lowering the humerus by performing a periglenoid capsulotomy. This position is maintained with a two-pronged double-bent retractor hooked below the lower pole of the glenoid. The glenoid is viewed frontally (Figure 3) and is prepared according to the needs of the surgeon and the implant used. The glenoid baseplate was implanted flush to the inferior, anterior and posterior rims of the glenoid, with an inferior inclination of approximately 10° and was secured using four lag screws inserted through the glenoid. The version of the component was adjusted in order to reproduce the physiological orientation of the glenoid, using prostheses of 36 mm in diameter.

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Exposing the humerus for preparation

Exposing the humerus for preparation is facilitated by lateral translation of the upper end guided by a fist in the armpit, with the elbow maintained close to the body. A slight anterior flexion and external rotation of the arm place the upper humeral resection in the enlarged acromial opening. The humerus is prepared according to the surgeon’s preferences and the implant material chosen.

The original stem was connected with the epiphyseal component and a 16-mm trial bearing cup. A trial glenoid bearing (36 or 42 mm) was positioned on the glenoid-bearing tray. After putting the trial stem into the humeral canal (without cement), the shoulder was reduced and assessed for stability through a full range of movement. Closing temporally the cuff with temporary fixation of the tuberosities is done to avoid a too voluminous implant. The tuberosities are sutured with nonresorbable suture (2-0 nylon). If there was adequate soft tissue tension, the stem was fixed with a clamp at the bone margin of the proximal humerus. The stem was removed with the clamp still in place. The components were changed to the original devices, and cement was filled into the humeral canal and the stem implanted. To find the correct position, the stem was placed into the humeral canal until the clamp reached the bone margin. The stem was implanted in 15-degree retroversion. After the cement was fixed, the clamp was removed. The shoulder was reduced and reassessed for stability. Adjustment of the version and of the length of the humerus was carried out after a trial reduction to test the laxity and stability of the joint. In the first half of the series the humeral component was positioned in retroversion, but in the remainder it was placed in neutral version to increase internal rotation, because retroversion was not found to be necessary for the stability of the implant. The definitive humeral stem was implanted with gentamicin-impregnated bone cement in all the shoulders. Insertion of the polyethylene insert completed the arthroplasty. The tuberosities were then sutured to each other and around the neck of the prosthesis in their anatomical position. No vertical sutures were required because the supraspinatus had been removed or was absent.

Closing

Closing the transacromial approach begins with reducing the acromio clavicular dislocation. This reduction, verified with a finger placed on the cutaneous side of the acromio clavicular joint, is obtained by reducing the acromioplasty, which is facilitated by laterally raising the upper limb toward 40°C. The acromioplasty is supported by two 3.5-mm-diameter parallel screws or two suture threads. The screws are placed back to front from the spine of the scapula inward from the acromial angle to the anterosuperior part of the anter ior acromion. The trapezius muscle is sutured using nonresorbable cross stitches. The fibers of the deltoid muscle that had been spread apart are joined with nonresorbable (0-0 nylon) cross stitches. Thin aspiration drainage is placed in the supraspinatus fossa.

Complications with the enlarged transacromial approach

The complications with the enlarged transacromial approach are exceptional. No axillary nerve involvement was noted clinically. All the acromioplasties joined by two compression screws or two suture threads consolidated and in only three cases did the screw points cause pain, requiring their removal. The consolidation of the acromio clavicular joint was difficult to confirm with imaging. However, it was noted that palpating the acromio clavicular joint zone was not painful and that mobilization of the shoulder did not cause creaking. After operation, the shoulder was immobilised for two days before active but gentle physiotherapy was begun. No luxation was observed contrary to a previous series with deltopectoral approach.

Discussion

The length of follow-up appeared to be sufficient to allow assessment of functional recovery. Indeed the definitive functional results after shoulder arthroplasty were acquired at the end of the first year.

Based on our own results and on the available literature, the reverse shoulder prosthesis may be considered a good alternative to other surgical procedures in comminuted fractures of the proximal humerus for elderly patients. Literature suggests that reverse arthroplasty in elderly patients sustaining a complex fracture of the upper humerus is an interesting option, because, like conventional replacement of the head, it provides excellent relief from pain and may also offer better and easier functional recovery than conventional arthroplasty in patients over 75 years of age.

This approach decreases the risks of intraoperative humeral diaphyseal fracture, since resection of the humeral head and exposure of the glenoid do not require rotating the humerus. The glenoid is viewed directly and the implant used. It decreases the main difficulty encountered with reverse arthroplasty, i.e. the fixation of the tuberosities in an anatomical position with a correct retroversion of the stem. In our series we found a mean external rotation of 25 degrees (10-35) and mean internal rotation up to L4. These results were better than expected. In a series of patients receiving reverse shoulder prosthesis to treat painful cuff tear arthropathy or a massive irreparable rotator cuff tear with pseudoparesis, Simovitch et al. showed that increa-
ing fatty infiltration of the teres minor muscle was associated with less postoperative external rotation and worse clinical outcomes after reverse total shoulder replacement. They suggested that reverse total shoulder replacement alone does not lead to a desired functional result unless the deficit of active external rotation is addressed in another fashion. The authors recommended the reattachment of the tuberosities for a better functional outcome regarding external/internal rotation. It ensures sagittal centering of the implanted joint and minimizes the risk of postoperative dislocation since the infraspinatus and the subscapularis are inserted with the tuberosities and the implant's volume, providing tensional balance, is easier to determine intraoperatively.

References