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Review article

Primary shoulder reverse arthroplasty: Surgical technique

C. Nerot*, X. Ohl

CHRU de Reims, hôpital Maison-Blanche, 45, rue Cognacq-Jay, 51092 Reims, France

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ABSTRACT

Total reverse shoulder replacement is now a very common surgical procedure that has been shown to be effective in the treatment of rotator cuff tear arthropathies or massive rotator cuff tears with pseudo paralysis, even without arthritis. However, the survival curves of the oldest series decrease between 8 and 10 years after arthroplasty (events: implant survival, or worsening of clinical outcome) which explains why the indication for this type of arthroplasty is usually limited to patients over seventy. Moreover, details and technical modifications have been suggested to improve the surgical technique, the quality of fixation and the mechanical conditions of this non-anatomical prosthesis to improve clinical outcome and implant survival. Within the framework of primary surgery, excluding traumatic or revision surgery, the primary indications for this option are massive rotator cuff tears with (or without) osteoarthritis and primary osteoarthritis with rotator cuff tears and/or with severe glenoid wear and finally, rheumatoid arthritis. The purpose of this conference was to assess and describe the most important preoperative criteria and surgical conditions necessary for this procedure as well as specific technical details about the surgical procedure itself based on available options and options under evaluation such as the positioning of the glenoid component (lateralization, bone graft, orientation) and the association of muscle transfers.

1. Introduction

After the rapid failure of models of constrained and/or reverse total shoulder arthroplasty (TSA) in the 1970's, the semi-constrained prosthesis developed by Grammont [1] was a real turning point in the treatment of painful functionally impotent shoulders with massive rotator cuff tears in elderly patients. This implant was original because it modified the functional center of rotation of the glenohumeral joint by adjusting several parameters: the center of rotation was now fixed on the glenoid bone and therefore medialized and lowered, thus lengthening the deltoid and raising its lever arm and moment of action. The principle was to optimize deltoid function to compensate for the functional deficiency of all or part of the rotator cuff. This optimization is caused by elongation of the muscle fibers resulting in improved performance [2,3]. Shear stress is replaced by compressive forces that improve the mechanical conditions at the bone/glenoid implant interface. The original Delta™ implant designed by Grammont has been modified, developed and transformed by numerous teams and manufacturers, confirming the continued interest in this concept thanks to the high quality clinical results in a population of elderly subjects who have often lost autonomy because of the condition of their shoulder(s). Numerous large published studies now exist with significant follow-up [4,5], describing the clinical results, complications (secondary infection, instability) and radiographic outcome of this technique. Because of the nearly constant development of scapular notching [6,7] and more rarely glenoid "loosening", different teams have modified certain elements of the shape of the prosthesis itself or changed the implantation technique (humeral retroversion, vertical position, glenoid tilt. . .). A glenoid bone graft may be considered, not only to improve fixation in case of severe glenoid erosion, but also to improve the biomechanics of the arthroplasty [8]. Finally, associated soft tissue procedures, in particular muscle transfers, can be proposed to improve the functional outcome.

Because this is a conference on surgical technique, we will focus upon technical details including certain changes that have now been proposed to prevent complications and improve clinical results. Compatible muscle transfers will also be discussed.

We have excluded traumatic indications or revisions to limit ourselves to eccentric glenohumeral arthritis, pseudo-paralytic and upper migrated shoulders secondary to massive rotator cuff tears, and primary osteoarthritis associated with a severe rotator cuff tear or severe glenoid wear and finally certain rheumatoid arthropathies, as long as there is sufficient bone quality and moderate stiffness.

2. Preoperative evaluation, surgical planning

A short presentation of preoperative planning, which is an integral part of the surgical procedure, is necessary.

* Tel.: +33 3 26 78 84 89/75 95; fax: +33 3 26 78 91 60. Private address: 11, cours J.B.-Langlet, 51100 Reims, France. Tel.: +33 6 87 51 32 86.
E-mail addresses: cnerot@chu-reims.fr, cecile.nerot@sfr.fr (C. Nerot).

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2.1. Clinical evaluation

Besides the patient's general condition (operability), particular attention must be paid to the patient's loss of autonomy due to the condition of the shoulder to be operated on and other articular deficiencies. Indeed, this may be a contraindication to surgery (inability to get up from a seated position without the help of the upper limbs, permanent use of crutches).

The cervical-dorsal-scapular morphology should be analyzed to define the functional axis of the upper limb (especially in case of significant dorsal kyphosis modifying the axis of the scapula, which must be taken into account during placement of the prosthesis). Joint range of motion should be carefully evaluated, passive range of motion first, because as in all shoulder surgery, the quality of functional outcome depends mainly upon the quality of recovery of joint range of motion, and preoperative stiffness can only be partially recovered by surgery.

Deltoid function should be confirmed because it is indispensible for mobility of the prosthesis. Loss of active range of motion is one of the main indications for this procedure. At worst, the shoulder may be pseudo-paralytic. But the deficit may be partial, during elevation (El) persistent (+) or deficient (−) and/or during External Rotation (ER), with various combinations: El(+)/ER(+), El(+)/ER(−), El(−)/ER(+), El(−)/ER(−). All of these elements must be identified to plan an associated muscle transfer if necessary.

It is useful to summarize this functional assessment with specific scores [9] (Constant Score, Disability of the Arm, Shoulder and Hand, Subjective Shoulder Value, etc.) which will be the basis for assessment of future improvement.

2.2. Imaging evaluation

A standard radiographic assessment is performed including 3 AP views (internal, external and neutral rotation, a lateral Lamy view, an axillary lateral view or a Garth view); an AP view centered on the acromio-clavicular joint can also be added.

CT scan is very useful, and even indispensable. Arthrography is not systematically necessary because clinical results are generally enough to identify a massive rotator cuff tear and confirmation is not needed. A fairly extensive axial CT scan must be performed (of the entire scapula) to analyze the muscular fossa and evaluate the angle between the glenoid axis and the scapular blade. The CT scan must also include bone windows, muscle windows and frontal and sagittal reconstructions.

The following will be analyzed:

- severity of osteoporosis;
- stage of arthritis (especially glenohumeral and subacromial);
- severity of the cranial migration according to Hamada [10] (Fig. 1), and the vertical glenoid erosion according to Levigne and Favard [6] (Fig. 2);
- severity of the axial posterior erosion according to Walch and Badet [11] (Fig. 3);
- acromion status: thickness, fragmentation, spurs;
- muscular trophicity [12] in particular of the teres minor, which is essential for active external rotation.

MRI is less pertinent because it mainly explores the soft tissues while it is indispensable to obtain information on the bone structures.

3. Preoperative preparation

The preoperative preparation should follow the required recommendations for all arthroplasty procedures: preparation of the skin surface, depilation, antibiotic prophylaxy, aseptic room, careful painting with Polyvidone® or Chlorhexidine®, which may be more effective against *Propionibacterium acnes*, a frequent source of postoperative infections of the shoulder.

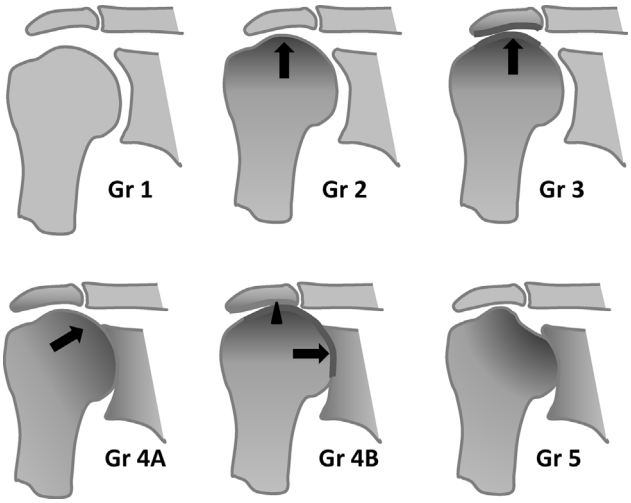

Fig. 1. Hamada classification [10].

Fig. 2. Coronal glenoid wear according to L. Favard [6].

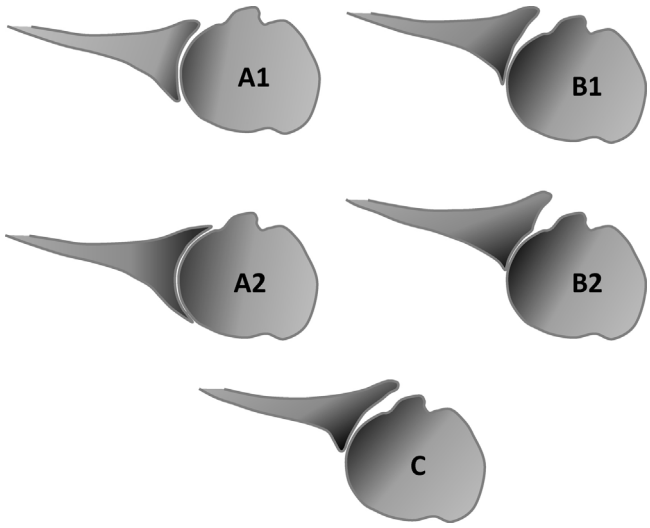

Fig. 3. Posterior glenoid wear according to G. Walch and R. Badet [11].

3.1. Anesthesia

General anesthesia is usually used, associated with locoregional anesthesia, by interscalene brachial plexus block (except if there is a contraindication, especially respiratory deficiency).

3.2. Installation

Some specific precautions must be taken when placing the patient in the beach chair position and should be controlled by both