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TECHNICAL NOTE

The reverse shoulder prosthesis (Delta III) in acute shoulder fractures : Technical considerations with respect to stability

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The reverse shoulder prosthesis reverses the relationship between the scapular and humeral component, resulting in a mechanical advantage as the deltoid muscle is able to compensate for the rotator cuff deficiency. Based on this mechanical advantage, the reverse shoulder prosthesis has become an accepted alternative for the treatment of complex proximal humeral fractures. The purpose of this article is to discuss technical considerations related to stability in the use of the reverse shoulder prosthesis in acute shoulder fractures, based on clinical experience.

Keywords : reverse shoulder prosthesis ; proximal humeral fracture ; operative technique ; stability.

INTRODUCTION

The reverse shoulder prosthesis reverses the relationship between the scapular (socket) and humeral (ball) component, shifting the center of rotation towards the glenoid (fig 1). This increases the length of the lever arm of the deltoid muscle, resulting in a mechanical advantage for the deltoid muscle, compensating for rotator cuff deficiency (*1*). The reverse shoulder prosthesis is indicated for the treatment of rotator cuff tear arthropathy, failed rotator cuff surgery and shoulder instability.

Severe fractures of the proximal humerus associated with fractures of the greater and lesser tuberosity (rotator cuff tendon insertions) were traditionally treated with a shoulder hemiarthroplasty. Failure to restore the rotator cuff anatomy and function led to limited strength and function after a conventional shoulder replacement (*2*).

Based on its mechanical advantages, the reverse shoulder prosthesis has become an accepted alternative for the treatment of complex proximal humeral fractures. This is reflected in a retrospective study in our department (*3*). We performed a retrospective study in which eight elderly patients treated with a hemiarthroplasty for three- or four-part fractures were compared to six elderly patients treated with a reverse prosthesis. The function in both patient groups was evaluated according to the Constant-Murley score. We found a significant difference in favour of the patient group treated with a reverse prosthesis. Evaluation of the postoperative radiographic images showed a greater incidence of migration of the greater tuberosity in the patient

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Fig. 1. — The components of the Delta CTA reverse shoulder prosthesis.

group treated with a hemiarthroplasty. This may explain the lower Constant-Murley score in this group. Our study showed that the reverse shoulder prosthesis is an acceptable alternative for the treatment of complex proximal humeral fractures.

However problems of instability and dislocation are a major disadvantage of the reverse shoulder prosthesis in comparison with conventional shoulder replacement. We noted one dislocation in the patient group treated with a reverse prosthesis.

METHOD

Using the reverse shoulder prosthesis for complex shoulder fractures requires an alternative surgical procedure for correct assesment of the soft tissue tension and thickness of the humeral cup. This is needed to prevent instability and dislocation which is a potential disadvantage of the reverse shoulder prosthesis in comparison with conventional shoulder replacement.

According to the surgical manual of the reverse prosthesis (designed for rotator cuff arthropathy) the first steps are resection of the humeral head, diaphyseal reaming and proximal reaming of the humerus. Following insertion of the humeral trial stem, the next step is the preparation of the glenoid with the insertion of the metaglene and the trial glenosphere placement. After trial reduction the final components including the polyethylene humeral cup are inserted.

Our suggested alternative surgical procedure consists of reversing the prescribed surgical order by first preparing and inserting the glenoid component, followed by the preparation and insertion of the humeral component (table I). This allows correct evaluation of the humeral stem position and the humeral cup thickness.

Three tests are currently used in our department to assess correct soft tissue tension and thickness of the humeral cup. All three tests should be performed before selecting the definitive humeral component with its determined height and its determined thickness of polyethylene.

1. The first test is performed after implantation of the metaglene and implantation of the trial humeral stem. When the arm is pulled down, the medial side of the trial humeral stem component should be level with the inferior side of the metaglene (fig 2). When the trial

Table 1. — Comparison between standard and alternative surgical procedure

Standard surgical procedure	Alternative surgical procedure
1. humeral head resection	1. humeral head resection
2. diaphyseal humeral reaming	2. glenoid preparation with metaglene implantation
3. proximal humeral reaming	3. diaphyseal humeral reaming
4. trial humeral stem insertion	4. proximal humeral reaming
5. glenoid preparation with metaglene implantation	5. trial humeral stem insertion
6. trial reduction and testing with trial components	5a. levelling to the inferior edge of the metaglene
7. definitive glenosphere placement	5b. levelling to the upper half of the glenosphere
8. definitive humeral stem and cup insertion	6. trial reduction and testing with trial components
	7. definitive glenosphere placement
	8. definitive humeral stem and cup insertion

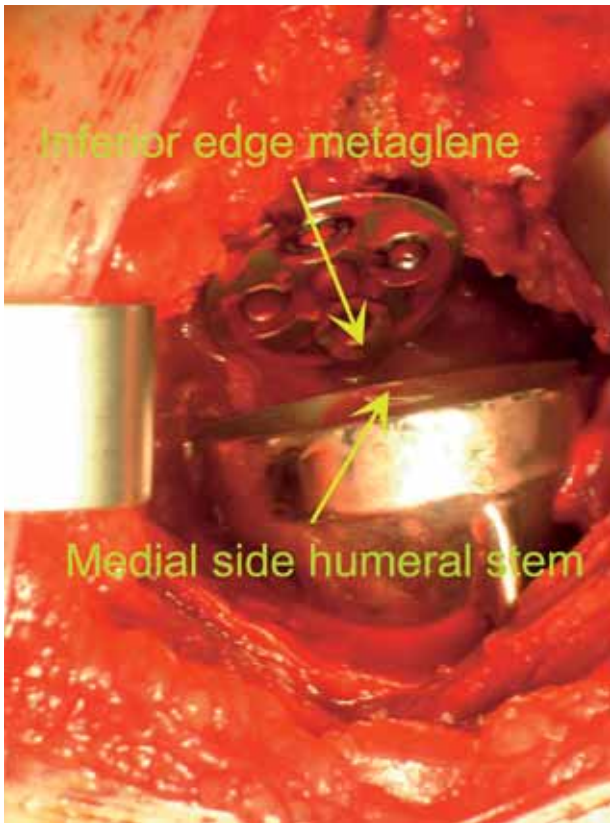

Fig. 2. — Correct configuration with medial side of the trial humeral stem component levelled with the inferior edge of the metaglene when the arm is pulled down.

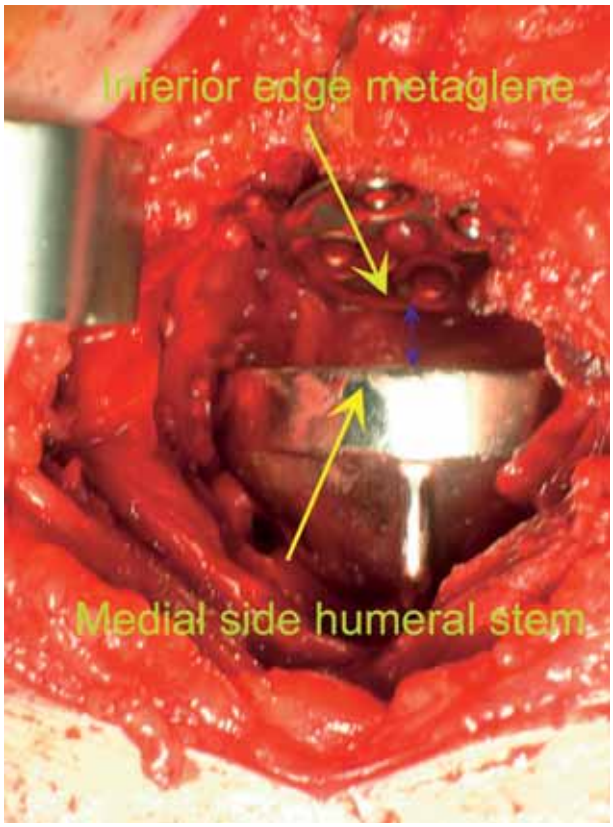

Fig. 3. — Incorrect configuration with medial side of the trial humeral stem component not levelled with the inferior edge of the metaglene when the arm is pulled down.

humeral stem is inserted too deep, the medial side will not reach the inferior edge of the metaglene (fig 3).

2. The second test is performed after inserting the glenosphere. When the arm is hanging down without traction, the medial side of the trial humeral stem component should correspond with the upper half of the glenosphere. Only the upper half of the glenosphere should be visible (fig 4).

3. The third test is performed when all the trial components are in place. The stability of the configuration is tested in resisted adduction, with the surgeon's fist in the axilla, inducing lateral translation of the proximal humerus (fig 5 a,b). Instability, if present, is related to insufficient thickness of the humeral polyethylene cup.

CONCLUSION

Instability and dislocation is a major disadvantage of the reverse shoulder prosthesis in

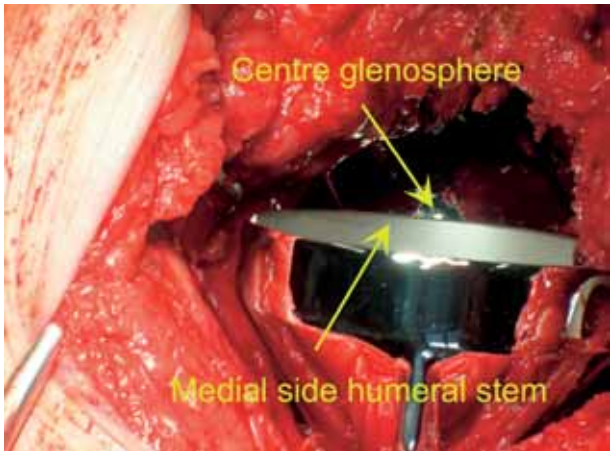

Fig. 4. — Correct configuration : the medial side of the trial humeral stem component should correspond with the upper half of the glenosphere when the arm is hanging down.

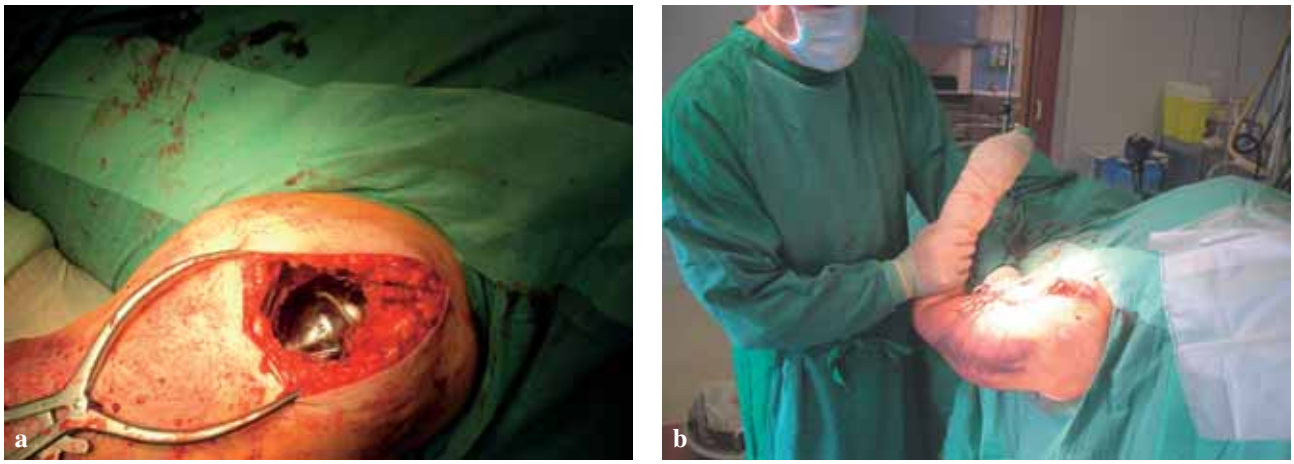

Fig. 5. — The third test is performed when all the trial components are in place. With the wrist in the axilla , the stability of the configuration is tested by forced adduction inducing lateral translation of the proximal humerus. During this test longitudinal traction should not be applied as this will always induce dislocation. Instability is then the result of an insufficient thickness of the humeral polyethylene cup.

comparison with conventional shoulder hemiarthroplasty. In order to obtain adequate stability, the suggested alternative surgical procedure reversing the prescribed surgical order, in combination with the three technical tests described, is currently used in our department to prevent instability and dislocation. This allows correct evaluation of the humeral stem position and the humeral cup thickness.

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