

Reverse shoulder arthroplasty for proximal humeral fractures in older patients with osteoporosis: a report of 2 cases

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Abstract

Objectives: Operative therapy for proximal humerus fractures in older patients has improved recently, but the optimal surgical procedure is still controversial in those with osteoporosis. Generally, hemiarthroplasty (HA) is indicated in older patients with osteoporosis with three part, group-6 fractures or worse, according to the Neer classification system. To recover a good range of motion (ROM), bone fragments of the greater tubercle and lesser tubercle must be united with a humeral implant. Occasionally, these fragments are displaced during follow-up. However, even when their position unchanged, osteolytic changes can occur. We treated two patients with reverse shoulder arthroplasty (RSA) who both exhibited good functional results postoperatively.

Methods: Two patients (mean age: 82 years) who sustained proximal humerus fractures were clinically and radiographically evaluated. Fracture types included three-part, group-6, and four-part, group-6 fractures according to the Neer classification. The mean follow-up period was 17 months. After the two patients were treated with RSA, their shoulder ROM was evaluated until the final follow-up.

Results: Osteolytic changes in the greater tubercle were observed during the course of treatment in both patients. The mean active shoulder ROM for elevation, abduction, external rotation, and internal rotation was 120°, 110°, 25°, and to L5, respectively.

Conclusions: We obtained good functional results with RSA in two older patients with proximal humerus fractures and thus believe that RSA can be an appropriate treatment for complicated proximal humerus fractures in older adults.

Keywords: Proximal humeral fractures, Reverse shoulder arthroplasty (RSA), Older patients

Introduction

Operative therapy for proximal humerus fractures in older patients has improved recently, but the optimal surgical procedure is still controversial in elderly patients with osteoporosis. Ultimately, the shoulder joint of patients should be painless and functional after treatment. However, in older patients with complicated fractures, it is difficult to achieve good results with operative treatment because of decreased bone quality.

Recently, several studies have reported good results in the treatment of proximal humerus fractures with reverse shoulder arthroplasty (RSA).¹⁻⁴

The RSA procedure was invented by Grammont in 1985.⁵ The goal of RSA is to achieve good active elevation of the shoulder joint without active use of the rotator cuff muscles. The procedure was designed to shift the shaft of the humerus infero-laterally to increase tensioning of the deltoid muscle and move the center of rotation internally to elongate the lever arm of the deltoid muscle. The main indication for RSA is disability of the

rotator cuff muscles, such as that observed in global cuff tear or cuff tear arthropathy. RSA is now also indicated for proximal humerus fractures to avoid cuff muscle disability due to the occurrence of nonunion of the greater tubercle with HA.

Here we report the results of two older women with proximal humerus fractures treated with RSA.

Patients and Methods

Two women who sustained proximal humerus fractures and were treated with RSA were clinically and radiographically evaluated. Fracture type was classified using the Neer classification system.⁵ As for the prosthesis, the Aequalis Reversed system (Wright Medical Japan, Tokyo, Japan[®]) was used. After the operation, a shoulder abduction brace was placed on the patient's body for 3 weeks. After removing the brace, mild shoulder range of motion (ROM) exercises were started. We analyzed shoulder ROM at 3, 6, and 9 months as well as at 1 year after surgery and final follow-up. We informed the patients that the data would be submitted for publication and obtained their consent.

Case 1

A 77-year-old woman sustained a three-part, group-6 (fracture with dislocation) proximal humerus fracture. She did not have an axillary nerve palsy (Figure 1). Her bone mineral density was measured and was found to be less than 70% of a young adult

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mean value at the femoral neck. Open reduction carries a high risk of humeral head necrosis and osteoporosis may complicate efforts to fix all fragments rigidly. Thus, either hemiarthroplasty (HA) or RSA was indicated. Prior to surgery, informed consent was obtained, and the risks and benefits of each treatment were explained to the patient and her family. RSA was performed 5 days after injury.

The humeral stem component was inserted at 20° of retroversion and the greater tubercle was placed on the humeral stem (Figure 2). No operative complications were observed. She underwent shoulder rehabilitation for 3 months after surgery.

At 3 months after surgery, her shoulder ROM for elevation, abduction, external rotation, and internal rotation was 110°, 100°, 30°, and to the buttock, respectively. At the final follow-up (2 years after surgery) her shoulder ROM was 140°, 140°, 40°, and to L5 for elevation, abduction, external rotation and internal rotation, respectively. However, at 3 months after surgery,



Figure 1 Case 1, radiographic images
The patient was a 77-year-old, woman, with a Neer 3-part group-6 fracture. a) X-ray and, b) 3D CT image of the fracture of the humeral anatomical neck and greater tubercle. The humeral head was dislocated anteriorly.

osteolytic changes of the greater tubercle fragment appeared, and this fragment could not be observed radiographically at the final follow-up (Figure 3).

Case 2

An 86-year-old woman with mild dementia sustained a four-part, group-6 (fracture with dislocation) proximal humerus fracture (Figure 4). She did not have an axillary nerve palsy. Prior to surgery informed consent was obtained, RSA was performed 5 days after injury.

The humeral stem component and greater tubercle were treated the same way as in Case 1 (Figure 5). After surgery, her

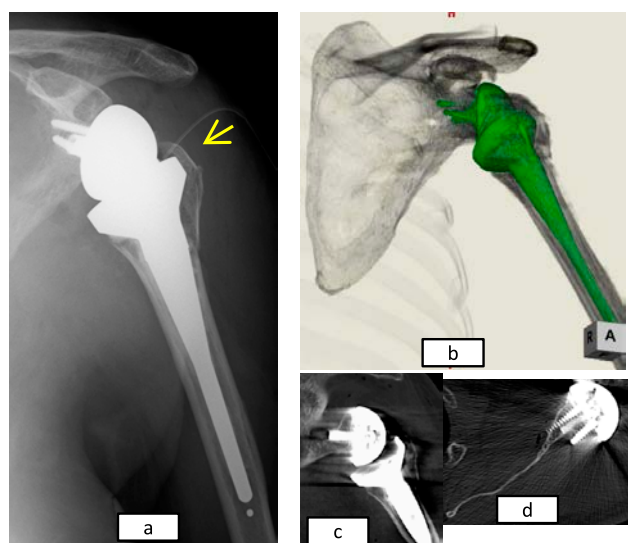


Figure 2 Immediate postoperative images.
a) X-ray showing: the greater tubercle placed on the humeral shaft implant (yellow arrow) is shown. b) 3D CT image, c) coronal MPR image, and d) axial MPR image.

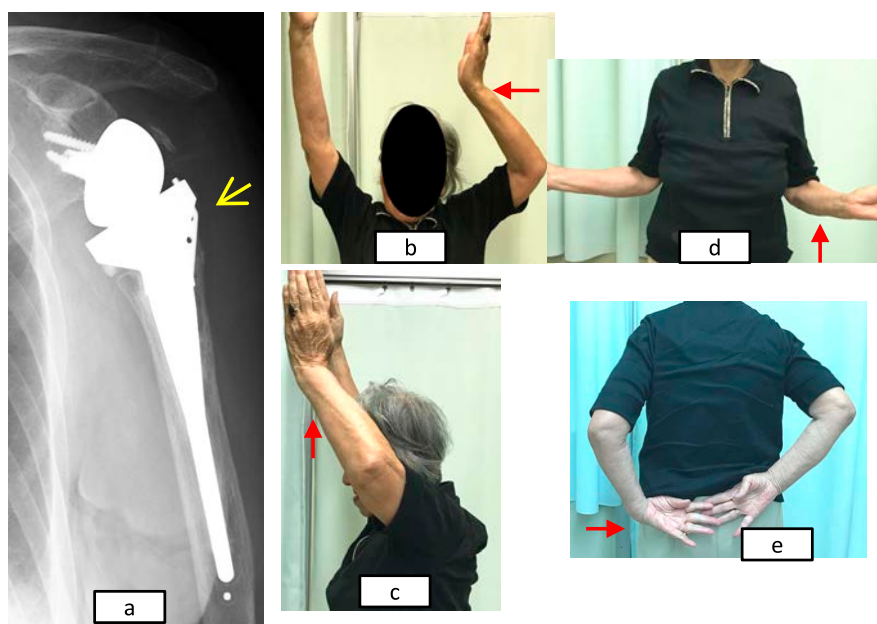


Figure 3 Two-year postoperative images
a) X-ray of the greater tubercle showing osteolytic changes (yellow arrow). The following active shoulder ranges of motion were achieved: b) elevation, 140°; c) abduction, 140°; d) external rotation, 40°; e) internal rotation to L5. The red arrow indicates the fractured side.

dementia progressively worsened, and at the final follow-up, she needed an assistant to help with activities of daily living. No complications from surgery were observed. She performed rehabilitation exercises for only 1 month postoperatively because of her dementia. At 3 months after surgery, her shoulder ROM for elevation, abduction, external rotation and internal rotation was 90°, 60°, 30°, and to the buttock, respectively. At 1 year after surgery her shoulder ROM values for the same variables were 90°, 80°, 40°, and to L5, respectively. At the final follow-up (14 months after surgery), her shoulder ROM was 85°, 80°, 35°, and to L5, for elevation, abduction, external rotation, and internal rotation respectively. However, at 2 months after surgery, osteolytic changes of the greater tubercle fragment appeared and, at the final follow-up, this fragment could not be observed radiographically (Figure 6).

Discussion

In cases of Neer three part, group-5 and above in older patients with osteoporosis, a HA is indicated to avoid humeral head necrosis.⁶ In HA, the fragment of the greater tubercle must be united with the humeral implant.

However during the follow-up period, this fragment may occasionally become displaced; if it does not displace, osteolytic changes appear progressively. As a result, the rotator cuff muscle becomes dysfunctional, and the shoulder ROM does not improve (Figure 7). Several studies have reported improvements in surgical outcomes with HA.^{7,8} However, non-union of the greater tubercle fragment remains an issue.

The RSA procedure was invented by Grammont in 1985.⁶ The goal of RSA is to achieve good active elevation of the shoulder joint without active use of the rotator cuff muscles. The procedure was designed to shift the shaft of the humerus

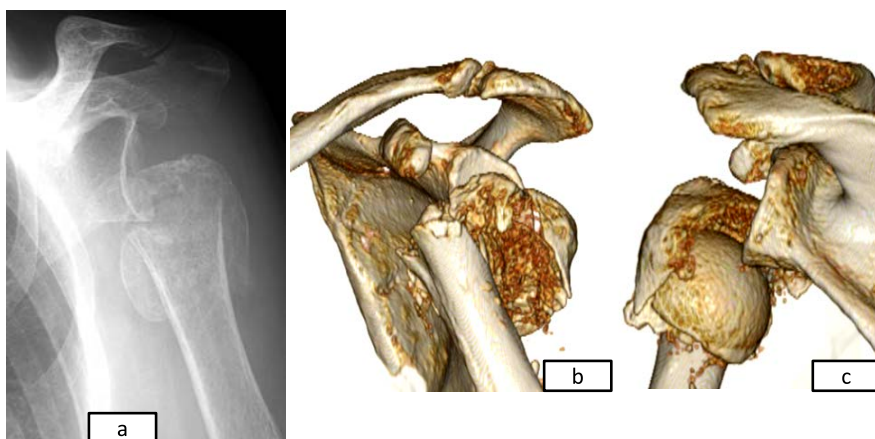


Figure 4 Case 2 : radiographic images
The patient was an 86-year-old woman, with a Neer 4-part, group-6 fracture. a) X-ray and b,c) 3D CT images of fractures of the humeral surgical neck, and lesser and greater tubercle. The humeral head dislocated inferiorly.

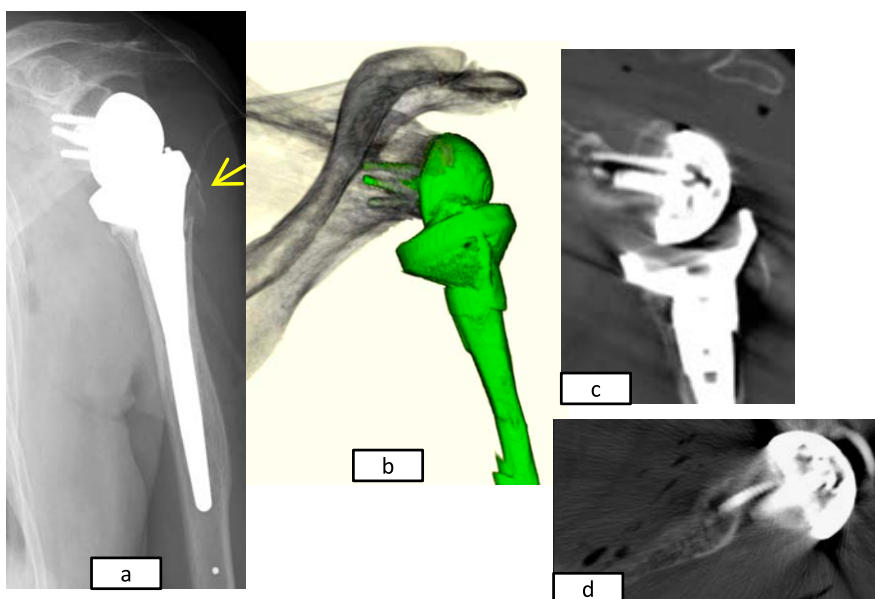


Figure 5 Immediate postoperative images.
a) X-ray, showing the greater tubercle fragment united with the humeral shaft implant (yellow arrow). b) 3D CT image, c) coronal MPR image, and d) axial MPR image.

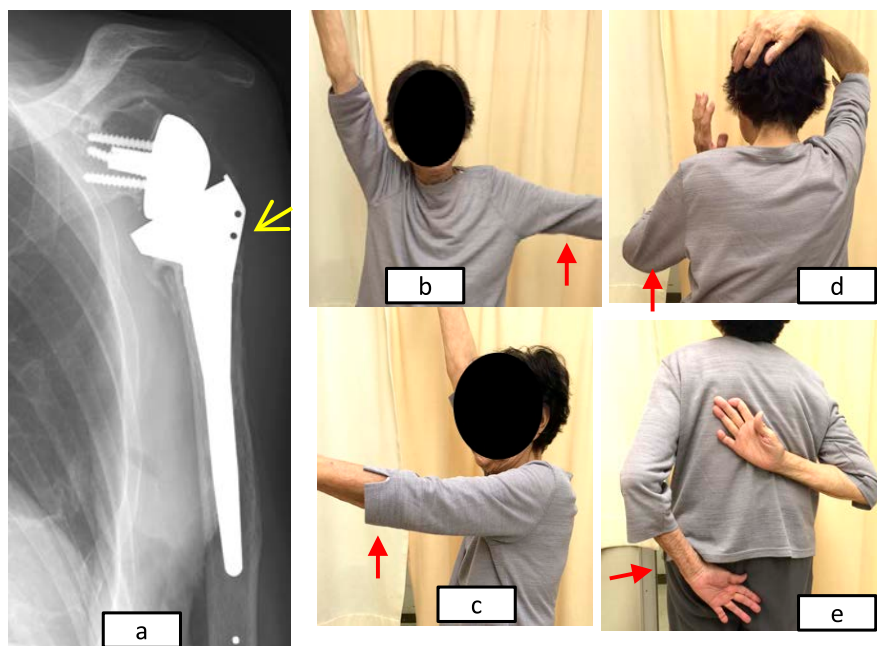


Figure 6 14 months postoperative images

a) X-ray of the greater tuberosity showing osteolytic changes (yellow arrow). The following shoulder active ROMs were achieved: b) elevation, 85°; c) abduction 80°; d) external rotation 35°; e) inner rotation, buttock. The red arrow indicated the fracture side.

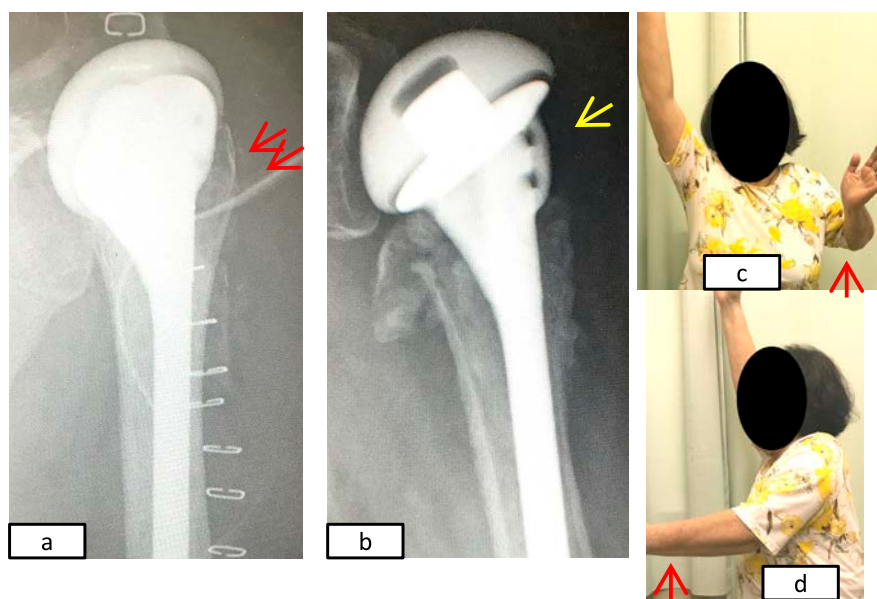


Figure 7 Images of an 86-year-old woman treated with hemiarthroplasty for a proximal humerus fracture.

a) Immediate postoperative images showing the greater tuberosity fragment united with the humeral shaft implant (red arrow). b) Image obtained 6 months postoperatively, with the greater tuberosity showing osteolytic changes. The patient achieved the following shoulder active ROMs: c) elevation, 30°; abduction, 30°.

inferolaterally to increase tensioning of the deltoid muscle and move the center of rotation internally to elongate the lever arm of the deltoid muscle. In RSA, deltoid muscle function is necessary for the elevation of the shoulder joint; conversely this action does not depend on a functional rotator cuff muscle. Moreover, if the rotator cuff muscles are dysfunctional, shoulder function can be maintained. The main indication for RSA is disability of the rotator cuff muscles, such as with a global cuff tear or cuff tear arthropathy. RSA is now also indicated for

proximal humerus fractures to avoid cuff muscle disability due to nonunion of the greater tuberosity that can occur with HA.

Since 1985, many studies have reported good results, but a number of major complications can occur, including infection,⁹ dislocation of the shoulder joint, loosening of the implant,¹⁰ inferior scapular notch,¹¹ and axillary nerve palsy.¹²

From these results, the Japanese Orthopaedic Association created strict guidelines to avoid complications. RSA was introduced in Japan in 2014.

Regarding surgical outcomes, Cuff and Pupello compared RSA and HA for proximal humerus fractures in older patients. They concluded that RSA resulted in better clinical outcomes than HA and a similar complication rate.² Mata-Fink et al. reported the results of RSA for proximal humerus fractures in older adults. They concluded that complications are not appreciably higher in patients with RSA and that this treatment is a reasonable alternative for treating older adults, however, more research and long-term observation are needed.³ Lopitz et al. studied 42 patients with proximal humerus fractures treated with RSA. They divided patients into the following two groups: patients aged greater than or less than 80 years. They concluded that age was a critical factor for a successful outcome with RSA. In patients ≥ 80 years, worse functional outcomes were observed.⁴ Frombach conducted a systematic review and compared RSA and HA. He concluded that RSA was a good option for the treatment of proximal humerus fractures, but this depended on the surgeon's familiarity with the procedure.⁵

Regarding shoulder elevation ROM, both patients were able to achieve 90° at 3 months after surgery. One patient's shoulder ROM improved progressively. The other patient's maximal ROM was observed at 1 year after surgery, following which her ROM decreased because her dementia worsened and her daily activity decreased. In addition, both patients had progressive osteolytic changes in the greater tubercle and finally the greater tubercle disappeared. However active shoulder ROM over 90° in both elevation and abduction was achieved (Figure 8). Both patients were observed for over 1 year post-operatively, and they did not have any complications with RSA. Compared with HA, RSA is more complicated because the glenoid component is inserted, which exposes the patient to more complications, such as infection, dislocation, and loosening of the implant, as well as inferior scapular notch, due to the design of the prosthesis. Regarding shoulder functional outcomes, RSA has been shown to be better than HA, even if the greater tubercle does not unite with the humeral implant.⁷ Since 2014, we have treated over 30 cases with RSA. Among these, one patient had a temporary axillary nerve palsy. Currently, RSA is a commonly performed treatment at our hospital. In addition, operative methods and

materials continue to be developed and improved, which have reduced the complication rates.

We provide evidence that RSA is a good option for the treatment of proximal humerus fractures in older patients with osteoporosis, and is associated with good functional outcomes.

Conflicts of Interest

No benefits in any form were received or will be received from any commercial party related directly or indirectly to the subject of this article. No funds were received in support of this study.

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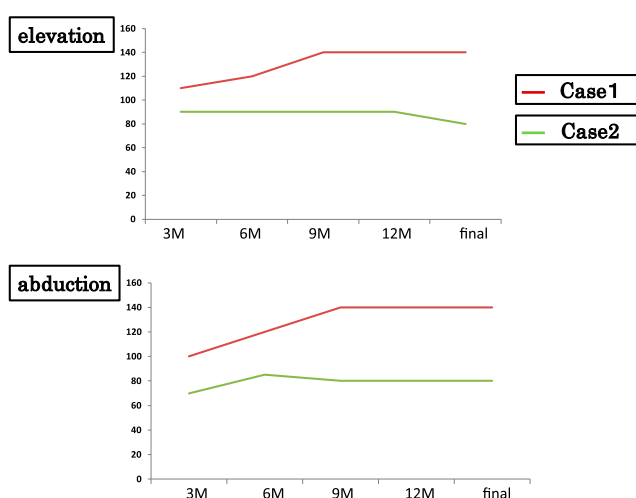


Figure 8 Recovery of ROM

The ROM in elevation improved rapidly, and at 3 months postoperatively, both patients achieved over 90° ROM. The improvement in abduction was modestly reduced in pace compared with the improvement in the ROM for elevation.

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