Revision shoulder arthroplasty with morselized bone allograft —a case report

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Following pseudoarthrosis of a 4-part fracture of the surgical neck of the humerus, a 60-year-old woman had been operated with a Neer II hemiarthroplasty through a deltopectoral approach. At 66 years old, she was referred to the senior author (AHK) because of consistent pain and limited range of motion (ROM) of her right shoulder. The radiographs revealed erosion of the posterior part of the glenoid, but there was no obvious misalignment of the prosthesis, nor any signs of loosening (Figure 1). Poor external rotation (–40°) and limited flexion/abduction (30°) led to the suspicion of poor soft-tissue balancing, with contracture and tightening of the anterior capsule and shortening of the subscapular tendon. To correct this, revision with a total arthroplasty was planned. The problem turned out to be of a different kind.

Operative findings and surgical procedure

As in the primary operation, we used a deltopectoral approach, but also a division of the coracoacromial ligament and an osteotomy of the coracoid process. The contract subscapular tendon was divided in a Z-shaped manner to allow lengthening. The greater tuberosity, attached to the stem with cerclage wires, had no contact with the humeral bone, but was adjacent to a rather large piece of cement around the proximal humerus. The prosthetic stem was found to be positioned in 70° of retroversion, thus causing posterior subluxation and limitation of the external rotation. Because the wear of the glenoid was small, we decided to change the humeral component to a hemiarthroplasty positioned in correct retroversion.

In contrast to the experience of others (Wallace 1998), the Neer stem was difficult to extract from the cement mantle. We did not manage to pull out the stem from the distal part of the mantle using an extraction instrument and a slot hammer. High-speed burrs and thin chisels had to be used to fragment the cement mantle around the stem before it could be taken out. The well-fixed cement mantle could not be extracted without first fragmenting it. This process severely damaged the thin humeral bone on the lateral side, leading to an extension of the defect distally from the estimated location of the greater tuberosity, 7 cm distally. On the medial side, there was a rather thin and a partially fractured bone continuous with the distal part of the humerus.

We decided to reconstruct the defect by a mixture of impacted morselized allograft and cancel-

Figure 1. The non-constrained prosthesis (Neer II) before revision. There are no signs of loosening, but there has been some bone loss in the inferior glenoid and slight upward subluxation.

Figure 2. Postoperatively, after revision with a Global prosthesis and extensive bone grafting enforced with a titanium mesh.

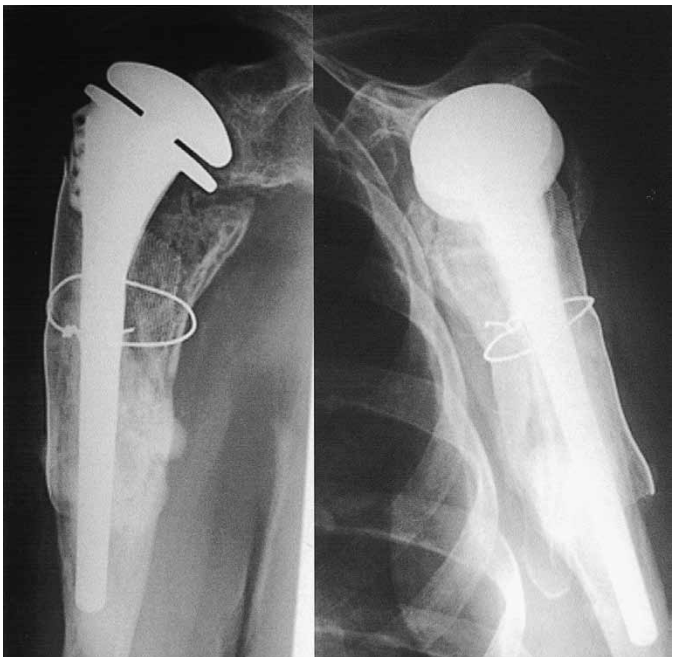

Figure 3. Five years postoperatively, showing consolidation of the bone graft around the stem.

lous autograft from the iliac crest, to support the fixation of the rotator cuff and obtain ingrowth of living bone for a biological fixation of the cuff, and bone remodeling around the stem further on.

A titanium mesh of small pore size overlapping the proximal end of the humerus was applied and fixed to the medial bone with a cerclage wire. 4–8 mm sized bone chips were prepared from a fresh-frozen femoral head using a hand-driven mill. These were mixed with cancellous bone from the iliac crest of the patient. The bone graft was firmly impacted into the humerus with tamps, supported by the mesh and the medial bone wall, and around a trial component, providing a seating for the rotator cuff. A standard stem (Global, De Puy) was cemented (Palacos with gentamycin, Schering-Plough) in 30° of retroversion and at the appropriate height. Special care was taken to avoid impregnation of cement into the proximal part of the graft. The rotator cuff was secured against the shoulder of the stem with sturdy nonabsorbable sutures and the subscapular tendon was sutured with a lengthening of 1 cm. Good overall stability and an abduction of 120° without impingement were achieved.

Postoperative course

A postoperative radiograph in an AP projection was unremarkable (Figure 2). The patient's arm was put in a sling and only passive pending exercises were allowed. Active exercises were allowed after 10 weeks. After 15 weeks, she felt that the pain had receded and motion was improved. She was able to reach her mouth with her right hand, which she had not been able to do since the primary arthroplasty. After 1 year she had active abduction of 50°, flexion of 60° and also an improvement in rotation compared to ROM preoperatively. She had no pain at rest, and only light pain at the end of movements.

During the second year the patient developed severe pain in the neck, radiating to the arms, which caused difficulties in her training program. Radiographs and MRT showed advanced degeneration. After 2 years, there was a decrease in active flexion/abduction to 30/30°, but no change in strength, nor in the range of external rotation. Radiographic assessment at 5 years showed consolidation of the graft, the stem in an unchanged position without any periprosthetic radiolucencies and no further erosion of the glenoid (Figure 3).

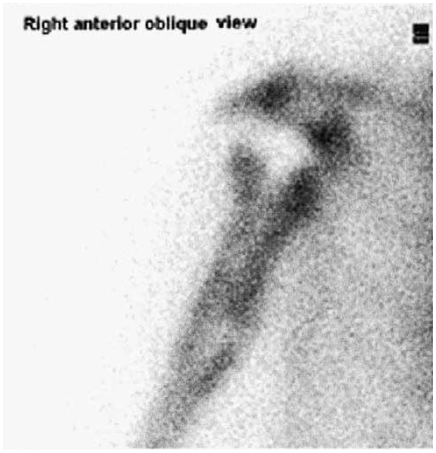

Figure 4. Technetium-99m methylene diphosphonate skeletal scintigraphy 4 years after the revision, showing increased activity in most parts of the allograft.

One could see some heterotopic bone formation on the medial proximal humerus and maybe this could develop an attachment to adjacent neocapsule, causing an increasing contracture which would explain the decrease in motion. Skeletal scintigraphy 4 years after the revision (technetium-99m methylene diphosphonate) showed increased activity in the major part of the allograft, indicating regeneration (Figure 4).

Discussion

Instability is one of the most common complications after shoulder arthroplasty. Posterior instability is less obvious than the anterior form (Lohr et al. 1998). When posterior instability occurs due to incorrect positioning of the stem, revision is recommended (Warren et al. 2002). The overall results are inferior to primary procedures, however (Cofield and Edgerton 1990, Wirth and Rockwood 1994, Petersen and Hawkins 1998). Functional outcome following revisions is often impaired by muscle damage, bone loss and scar (Neer and Kirby 1982). In our case, we had to deal with an extended proximal bone deficiency, which necessitated a large bone graft for reinsertion of the cuff, and to provide additional support to the proximal part of the stem.

Previous studies have reported good results from the use of structural autogenous bone grafts on the glenoid side, but there have also been reports of some failures due to resorption and non-healing of grafts (Steinmann and Cofield 2000, Hill and Norris 2001). Cancellous grafts are mainly replaced by creeping substitution into viable bone, whereas structural grafts are only marginally replaced by new bone (Burchardt 1983, Goldberg and Stevenson 1987).

At the time of surgery, we had not found any studies considering the use of impacted morselized allograft in the proximal humerus. However, several studies of revision hip and knee arthroplasties have shown the value of this procedure (Ling et al. 1993, Buma et al. 1996, Ullmark and Linder 1998, Kärrholm et al. 1999, Loon et al. 2000). There has been one case report about the use of impaction bone grafting in the distal humerus, with a successful clinical and radiographical result (Halstead et al. 2000).

To date, our attempt to restore the continuity between the remaining humeral bone and the rotator cuff, providing a viable seating for the cuff to heal against, has turned out to be successful. Scintigraphy has indicated that the graft is in the process of incorporation and the radiographic findings have also shown signs of restructuring and bony ingrowth (Figures 3 and 4). This seems to be a promising strategy in restoring bone loss, even in the proximal humerus.

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