Internal fixation and strut allograft augmentation for periprosthetic humeral fractures

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ABSTRACT

Purpose. To report 6 patients with periprosthetic humeral fractures treated with open reduction and internal fixation with plate and strut allograft augmentation.

Methods. 6 women aged 69 to 79 (mean, 73) years underwent open reduction and internal fixation with plate and strut allograft augmentation for periprosthetic humeral fractures (type C) after a fall. They had undergone reverse shoulder arthroplasty for rotator cuff arthropathy. The mean interval between the initial arthroplasty and the fracture was 17 (range, 11–21) months.

Results. The mean follow-up period was 14 (range, 12–16) months. The mean time to union was 5.4 (range, 4–6) months. All fractures united without complications. The mean Constant score at the last follow-up was 64 (range, 56–80). The range of shoulder movement and patient satisfaction were restored to pre-fracture status in all patients, except for one who had more pain in the lateral area of the arm (probably because of soft-tissue irritation by the plate and wires). Three patients had evidence of graft-to-host union and 3 others had graft resorption.

Conclusion. Internal fixation with plate, cable wires and strut allograft augmentation achieves satisfactory results for periprosthetic humeral fractures.

Key words: bone plates; fracture fixation, internal; humeral fractures; periprosthetic fractures; transplantation, homologous

INTRODUCTION

Periprosthetic humeral fractures affect 1–2% of all shoulder arthroplasties and may occur during surgery or as a late complication.1,2 Risk factors include osteopenia, prosthetic loosening, and cortical thinning secondary to osteolysis.2,3 Periprosthetic humeral fractures are classified as type A (around the prosthesis tip with proximal extension), type B (around the prosthesis tip with no or minimal proximal extension and variable distal extension), and type C (ensuing distal to the tip).1 They can be
treated surgically or conservatively (with casts and braces).3,5

When the humeral prosthetic component is loose or the fracture line overlaps most of the length of the prosthesis, revision with a long-stem implant should be considered.3,6 When the fracture overlaps the tip of the prosthesis and extends distally or is completely distal to the prosthesis, open reduction and internal fixation is recommended.5–10 Conservative treatment requires long-term immobilisation and has a higher rate of non-union.3,5 We report a series of 6 periprosthetic humeral fractures treated with open reduction and internal fixation using plate and strut allograft augmentation.

MATERIALS AND METHODS

Between March 2007 and February 2009, 6 women aged 69 to 79 (mean, 73) years underwent open reduction and internal fixation with plate and strut allograft augmentation for periprosthetic humeral fractures after a fall. They had undergone reverse shoulder arthroplasty for rotator cuff arthropathy. One of the patients had had an intra-operative humeral shaft fracture fixed with a cerclage wire. The mean interval between the initial arthroplasty and the fracture was 17 (range, 11–21) months. All fractures were type C (Fig.).

A broad 4.5 mm locking compression plate was applied onto the lateral surface of the humerus through an anterolateral approach. The radial nerve was identified and protected. Bicortical screws were used for distal fixation, and cable wires for proximal and distal fixation. A strut allograft was filled into the medial surface of the humerus to improve fixation stability. The graft was fixed with wires and distal bicortical screws (Fig.). Cancellous bone grafts from the allograft were added to the fracture site. Postoperatively, free mobilisation was allowed.

Fracture union was defined as the presence of bridging bone on 2 radiographic views with no evidence of hardware failure and the absence of pain at the fracture site. Functional outcome was assessed using the Constant score. Patients’ subjective evaluations (worse, equal, or better) of their shoulder function and satisfaction before the fracture and after surgery were compared.

![Figure](a) Type-C periprosthetic humeral fracture, (b) internal fixation with plate and cable wires and strut allograft augmentation, (c) fracture union and graft incorporation, and (d) graft resorption.

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Gender/age (years)</th>
<th>Time from arthroplasty to fracture (months)</th>
<th>Type of fracture</th>
<th>Time from fracture to internal fixation (days)</th>
<th>Time to union (months)</th>
<th>Postoperative Constant score</th>
<th>Postoperative range of shoulder motion (degrees)</th>
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RESULTS

The mean follow-up period was 14 (range, 12–16) months. The mean time to union was 5.4 (range, 4–6) months (Table). All fractures united without complications. The mean Constant score at the last follow-up was 64 (range, 56–80). The range of shoulder movement and patient satisfaction were restored to pre-fracture status in all patients, except for one who had more pain in the lateral area of the arm (probably because of soft-tissue irritation by the plate and wires). Three patients had evidence of graft-to-host union and 3 others had graft resorption (Fig.).

DISCUSSION

Transverse or short oblique fractures at the distal end of the stem do not unite when treated conservatively. In the presence of a stable prosthesis, open reduction and internal fixation with a plate and additional cable wires has achieved good results. Nonetheless, proximal screw fixation adjacent to the stem is not feasible, and severe osteoporosis and a thin cortex prevent a solid grip for the screws distally. Strut allograft augmentation reinforces the fixation of periprosthetic fractures after total elbow arthroplasty. In osteoporotic bone, the medial cortical bone can break when the wires are tightened, whereas strut allograft augmentation enhances fixation stability of the wires and screws. Bone union was achieved for osteopenic humeral shaft non-unions after compression plating, humeral cortical allograft struts, and bone grafting.

The locking compression plate and screws provides more stability and strength to the fixation, and the distal bicortical screws can be used to fix the graft. Graft resorption did not induce loosening of the fixation. The role of the graft is to improve the initial strength of the fixation, to enhance the fixation stability of wires and screws, and to enable immediate postoperative mobilisation, but not to unite to the humerus.

In our study, the periprosthetic humeral fracture rate of 10% in 5 years is quite high, but all fractures occurred as a result of a fall. We considered this implant for reverse shoulder arthroplasty appropriate for patients with cuff tears or arthritis. The constrained design of the implant and the limited glenohumeral motion may increase torsional stress at the tip of the prosthesis.

REFERENCES