The authors report their experience in the management of a 53-year-old woman with rheumatoid arthritis who presented with bilateral asynchronous traumatic periprosthetic fractures of the humerus after bilateral elbow replacements. One side was treated with a long-stem revision and internal fixation with bone graft, while the other side was treated with a long-stem distal humeral replacement. She sustained pathological periprosthetic fractures on top of the long-stemmed implants. Total humeral endoprosthesis replacements were performed bilaterally as salvage procedures to provide a stable platform for her elbow and hand function. At manuscript submission, the patient was 24 months and 36 months postoperatively on the left and right sides, respectively. Her Oxford Shoulder Scores were 21 (left side) and 24 (right side). There is little information about the management of periprosthetic fractures of the humerus after long-stem revisions with severe bone loss. To the best of the authors’ knowledge, this is the first case report describing the use of bilateral total humeral endoprosthesis replacements in the management of complex unstable periprosthetic fractures. This is a valuable treatment option for patients with poor bone quality, bone loss, and loose components. [Orthopedics. 2017; 40(2):e363-e366.]

Orthroplasty for patients with rheumatoid arthritis is often complicated by the presence of bone densities in the osteopenic or osteoporotic range. As a result, there is an increased risk for periprosthetic fracture. A 5% incidence rate of periprosthetic humeral fractures after elbow arthroplasty has been reported.\textsuperscript{1,2} There are few reports in the literature that address the use of total humeral endoprosthesis replacement (THER) for the treatment of malignant bone tumors. Total humeral endoprosthesis replacement decreases pain, improves function, and provides a stable platform for elbow and hand function, with an acceptable patient-reported outcome.

**Case Report**

The patient was a 53-year-old white woman with rheumatoid arthritis. She presented with symmetrical bilateral periprosthetic fractures of the humerus; current concepts of treatment are based on those for periprosthetic hip fractures. The few studies about the treatment of periprosthetic fractures of the humerus have mainly analyzed the outcome of nonoperative treatment and internal fixation.\textsuperscript{3,4} There are few reports in the literature that address the use of total humeral endoprosthesis replacement (THER) for the treatment of malignant bone tumors. Total humeral endoprosthesis replacement provides consistent and predictable results with low rates of complication. Destruction of a large part of the humerus may be caused by injury, rheumatoid arthritis, infection, tumor, or failed total shoulder and total elbow replacements, and can result in a flail elbow and a disabled hand.\textsuperscript{5,6}

The purpose of presenting this case is to show that THER could be a salvage procedure in periprosthetic humeral fractures, especially if rheumatoid arthritis, injury, and failed humeral component of total elbow replacement are all present in a patient. Total humeral endoprosthesis replacement decreases pain, improves function, and provides a stable platform for elbow and hand function, with an acceptable patient-reported outcome.\textsuperscript{5,6}

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vere pain and poor function in her elbows. After consideration of her medical history, physical examination, and radiographs, the senior author (M.R.) concluded that total elbow arthroplasty was the appropriate step for this patient’s surgical management. The Discovery Elbow System (Zimmer Biomet, Warsaw, Indiana) was used on both sides 6 months apart.

**Left Side**

The left elbow replacement (Figure 1) was complicated by elbow stiffness. Twelve months postoperatively, the authors performed anterior capsular release with excision of the nonunited medial condyle and a remaining radial head fragment. Then, 9 months later, the patient tripped and fell onto her left arm, sustaining a periprosthetic humeral fracture. This was fixed with cables, and the humeral stem was revised to a longer stem. Twelve months later, she developed acute pain and weakness in her left arm. Radiographs showed failure of the tuberosities to heal and superior migration of the humeral head due to rotator cuff failure. The proximal Mosaic humeral component was then revised to a reverse polarity total shoulder replacement (Comprehensive Segmental Revision System; Zimmer Biomet) (Figure 3).

**Right Side**

After her right elbow replacement, the patient had pain-free full range of motion of her elbow. Three years postoperatively, she fell onto her right side and sustained a periprosthetic humeral fracture. This was treated using a Mosaic distal humeral replacement system because of poor bone stock distally. After 11 months, she developed sudden onset of pain and weakness in her right arm. Radiographs revealed a pathological proximal humeral periprosthetic fracture (Mayo type H-II3: implant loose with severe bone loss) with proximal migration of the long humeral stem. This was revised to a THER using the Comprehensive Segmental Revision System (Figure 4).

At manuscript submission, the patient was 24 months and 36 months postoperatively on the left and right sides, respectively. Her Oxford Shoulder Scores were 21 (left side) and 24 (right side) and she reported no pain. Her shoulder range of motion on the left side was 50° of abduction, 30° of flexion, 0° of external rotation, and internal rotation until T7. Her shoulder range of motion on the right side was 80° of abduction, 45° of flexion, 20° of external rotation, and internal rotation until L1. The elbow extension deficits were 80° and 40° for the left and right elbows, respectively (Figure 5).

**DISCUSSION**

Periprosthetic fractures are among the most challenging complications of elbow arthroplasty, and published information about the outcome of treatment is lim-
Risk factors include female sex, revision surgery, rheumatoid arthritis, overreaming of the humeral canal, soft tissue contracture, aggressive manipulation, and osteopenia. The few reports in the literature that address the management of periprosthetic humeral fractures describe only a small number of patients. Nonoperative treatment is indicated when the fracture is stable and undisplaced with a fixed stem. These fractures are usually difficult to control in a brace. Internal fixation is indicated when reduction cannot be maintained in an orthosis and when there is a stable prosthesis and adequate bone stock. However, osteosynthesis is unlikely to be successful for patients with rheumatoid arthritis because the small amount of osteopenic bone that remains is insufficient to provide adequate purchase for screws. When the prosthesis is unstable and in the presence of inadequate bone stock, revision surgery is recommended.

It is widely acknowledged that periprosthetic fractures of the humerus are difficult to treat and have a high rate of complications. Campbell et al reported a 43% complication rate after the operative treatment of periprosthetic fractures. Complications included inadequate fixation (31%), delayed union or nonunion (12%-22%), fracture displacement (9%), nerve injury (13%-25%), rotator cuff tears (5%), frozen shoulder (6%), and infection (6%-10%). Dissatisfaction rates between 56% and 66% have been reported. The loss of shoulder movement was the principal reason for this unsatisfactory outcome.

The current authors believe that the relatively good satisfaction reported by their patient was likely due to the fact that she had already undergone many operations and had low expectations. The low Oxford Shoulder Scores after THER reflect the salvage nature of this procedure.

In the management of the first periprosthetic fracture (left side), the cable fixation and bone grafting with a longer humeral stem proved to be inadequate. Therefore, the authors decided to treat the contralateral side with a distal humeral replacement. However, both options failed proximally in this patient because of her poor bone quality. In the first THER (left side), the authors performed the shoulder hemiarthroplasty part of the procedure by osteotomizing the tuberosities and then...
repaired the tuberosities onto the stem, similar to a trauma shoulder hemiarthroplasty. The tuberosities failed to heal and the humeral head migrated proximally. The shoulder became dysfunctional, which necessitated a reverse polarity revision. When executing the same procedure on the contralateral side, the authors excised the humeral head through the rotator interval and broached the humeral canal while preserving the tuberosities.

**Conclusion**

Total humeral endoprosthesis replacement for patients with a periprosthetic humeral fracture associated with severe bone loss and loose components can provide a stable platform for elbow and hand function at waist level. However, it is a salvage procedure associated with a high rate of complications and function is not as good as that from the primary total elbow replacement prior to fracture. Patients undergoing these procedures have to be clearly informed about the high risk of complications.

**References**