Functional Outcomes for Surgically Treated 3- and 4-part Proximal Humerus Fractures

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Surgical treatment of 3- and 4-part proximal humeral fractures remains challenging. This study retrospectively evaluated functional outcomes of locked plate fixation vs hemicaproplasty in 57 patients with 3- and 4-part proximal humerus fractures from 2003 to 2005 with a mean follow-up time of 35 months (range, 15.7-52.7 months). Mean patient age was 56.9 years (range, 29-81.7 years) for the open reduction and internal fixation group (n=42) and 66.4 years (range, 38.1-90 years) for hemiarthroplasty group (n=15). All 57 patients completed the American Shoulder and Elbow Surgeons score, the Simple Shoulder Test, the Euroqol EQ-50, and the visual analog pain scale. Range of motion, the Constant Score, and the UCLA Shoulder score were used to evaluate a subset of 33 patients. Forty-one patients in the open reduction and internal fixation group achieved union, and 1 had symptomatic avascular necrosis requiring subsequent hemiarthroplasty. Two patients had implant removal for impingement symptoms. In the hemiarthroplasty group, there was 1 revision for a loose prosthesis. The American Shoulder and Elbow Surgeons score (P=.023), Simple Shoulder Test (P=.012), patient satisfaction (P=.034), Constant Score (P=.008), Kelsh Adjusted Constant Score (P=.015), UCLA Shoulder score (P=.01), and range of motion (forward flexion, P=.002; abduction, P=.001) were significantly better in the open reduction and internal fixation group than the hemiarthroplasty group. No significant differences between the groups existed in terms of SF-12 (physical, P=.118; mental, P=.134), Euroqol EQ-50 (P=.169), or visual analog pain scale scores (P=.135), but all trended toward better with open reduction and internal fixation.

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Proximal humerus fractures trail behind only femoral neck and distal radius as the third most common fracture in patients older than 65 years. Although 80% are nondisplaced and can be managed nonoperatively, displaced and unstable fractures often require surgical treatment. Goals of treatment are to relieve pain and achieve stability to allow for early mobilization and restoration of function. Differences in opinion exist with regard to which type of operative treatment is best suited to achieve these goals for 3- and 4-part proximal humerus fractures, especially in elderly patients with osteoporotic bone. Classic teaching specified that hemiarthroplasty was favored in an elderly population. This was based on Neer’s report of successful treatment of these fractures with hemiarthroplasty, and reports of failure with open reduction and internal fixation (ORIF) with non-locked plates. Recent functional outcomes studies looking at hemiarthroplasty, however, have been much less favorable.

Mixed outcomes of early internal fixation studies have also been difficult to interpret. With the success of locked plating for treatment of periarticular fractures elsewhere in the body, and with the availability of precontoured locking proximal humeral plates, osteosynthesis of 3- and 4-part proximal humerus fractures has emerged as an attractive alternate option to hemiarthroplasty. Stable fixation encourages bony healing and allows for early range of motion (ROM). A retrospective study was conducted to evaluate differences in subjective outcome and satisfaction scores as well as objective ROM data between ORIF with locking plates and hemiarthroplasty for treatment of 3- and 4-part proximal humerus fractures.

Materials and Methods

This study was approved by the Hospital Institutional Review Board. All patients who underwent either ORIF or hemiarthroplasty for proximal humerus fractures between January 1, 2003, and January 31, 2006, were studied retrospectively. All surgeries were performed at a single Level I institution by 8 different fellowship-trained orthopedic trauma surgeons. At the surgeon’s discretion, the fractures were addressed using either ORIF with the 3.5-mm LCP precontoured locking proximal humerus plate (Synthes, Paoli, Pennsylvania), or with cemented hemiarthroplasty (Global Fracture System, DePuy Orthopaedics, Warsaw, Indiana). All procedures were performed via the standard deltopectoral approach. Suture augmentation of tuberosity fragments was performed with #2 FiberWire suture (Arthrex USA, Naples, Florida) tied through the proximal holes in the locking plate. Patients were identified via a trauma database query for Current Procedural Terminology codes 23615 (ORIF) and 23616 (hemiarthroplasty). Radiographs and operative reports were used to select only those patients treated for displaced 3- or 4-part fractures of the proximal humerus (Orthopaedic Trauma Association 11-B). Exclusion criteria were patients with multiple injuries to the same extremity or pre-existing upper extremity disability, patients with <12 months of follow-up, age <18 years, and pathologic fractures. This yielded a cohort of 110 patients (85 were treated with ORIF and 25 with hemiarthroplasty) who met our criteria.

Functional outcomes questionnaires were sent out to all 110 patients with an invitation to return to the office for a physical examination. Of the 110 patients identified, 22 did not return the questionnaire or schedule an examination, 22 were unable to be located (via phone, e-mail, or mail), 2 were deceased, and 8 were not interested in participating. This left 57 respondents (ORIF, n=42; hemiarthroplasty, n=15) who agreed to participate. Thirty-three of these 57 (ORIF, n=25, hemiarthroplasty, n=8) also agreed to present for an additional follow-up visit and physical examination.

Five functional outcome scores were used to evaluate all 57 patients: the American Shoulder and Elbow Surgeons score, the Simple Shoulder Test, the Euroqol EQ-50, a visual analog pain scale, and the Short Form-12 (SF-12v2) health survey. Patients were also queried whether they were satisfied with their outcome. Patient demographics recorded were age, sex, dominant and injured extremities, and length of follow-up. A 33-patient subgroup also agreed to a physical examination. This permitted calculation of 2 additional validated functional outcome scores for this group: the Constant score and UCLA Shoulder score, as these tests require ROM and strength data.

For statistical analysis, patients were divided into ORIF and hemiarthroplasty groups. Each of the outcome measures was compared between the 2 groups using Student’s t test. Fisher’s exact test was used to compare differences in sex, handedness, and satisfaction between the 2 groups. The level of significance for all parameters was set at P<.05.

Results

Fifty-seven patients with an average follow-up of 35.4 months (range, 15.7-52.7 months) were analyzed. There was a statistically significant difference in age breakdown between the ORIF group and the hemiarthroplasty group, with an average age of 56.9 years (range, 29-81.7 years) and 66.4 years (range, 38.1-90 years), respectively (P=.02). There was a trend toward a sex difference, with 67% women in the ORIF and 93% women in the hemiarthroplasty groups (P=.08). No significant differences existed between the 2 groups in terms of length of follow-up or dominant injured extremity. Patients in the ORIF group had statistically better outcomes compared to the hemiarthroplasty group as measured by the American Shoulder and Elbow Surgeons score and Simple Shoulder Test outcome measures. Patients in the ORIF group also had a higher rate of satisfaction with their outcome: 83% vs 53% (P=.03). The visual analog pain scale, EQ-50, and SF-12v2 trended toward better in the ORIF group, but failed to achieve statistical significance (Table 1).
After exclusion of the patients who did not agree to a physical examination appointment, a 33-patient subgroup remained with a mean follow-up of 33.6 months (range, 17.3-52.5 months). Mean age was 58.3±11 years (range, 38-81.7 years). In this subgroup, no significant differences existed between the 2 groups in terms of age, dominant handedness, or length of follow-up (Table 2). The hemiarthroplasty group retained its trend toward a higher female population (M:F=1:7) compared to the ORIF group (M:F=6:13) (P=.08). Range of motion data, Constant Score, Kelsh Adjusted Constant Score, and UCLA Shoulder outcomes were analyzed separately from the original cohort. The ORIF group demonstrated statistically better outcomes compared to the hemiarthroplasty group as measured by each of these measures (Table 2). There was a striking difference in ROM between the 2 groups, with the ORIF group having an average forward flexion of 140° vs 90° in the hemiarthroplasty group (P=.002) and an average abduction of 126° vs 100°, respectively (P=.001).

Clinical and radiographic review of the ORIF group showed union in 41 patients (97.6%) and symptomatic avascular necrosis with a nonunion in 1 patient who underwent subsequent hemiarthroplasty. Plate removal was performed in 2 patients at an average of 3 months from the index surgery, secondary to impingement symptoms. In the hemiarthroplasty group, 1 patient underwent revision surgery for greater tuberosity nonunion and implant loosening. No infections occurred in either group.

### Discussion

Selecting and executing a treatment option for complex proximal humerus fractures remains a significant challenge, as universally accepted guidelines for treatment modality have not been established. While indications for hemiarthroplasty are not absolute, it has been recommended for patients with osteoporosis, severe comminution, head splitting fractures, and fractures with a high probability of osteonecrosis.15,16 Many authors favor primary hemiarthroplasty for complex proximal humerus fractures because it is successful in providing pain relief and is often considered less technically demanding than ORIF. Unfortunately, functional results of hemiarthroplasty have been disappointing.5,13,17,18 Zyto et al18 reviewed 27 patients after a mean of 3 years who had sustained displaced 3- and 4-part fractures of the proximal humerus treated with hemiarthroplasty; mean Constant Score was 46 (range, 11-78), median ROM was 70° of flexion and abduction, and 9 patients had moderate or severe pain. Compito et al19 achieved excellent results in only 48.5% of their fractures after hemiarthroplasty. Kralinger et al15 found that after hemiarthroplasty, the outcome was generally satisfactory in regard to pain, but only 41.9% of patients were
able to flex the shoulder >90°. Goldman et al. report that 73% of patients reported difficulty with at least 3 of 15 functional tasks on the American Shoulder and Elbow Surgeons score scale.

Our results with hemiarthroplasty are comparable to those in the literature. Our patients treated with hemiarthroplasty had effective relief of their pain comparable to that of ORIF. However, they had decreased ROM, with forward elevation and abduction means of 90° and 100°, respectively. They also had difficulty with many functional tasks, as illustrated by a mean American Shoulder and Elbow Surgeons score of 56.9 and a mean Constant score of 44.8. Reasons cited for poor functional outcome include poor rotator cuff integrity, advanced age, difficulty with tuberosity healing, limited ROM, difficulty in soft tissue balancing, and component malposition.24

Although no panacea for this difficult fracture exists, ORIF with locked plating has regained popularity as an attractive alternative to hemiarthroplasty. In a recent study, Durall and Leedy25 prospectively explored the results of locking-plate ORIF in unstable fractures. They had a good to excellent result in 82% of patients with an average forward elevation of 156°. They attributed their good results to anatomic reduction, careful soft tissue technique, and suture-augmentation of the repair with Fiber-Wire sutures through the rotator cuff and tied around the plate. Similarly, Richter et al. studied 52 patients treated with proximal humeral locking plates. They found a mean forward elevation of 130° and an average American Shoulder and Elbow Surgeons score of 70.8. In our series, 97.6% of patients treated with ORIF healed their fracture. There was no recorded screw penetration and only 1 case of avascular necrosis. Our results are comparable with the recent literature with an average American Shoulder and Elbow Surgeons score of 71.6, an average Constant Score of 70.1, and average forward elevation of 140°.

When comparing the results between our 2 groups, our study suggests several important differences in outcome with respect to surgical treatment type. Patients in the ORIF group had significantly better functional outcomes as measured by the American Shoulder and Elbow Surgeons score, Simple Shoulder Test, Constant Score, and UCLA shoulder score. Patient satisfaction and ROM were also better in the ORIF group. On average, the patients treated with ORIF had 50° more forward flexion and 26° more abduction than the hemiarthroplasty group. Our results are in support of recent recommendations showing that it is reasonable to use the locking proximal humerus plate for fractures that would have historically been treated with hemiarthroplasty, specifically in 3- and 4-part fractures in patients with osteoporosis.17

This study has limitations. It is a retrospective review, and only a limited number of patients participated in the functional assessment as well as the physical examination, making it prone to a sampling error. Final radiographs were not obtained during the functional examination visit, as patients were already clinically and radiographically healed. Demographic composition of our 2 groups was statistically different with respect to age, with the hemiarthroplasty group being an average of 9.4 years older than the ORIF group. Although this could explain the difference in functional outcomes, the results for each group are consistent with those published in recent reports. In addition, subgroup analysis of patients who presented for clinical follow-up yielded 2 demographically similar groups. Also, the Kelsh method for adjustment of the Constant Score normalizes results for sex and age. This score was also significantly better in the ORIF group.

Our functional results for hemiarthroplasty are consistent with traditional results using this method of treatment. Hemiarthroplasty is effective in eliminating pain. However, this study adds support that it is inferior to ORIF with regard to restoration of function and overall patient satisfaction. It is the our opinion that the majority of 3- and 4-part proximal humerus fractures in elderly patients with osteoporosis can be treated successfully with proximal humeral locking plates, yielding a more functional shoulder, as long as care is paid to achieving an anatomic reduction and tuberosity fixation as elucidated in recent literature. Hemiarthroplasty may serve as a salvage procedure should ORIF fail, or in the situation where acceptable reduction is not obtainable or maintainable.

REFERENCES


