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Nonoperative management versus reverse shoulder arthroplasty for treatment of 3- and 4-part proximal humeral fractures in older adults

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Background: The treatment of 3- and 4-part proximal humeral fractures in the older adult is controversial. No study has directly compared reverse shoulder arthroplasty (RSA) with nonoperative treatment for these fractures. The purpose of this study was to compare clinical and patient-reported outcomes between RSA and nonoperative treatment groups.

Methods: A retrospective review was performed on all 3- and 4-part proximal humeral fractures treated with either RSA or nonoperative treatment with minimum 1-year follow-up. All patients in the nonoperative cohort were offered RSA but declined. Objective patient data were obtained from medical records. Patient-reported outcomes including visual analog scale score, Single Assessment Numeric Evaluation score, Penn Shoulder Score, American Shoulder and Elbow Surgeons score, resiliency score, and Veterans Rand-12 scores were obtained at follow-up. Statistical analysis was performed by use of the Student *t* test for continuous variables and χ^2 analysis for nonparametric data.

Results: We analyzed 19 nonoperative and 20 RSA patients with a mean follow-up period greater than 2 years (29 months in nonoperative group and 53 months in RSA group). There were no differences in range of motion between groups (forward elevation, 120° vs 119° [$P = .87$]; external rotation, 23° vs 31° [$P = .06$]). No differences between the nonoperative and RSA groups were noted for any patient-reported outcomes. Among patients receiving RSA, there was no difference in outcomes in those undergoing surgery less than 30 days after injury versus those receiving delayed RSA.

Conclusions: This study suggests that there are minimal benefits of RSA over nonoperative treatment for 3- and 4-part proximal humeral fractures in older adults.

Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Proximal humeral fracture; reverse shoulder arthroplasty; older adult; nonoperative treatment; complications; patient-reported outcomes

Institutional review board approval for this project was received from Greenville Health System (No. Pro00040469).

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Proximal humeral fractures pose a significant challenge in the orthopedic community, with an annual incidence of 6 per 10,000 persons in the United States.[22] These fractures commonly present as fragility fractures in older adults,[33] and US census data project a continued rise in this aging population over the next 2 decades, with an even more dramatic increase worldwide.[19,38] The societal and economic burden of this injury is felt not only in the reduction in quality of life but also in the use of available health care resources.[43] The most common treatment modalities for these fragility fractures include nonoperative treatment, open reduction–internal fixation (ORIF), hemiarthroplasty (HA), or reverse shoulder arthroplasty (RSA).

When considering surgical treatment in older adults, 3- and 4-part fractures are the most common indications.[36] However, operative treatment with ORIF can result in a high complication rate.[45] These concerns over complications have led some investigators to question whether the benefit of ORIF is worth the risk, with multiple systematic reviews of randomized controlled trials suggesting no difference in outcomes between nonoperative treatment and ORIF in older patients with 3- and 4-part fractures.[27,30,40]

In addition to ORIF, HA is a common treatment for displaced 3- and 4-part fractures in older adults for many investigators.[16] HA is proposed as an alternative to bypass the concerns of bone quality pertaining to ORIF; some investigators have reported acceptable overall outcomes,[25,34,39,42] whereas others have reported less optimal results.[3,35,55] In a systematic review of HA for 3- and 4-part proximal humeral fractures in nearly all cases, Kontakis et al[24] found relatively good relief of pain but poor range of motion (ROM). In regard to functional outcomes, the mean Constant score was 57, with only 40% of patients achieving either an excellent or satisfactory outcome according to Neer.[36] One explanation for these results is malunion or nonunion of the tuberosities.[5,31] Two randomized controlled trials have compared HA with nonoperative treatment in older patients,[6,37] finding no difference in functional outcome scores and a modest increase in health-related quality of life (HRQoL) in one of the studies.[37] High complication rates and concern over tuberosity malposition and nonunion have led to the increased use of RSA in this population.[17,44] One study has shown improved elevation, external rotation, and internal rotation after tuberosity repair,[13] but another has found function to be independent of tuberosity healing.[46] Studies directly comparing RSA with HA have shown RSA to provide superior ROM,[2,8,9,14,46] improved pain,[2,46] and overall improved functional outcomes[2,7-9,13,14,46,47] in the treatment of proximal humeral fractures. However, to date, no studies have directly compared RSA with nonoperative treatment for proximal humeral fractures in the older adult. Therefore, this study was performed to compare nonoperative treatment with RSA for displaced 3- and 4-part proximal humeral fractures in older adults in relation to complications, ROM, and patient-reported outcomes.

Methods

A retrospective review was performed on all RSAs performed over a 7-year period (2007-2014) at a single institution. Institutional records were similarly queried for all nonoperatively treated displaced 3- and 4-part proximal humeral fractures over the same period. Plain radiographs and advanced imaging when available were reviewed by 2 orthopedic surgeons to identify 3- and 4-part fractures as defined by Neer[36] for inclusion in the groups. The nonoperative group comprised patients with displaced 3- and 4-part proximal humeral fractures who met surgical indications as per the surgeon's discretion and were offered RSA but elected to undergo nonoperative treatment. The RSA group comprised patients with displaced 3- and 4-part proximal humeral fractures who underwent RSA.

All operations were performed by 1 of 4 fellowship-trained shoulder surgeons. The patients were positioned in the beach-chair position. A standard deltopectoral approach was used to enter the shoulder joint. Two implant systems were used: Reverse Shoulder Prosthesis (DJO Surgical, Austin, TX, USA) or Reverse Shoulder System (Zimmer, Warsaw, IN, USA). The glenoid baseplate was placed as per manufacturer recommendations. It was placed inferiorly on the glenoid and with an inferior tilt to minimize scapular notching.

Both nonoperative and RSA patients underwent supervised physical therapy with an emphasis on early ROM with progressive strengthening. Specifically, in patients in the nonoperative group, sling use was maintained for the first 2 weeks. After 2 weeks, patients started a physical therapy protocol in which they started with Codman exercises and passive ROM with forward elevation and abduction. After 6 weeks, patients no longer used the sling and progressed to full active and passive ROM without restrictions. Both groups were allowed to return to full activity without restriction at 3 months.

Medical records were reviewed for patient demographic characteristics, complications, reoperations, and ROM measurements. The overall burden of comorbidities was compared between groups with the respective Charlson comorbidity indices, and patients' self-perceived reaction to adversity was assessed with resiliency scores measured via the Brief Resilience Scale.[50] Complications were defined as an adverse event directly related to the treatment choice, and reoperation was defined as any subsequent surgical intervention related to the index procedure.

Functional outcomes recorded for both groups included ROM measurements and patient-reported outcomes including visual analog scale score, Single Assessment Numeric Evaluation score, Penn Shoulder Score (PSS), and American Shoulder and Elbow Surgeons (ASES) score. HRQoL was assessed with the Veterans Rand-12 (VR-12) physical and mental component scores, which were obtained at a minimum of 1 year from the time of injury. Patients undergoing RSA were further analyzed by the timing of RSA: early (<30 days) versus delayed. Patients in the delayed group either presented to the treating surgeon beyond 30 days from injury or declined surgery and changed their minds requesting surgery after 30 days. Statistical analysis was performed by use of the Student t test for continuous variables and χ^2 analysis for nonparametric data, with $P < .05$ considered significant.

Results

In total, 39 patients were identified with 3- and 4-part proximal humeral fractures, with 20 in the RSA group and 19 in the nonoperative group, at a mean follow-up of greater than 2 years (29 months in nonoperative group and 53 months in