



Difficulty in decision making in the treatment of displaced proximal humerus fractures: the effect of uncertainty on surgical outcomes



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Background: Decision making in the management of proximal humerus fractures can be difficult in situations in which the surgeon is uncertain of the ideal treatment.

Methods: Two shoulder surgeons operatively treated 476 proximal humerus fractures from 1998-2014 with open reduction–internal fixation (ORIF), hemiarthroplasty, or reverse shoulder arthroplasty. Operative treatment was stratified by year to determine the evolution of technological influences on treatment over time. To evaluate the effect of uncertainty, 274 clinical vignettes were created for all patients with 1 year of follow-up or more and reviewed by 3 fellowship-trained shoulder surgeons to determine the type of treatment for each case. To evaluate the effect of certainty, range of motion for each patient with unanimous agreement on treatment was analyzed.

Results: ORIF treatment increased from 40% to 62% after release of the proximal humerus locking plate. Introduction of the fracture stem in 2011 increased reverse shoulder arthroplasty for fractures from 8.8% to 44.3%. Unanimous agreement on either operative or nonoperative treatment occurred 70.5% of the time. Only 63.5% of patients received the actual treatment selected ($P = .001$). Patients for whom unanimous agreement matched actual treatment in the ORIF treatment group showed improvement of forward elevation (144° vs 123° , $P = .005$) and abduction (129° vs 103° , $P = .002$).

Conclusion: Successful management of displaced proximal humerus fractures requires both technical and decision-making abilities. The difficulty in making these decisions is reflected by the agreement of experienced shoulder surgeons only 63.5% of the time regarding the treatment performed. When uncertainty occurs, patients may have reduced outcomes as seen in the ORIF treatment group.

Level of evidence: Level IV; Decision Analysis Study

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This study was determined to be exempt from review by the Western Institutional Review Board.

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Proximal humerus fractures are often complex injuries that challenge orthopedic surgeons on many levels. To this day, there is substantial disagreement, beginning with simply classifying each proximal humerus fracture.^{1,4,13} There is evidence to suggest that enhanced 3-dimensional imaging may help to improve fracture classification and management, but the results of studies addressing this issue are far from absolute.^{4,13} Similarly, there is substantial disagreement about how to best treat patients with these injuries, and over the years, the evolution of techniques and implants has certainly helped shape the way proximal humerus fractures are managed. Presently, there are several surgical treatment options available, most of which could be broadly classified as open reduction–internal fixation (ORIF) or arthroplasty. Moreover, there is evidence to suggest that subspecialty training influences the operative treatment method chosen.^{2,7} That said, the clear majority of proximal humerus fractures are treated nonoperatively, and there is level I evidence to suggest that nonoperative management may yield similar outcomes to operative management.¹¹

In 2015, *JAMA: The Journal of the American Medical Association* published the ProFHER (Proximal Fracture of the Humerus: Evaluation by Randomization) trial,¹¹ the results of which suggest that perhaps orthopedic surgeons are operating on too many proximal humerus fractures. Unfortunately, because of the inclusion of all types of proximal humerus fractures, the generalized message of the ProFHER study further added to the confusion in managing these fractures, as there is good evidence to support operative treatment in appropriate scenarios.^{9,10} This suggests that there is a cohort of patients on each end of the treatment spectrum with injuries that are very obviously best managed either nonoperatively or operatively. There is, however, a subset of patients with displaced fractures that provides the treating surgeon a great deal of uncertainty in management, and to date, there has been no study evaluating the effect of decision making in the management of this particular group. For this reason, we evaluated the treatment experience and the evolution in decision making of 3 fellowship-trained shoulder surgeons with 5 years (R.J.O.), greater than 15 years (M.A.M.), and greater than 25 years (M.A.F.) of shoulder experience. In doing so, the purpose of our study was threefold: (1) to determine how the introduction of new technology affected the choice of treatment of proximal humerus fractures, (2) to report on the clinical outcomes of patients treated with ORIF or arthroplasty for proximal humerus fractures, and (3) to assess the effect of uncertainty on the decision making of 3 shoulder surgeons by comparing the clinical outcome scores in those cases in which there was agreement on the mode of treatment versus those in which some degree of uncertainty existed. On the basis of our study design, we hypothesized that the introduction of technology would influence the type of operative treatment performed, and last, we hypothesized that patients would have better outcomes in those cases in which there was agreement on the type of operative treatment.

Methods

Our institution's orthopedic database, FileMaker Pro 12 (FileMaker, Santa Clara, CA, USA), was queried for all patients (N = 476) with proximal humerus fractures treated operatively by 2 orthopedic shoulder and elbow surgeons (M.A.M. and M.A.F.) from 1998-2014. Operative treatment included ORIF, hemiarthroplasty (HA), or reverse shoulder arthroplasty (RSA). This group of 476 operatively treated patients was used to graph the number of cases by treatment type (ORIF, HA, or RSA) per year from 1998-2014. The dates of the release of the first Synthes proximal humerus locking plate (Johnson & Johnson, Westchester, PA, USA) and the first DJO reverse arthroplasty fracture stem (DJO Global, Vista, CA, USA), both of which were the preferred implants at our institution, were applied to the graph to further evaluate the evolution in operative treatment over time. Percentages of each operative treatment method relative to the release dates of the proximal humerus locking plate and reverse arthroplasty fracture stem were then calculated to demonstrate the evolution in practice.

The second phase of the study began with identifying all patients (N = 476) having undergone operative treatment of proximal humerus fractures by 2 orthopedic shoulder and elbow surgeons (M.A.M. and M.A.F.) from 1998-2014. Patients having undergone ORIF were included if they were treated with operative fixation within 3 weeks of injury and had at least 3 months of follow-up with postoperative radiographs to confirm healing. Patients having undergone arthroplasty (HA or RSA) were included if they were treated operatively within 3 weeks of injury and followed up postoperatively for at least 1 year with radiographs. All other patients were excluded, yielding a total of 250 patients treated with ORIF, HA, or RSA. By use of this group of patients, clinical vignettes were composed consisting of injury radiographs and 6 factors about each patient that were agreed on and used by 3 fellowship-trained shoulder and elbow surgeons in assessing patients with proximal humerus fractures and in deciding whether to operate on them. These factors included age, sex, handedness, occupation, mechanism of injury, and medical history. A total of 24 patients with proximal humerus fractures treated nonoperatively during the study period were randomly selected from the FileMaker Pro 12 database and added to the cohort of 250 operatively treated patients, for a total of 274 included patients. These 274 cases were then divided among 10 surveys of clinical vignettes, each of which was distributed to 3 fellowship-trained shoulder and elbow surgeons (M.A.M., M.A.F., and R.J.O.) to determine "how they would presently treat" each patient based on demographic characteristics and injury radiographs. The same set of vignettes was given to the 3 current fellows at the institution to evaluate the effect of experience on decision making. In addition, range-of-motion data were gathered from patient charts and used as functional outcome measures, comparing the range of motion in those patients for whom the surgeons unanimously agreed on the type of treatment and the patients in fact received that treatment versus those cases in which there was unanimous agreement but the patients received an alternative treatment.

Finally, a subgroup analysis was performed evaluating range-of-motion data for those patients who were followed up for less than 1 year compared with those who were followed up for 1 year or longer. This was done to provide justification for inclusion of ORIF patients with at least 3 months of follow-up.

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