

The Value of Lateral Glenohumeral Offset in Predicting Construct Failure in Proximal Humerus Fractures

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Purpose: Proximal humerus fractures are among the most common osteoporosis-defining injuries in the US, yet operative fixation of these injuries remains technically challenging. While several modifiable and non-modifiable risk factors have been correlated with failure of operative fixation in the proximal humerus, no study has investigated whether shoulder offset plays a part in fixation failure. The purposes of this study are: (1) Can the ratio between lateral glenohumeral offset (LGHO) and humeral head diameter (HHD) be reliably measured with adequate interobserver reliability? (2) Does failure to restore the LGHO:HHD relationship after proximal humerus open reduction and internal fixation (ORIF) with a plate and screw construct predispose patients to construct failure? (3) Are there any other factors associated with implant failure? (4) Can there be any recommendations made with regard to the ideal LGHO:HHD ratio?

Methods: Patients who underwent operative fixation for proximal humerus fractures were retrospectively collected between 2005 and 2018. During this period, 183 patients underwent ORIF with a plate and screw construct. Construct failure was defined as (1) screw cut-out, (2) screw penetration into the glenohumeral joint, or (3) posttraumatic arthrofibrosis requiring return to the operating room. Patients suffering construct failure requiring reoperation were compared to clinically successful surgeries on the basis of age, sex, fracture morphology, head-shaft angle, presence or absence of a calcar screw, and LGHO:HHD ratio. The groups were compared using a combination of Student t tests, χ^2 , and bivariate and multivariate logistic regression analyses where appropriate. Student t test and intraclass correlation coefficient (ICC) were both utilized to assess interobserver reliability.

Results: The average ICC for LGHO:HHD was 0.80 with a 95% confidence interval ranging from 0.65 to 0.89 indicating appropriate interobserver reliability. Patients suffering construct failure had a significantly lower LGHO:HHD ratio compared to those who did not (0.94 vs 1.03, $P < 0.001$). The LGHO:HHD ratio was an independent predictor of implant failure even after controlling for other potential risk factors. Patients with an LGHO:HHD of 1.0 or above have a <10% chance of failure compared to a 20% risk with a ratio of 0.9 and a 40% risk at 0.8.

Conclusion: Lateral glenohumeral offset is an important anatomic relationship within the shoulder girdle that can be reliably measured between observers. Failure to restore the normal anatomy of the shoulder, represented by an LGHO:HHD ratio of at least 1.0, predisposes patients to construct failure after proximal humerus fracture fixation with a plate and screws. This measurement can be easily obtained intraoperatively and can help inform the surgeon as to the adequacy of reduction.