

## Achieving Satisfactory Functional Outcomes in Proximal Humerus Fractures: Relationship Between Shoulder Range of Motion and Patient-Reported Clinical Outcome Scores

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**Purpose:** Proximal humerus fractures are a common fragility fracture. Objective measures (eg, range of motion [ROM]) are commonly used in busy clinical practices as surrogates in predicting functional outcomes but the relationship to patient-reported outcome measure (PROM) scores has not been established. Our primary aim was to evaluate the relationship between the active ROM and PROM scores at 1 year post-fracture. Our secondary aim was to determining optimal cut-offs for active ROM to predict satisfactory PROMs.

**Methods:** In this prospective longitudinal cohort study design, inclusion criteria were (1) proximal humerus fracture presented within 3 weeks of injury and (2) more than 21 years old. Exclusion criteria were (1) delayed presentation (>3 weeks), (2) cognitive impairment, (3) severe medical comorbidities precluding surgery, (4) polytrauma, and (5) pathological fracture. Functional outcomes were the Oxford Shoulder Score (OSS) and QuickDASH score (an abbreviated version of the Disabilities of the Arm, Shoulder and Hand questionnaire) assessed at 1 year. Active ROM (flexion, extension, abduction, adduction, internal and external rotation) were measured in a standardized manner by an occupational therapist. Correlation and adjusted linear regression analysis were performed to establish relationships between ROM and PROMs. ROMs with significant correlation were then analyzed using receiver operating characteristic (ROC) curve analysis to determine the optimal cut-off that best predicts a satisfactory outcome.

**Results:** 67 patients were recruited (mean age 68 years, 81% female). Mean flexion was 132°, extension 62°, abduction 126°, external rotation 61°, and internal rotation 70°. Mean QuickDASH score was 8.82 and mean OSS was 43.65. Significant relationships were observed between PROMs and flexion (QuickDASH: R2: 0.121; adj coeff: -0.122, P = 0.011; OSS: R2: 0.303; adj coeff: 0.101, P<0.001), extension (QuickDASH: R2: 0.300, adj coeff: -0.415, P = 0.001; OSS: R2: 0.101, adj coeff: 0.150, P = 0.007), and abduction (QuickDASH: R2: 0.147, adj coeff: -0.118, P = 0.007; OSS: R2: 0.311, adj coeff: 0.093, P<0.001). ROC curve analysis showed cut-offs of 123° flexion, 60° extension, and 113° abduction with area under the curve of 0.751, 0.706, and 0.726, respectively predicting satisfactory PROM scores (OSS ≥40).

**Conclusion:** Active ROMs have a limited ability to predict PROMs with shoulder flexion, extension, and abduction the most predictive. Internal and external rotation was not predictive. Incorporating both objective ROM measurements and subjective PROMs are key for holistic patient evaluation through tools like the Constant score, which incorporate both elements. Full ROM is not required for activities of daily living with 1-year active ROM of 123° flexion, 60° extension, and 113° abduction associated with satisfactory functional outcomes. These ROMs can be used as goals guiding targeted rehabilitation protocols to optimize functional outcomes, particularly in elderly patients.