

The Impact of Residual Angulation on Patient-Reported Functional Outcome Scores after Nonoperative Treatment for Humeral Shaft Fractures

Edward Shields, MD; Leigh Sundem, BS; Sean Childs, BS; Michael Maceroli, MD; Catherine Humphrey, MD; John Ketz, MD; Gillian Soles, MD; John Gorczyca, MD; University of Rochester Medical Center, Rochester, New York, USA

Purpose: Data looking at the magnitude of residual angulation in the healed humeral diaphysis and its relationship to patient reported outcomes are lacking. The purpose of this study was to identify if correlation exists between residual angular deformity after nonoperative treatment for humeral diaphyseal fractures and patient-reported outcome measures, including patient satisfaction.

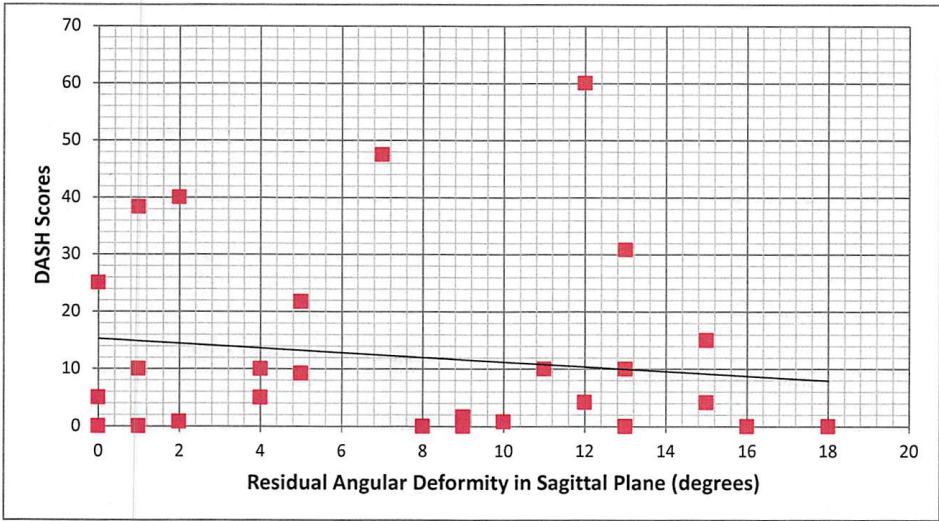
Methods: Patients treated from 2004-2011 for humeral shaft fractures were retrospectively identified for 3 surgeons at a single institution. All skeletally mature patients at least 1 year post-injury at the time of study participation were included in the study. Patients were excluded if they were treated surgically, were deceased, did not have available contact information, diagnosed with dementia, had subsequent but unrelated trauma or surgery to the injured extremity, and non-English speaking. 42 patients met criteria and were recruited by telephone to obtain the following outcome scores: Disabilities of the Arm, Shoulder, and Hand (DASH), the Simple Shoulder Test (SST), and general health questionnaire Short Form-12 physical component summary (SF-12 PCS) and mental component summary (SF-12 MCS). The patient chart was reviewed to analyze most recent radiographs to obtain residual diaphyseal angulation in the sagittal and coronal planes. Pearson correlation coefficients and Student t tests were calculated with IBM SPSS v19, with significance set at $P < 0.05$. All values are average \pm standard deviation.

Results: 32 patients were successfully recruited with an average age 45 ± 22 years, and average time from injury to study follow-up being 47 ± 29 months. The average outcome scores were DASH 12 ± 16 , SST 10 ± 2.7 , SF-12 PCS 50 ± 7.9 , and SF-12 MCS 54 ± 8.8 . Healed angular deformity in the sagittal plane measured on average $8^\circ \pm 5.7^\circ$ (range, 0-18), and $15^\circ \pm 7.9^\circ$ (range, 2-27) in the coronal plane. There was no significant correlation between residual sagittal plane angular deformity and outcome scores (DASH score $r = -0.14$, $P = 0.47$; SST $r = 0.22$, $P = 0.25$). There was no significant correlation between residual coronal plane angular deformity and outcome scores (DASH score $r = -0.17$, $P = 0.38$; SST $r = 0.28$, $P = 0.14$). All patients had less than 20° of residual sagittal plane deformity. Seven patients (22%) had residual coronal plane deformity of at least 20° . These 7 patients had similar DASH scores (13.2 ± 18.7 vs 11.7 ± 16.1 ; $P = 0.83$), SST scores (10.3 ± 2 vs 10.0 ± 2.9 ; $P = 0.81$), and overall satisfaction with their treatment ($P = 0.08$) and cosmesis ($P = 0.44$) compared to the rest of the cohort. Higher SF-12 PCS scores correlated with better DASH ($r = -0.49$, $P = 0.007$) and SST scores ($r = 0.52$, $P = 0.004$). Similarly, higher SF-12 MCS scores also correlated with better DASH ($r = -0.41$, $P = 0.03$) and SST scores ($r = 0.47$, $P = 0.01$). There was no significant correlation between outcome and age for either measure ($P = 0.41$ for DASH and SST).

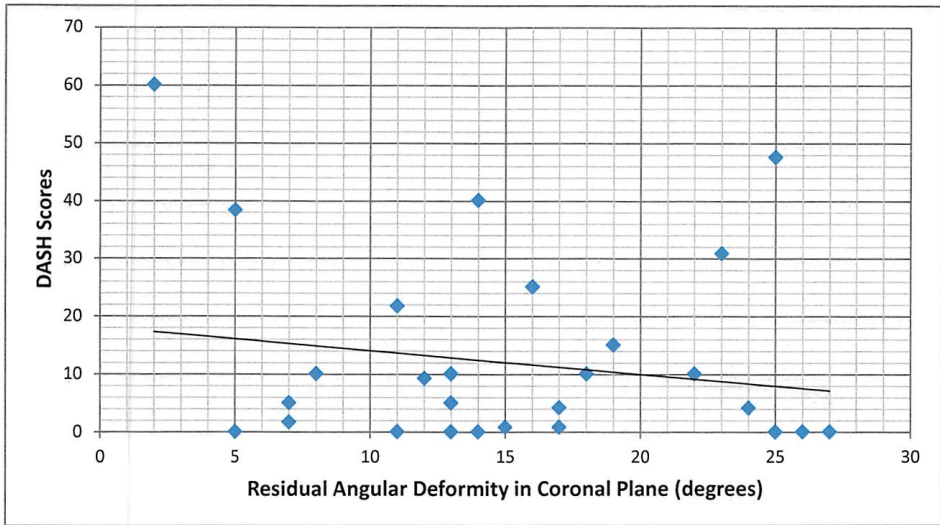
Conclusion: Residual angular deformity ranging from 0-18° in the sagittal plane and from 2-27° in the coronal plane after nonoperative treatment for humeral shaft fractures had no

correlation with patient reported DASH scores, SST scores, or patient satisfaction. Instead, overall physical and mental health status as measured by the SF-12 significantly correlated with patient-reported outcomes.

Figure 1. Scatter plots with best fit line for angular deformity in the sagittal and coronal planes after humeral shaft fractures and resulting DASH scores.

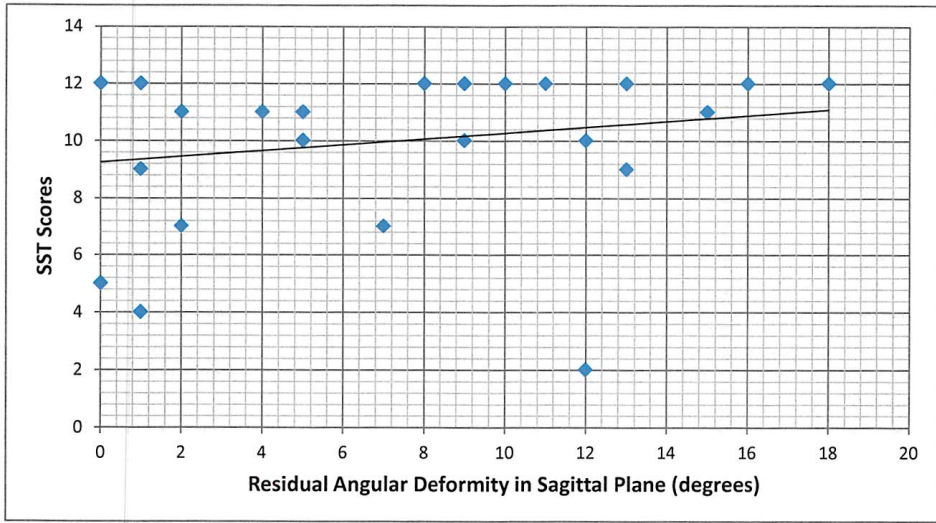


A. There was no correlation between residual angular deformity of the humeral shaft in the sagittal plane and resulting DASH scores ($r=-0.14$; $P=0.47$).

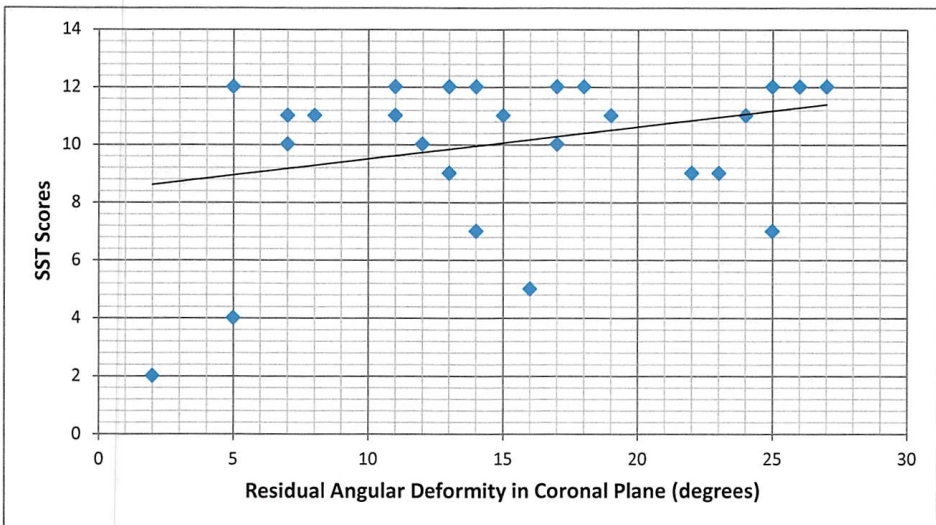


B. There was no correlation between residual angular deformity of the humeral shaft in the coronal plane and resulting DASH scores ($r=-0.17$; $P=0.38$).

Figure 2. Scatter plots with best fit line for angular deformity in the sagittal and coronal planes after humeral shaft fractures and resulting Simple Shoulder Test (SST) scores.



A. There was no correlation between residual angular deformity of the humeral shaft in the sagittal plane and resulting Simple Shoulder Test (SST) scores ($r=0.22$; $P=0.25$).



B. There was no correlation between residual angular deformity of the humeral shaft in the coronal plane and resulting Simple Shoulder Test (SST) scores ($r=0.28$; $P=0.14$).

The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.