

Assessment of Pronator Quadratus Repair Integrity Using Dynamic Ultrasonography Following Volar Plate Fixation for Distal Radius Fractures

John Capo, MD; Ronald Adler, MD, PhD; Richard Hinds, MD; Nicole Montero-Lopez, MD; Katharine Criner, MD; Kenneth Brock, BS; Anthony Sapienza, MD; Nader Paksima, DO, MPH; New York University Hospital for Joint Diseases, New York, New York, USA

Purpose: Previous work evaluating the pronator quadratus muscle (PQ) following volar plate fixation (VPF) of distal radius fractures suggests that the PQ repair often fails in the postoperative period. However, these postoperative evaluations of the PQ have been limited to indirect imaging methods. The purpose of this study was to directly and quantitatively assess the integrity of the PQ after repair following VPF of distal radius fractures using dynamic musculoskeletal ultrasonography. We hypothesized that PQ repair results in a low rate of failure.

Methods: We retrospectively identified patients who underwent VPF by 3 hand surgeons from January 2013 to January 2015. Patients aged 18-90 years with a minimum postoperative follow-up of 3 months were initially included for analysis. Patients with concomitant fractures of the contralateral upper extremity were excluded. Study patients underwent bilateral dynamic wrist ultrasonography by a single fellowship-trained musculoskeletal radiologist. Our primary objective was to determine whether the PQ muscle remained intact as evidenced by complete continuity of the muscle as visualized on ultrasound. Secondary data points included whether the PQ completely covered the volar plate, bilateral PQ volume, bilateral wrist range of motion (ROM), bilateral grip strength, visual analog scale (VAS) for pain, and Disabilities of the Arm, Shoulder and Hand (DASH) score. Age, gender, occupation, mechanism of injury, hand dominance, presence of complications, and length of follow-up were also noted for all subjects. Mann-Whitney U tests were utilized to compare PQ volume, wrist ROM, and grip strength between operative and contralateral nonoperative wrists. A P value <0.05 was considered significant.

Results: 13 patients (7 men and 6 women) underwent bilateral wrist ultrasonography. Mean age was 57 ± 17 years and 92% (12 of 13) were right-hand dominant. 62% (8 of 13) underwent VPF of their dominant wrist. 11 patients sustained their injury secondary to fall, while the remaining 2 patients incurred sports injuries. Patients were evaluated a mean 10 ± 4 months after VPF and demonstrated mean VAS and DASH scores of 0.8 ± 1.3 and 14 ± 16 , respectively. Dynamic sonographic assessment revealed an intact PQ repair in all patients with the volar plate completely covered by the PQ in 54% (7 of 13) of patients. Statistical analysis revealed significantly poorer wrist flexion ($P = 0.04$), pronation ($P = 0.009$), and ulnar deviation ($P = 0.007$) in operative wrist compared to the nonoperative wrist. There were no significant differences in PQ volume, extension, supination, radial deviation, and grip strength between wrists (Table 1).

Conclusion: The PQ demonstrates substantial durability after repair following VPF. Although wrist flexion, pronation, and ulnar deviation were significantly decreased in the operative wrist, PQ repair is unlikely to be a factor as PQ volume and grip strength were similar in operative and nonoperative wrists.

Table 1.

Comparison of PQ volume, wrist ROM, and grip strength between operative and contralateral nonoperative wrists

Measurement	Units	Operative Wrist	Nonoperative Wrist	P value
PQ volume, (SD)	cm ³	13.5 (7.0)	16.5 (6.6)	0.174
Flexion, (SD)	Degrees	59 (17)	73 (17)	0.04
Extension, (SD)	Degrees	53 (11)	61 (15)	0.119
Pronation, (SD)	Degrees	79 (9)	89 (14)	0.009
Supination, (SD)	Degrees	88 (15)	97 (18)	0.49
Radial deviation, (SD)	Degrees	18 (7)	22 (7)	0.095
Ulnar deviation, (SD)	Degrees	34 (10)	46 (10)	0.007
Grip strength, (SD)	Kg	52 (26)	64 (22)	0.174

Abbreviations: PQ, pronator quadratus; ROM, range of motion, SD, standard deviation.