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Radial Plate Fixation: A Novel Technique for Distal Radius Fractures

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Abstract

Background: Distal radius fractures represent a common fracture pattern frequently treated with volar locked plating for fixation. However, other methods may provide equivalent outcomes and minimize risks associated with the volar approach and hardware placement. One such method is the radial plate. **Methods:** After confirmation of institutional board review, we retrospectively reviewed data from 7 patients with our primary functional outcomes measured by Mayo wrist and Disabilities of the Arm, Shoulder and Hand (QuickDASH) scores. The most recent radiographic and motion parameters were recorded. **Results:** Mean age at time of injury was 49 years (range, 19-68 years) with clinical follow-up of 81.6 months (range, 43.5-95.5 months). Five patients had good to excellent outcomes with a mean QuickDASH score of 0.92 for those patients. The mean QuickDASH score for all patients was 18.5. Mean radial height, inclination, and volar tilt were within 5% of the contralateral side. Standard deviation values for radiographic measures and clinical range of motion indicate significant variability in our data set. **Conclusions:** Although the results are mixed, our small cohort indicates radial plate fixation could provide a viable alternative to volar plate fixation of distal radius fractures. Further prospective investigation is warranted to better describe long-term outcomes using this technique.

Keywords: distal radius fracture, radial plate, novel technique

Introduction

The distal radius fracture (DRF) is a common fragility fracture in the elderly.[14] In 2001, there were 640 000 reported DRFs in the United States alone,[4] while the incidence of these fractures is currently rising.[14] These fractures may be effectively managed either operatively or nonoperatively.[1,7,8] However, 1 study reported that nearly half of their DRFs had some degree of lasting dysfunction.[6] Recently, the trend has leaned toward operative fixation.[2,3,22]

Although open reduction and internal fixation with a dorsal plate is an acceptable method of operative treatment,[24] the volar locking plate has achieved excellent results and has become the preferred operative treatment of choice.[18,19,23] However, a third option of internal fixation exists: the radial plate. Although initially described as a component of fragment-specific fixation of DRFs,[16,21] it may also be used as isolated fixation as presented previously for correction of distal radius malunion.[9] We present a case series of acute DRFs treated with the radial plate. We propose that the radial plate may be used for acute DRFs.

Methods and Materials

After obtaining institutional review board approval, we performed retrospective chart review. Informed consent was obtained from all individual participants included in the study. We collected basic demographic data for a total of 7 patients who received distal radius fixation with a radial plate. The characteristics of right- or left-sided fracture, presence of ulnar styloid fracture, and radiographic measurements were recorded for all patients. To measure outcomes, wrist range of motion, Mayo wrist scores, and QuickDASH scores were recorded at final clinical follow-up, and for 6 of 7 patients, a final telephone interview was conducted for final Mayo wrist and QuickDASH scores.

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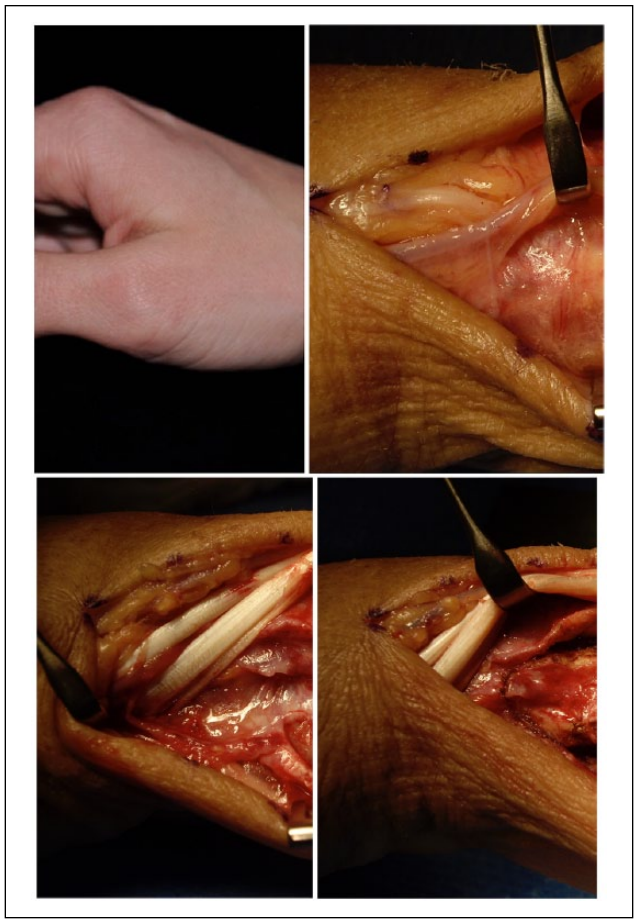

Figure 1. Top left, Midline radial approach. Top right, Radial dissection with dorsal retraction of the superficial branch of the radial nerve. Bottom left, Retraction of abductor pollicis longus and extensor pollicis brevis dorsally exposing the distal insertion of the brachioradialis. Bottom right, Full exposure of the distal radius.

The surgical technique utilizes the previously described radial approach.[17] A midline radial incision starting at the tip of the radial styloid proceeding proximally is made (Figure 1). The superficial branch of the radial nerve (SBRN) is isolated and mobilized, being mindful that it can split into 2 distinct nerves about the distal radius. The first dorsal extensor compartment is opened, the tendons released and retracted, and brachioradialis tendon insertion is released. The pronator quadratus's radial attachment is released exposing the volar aspect of the distal radius and allowing good visualization of the fracture site. Subsequent reduction may be held by 1.1 mm Kirschner wires (K-wires) through the radial styloid as needed for temporizing fixation.

The radial plate should be positioned 1.0 cm proximal to the tip of the radial styloid along the midline of the distal radius in the sagittal plane. The plate should match the metaphyseal flare of the distal radius. Once positioned, the plate may be held by a K-wire in the most distal hole, and if both the plate and distal K-wire are in acceptable position, that K-wire is replaced with the first screw (Figure 2). The senior author recommends the remaining 3 distal screws be placed in locking fashion with more proximal shaft screws being either locking or nonlocking depending on the quality of bone (Figure 2).

After final radiographs, repair of the pronator quadratus and brachioradialis can be performed by reattaching these structures to empty screw holes in the plate. Closure is carefully performed to avoid injury to SBRN. Patients are placed in a volar splint allowing for motion about the metacarpophalangeal joints with immediate finger motion with initiation of gentle wrist motion at the 10- to 14-day follow-up appointment.

Results

A total of 7 patients with mean age of 48.9 years (range, 19-68 years) at time of injury were isolated with final clinical follow-up in person or via phone interview of 81.6 months (range, 43.5-95.5 months), and an average of 20.3 months radiographic follow-up (Table 1). The majority of patients (6) had concomitant ulnar styloid and other injuries. Radiographic parameters were measured on operative and nonoperative extremities (Table 2). Mean measures for radial height, inclination, and volar tilt were within 5% of the mean values of the contralateral side with high standard deviation measures. With regard to motion, average motion lost was 7% to 18% compared with the contralateral side, with greatest loss of motion being 17.7% of flexion value compared with contralateral side (Table 3).

Five of 7 patients with final follow-up had good or excellent Mayo wrist score outcomes, with average QuickDASH score for all patients being 18.5 (Table 4). The 5 patients with good to excellent outcomes had average QuickDASH score of 0.92, while the average for the 2 patients with poor outcomes was 62.5. Records for the 2 patients with poor outcomes indicate that 1 patient denied wrist problems, but noted chronic lower back pain and was undergoing litigation from injuries during the motor vehicle accident causing his DRF. The second patient developed complex regional pain syndrome but had not attended postoperative therapy until symptoms had developed.

Discussion

Our study is a retrospective case series of 7 patients treated with radial plate for acute DRFs. Previously the radial plate was described for use of correction of malunions of the distal radius.[9] This approach allows correction of 3 primary deformities: reversal of palmar tilt, radial shortening, and loss of radial inclination. The radial plate can offer stable fixation in acceptable alignment in acute DRFs by correcting the same deformities. Other benefits of the radial plate and approach include avoidance of the median nerve and radial artery during dissection, as well as obviating the

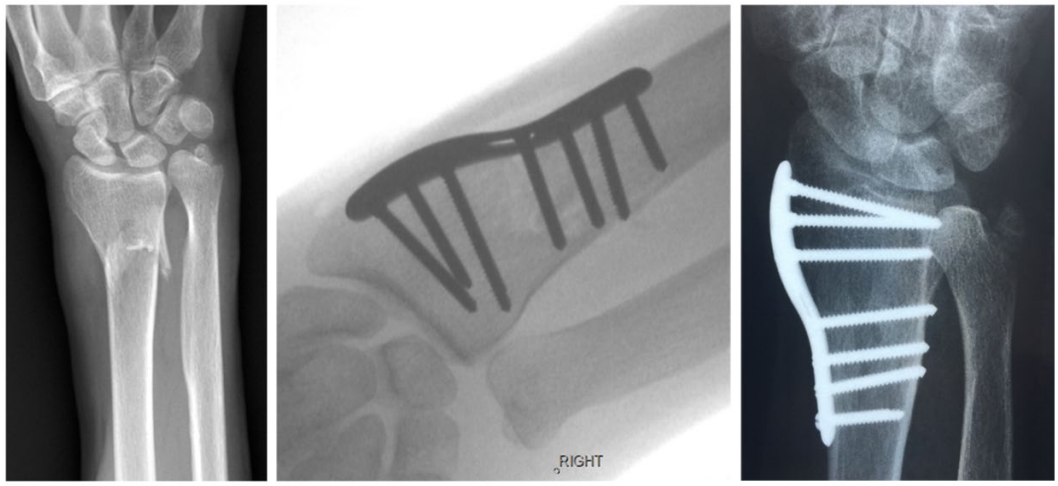

Figure 2. Distal radius preoperative fracture (left), fluoroscopic and final (middle, right) images of fixation using the radial plate.

Table 1. Patient Demographic and Clinical Profile.

Variable	
Total patients, n	7
Sex, M/F	3/4
Age, y, mean (range)	48.9 (19-65)
Radiographic follow-up, mo, mean (range)	20.3 (0.5-45.0)
Clinical follow-up, mo, mean (range)	81.6 (80.1-95.5)
Laterality, R/L	3/4
Concomitant ulnar styloid fracture, n (%)	5 (71.4%)
Other concomitant injuries, n (%)	5 (71.4%)

documented risk to volar flexor tendons with volar plate fixation.[20] We believe our data demonstrate comparable radiographic and clinical results to volar plate fixation, with a possible improvement in volar tilt compared with that method of fixation.

Our study demonstrated mixed functional outcomes; 5 patients had good to excellent Mayo wrist score outcomes while 2 patients had poor results. Poor patient reports could be confounded by other patient variables such as other injuries, underlying medical conditions, or delay in adequate postoperative therapy which were not controlled in this study. Our average QuickDASH score was 18.5, with a score of 0.92 for the 5 patients with the best outcomes. Two separate studies on volar plate fixation of DRFs with mean 12 and 14 month follow-up of 49 and 37 patients, respectively, report average DASH scores of 6, with Osada et al noting a range from 0 to 30.[11,15] Other authors on volar plate fixation note DASH scores of 12.8 (range, 0-68) and 25, values all comparable to our results.[10,13] The above results indicate that functional outcomes are similar between radial and volar plating techniques.

Radiographic parameters demonstrate maintenance of acceptable values comparable to volar plating systems.[10,11,13,15] Most authors report average postoperative radial height of 9 to 12 mm and inclination of 21° to 22°; our values were 11 and 22, respectively. However, our volar tilt averaged 12.9°, with only 5% average discrepancy from the contralateral side. Some authors note volar tilt of 2° to 4°,[11,12] while other report values of 6° to 7°.[10,13] Osada et al reported an average volar tilt of 9° compared with 12° on the uninjured side.[15] The above evidence may indicate better radiographic restoration of volar tilt using radial plate fixation than achieved by volar plate fixation. Further investigation and correlation to clinical outcomes are necessary to better characterize the true outcomes of radial plate fixation.

Clinical motion results are variable in the literature, making comparisons to volar plate fixation less precise. Two authors note percentage loss of motion compared with the contralateral side.[10,12] Figl et al noted a 21% decrease in flexion/extension with 11% decrease in radial/ulnar motion while Lattmann et al reported 6% to 7% decreased motion in all parameters. Our results indicated 9% to 18% loss of motion for the above movements, which is comparable to the results of other others; our most significant loss being 18% of average flexion. Our results demonstrate better motion than found in the cohort reported by Loveridge et al and is within 10° to 15° of the values reported by Osada et al.[13,15] The above data, particularly in the context of good overall functional outcome scores, indicate that radial plate fixation can provide similar postoperative motion to that of patients undergoing volar plate fixation.

The mean age of our cohort, 49 years, was slightly lower than the above cited literature whose mean values were 53 to 62 years.[10,11,13] Data from Chung et al indicate similar function on the Michigan Hand Outcomes Questionnaire (MHQ) without a difference in complication rates between patients older than 60 years and a cohort of 20 to 40 year olds.[5] In addition, 2 of the above sources note patients as

Table 2. Radiographic Outcomes.

Measurement	Operative extremity	Difference in mean values from contralateral side, %, mean ± SD
Radial height, mm, mean ± SD (range)	10.9 ± 3.02 (7-15)	2.6 ± 27.0
Radial inclination, degree, mean (range)	22.4 ± 6.63 (14.0-28.0)	−0.2 ± 25.5
Volar tilt, degree, mean (range)	12.9 ± 5.43 (9.0-20.0)	5.0 ± 46.5

Table 3. Clinical Motion.

Measurement	Operative extremity	Nonoperative extremity	Percentage loss of motion
Flexion, degree, mean ± SD (range)	55.7 ± 19.5 (25-80)	67.7 ± 15.9 (38-86)	17.7
Extension, degree, mean ± SD (range)	61.4 ± 17.1 (40-84)	67.4 ± 14.8 (40-86)	8.9
Ulnar deviation, degree, mean ± SD (range)	26.3 ± 11.4 (15-44)	29.7 ± 7.5 (22-42)	11.5
Radial deviation, degree, mean ± SD (range)	24.3 ± 14.2 (5-46)	26.3 ± 13.7 (11-46)	7.6

Table 4. Outcome Scores.

Measurement	Operative extremity
QuickDASH, mean (range)	18.5 (0-65.9)
Mayo wrist	
Excellent	4
Good	1
Satisfactory	0
Poor	2

young as 16 and 19 in their cohorts.[11,13] Given the above, we do not believe the age of our cohort significantly impacted our comparison to volar plate fixation.

Our study is limited by being underpowered with highly variable data. The quality of our data is limited by inherent difficulty in using medical records and the ability to contact patients for follow-up. Significant variability reflected in larger standard deviations for both radiologic and motion measurements is concerning. It may reflect anatomic patient variability, as similarly sized deviations were noted in nonoperative values. It could also reflect the small sample size or even underlying problems with the recorded data itself.

We believe the radial plate can be a viable option in fixation of acute DRFs but requires further prospective study. Such a study could help get a broader data set, limit variability, more specifically record and target confounding factors. It could allow longer term radiographic follow-up to scrutinize for radiographic loss of reduction, and aid in a more accurate evaluation of the clinical outcomes of radial plate fixation for acute DRFs.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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