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Original Research

Bridge Versus Volar Plating Distal Radius Fractures in Patients With Concomitant Lower-Extremity Fractures

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Purpose: Our objective was to determine if patients with a distal radius fracture and concomitant lower-extremity fracture benefit from bridge plating when compared with volar plating.
Methods: We conducted a retrospective cohort study evaluating distal radius fractures fixated by bridge or volar plating in orthopedic trauma patients with a concomitant lower-extremity fracture. Patients were prescribed a platform walker and followed for gait aid use and both upper and lower-extremity fracture-related outcomes.
Results: Differences in platform walker use, radiographic findings, and rates of complications for both distal radius and lower-extremity fractures were comparable between groups.
Conclusions: Although more studies are needed, it appears that this cohort of patient's ability to mobilize using a gait aid is similar, regardless of the distal radius fracture fixation method. A concomitant lower-extremity fracture should not necessarily indicate bridge plating over volar plate fixation.
Type of study/level of Evidence: Therapeutic Study IV.

Treatment options for distal radius fractures include both nonsurgical and surgical techniques that focus on stabilizing the fractures, maximizing quality of life, and managing the burdens of care.[1–7] When treating distal radius fractures in trauma patients with concomitant lower-extremity fractures, it is necessary to consider each extremity's healing process for optimal patient care. Two commonly used fixation methods for distal radius fractures are bridge plating and volar plating.[1,8]

Bridge plates, also known as dorsal spanning plates or distraction plates, were initially introduced to treat complex intra-articular fractures of the distal radius and offer improvements over external fixation.[3,9,10] Deliberately bridge plating in patients with lower-extremity fractures suggests that the strength provided by the plate enhances upper-extremity weight-bearing, which is crucial for patients who require the use of a gait aid during mobilization.[9–14] This support presumably enhances a patient's function during the early stages of recovery. Bridge plating is less invasive and technically demanding than volar plating, which can be advantageous in certain resource-limited or time-constrained scenarios encountered while providing care for complex polytrauma patients. However, bridge plating requires additional surgery for implant removal, which can be a significant barrier for many trauma patients and may not be the ideal choice for some fracture patterns. Moreover, clinical studies have yet to evaluate the value of bridge plate fixation on gait aid use and lower-extremity outcomes.

The purpose of this study was to compare the effects of two distal radius fracture fixation methods, bridge plating versus volar plating, on the recoveries and outcomes of patients with lower-extremity fractures and concomitant surgically treated distal radius fractures. We hypothesized that the amount of walker use was independent of the method of distal radius fixation.

Methods

Study population and inclusion criteria

Following approval by the institutional review board, a retrospective review was conducted from April 1, 2009 to April 1, 2021,

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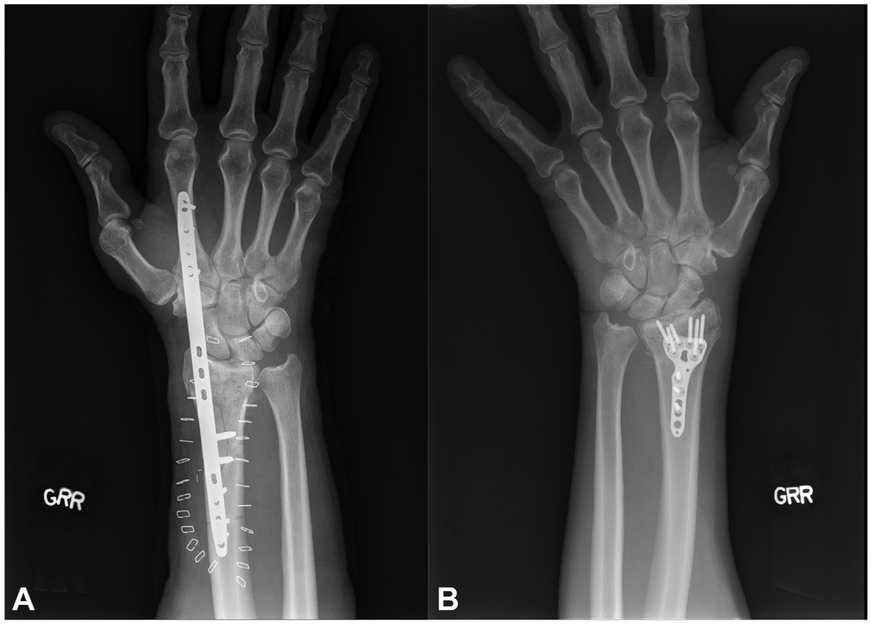

Figure 1. Bridge and volar plates. **A** Radiograph showing a bridge plate running from the radial shaft to the second metacarpal spanning a comminuted distal radius fracture. **B** Radiograph shows a volar plate fixated over a distal radius fracture.

at a level-1 trauma center. This review focused on all orthopedic trauma patients who underwent surgical fixation of a distal radius fracture and treatment for concomitant lower-extremity fractures. An institutional trauma database was queried to identify eligible patients. The inclusion criteria included patients aged 18 years or older who sustained distal radius fractures treated with either bridge plate or volar plate fixation, alongside concomitant lower-extremity fracture(s) from a single traumatic event. Lower-extremity fractures included fractures of the sacrum, pelvis, femur, tibia, fibula, and all bones of the ankle and foot. Patients were followed for a minimum of 12 months.

Exclusion criteria were patients who primarily used a wheelchair for mobility; did not use a gait aid; had a distal radius fracture treated by both volar and bridge plating simultaneously; refused participation in research activities; had concomitant head, brain, spinal cord, or other visceral injuries that impeded mobilization postsurgery such that signs of distal radius fracture healing had been observed prior to the time of initiating gait aid use; or were lost to follow-up before ceasing to use their gait aid.

Data measurement

Demographic and clinical outcome data were extracted from each eligible patient's electronic medical record. This included age, gender, height, weight, body mass index, concomitant injuries, distal radius fixation method, treatment method of lower-extremity fracture(s), time to bridge plate removal, dates of upper or lower-extremity surgery, and gait aid usage. Palmar tilt, radial inclination, and Orthopaedic Trauma Association (OTA) distal radius fracture classifications were obtained from orthogonal wrist radiographs and/or computed tomography.

The number of days patients used a platform walker was calculated based on the date range from the initial to the final use, as related to the traumatic event. The number of days from distal radius fracture fixation surgery to the initiation or resumption of platform walker use was also recorded. If a patient ceased using their gait aid or platform attachment prematurely, and the exact date was unknown, it was approximated to the day before their next clinical visit.

Surgical indications and technique

Intra-articular and unstable extra-articular fractures and distal radius fractures were assessed by the treating hand surgeon for surgical management. The application of bridge and volar plates followed techniques described by fellowship-trained hand surgeons (Fig. 1).[10,15,16] Patients undergoing bridge plating typically had the plate removed between 3 and 5 months post initial surgery.

Subject follow-up and evaluation

Postsurgery, immobilization of the distal radius fracture was at the surgeon's discretion. All patients were initially advised to avoid weight-bearing through the wrist until further evaluation and were trained in using a platform walker. Standard clinical follow-ups, radiographs, and additional hand therapy sessions were part of the routine postoperative management. Lower-extremity injuries were managed by a fellowship-trained orthopedic trauma surgeon (Fig. 2).

Statistical analysis

Because of the small sample size and the presence of categorical variables, Fisher exact tests were employed to determine statistical significance. Post-hoc power analysis was conducted using the observed Cohen's effect size. Descriptive statistics were summarized as means, medians, and confidence intervals for continuous variables and as counts and percentages for categorical variables. All statistical analyses were performed using RStudio Version 1.4.1103 (Rstudio, PBC).

Results

Twenty-nine distal radius fractures with concomitant lower-extremity fractures were identified. Fourteen patients were

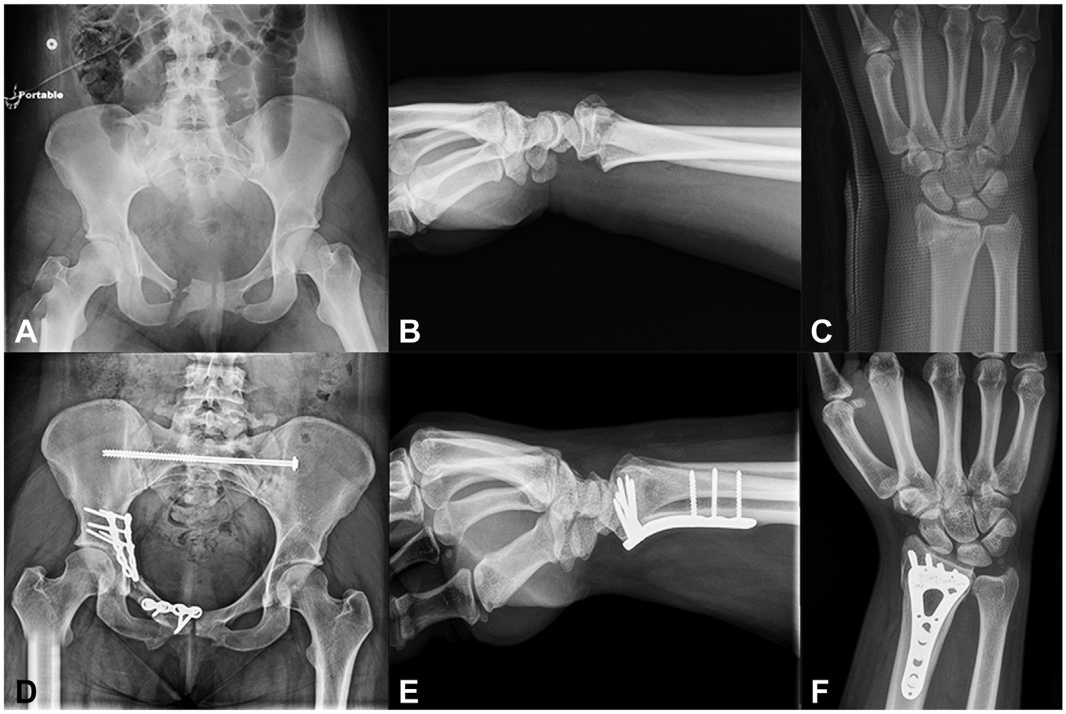

Figure 2. Polytrauma case. **A** Preoperative anteroposterior pelvis radiograph of 19-year-old right-hand-dominant female following a motor vehicle collision. The patient had bilateral sacral fractures extending into the foramina, a right-sided T-shaped acetabulum fracture, and bilateral superior and inferior pubic rami fractures. **B, C** Anteroposterior and lateral wrist radiographs show a right-sided comminuted fracture of distal radial metadiaphysis extending into the distal radial ulnar joint and dorsal margin of the distal radial articular surface. **D** Postoperative radiograph shows plating of the right acetabulum and pubic bone, with percutaneous screw fixation of the sacrum. **E, F** Anteroposterior and lateral postoperative radiographs of the distal radius show fixation by volar plate with bony union. She recovered to excellent right wrist function without associated complications.

excluded from the analysis for the following reasons: four could mobilize without the need for a gait aid, four had fractures treated simultaneously with both bridge and volar plating, one was lost to follow-up, three deceased prior to completing follow-up, and two had life-threatening injuries that prevented mobilization. Consequently, 15 patients were included in the evaluation. Post-hoc power analysis using the observed Cohen's effect size of 0.04 for platform walker use days showed a beta equal to 5%.

Patient ages ranged from 18 to 85 years, with a mean age of 59 years, and nine were women. Body mass index ranged from 20 to 53 with a mean of 29. Prior to the traumatic incident, two patients were already using a nonplatformed gait aid. Among the distal radius fractures, 10 were intra-articular OTA type 23C1, 23C2, or 23C3, with the rest being OTA types 23A2 or 23A3. Six had additional upper-extremity fractures, and 12 sustained fractures to the proximal femur or pelvis.

The mean palmar tilt and radial inclination were measured at 6 and 21 degrees, respectively. The median number of days of platform walker use was 46 days (95% CI = 31–74), with a mean of 45 days (95% CI = 39–84) and an interquartile range of 31–68 days. The median number of days from fracture fixation to beginning platform walker use was 2 days (95% CI = 1–5), with a mean of 10 days (95% CI = 2–24) and an interquartile range of 1–7 days.

We observed complications related to the distal radius in five patients, including three cases of painful wrists, one carpal tunnel release, one tenolysis, and one surgical site infection. There were seven lower-extremity complications, which included one nonunion, one malunion with peri-implant fracture, two cases of chronically painful lower extremities, one prosthetic hip dislocation, and two patients with muscular weakness.

Four distal radius fractures underwent fixation by bridge plate and 11 by volar plate alone. Demographics and injury patterns were similar between groups (Table 1). The mean number of days of platform walker use, days from fracture fixation to starting platform walker use, palmar tilt, radial inclination, wrist pain, upper-extremity complications, and lower extremity complications were compared (Table 2). Higher days from fracture fixation to starting platform walker use, wrist pain, and distal radius complications were observed in the bridge plating group. The mean time to bridge plate removal after fixation was 144 days (range: 90–238).

Discussion

Volar plating is often the preferred method for many complex distal radius fracture patterns; nevertheless, small fracture fragments can be technically challenging with this technique.[14,16,17] Bridge plating is considered technically simpler for highly comminuted intra-articular distal radius fractures. Additionally, some surgeons advocate bridge plating because of the structural strength it provides, which is crucial for patients with increased upper-extremity weight-bearing needs.[9,10,13] However, clinical studies focusing on the effects of distal radius fracture fixation techniques on gait aid use, and outcomes in polytraumatized patients are scarce.

Our study is limited by the inherent challenges of any small, retrospective cohort study, including selection bias, nonrandomized groups, and limited effect size. Outliers likely had a disproportionate impact on some of this study's results. One patient, who experienced a delay before starting to use a platform walker after bridge plate surgery but still met the inclusion criteria, likely inflated the observed differences between the groups. Importantly, the number of days a platform walker is used may not fully capture the effects of upper-extremity weight-bearing, and factors like the severity of the lower-extremity fracture play a

Table 1
Bridge Plate and Volar Plate Patient Demographics

Demographics	Bridge (N = 4)	Volar (N = 11)	Total (N = 15)	*P* value
Age (y)				1.000
Mean (SD)	61,750 (18,661)	57,545 (21,309)	58,667 (20,067)	
Range	39,000–84,000	18,000–85,000	18,000–85,000	
Gender				.235
F	1 (25.0%)	8 (72.7%)	9 (60.0%)	
M	3 (75.0%)	3 (27.3%)	6 (40.0%)	
BMI				1.000
Mean (SD)	28.8 (6.6)	28.5 (9.3)	28.6 (8.4)	
Range	23.8–38.5	19.7–52.9	19.7–52.9	
Using Gait aid prior to trauma?				.476
No	3 (75.0%)	10 (90.9%)	13 (86.7%)	
Yes	1 (25.0%)	1 (9.1%)	2 (13.3%)	
OTA fracture classification				.197
23A2	0 (0.0%)	2 (18.2%)	2 (13.3%)	
23A3	0 (0.0%)	3 (27.3%)	3 (20.0%)	
23C1	1 (25.0%)	3 (27.3%)	4 (26.7%)	
23C2	0 (0.0%)	2 (18.2%)	2 (13.3%)	
23C3	3 (75.0%)	1 (9.1%)	4 (26.7%)	
Additional upper-extremity fracture				
Yes	3 (75.0%)	3 (27.3%)	6 (40.0%)	.235
No	1 (25.0%)	8 (72.7%)	9 (60.0%)	
Lower-extremity fracture region				
Hip/Pelvis	3 (75.0%)	9 (81.8%)	12 (80.0%)	1.000
Other	1 (25.0%)	2 (18.2%)	3 (20.0%)	

Table 2
Bridge Plate and Volar Plate Patient Outcomes

	Bridge (N = 4)	Volar (N = 11)	Total (N = 15)	*P* value
Palmar tilt				1.000
Mean (SD)	5.6 (3.3)	6.7 (3.7)	6,.4 (3.6)	
Range	2.1–10.1	0.6–12.5	0.6–12.5	
Radial inclination				1.000
Mean (SD)	19.6 (2.5)	21.3 (3.9)	20.9 (3.6)	
Range	17.5–23.1	17.1–29.9	17.1–29.9	
Platform walker days				.581
Mean (SD)	57.5 (55.0)	59.8(45.8)	59.2 (46.3)	
Range	19.0–136.0	26.0–187.0	19.0–187.0	
Distal radius surgery to starting platform walker days				.908
Mean (SD)	29 (52.1)	2.9 (2.9)	9.9 (27.0)	
Range	0–107	0–8	0–107	
Wrist pain				.154
No	2 (50.0%)	10 (90.9%)	12 (80.0%)	
Yes	2 (50.0%)	1 (9.1%)	3 (20.0%)	
Distal radius complication				.560
No	2 (50.0%)	8 (72.7%)	10 (66.7%)	
Yes	2 (50.0%)	3 (27.3%)	5 (33.3%)	
Lower-extremity complication				1.000
No	2 (50.0%)	6 (54.5%)	8 (53.3%)	
Yes	2 (50.0%)	5 (45.5%)	7 (46.7%)	

significant role in our findings. Given the variety of lower-extremity fracture patterns witnessed in our study, this is an essential consideration. Employing weight-bearing sensors or conducting prospective surveys could enhance our understanding of patient behavior.

If bridge plates changed wrist function compared with volar plates, it might be expected that patients would adjust their gait aid behavior somehow. Our observations show that this may not necessarily be true. It would be reasonable to conclude that a patient's weight-bearing behavior could be independent of the implant choice. Counseling on weight-bearing may have a greater impact than the choice of implant on weight-bearing behavior and warrants further investigation.

Biomechanical studies indicate that bridge plate deformity is likely to occur with early axillary crutch weight-bearing, and a 1-month delay before weight-bearing through the bridge plate is recommended.[10–12] However, many lower-extremity fracture patterns require less than a month of weight-bearing assistance.[18] We observed that approximately a quarter of our patients used a gait aid for less than a month. For these patients, the distal radius implant was less likely to be seriously tested via axial loads. Conversely, trauma patients with prolonged lower-extremity weight-bearing limitations are more likely to stress a bridge or volar plate significantly.

Surgical fixation adds structural support to facilitate bony union and early weight-bearing, potentially improving patient quality of life and outcomes.[11,19] The relationship between concomitant upper-extremity fractures and lower-extremity fractures remains inconclusive.[20,21] Although our study noted higher complication rates for bridge plating than previously reported, likely because of its small sample size, all other outcomes and complications were comparable with previous studies.[22,23] Although larger studies are needed to confirm our observations, currently, no clear advantage in upper or lower-extremity outcomes for polytrauma patients has been shown with either implant choice.

Statement: During the preparation of this work, the author(s) used (ChatGPT 4/OpenAI) in order to edit grammar and enhance readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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