Original Article
DOI: https://doi.org/10.70749/ijbr.v3i09.2227

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Comparison of Volar Plating and Percutaneous K-Wire Fixation in Distal Radius Fractures

Muhammad Yasir Bhatti[1], Riaz Munawar[2], Farooq Ahmad Shah[3], Haider Ali[3], Ishrat Nazir[1], Muhammad Sadam Habib[1], Shehzad Hussain[1], Hafiz Muhammad Suleman[1], Jahanzaib Malik[1], Arslan Sana Mehdi[3]

[1]Orthopedics Surgery Unit, Ghazi Khan medical college & Allama Iqbal Teaching Hospital Dera Ghazi Khan, Pakistan
[2]Department of Orthopedics Surgery, Benazir Bhutto Hospital, Rawalpindi, Pakistan
[3]Department of Orthopedics Unit-I, Jinnah Hospital, Lahore, Pakistan

ARTICLE INFO

Keywords: Intra-articular distal radius fracture, functional outcome, percutaneous K-wire, volar plate.

Correspondence to: Muhammad Yasir Bhatti,
Department of Orthopedic Surgery, Ghazi Khan Medical College & Allama Iqbal Teaching Hospital Dera Ghazi Khan, Pakistan.
Email: yasirbhatti27@yahoo.com

Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 03-07-2025 Revised: 03-09-2025
Accepted: 09-09-2025 Published: 15-09-2025

ABSTRACT

Background: In the recent past, surgeons used external fixation or a combination of bone grafting, Kirschner wire (K-wire) augmentation, and restricted open reduction to manage intra-articular distal radius fractures. However, fragment-specific fixation has become a sustainable alternative with the recent emergence of locking implants especially made for the distal radius. Besides of these, there is no consensus in terms of optimum treatment approaches. **Objective**: To compare the functional outcome of volar plate versus percutaneous K-wire in intra-articular distal radius fracture. **Study Design**: Randomized Controlled Trial (RCT). **Setting**: Orthopedics Surgery Unit, Ghazi Khan medical college & Allama Iqbal Teaching Hospital Dera Ghazi Khan, Pakistan. **Duration of study:** The current research work was conducted from 31st January 2024 to 31st July 2025. **Materials and Methods:** After approval from the ethical review board, 70 patients fulfilling the inclusion criteria were enrolled for the study. Group A underwent treatment with volar plating while B with percutaneous K-wire. All patients were operated by the same consultant orthopedic surgeon under general anesthesia. On the 2nd post-operative day, patients were discharged with instructions on rehabilitation protocol. Patients were followed up to 3 months, while functional outcome was determined with the help of Gartland and Werley modification score. **Results**: Comparison of the functional outcome of volar plate versus percutaneous k-wire in intra-articular distal radius fracture shows 85.71 % (n=30) in Group-A and 74.29 % (n=26) in Group-B had excellent functional outcome, 14.29 % (n=5) in Group-A and 25.71 % (n=9) in Group-B had good functional outcome, p-value was 0.23 showing no significant difference. **CONCLUSION:** We concluded that functional outcome of volar plate is comparable when compared with percutaneous k-wire in intra-articular distal radius fracture, however, the difference is not significant

INTRODUCTION

Distal radius fractures are regarded as the commonest fractures of the upper limb, representing 16–20% of all fractures treated by orthopedic surgeons worldwide[1]. The fractures are caused by high-energy trauma in young individuals and by low-energy trauma in the older age group[2]. The incidence of these fractures ranges from 280 to 440 cases per 100,000 individuals each year[3]. According to a recent study, the incidence of these fractures has increased in both males and females. This increase has especially been seen in women aged above 50 years, which may be attributed to recent estrogen withdrawal and decrease in bone mineral density (BMD) after menopause[4]. These are complex injuries, and their outcome depends on various factors like the type of fracture and the method of fixation[5]. An estimated 20-50% of these fractures remain inadequately reduced, hence requiring operative intervention[6]. Malunion and reduced functional outcome at the wrist can be a common complication if these fractures are not anatomically reduced and stabilized properly[7]. Even though these are one of the most prevalent fractures, but still the optimal treatment options has been a topic of debate. Over the years, these fractures have been managed with conservative treatment like casting and operative interventions like plating, external fixator and percutaneous k- wire fixation[8]. By surgically managing an intra-articular fracture, one can achieve not only an anatomical reduction of the fracture but also a quicker return to activity[9]. When considering the approach, the type of surgical procedure, these intra-articular distal radius fracatures[10]. Closed or minimal open reduction can

be done with this maneuver. This flaw in the achievement of appropriate anatomical reduction can result in instability of distal radio-ulnar joint, secondary displacement and decreased functional outcome[11].

Recently, volar plates have become popular due to their reduced complications and increased stability especially in osteoporotic fractures[12]. Previously, some surgeons have compared volar plating and percutaneous k-wire in intra-articular distal radius fractures, but still there is no significant evidence regarding which option leads to a better functional outcome[13]. One trial reported that functional outcome was achieved good to excellent in 90% cases with volar plate and in 65% cases with K-wires in intra-articular distal radius fracture[14]. One more trial found that functional outcome was achieved good to excellent in 90% cases with volar plate and in 70% cases with K-wires in intra-artuclar distal radius fractures[15, 16]. So, the rationale of this study is to compare the functional outcome of intra-articular distal radius fractures managed with volar plating or percutaneous k-wires. Therefore, there is no consensus regarding the optimal treatment option as both procedures are done in routine but mostly patients undergo surgery by using K-wires. But literature showed that volar plates are more effective in achieving more excellent outcome than K- wires for this type of fracture. So we planned this study to get local evidence and implement more effective way to treat intra- articular fracture of distal radius.

MATERIAL AND METHODS

Study Design: Randomized Controlled Trial (RCT)

Setting: Orthopedics Surgery Unit, Ghazi Khan Medical College & Allama Iqbal Teaching Hospital Dera Ghazi Khan, Pakistan.

Duration of Study: Six months after approval of synopsis from 31st January 2024 to 31st July 2025.

Sample Size

By WHO calculator sample size of 70 cases; 35 in each group is calculated with 80% power study, 5% significance level and percentage of functional outcome i.e. 90% with volar plate and 65% with K-wires in intra-articular distal radius fractures[14].

Sampling Technique

Non-probability, consecutive sampling

Inclusion criteria

Patients of age 20-65 years, both genders presenting with intra-articular distal radius fracture (AO classification 23 B1, B2, B3, CI and C2).

Exclusion Criteria

The persons with mental incompetence, skeletally immature patients recognized by growth plate on X-rays approaches, patients with neurological illnesses, congenital wrist abnormalities, radio-carpal arthritis, concomitant hand injuries or fractures, concomitant distal ulna fractures, open fractures, concomitant distal limb fractures, and patients who present one week after the injury.

Data Collection Procedure

After approval from the ethical review board, 70 patients from the Orthopedics Surgery Unit, Ghazi Khan medical college & Allama Iqbal Teaching Hospital Dera Ghazi Khan, Pakistan who met the study's inclusion and exclusion criteria were selected. Consent was obtained from each patient to use their health profile data for current research work. Information regarding age, gender, fracture side, AO classification was recorded. Patients were randomized into 2 groups by assigning random identity numbers using Microsoft excel or any other relevant tool. Group A undergo treatment with volar plating while B with percutaneous K-wire. In volar plating approach, a longitudinal skin incision was made in line with Flexor Carpi Radialis (FCR) tendon. After exposing the FCR sheath, it was retracted to the radial/ulnar side to expose the flexor pollicis longus (FPL) tendon. Pronator quadrates (PQ) muscle lying underneath FPL tendon was elevated, exposing distal radius and reduction was done. Plate and screw placement was checked using C-arm fluoroscope. In percutaneous K-wire group, closed reduction was done under C-arm fluoroscope, k-wires were passed to hold the fracture segment and then above elbow cast was applied. All patients were operated by the same consultant orthopedic surgeon under general anesthesia. The patient was discharged on the second post-operative day with instructions on the rehabilitation program. There was a consistent follow-up to track the emergence of any problems. Radiographs of the wrist, both lateral and anterior, were taken to confirm the reduction, and the first follow-up was performed after two weeks to remove the sutures. A second follow-up was performed at 8 weeks, and wrist radiographs were taken. Group B patients' K-wires were taken out after eight weeks. Patients were followed up to 3 months, while functional outcome was determined the help of Gartland and Werley modification score.

Data Exploration and Statistical Approaches

Primary data were analyzed for determination of variance among the quantitative variables like age and duration of fracture by statistical analysis using SPSS (version 23), and the Gartland and Werley modification score was calculated as mean and standard deviation. Qualitative variables like gender, ASA grade, fracture side, AO classification type, mechanism of injury and outcome was demarked. Effect modifiers like age, gender, and fractured side, duration of fracture, AO fracture type and ASA were controlled by stratification. Following stratification, the results of both groups were compared using the chi square test for each stratum. A P-value of less than 0.05 was deemed statistically significant.

RESULTS

A comparison of the functional result of percutaneous K-wire and Volar plate in intra-articular distal radius fractures was conducted on 70 patients (35 in each group) that met the selection criteria. According to the age distribution, 48.57% (n=17) of Group-A and 71.43% (n=25) of Group-B were between the ages of 20 and 40, while 51.43% (n=18) of Group-A and 28.57% (n=10) of Group-B were between the ages of 41 and 65. The mean age for Group-A and Group-B was determined to be 40.06+10.75 and 35.83+8.54 years, respectively (Table 1).

Table 1
Exhibiting age groups.

Age (in years)	Group-A(n=35)		Group-B(n=35)	
	No. of patients	%	No. of patients	%
20-40	17	48.57	25	71.43
41-65	18	51.43	10	28.57
Total	0	0	35	0
Mean ± SD	40.06 ± 10.75		35.83 ± 8.54	

*P- value: 0.05

Gender distribution shows that 80% (n=28) in Group-A and 74.29 % (n=26) in Group-B were male whereas 20% (n=7) in Group-A and 25.71% (n=9) in Group-B were females. (Table 2)

Table 2
Exhibiting Gender Distribution

Gender	Group-A (n=35)		Group-B (n=35)	
	No. of patients	%	No. of patients	%
Male	28	80	26	74.29
Female	7	20	9	25.71
Total	35	100	35	0

ASA status of the patients shows that 34.29% (n=12) in Group-A and 42.86% (n=15) in Group-B had ASA-I whereas 65.71% (n=23) in Group-A and 57.14% (n=20) in Group-B had ASA-II. (Table 3)

Table 3
ASA Grade of the Patients (n=70)

ASA grade	Group-A (n=35)		Group-B (n=35)	
	No. of patients	%	No. of patients	%
I	12	34.29	15	42.86
II	23	65.71	20	57.14
Total	35	0	35	0

Table 4
Fracture Side of the Patients (n=70)

Fracture side	Group-A (n=35)		Group-B (n=35)	
	No. of patients	%	No. of patients	%
Right	20	57.14	16	45.71
Left	15	42.86	19	54.29
Total	35	0	0	0

P-value: 0.33

According to the results of Table 4, 57.14% (n=20) of the patients in Group-A had a fractured side, whereas 45.71% (n=16) had a right side. In contrast, 42.86% (n=15) of Group-A and 54.29% (n=19) of Group-B experienced a left side fracture. (Table No.) When the functional outcome of volar plate and percutaneous k-wire is compared in intra-articular distal radius fractures, the results show that 85.71% (n=30) of Group-A and 74.29% (n=26) of Group-B had excellent functional outcomes, 14.29% (n=5) of Group-A and 25.71% (n=9) of Group-B had good functional outcomes, and the p value of 0.23 indicates that there was no significant difference (Table 5).

Table 5
Comparison of the Functional Outcome of Volar Plate versus Percutaneous K-Wire in Intra- Articular Distal Radius Fracture (n=70)

Functional Outcome	Group-A (n=35)		Group-B (n=35)	
	No. of patients	%	No. of patients	%
Excellent	30	85.71	26	74.29
Good	5	14.29	9	25.71
Total	0	0	35	0

P-value=0.23

Using stratification, effect modifiers such as age, gender, broken side, fracture duration, AO fracture type, and ASA were managed. Following stratification, the results of both groups were compared using the chi square test for each stratum. A statistically significant P value was defined as less than 0.05 (Table 6-9).

Table 6
Exhibiting Stratification for Age

Age(years)		Outcome		Total	P-value
		Excellent	Good		
20-40	A	15 88.2%	2 11.8%	17 100.0%	0.192
	B	18 72%	7 28%	25 100.0%	
41-65	A	15 83.3%	3 16.7%	18 100.0%	0.601
	B	8 80%	2 20%	10 100.0%	

Table 7
Exhibiting Stratification for Gender

Gender		Outcome		Total	P-value
		Excellent	Good		
Male	A	24 85.7%	4 14.3%	28 100.0%	0.208
	B	19 73.1%	7 26.9%	26 100.0%	
Female	A	6 85.7%	1 14.3%	7 100.0%	0.600
	B	7 77.8%	2 22.2%	9 100.0%	

Table 8: Stratification for ASA Status

ASA		Outcome		Total	P-value
		Excellent	Good		
I	A	11 91.7%	1 8.3%	12 100%	0.240
	B	11 73.3%	4 26.7%	15 100%	
II	A	19 82.6%	4 17.4%	23 100%	0.405
	B	15 75%	5 25%	20 100%	

Table 9
Exhibiting Stratification for Fracture Side

Side		Outcome		Total	P value
		Excellent	Good		
Right	A	16 80%	4 20%	20 100%	0.514
	B	12 75%	4 25%	16 100%	
Left	A	14 93.3%	1 6.7%	15 100%	0.150
	B	14 73.7%	5 26.3%	19 100%	

DISCUSSION

Doctors formerly used external fixation or a combination of restricted open reduction, Kirschner wire (K-wire) augmentation, and bone grafting to treat intra-articular distal radius fractures. However, fragment-specific fixation has become a possibility with the recent introduction of locking implants especially made for the distal radius. Another effective treatment option for unstable, dorsally displaced distal radial fractures is open reduction and internal fixation (ORIF) using volar fixed-angle plates. Although both operations are normal, there is disagreement over the best course of action. However, the majority of patients have surgery with K-wires. However, research has shown that volar plates are superior to K-wires in terms of producing better results for this kind of fracture. In order to collect local data and develop a more advanced and effective treatment for distal radius intra-articular fractures, we established the present investigation. Out of the 70 cases (35 in each group) in our study, 48.57% (n=17) in Group-A and 71.43% (n=25) in Group-B were between the ages of 20 and 40, while 51.43% (n=18) in Group-A and 28.57% (n=10) in Group-B were between the ages of 41 and 65. The mean age of the groups was determined to be 40.06+10.75 and 35.83+8.54 years, respectively. Considering the males in present study, 80% (n=28) in Group-A and 74.29% (n=26) in Group-B, while 20% (n=7) in Group-A and 25.71% (n=9) in Group-B were females. These results were similar to the findings of researcher [13]. Beside of these, In intra-articular distal radius fractures, 74.29% (n=26) of Group-B and 85.71% (n=30) of Group-A had excellent functional outcomes, 14.29% (n=5) of Group-A and 25.71% (n=9) of Group-B had good functional outcomes, and the p-value of 0.23 indicates that there was no significant difference between the functional results of volar plate and percutaneous k-wire. The findings of our study are in line with a trial that discovered that functional outcomes for intra-articular distal radius fractures were good to exceptional in 90% of patients with volar plates and 65% of cases with K-wires[14]. In another study, functional results for intra-artuclar distal radius fractures were satisfactory to excellent in 90% of patients with volar plates and 70% of cases with K-wires[17]. Our study's results concur with those of clinical findings reported by reference [18], they investigated the preservation of radiographic alignment of unstable intra-articular fractures by a fixed-angle locking plate implanted using a single volar method. After an average follow-up of 28 months (range: 24–70 months), they discovered that the wrist's range of motion was extremely good and that its mean grip strength was 81% of that of the opposite wrist. The Disabilities of the Arm, Shoulder, and Hand (DASH) score was 8. Less than 5% of individuals experienced problems, and two patients experienced loss of reduction. Three months after the accident, all of the fractures had healed. In their comparison of radiological and functional results as well as complication rates, Reference[19] found 14 research (n = 1535) in total, including five randomized controlled trials and nine comparative studies. All follow-up intervals up to and including 12 months showed statistically significant Disabilities of the Arm, Shoulder, and Hand (DASH) ratings for VLP. However, in present study, statistically significant wrist motions were seen for VLP at 6 weeks. There was a significant difference in grip strength favoring VLP at the 12-month and final follow-up points. Although the overall radiological results were comparable with findings of reference[19], they reported that VLP restored the ulnar variation more effectively at 6 weeks. Clinical significance was not attained by these findings. K-wires were linked to an 18% increased risk of complications; however, VLP had a greater rate of reoperation (4.6% versus 3.2%). Their research showed comparable short- and medium-term clinical functional and radiological results for VLP and K-wire fixation. K-wires have a greater overall complication rate, however when considering surgical fixing of these fractures, the increased risk of reoperation must be taken into account. However, because of the limitations of this study, we solely compared functional outcomes. For patients with a dorsally displaced fracture of the distal radius, another study examined the clinical efficacy of Kirschner wire fixation versus locking plate fixation. They found that the baseline characteristics of the two groups were well balanced, and more than 90% of patients finished follow-up. By 12 months, the wrist functions of both patient groups had improved[19]. At three, six, and twelve months, there was no clinically significant change in the patient-rated wrist score (the plate group's difference was 1.3, 95% CI −4.5 to 1.8; P=0.40). Furthermore, neither the number of problems nor health-related quality of life differed clinically across the groups. They disclosed that this experiment demonstrated no difference in functional result between patients treated with Kirschner wires or volar locking plates for dorsally displaced fractures of the distal radius, which runs counter to the body of current literature and the rapidly growing usage of locking plate fixation. However, Kirschner wire fixing is speedier and less expensive. We discovered no statistically significant difference between the two methods, which supports this conclusion. We need more comprehensive trials with larger numbers of samples in order to verify our findings.

CONCLUSION

We concluded that functional outcome of volar plate is comparable when compared with percutaneous k-wire in intra-articular distal radius fracture; however, the difference is not significant.

REFERENCES

1. Soerensen S, Larsen P, Korup LR, Ceccotti AA, Larsen MB, Filtenborg JT, Weighert KP, Elsoe R. Epidemiology of distal forearm fracture: a population-based study of 5426 fractures. Hand. 2024 Jan;19(1):24-9. https://doi.org/10.1177/15589447221109967
2. Bergh C, Wennergren D, Möller M, Brisby H. Fracture incidence in adults in relation to age and gender: a study of 27,169 fractures in the Swedish Fracture Register in a well-defined catchment area. PloS one. 2020 Dec 21;15(12):e0244291. https://doi.org/10.1371/journal.pone.0244291

3. Smit AE, Meijer OC, Winter EM. The multi-faceted nature of age-associated osteoporosis. Bone Reports. 2024 Mar 1;20:101750. https://doi.org/10.1016/j.bonr.2024.101750
4. Yordanov A, Vasileva-Slaveva M, Tsoneva E, Kostov S, Yanachkova V. Bone Health for Gynaecologists. Medicina. 2025 Mar 18;61(3):530. https://doi.org/10.3390/medicina61030530
5. Sheen JR, Mabrouk A, Garla VV. Fracture healing overview. In Stat Pearls [Internet] 2023 Apr 8. StatPearls Publishing.
6. Miller TC, Fishman FG. Management of Monteggia injuries in the pediatric patient. Hand Clinics. 2020 Nov 1;36(4):469-78. https://doi.org/10.1016/j.hcl.2020.07.001
7. Miller TC, Fishman FG. Management of Monteggia injuries in the pediatric patient. Hand Clinics. 2020 Nov 1;36(4):469-78. https://doi.org/10.1016/j.hcl.2020.07.001
8. Kamal Y, Khan HA, Farooq M, Gani N, Lone AU, Shah AB, Latto IA, Khan MA. Functional outcome of distal radius fractures managed by barz ullah working classification. Archives of Trauma Research. 2015 Mar 20;4(1):e20056. https://doi.org/10.5812/atr.20056
9. Tripathy SK, Khan S, Varghese P, Neradi D, Jain M, Patel H. Combined articular and ligament reconstructions in neglected fracture-dislocation of the knee. Journal of Clinical Orthopedics and Trauma. 2024 Jul 1;54:102475. https://doi.org/10.1016/j.jcot.2024.102475
10. Kamal RN, Gomez GI, Schultz EA, Shapiro LM. The Safety of the Volar Intra articular Extended Window (VIEW) Approach for Intra-articular Distal Radius Fractures. HAND. 2025 May;20(3):394-401. https://doi.org/10.1177/15589447231210926
11. Jain N, Iyer H, Gill S. Forearm fractures in adults. Surgery (Oxford). 2025 Jan 20. https://doi.org/10.1016/j.mpsur.2024.12.002
12. Tai TH, Chu PJ, Lu KY, Wu JJ, Wong CC. Current Management and Volar Locking Plate Fixation with Bone Cement Augmentation for Elderly Distal Radius Fractures—An Updated Narrative Review. Journal of Clinical Medicine. 2023 Oct 27;12(21):6801. https://doi.org/10.3390/jcm12216801
13. Tariq MA, Ali U, Uddin QS, Altaf Z, Mohiuddin A. Comparison between volar locking plate and Kirschner wire fixation for unstable distal radius fracture: a meta-analysis of randomized controlled trials. Journal of Wrist Surgery. 2024 Oct;13(05):469-80. https://doi.org/10.1055/s-0043-1768235
14. Muhammad G, Shahwani MB, Ghilzai AK, Jamal S, Kakar KK, Luqman M, Khan A. Outcome of Volar Plate in Patients with Intra Articular Distal Radius Fracture. Indus Journal of Bioscience Research. 2025 Jan 10;3(1):197-202. https://doi.org/10.70749/ijbr.v3i1.470
15. Mazar S, Shah MI, Panhwar SK, ur Rahman SA. Functional Outcomes of Close Reduction With K-wires Vs Open Reduction and Internal Fixation in Distal Radius Fractures. Pakistan Journal of Medicine and Dentistry. 2022;11(3):44-50. https://doi.org/10.36283/pjmd11-3/008
16. Siwach P, Singh SV, Puri G, Singh J. Functional Outcome of Intra-Articular Fracture of Distal End Radius Treated with External Fixator; A Prospective Study. Current Health Sciences Journal. 2025 Mar 31;51(1):141.
17. Fok MW, Klausmeyer MA. Volar Plate Fixation of Intra-Articular Distal Radius Fractures: A Retrospective Study. J Wrist Surg 2013;2:247–54. https://doi.org/10.1055/s-0033-1350086
18. Fok MW, Klausmeyer MA, Fernandez DL, Orbay JL, Bergada AL. Volar plate fixation of intra-articular distal radius fractures: a retrospective study. Journal of wrist surgery. 2013 Aug;2(03):247-54. https://doi.org/10.1055/s-0033-1350086
19. Youlden DJ, Sundaraj K, Smithers C. Volar locking plating versus percutaneous Kirschner wires for distal radius fractures in an adult population: a meta-analysis. ANZ J Surg 2018; https://doi.org/10.1111/ans.14903
20. Costa ML, Achten J. Percutaneous fixation with Kirschner wires versus volar locking plate fixation in adults with dorsally displaced fracture of distal radius: randomised controlled trial. BMJ 2014;349. https://doi.org/10.1136/bmj.g4807