

Functional Outcome of Extra-Articular Distal Radius Fractures Managed with Closed Reduction and Cast Immobilization Versus Closed Reduction with Percutaneous K-Wire Fixation in the Elderly: A Prospective Comparative Study

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Received: 05-10-2022 / Revised: 12-11-2022 / Accepted: 20-11-2022

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Conflict of interest: Nil

Abstract

Background: Distal radius fractures are among the most common fragility fractures in the elderly population. Although closed reduction with cast immobilization remains a widely used treatment modality, maintaining fracture reduction in osteoporotic bone is often difficult. Percutaneous Kirschner wire (K-wire) fixation has been proposed as a minimally invasive alternative to improve stability and functional outcomes. This study was designed to compare the functional outcomes of extra-articular distal radius fractures managed with closed reduction and traditional cast immobilization versus closed reduction with percutaneous pinning in elderly patients.

Materials and Methods: A total of 48 patients aged 60 years and above with extra-articular distal radius fractures. Patients were allocated into two groups: Group A (n=24) underwent closed reduction and below-elbow cast immobilization, while Group B (n=24) received closed reduction with percutaneous K-wire fixation supplemented by casting. Patients were followed for six months. Functional outcome was assessed using the Modified Mayo Wrist Score (MMWS). Secondary outcomes included radiological parameters, wrist range of motion, fracture union, and complications.

Results: Both groups achieved satisfactory fracture union. However, the K-wire group demonstrated significantly better maintenance of radial height, radial inclination, and volar tilt ($p < 0.001$). Mean MMWS at six months was significantly higher in the K-wire group (89.4 ± 8.2) compared with the cast group (79.2 ± 10.6) ($p < 0.001$). Improved wrist mobility was observed following percutaneous pinning. Loss of reduction and malunion were more frequent in the cast group, whereas minor pin tract infections occurred in two patients in the K-wire group.

Conclusions: Closed reduction with percutaneous K-wire fixation provides superior short-term functional and radiological outcomes compared with cast immobilization alone in elderly patients with extra-articular distal radius fractures, with an acceptable complication profile.

Keywords: Distal radius fracture, Closed reduction, Cast immobilization, Modified Mayo Wrist Score.

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Introduction

Distal radius fractures (DRFs) are among the most frequently encountered fractures in orthopaedic practice and constitute the most common fractures involving the upper extremity in older adults. Their incidence increases substantially with advancing age owing to osteoporosis, diminished bone mineral density, impaired balance, and a higher propensity for low-energy falls, particularly among postmenopausal women and elderly individuals living independently. It has been estimated that DRFs account for nearly one-sixth of all fractures presenting to emergency departments, representing

a major source of morbidity, functional limitation, and healthcare expenditure worldwide [1,2]. The management of distal radius fractures in the elderly remains controversial. Historically, closed reduction followed by cast immobilization has been considered the standard treatment because of its simplicity, low cost, and avoidance of surgical complications [3]. However, maintenance of fracture reduction in osteoporotic bone is often challenging, leading to secondary displacement, malunion, reduced grip strength, restricted wrist motion, and compromised functional outcomes [4].

Consequently, various surgical techniques have been advocated to improve anatomical alignment and facilitate early recovery.

Percutaneous Kirschner wire (K-wire) fixation following closed reduction has gained popularity as a minimally invasive technique for unstable extra-articular distal radius fractures. The method provides additional stability while preserving soft tissue integrity and minimizing operative morbidity. Compared with more extensive procedures such as volar locking plate fixation, percutaneous pinning requires shorter operative time, lower implant costs, and limited surgical exposure, factors particularly relevant in elderly patients with multiple comorbidities [5,6].

Despite widespread clinical use, evidence regarding the superiority of percutaneous pinning over conventional cast treatment in the elderly remains inconclusive. Systematic reviews have reported that although surgical interventions may provide improved radiographic alignment and faster functional recovery, long-term patient-reported outcomes are often comparable with conservative management [7,8]. Costa ML et al. further highlighted the ongoing uncertainty regarding the optimal treatment strategy for displaced distal radius fractures managed by manipulation [9]. Moreover, relatively few studies have specifically focused on extra-articular fractures in elderly populations, in whom treatment goals emphasize restoration of function, independence in activities of daily living, and minimization of treatment-related complications. Therefore, the present study was undertaken to compare the functional outcomes of extra-articular distal radius fractures managed with closed reduction and traditional cast immobilization versus closed reduction with percutaneous K-wire pinning in elderly patients.

Materials and Methods

The present prospective comparative observational study was conducted in the Department of Orthopaedics at Prathima Institute of Medical Sciences, Karimnagar and Pratima Relief Institute of Medical Sciences, Hanamkonda, Telanganafrom July 2021 to September 2022. a total of 48 elderly patients diagnosed with extra-articular fractures of the distal end of the radius. After obtaining prior approval from the Institutional Ethics Committee, written informed consent was obtained from all participants prior to inclusion in the study.

Inclusion Criteria

Patients aged ≥ 60 years, radiologically confirmed extra-articular distal radius fractures corresponding to AO/OTA Type 23-A fractures, closed fractures presenting within seven days of injury, medically fit to undergo the study procedures and willing to

provide informed consent and comply with followup evaluations.

Exclusion Criteria

Patients with intra-articular distal radius fractures (AO/OTA Type 23-B and 23-C), open fractures, bilateral distal radius fractures, associated fractures involving the ipsilateral upper limb, functional impairment of the affected wrist, history of surgeries, polytrauma patients requiring prolonged immobilization, and patients lost to follow-up before completion of the study period.

All the study participants were allocated randomly into two treatment groups. Group A (n=24) cases managed with Closed reduction followed by traditional below-elbow cast immobilization and group B (n=24) cases managed with closed reduction followed by percutaneous K-wire fixation and cast immobilization. Detailed demographic information including age, sex, mechanism of injury, side involved, hand dominance, and associated comorbidities was recorded at admission. A thorough clinical examination was performed to assess swelling, deformity, neurovascular status, and associated injuries. Standard AP view and lateral view radiographs of the affected wrist were obtained before reduction. Fractures were classified according to the AO/OTA classification system.

For Group A, closed reduction was performed under analgesia followed by below-elbow cast immobilization for six weeks. Group B underwent closed reduction with percutaneous K-wire fixation under image guidance, supplemented with casting. After cast removal, all patients received standardized rehabilitation emphasizing wrist mobilization, forearm movements, grip strengthening, and gradual return to daily activities while avoiding heavy lifting until fracture union.

Postoperative follow-up: Patients were evaluated at regular intervals of 2 weeks, 6 weeks, 3 months, and 6 months following treatment. At each follow-up visit, clinical and radiographic assessments including radial height, radial inclination, volar tilt, and ulnar variance were performed. Fracture union was defined as the presence of bridging trabeculae across the fracture site on radiographs accompanied by absence of local tenderness at the fracture site.

The pain, functional status, range of motion, grip strength was assessed using the Modified Mayo Wrist Score (MMWS) at six months. In continue, time to radiological union, maintenance of radiographic parameters, wrist range of motion, and treatment-related complications were recorded.

Statistical Analysis: The collected data was extracted into Microsoft Excel sheet and analysed using the SPSS v.26.0.

Continuous variables were expressed as mean and standard deviation, whereas categorical variables were presented as frequencies and percentages. Comparisons between the two groups were performed using the independent Student's t-test for

normally distributed continuous variables and the Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant for all analyses.

Results

Table 1: Demographic characteristics study participants.

Demographic variable	Group A (n=24)	Group B (n=24)	p-value
Age (In years)	67.5 ± 5.8	68.2 ± 6.1	0.68
Gender			
Female	17 (70.8)	16 (66.7)	0.76
Male	7 (29.2)	8 (33.3)	
Dominant side involved	13 (54.2)	12 (50.0)	0.77
Fall from standing height	20 (83.3)	19 (79.2)	0.71
Other mechanisms	4 (16.7)	5 (20.8)	

Table 2: Postoperative assessment of parameters at 6 months follow-up

Parameter	Group A	Group B	p-value
Radiological evaluation			
Radial height (mm)	8.6 ± 1.5	10.8 ± 1.3	<0.001
Radial inclination (degree)	18.4 ± 2.7	21.3 ± 2.2	<0.001
Volar tilt (degree)	4.1 ± 3.6	8.5 ± 2.8	<0.001
Ulnar variance (mm)	2.4 ± 0.8	1.4 ± 0.6	<0.001
Wrist range motion			
Flexion	55.3 ± 8.1	63.7 ± 7.5	0.001
Extension	56.8 ± 7.6	65.8 ± 6.9	0.001
Supination	70.4 ± 6.4	76.2 ± 5.7	0.002
Pronation	72.5 ± 5.8	77.8 ± 5.3	0.003
Modified mayo wrist score			
Excellent (90-100)	5 (20.8)	12 (50.0)	-
Good (80-89)	8 (33.3)	9 (37.5)	
Fair (65-79)	7 (29.2)	3 (12.5)	
Poor (<65)	4 (16.7)	0 (0.0)	

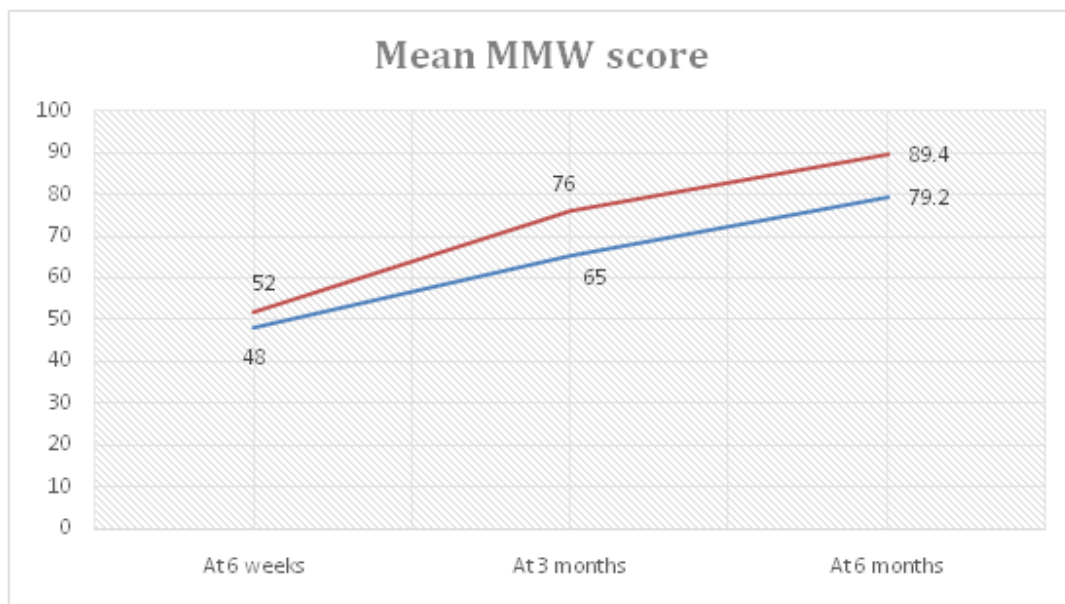


Figure 1: Mean Modified Mayo Wrist Score

Fracture union was occurred in 7.8 weeks of group A and 7.2 weeks of group B which was statistically significant (p<0.05).

Table 6: Postoperative complications

Complications	Group A	Group B
Loss of reduction	5 (20.8)	1 (4.2)
Wrist stiffness	4 (16.7)	2 (8.3)
Malunion	3 (12.5)	1 (4.2)
Pin tract infection	0 (0.0)	2 (8.3)
Complex regional pain syndrome	1 (4.2)	0 (0.0)
Redisplacement requiring intervention	2 (8.3)	0 (0.0)

Discussion

Distal radius fractures are common fragility fractures in the elderly, predominantly resulting from low-energy falls associated with osteoporosis and age-related decline in bone quality [1,2]. Traditionally, cast immobilization has been widely accepted as the preferred treatment in older adults because it is inexpensive, technically straightforward, and avoids surgical risks. However, maintaining reduction in osteoporotic bone remains challenging, predisposing patients to secondary displacement and malunion [3].

In the present study, the cast group showed a higher incidence of loss of reduction and malunion compared with the K-wire group. Similar observations were reported by Walenkamp et al., who identified advanced age, metaphyseal comminution, and initial displacement as important predictors of instability after closed reduction [4]. Diaz-Garcia et al., in their systematic review, also concluded that conservative treatment in unstable fractures frequently resulted in radiographic deterioration despite acceptable fracture healing [7].

Patients treated with percutaneous pinning in our study demonstrated better preservation of radial height, radial inclination, and volar tilt. These findings are consistent with those of Miller et al., who reported that supplemental K-wire fixation improved maintenance of anatomical reduction when compared with cast treatment alone [10]. Likewise, Azzopardi et al. observed superior radiological alignment in elderly patients managed surgically, although differences in patient satisfaction narrowed over longer follow-up periods [11].

Functional outcome represents the principal determinant of treatment success in elderly individuals. The significantly higher Modified Mayo Wrist Scores observed in the K-wire group in our study suggest that improved anatomical restoration may translate into enhanced short-term functional recovery.

Arora et al. similarly demonstrated that operative fixation produced earlier functional benefits despite comparable long-term outcomes between treatment strategies [12]. Better range of motion and grip strength following stable fixation may facilitate

earlier return to activities of daily living and preservation of independence.

The complication profile observed in our study reflected the inherent advantages and limitations of each modality. Loss of reduction and malunion were more frequent after cast immobilization, whereas minor pin tract infections occurred only in the K-wire group. Previous studies have documented pin tract infection rates ranging from 2% to 12%, most of which respond satisfactorily to local wound care and oral antibiotics without compromising fracture healing [13]. Importantly, no major neurovascular complications or tendon injuries were encountered in our series.

Recent evidence has questioned whether improved radiographic outcomes necessarily translate into superior long-term patient-reported results. The DRAFFT2 multicentre randomized controlled trial reported no clinically meaningful differences in wrist pain or function between K-wire fixation and casting at one year following manipulation of dorsally displaced distal radius fractures [9]. Similarly, the systematic review by Luokkala et al. emphasized that treatment selection in elderly patients should account for functional demands, comorbidities, and patient preferences rather than radiographic appearance alone [8].

Nevertheless, the current study specifically evaluated extra-articular fractures in an elderly cohort and demonstrated that percutaneous pinning provided superior short-term functional and radiological outcomes with an acceptable complication rate. These findings suggest that closed reduction with K-wire fixation represents an effective and minimally invasive alternative to cast immobilization in selected elderly patients with unstable extra-articular distal radius fractures. Larger randomized trials with longer follow-up are warranted to determine whether these early advantages persist over time and justify routine surgical intervention in this growing patient population.

Conclusion

The closed reduction with cast immobilization and closed reduction with percutaneous K-wire fixation achieved satisfactory fracture union in elderly patients with extra-articular distal radius fractures. However, percutaneous pinning provided superior

maintenance of radiological alignment, improved wrist range of motion, and better short-term functional outcomes, as reflected by significantly higher Modified Mayo Wrist Scores. Although minor pin-related complications were observed, these were manageable and did not adversely affect recovery. Therefore, closed reduction with percutaneous K-wire fixation may be considered a safe, minimally invasive, and effective treatment option for selected elderly patients with unstable extra-articular distal radius fractures.

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