Functional outcome of cast immobilization versus volar-locked plate in fixation of AO type-C distal radial fractures in the elderly

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Background
Distal-end radius fractures account for 16% of all fractures. The incidence of this fracture has bimodal distribution with increasing number of elderly population affection. While closed reduction and cast immobilization may represent a good option in elderly patients, it may fail to maintain acceptable radiological parameters. Volar locking plate is an alternative option, but has its own complications.
Patients and methods
We prospectively conducted a study to compare the functional outcomes of isolated type-C distal radius fractures in 90 patients over 60 managed by closed reduction and cast immobilization (group A) or volar locking plates (group B). Patients were evaluated regarding radiological parameters, grip strength, range of motions, and quick disabiliy arm shoulder hand (DASH) score at 6 months follow-up.
Results
There was no statistical difference in range of motions between the two groups at 6 months follow-up. However, the results of quick DASH score and grip strength were better in group B with statistical significance at 3 months follow-up. No statistical differences in the results of quick DASH score and grip strength at 6 months follow-up.
Conclusion
Closed reduction and cast immobilization could provide an alternative comparable method for volar locking plates in the management of distal-end radius fractures in the geriatric population.

Keywords:
cast immobilization, distal-end radius, geriatrics, volar locking plate

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Introduction

Distal radius fractures account for 16% of all fractures and are the most prevalent fractures treated by trauma surgeons [1]. These fractures are commonly seen in elderly patients with increasing number and can cause a loss of wrist function [2]. Approximately 50% of these fractures are intraarticular and have common complications, including arthritis in up to 65% of patients, and diminution of movement in up to 31% [3].

There are varieties of treatment modalities available. Closed reduction with casting alone, percutaneous pinning, or external fixation. Another modality is open reduction by volar or dorsal approach and internal fixation. Which modality is better in management of complex geriatric distal radial fractures remains a matter of controversy [1].

The benefit of casting is that it does not interfere with the complex sequence of healing events at the fracture site and the patient is not exposed to the risks of surgery [4]. While the disadvantages are imposing restrictions, particularly in bathing and driving, and have some complications such as arthritis and complex pain syndromes [5].

On the other side, volar-locked plating (VLP) allows for better anatomic reduction, earlier return of hand and upper limb function, and reduced risk of redisplacement [6]. Its disadvantages include hardware failure, flexor tendon lesions, extensor tendon rupture, infection, and the cost [7].

In this study, we are evaluating the functional outcome of cast immobilization versus volar locking plate for treatment of distal radius fracture AO classification type C in patients over 60 years of age.

Patients and methods

After approval by Local Research Ethics committee, we conducted a prospective series study involving 90 patients from April 2019 to December 2020. The inclusion criteria were isolated closed intraarticular fractures of the distal radius AO type C [8] with age

more than 60 years and injuries not more than 2 weeks. We excluded patients with severe soft tissue injury or having other fractures.

Patients were randomly allocated into two groups: 45 in each one. Group A patients underwent closed reduction and cast immobilization and group B VLP. All patients had informed written consents and were followed prospectively for at least 6 months.

Data collection included age, sex, side affection, mode of trauma, American Society of Anesthesiologists classification for risk assessment [9], and both plain radiograph and computed tomography scan.

In group A, the fracture reduction was carried out under local hematoma block in a well-padded above-elbow plaster cast extending to the metacarpal heads. The patients were admitted for 24 h under observation.

In group B: all patients underwent general anesthesia. Prophylactic antibiotic was given 30 min before surgery. Under tourniquet, we used the modified Hennery's approach between the radial artery and flexor carpi radialis muscle tendon. Definitive fixation was carried out using a VLP, which was applied proximal to the anatomic watershed zone of the distal radius. Patients were discharged in below-elbow splints.

Patients were followed biweekly for the first month and then monthly afterward. For group A, the cast was changed into a better-molded below-elbow one at 2 weeks for another 4 weeks.

At 6 months (final follow-up), we evaluated the patients both functionally (range of motion, grip strength, quick disabiliy arm shoulder hand (DASH) score [10]) and radiologically (radial height–volar tilt).

Statistical analysis

Data were coded and entered using the Statistical Package for the Social Sciences (SPSS), version 23 (IBM Corporation, Armonk, New York, USA) and summarized using mean, SD, median, minimum, and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. *P* values less than 0.05 were considered as statistically significant.

Results

There was no statistical significance difference between both groups regarding age, sex, and side affection, mode of trauma, ASA classification, and AO classification (Table 1).

The mean radial height value in group A (7.30 ± 2.08 mm) was lower than group B (9.98 ± 1.01 mm), as well as volar tilt was lower in group A (3.50 ± 1.52°) than group B (8.53 ± 1.30°) with both having *P* value less than 0.005.

Table 1 Demographics of both groups

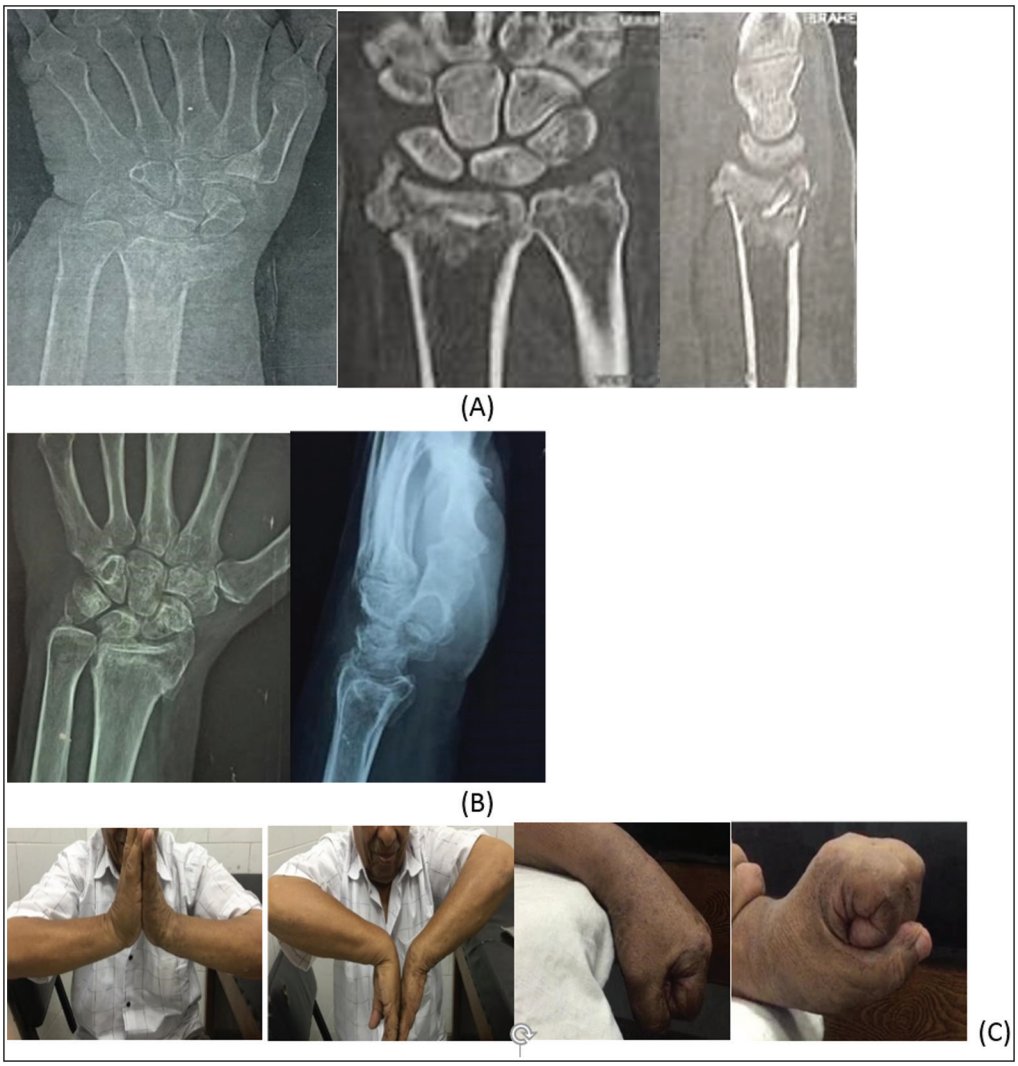
Age (years)	Group A		Group B		*P* value
	Minimum–maximum	Mean±SD	Minimum–maximum	Mean±SD	
	54–80	67.13 ± 8.07	59–75	66.40 ± 5.21	0.770
		Sex			
	n (%)		*n* (%)		0.273
Male	6 (40)		9 (60)		
Female	9 (60)		6 (40)		
		Side			
Right	7 (46.7)		8 (53.3)		0.715
Left	8 (53.3)		7 (46.7)		
		Mode of trauma			
RTA	3 (20)		5 (35)		0.682
Falling to ground	9 (60)		6 (40)		0.273
Falling from 2 m	3 (20)		2 (0.240)		1.000
Falling from 3 m	0		2 (2.143)		0.483
		ASA			
ASA1	6 (40)		6 (40)		
ASA2	6 (40)		5 (33.3)		1.000
ASA3	3 (20)		4 (26.7)		
		AO classification			
C1	7 (46.7)		4 (35)		
C2	4 (26.7)		7 (40)		0.428
C3	4 (26.7)		4 (25)		

Table 2 Functional outcomes at final follow-up

Mean±SD	Group A	Group B	*P* value
Flexion	48.40±5.58°	50±5.35°	0.429
Extension	51.67±5.16°	53.07±5.46°	0.476
Radial deviation	19.33±3.27°	20.27±3.41°	0.450
Ulnar deviation	24.0±5.10°	25.13±4.88°	0.539
Supination	77.53±5.74°	79.0±4.71°	0.451
Pronation	83.87±4.19°	85.33±4.42°	0.359
Grip strength	28.13±6.13 kg	37.13±12.26 kg	0.020 (S)
Q-DASH	14.33±3.14	18.65±4.39	0.001 (S)

DASH, disabiliy arm shoulder hand; S, statistically significant.

Figure 1



A 75-year-old male patient medically free (ASA1) had left fracture distal radius falling from two meters on the outstretched hand. (a) Prereduction radiograph and computed tomography scan. (b) Final follow-up radiograph. (c) Functional outcome.

Table 2 shows the functional outcomes in both groups at the final follow-up (6 months). Figures 1 and 2 demonstrate cases from both groups.

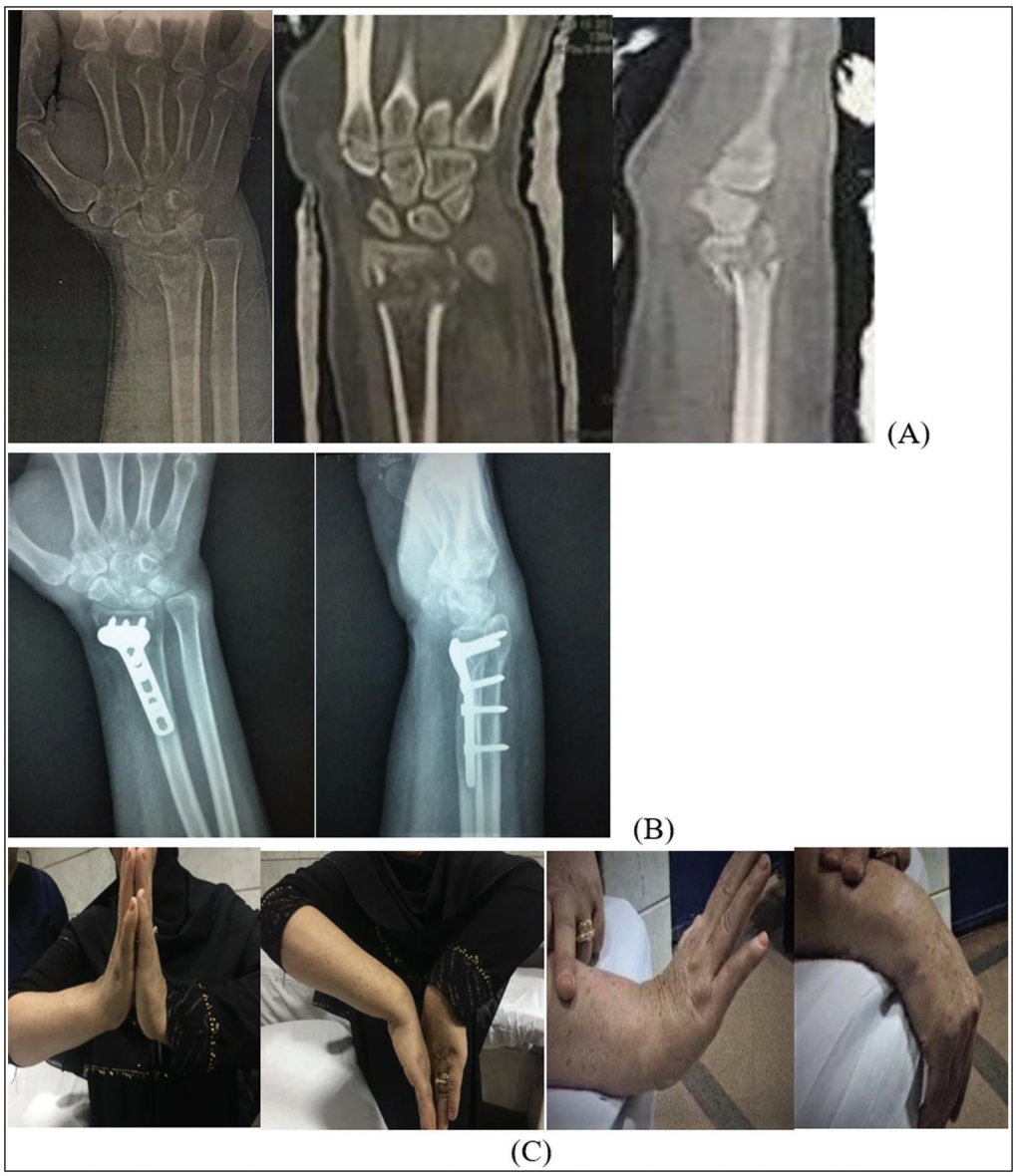
Discussion

Distal radius fractures are frequently seen in elderly patients due to aging of population, an increasing number of road accidents, and osteoporosis [1].

The ideal aim of treatment in these fractures is to regain the preinjury function level by restoring the normal anatomy. However, the precise methods to achieve that desired outcome are still controversial [1].

For maximum daily activities, the minimal functional wrist motions are 35° extension, 10° flexion, 15° ulnar deviation, and 10° radial deviation [11]. In order to achieve this, the acceptable radiographic parameters for a healed radius in

Figure 2



A 65-year-old female patient medically free (ASA1) with right distal radius fracture fall to the ground. (a) Preoperative radiograph and computed tomography. (b) Final follow-up. (c) Functional outcome.

an active, healthy individual include radial height more than 5 mm, radial inclination more than 15°, volar tilt from 15° to neutral, ulnar variance less than 2 mm, and articular step-off or gap less than 2 mm [12].

The success of conservative treatment with closed reduction and plaster immobilization is directly related with the degree of comminution, the age of the patient, osteopenia and osteoporosis, and the associated soft tissue injuries. Although recent studies have described the usefulness of VLP implants, for the treatment of displaced, unstable distal radius fractures in elderly patients, there are disadvantages such as hardware failure, flexor tendon lesion extensor tendon ruptures, infection, and hospital cost [7].

In comparing the results between cast immobilization and VLP in elderly patients with type-C distal radius fracture, Zengin *et al.* [13] showed that the quick DASH score of the VLP group was lower than that of the cast group, but was not statistically significant. Chan *et al.* [14] found no statistical difference between both groups regarding grip strength at 6 months despite it was better in the VLP group at 3 months. Ulnar deviation was statistically significantly higher in the VLP group as reported by Toon *et al.* [15]. There was no statistical difference between the two groups in supination or pronation range of motion at 3 and 6 months in the study by Arora *et al.* [16].

In all previous studies, the radiological parameters (radial height–volar tilt) were superior in the VLP group.

We evaluated the outcomes of closed isolated type-C distal radius fracture management in 30 patients above 50 years by either VLP or cast. At 6 months

follow-up, grip strength and quick DASH score were significantly better in the VLP group. However, there is no significant difference in range of motion between the two groups.

Despite the small sample size, our results were comparable to previous published studies. Although the functional outcomes were assessed by quick DASH score, grip strength, and the degree of motions, the authors believe that patients' satisfaction with the management method and its outcome should be evaluated also especially in elderly age group as the functional outcome should be individualized for each patient.

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Conflicts of interest
The authors declare that they have no competing interests.

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