

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF DIFFERENT PINNING CONFIGURATION (CROSS PINNING VERSUS DIVERGENT PINNING) IN FIXATION OF EXTRA-ARTICULAR FRACTURE OF DISTAL END RADIUS IN ELDERLY PATIENTS

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ABSTRACT

Objective: The objective of the study is to compare the functional and radiological outcomes of different pinning configuration (cross pinning versus divergent pinning) in the fixation of extra-articular fracture of distal end radius in elderly patients.

Methods: An observational prospective study was conducted at Sri Aurobindo Medical College and PG Institute, Indore, MP, from December 2019 to May 2021. After the approval of the Institutional Ethics Committee, informed consent was obtained from the 40 elderly patients of the both sex in the age group of more than 50 years with closed fracture. 20 Patients were subjected to divergent pinning and 20 patients were subjected to cross pinning. Regular follow-up with the X-ray imaging.

Results: Statistically no significant difference was found in palmar tilt, radial shortening, and loss of radial deviation. Mayo wrist score compare between the two groups. The result showing the functional outcome of configuration B (cross-pinning) is better than that of configuration A (divergent pinning). The only significant complication is pin migration, pin site infection, and stiffness. Pin tract infections are resolved by oral antibiotics, good pin tract care and wrist stiffness treated with vigorous physiotherapy.

Conclusion: Cross pinning had better functional and radiological outcome as compared to the divergent pinning in extra-articular fracture of the distal end of the radius. The percutaneous pinning technique is less time-consuming and allows earlier rehabilitation without jeopardizing the fracture alignment.

Keywords: Pinning, Extra-articular fracture, Distal end radius, Divergent, Cross.

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INTRODUCTION

Distal radial fractures, often referred to as radial fractures, are quite common among older individuals, particularly due to their decreased bone density and the potential for low-energy trauma to cause fractures. It is the bone on the thumb side of the forearm, and its metaphysis is the region between the shaft (diaphysis) and the articular surface. In the elderly population, due to age-related bone changes, the metaphysis of the distal radius can become more vulnerable to fractures. The major precipitating risk factors are low bone mineral density and a high tendency to fall. Extra-articular fractures that are non-reducible intra-articular fractures and fractures for demanding patients who require early mobilization and return to work are commonly treated with plating (more often with palmar plating), intramedullary fixation, external fixation, or pinning [1-4]. Techniques such as external fixation used for ligamentotaxis percutaneous fixation with K-wires or plate osteosynthesis or combination of all of these have been implemented to achieve satisfactory reduction and fixation of displaced distal radius fractures [5]. Our aim is to achieve minimal complications and better recovery, focused on the treatment in terms of post-operative infection and deformity.

Aims and objective

This study aims to study the functional and radiological outcomes of different pinning configurations (cross pinning versus divergent pinning) in the fixation of extra-articular fracture of distal end radius in elderly patients.

- To compare the minimally invasive surgical techniques for distal end fracture of radius among elderly patients.

- To compare the functional outcome by modified Mayo wrist score and radiological outcome by Sarmiento's modification of Lindstrom criteria of different configurations of percutaneous k- wire fixation in fracture distal end radius.
- To assess the complications, if any (non-union, implant loosening, and infection).

METHODS

Prospective observational study that was conducted at Sri Aurobindo Medical College and PG Institute in Indore, India, from December 2019 to May 2021. The study focused on elderly patients with extra-articular distal end radius fracture. A period was approximately 1.5 years. The study received approval from the Institutional Ethics Committee, ensuring that ethical guidelines were followed. Informed consent was obtained from all 40 patients who participated in the study. The study included individuals categorized as elderly, which in this case means those aged 50 years and above extra-articular distal end radius fractures: The study focused on fractures occurring at the distal end of the radius bone that did not involve the joint surface (extra-articular fractures). Patients of both male and female genders were included in the study. Patients below the age of 50 years were excluded compound fractures were excluded. Patients with injuries that caused nerve or blood vessel damage were excluded, and patients with congenital (present from birth) or other anomalies in the forearm were excluded. Fractures involving the joint surface were excluded. Patients who presented with a fracture more than 2 weeks after the injury were excluded. Preoperatively, X-ray of the wrist joint with AP and Lateral view was done. Pre-anesthetic evaluation was done in all cases. Parenteral routine antibiotics were given 1 h before

surgery. Patients operated by following two approaches. Configuration A-Two k-wire are placed through the radial styloid in diverted fashion. Configuration B-Two cross-k-wires with one through radial styloid and the other through dorso ulnar aspect of distal radius followed by cast application. Group A, two K-wire of 2.0 mm inserted from the radial styloid of the distal radius fragment across the fracture and into the proximal fragment in a diverted pattern under image intensifier guidance, and Group B first K-wire inserted from the radial styloid of the distal radius fragment across the fracture and into the proximal fragment followed by second k-wire through dorsal ulnar aspect of distal radius. After checking the stability of the fracture under image intensifier, the wires were drilled to engage the opposite cortex bent at a right angle and cut short outside the skin for easy removal. A sterile dressing including sponge padding applied to prevent skin irritation with the wrist in the neutral position, a dorso radial below elbow plaster of Paris slab was applied up to the knuckles. Postoperative radiographs will be obtained in the anteroposterior and lateral planes. Patients were discharged thereafter and followed up at the end of 6 weeks, 3, 6 months. At each follow-up lateral X-rays and AP were taken along with clinical findings and examination were noted. Mayo wrist score was measured for both the groups. Patients have been evaluated clinically and radiologically after assessment of the range of motion of wrist and functional evaluation using modified mayo wrist score and radiological evaluation by Sarmiento modification of Lindstrom criteria.

Statistical analysis

Analyzed the results using unpaired *t*-test, and Pearson Chi-square test.

RESULTS

At 6 weeks, the mean mayo wrist score in Group A was 73.55±6.46, and in Group B, it was 79.45±6.84. The difference was found to be statistically significant ($p=0.008$), showing a significantly higher mayo wrist score in Group B in comparison to Group A.

At 3 months, the mean mayo wrist score in Group A was 81.30±6.62, and in Group B, it was 84.70±7.20. The difference was found to be statistically not significant ($p=0.128$), showing a comparable mean mayo wrist score between the two groups.

At 6 months, the mean mayo wrist score in Group A was 85.80±6.50, and in Group B, it was 91.40±6.02. The difference was found to be statistically significant ($p=0.007$), showing a significantly higher mayo wrist score in Group B in comparison to Group A.

At 6 weeks and at 6 months, the mean mayo wrist score was significantly higher in Group B in comparison to Group A, while at 3 months, the mean Mayo wrist score was comparable between the two groups.

The Table 5 shows the comparison of the mean Loss of Palmar Tilt at different time intervals between the two groups.

Postoperative: The mean loss of palmar tilt in Group A was 7.30±1.89, and in Group B, it was 6.50±1.15. The difference was found to be statistically not significant ($p=0.155$), showing a comparable mean loss of palmar tilt between the two groups.

At 6 weeks, the mean loss of palmar tilt in Group A was 6.50±2.04, and in Group B, it was 6.25±1.59. The difference was found to be statistically not significant ($p=0.668$), showing a comparable mean loss of palmar tilt between the two groups.

At 3 months, the mean loss of palmar tilt in Group A was 5.15±1.66, and in Group B, it was 4.90±1.65. The difference was found to be statistically not significant ($p=0.636$), showing a comparable mean loss of palmar tilt between the two groups.

At 6 months, the mean loss of palmar tilt in Group A was 4.90±1.99, and in Group B, it was 4.35±2.06. The difference was found to be statistically

Table 1: Distribution of patient according to the age, shows not significant mean age group in between Group A and B

Age	Group A		Group B	
	No.	%	No.	%
50-55 years	5	25	6	30
56-60 years	8	40	6	30
61-65 years	6	30	6	30
66-70 years	1	5	2	10
Total	20	100	20	100
Mean±SD	58.80±5.06		58.20±5.62	
Total	0.355, df=35			
p value	0.725, NS			

Table 2: Gender frequency in female are more than male

Sex	Group A		Group B	
	No.	%	No.	%
Female	11	55	11	55
Male	9	45	9	45
Total	20	100	20	100

Table 3: Complications 75% had no complications in Group A and 85% in Group B

Complications	Group A		Group B	
	No.	%	No.	%
None	15	75	17	85
Pin migration	2	10	0	0
Pin site infection	2	10	1	5
Stiffness	1	5	1	5
Implant loosening	0	0	1	5
Total	20	100	20	100

Table 4: Mayo wrist score at frequent intervals

Time interval	Group	No.	Mean±SD	"t" value	p value
6 weeks	A	20	73.55±6.46	-2.804, df=38	0.008*
	B	20	79.45±6.84		
3 months	A	20	81.30±6.62	-1.554, df=38	0.128, NS
	B	20	84.70±7.20		
6 months	A	20	85.80±6.50	-2.826, df=38	0.007*
	B	20	91.40±6.02		

Table 5: Comparison of loss of palmar tilt between the two groups at different time intervals

Time interval	Group	No.	Mean±SD	"t" value	p value
Postoperative	A	20	7.30±1.89	1.615, df=38	0.155, NS
	B	20	6.50±1.15		
6 weeks	A	20	6.50±2.04	0.433, df=38	0.668, NS
	B	20	6.25±1.59		
3 months	A	20	5.15±1.66	0.477, df=38	0.636, NS
	B	20	4.90±1.65		
6 months	A	20	4.90±1.99	0.857, df=38	0.397, NS
	B	20	4.35±2.06		

not significant ($p=0.397$), showing a comparable mean loss of palmar tilt between the two groups.

The mean loss of palmar tilt in both the groups was comparable throughout the study.

The Table 6 shows the comparison of mean radial shortening at different time intervals between the two groups.

Postoperative: The mean radial shortening in Group A was 4.09 ± 1.34 mm, and in Group B, it was 2.97 ± 0.05 mm. The difference was found to be statistically significant ($p=0.001$), showing more radial shortening in Group A in comparison to Group B.

At 6 weeks, the mean radial shortening in Group A was 3.69 ± 1.04 mm, and in Group B, it was 2.96 ± 0.05 mm. The difference was found to be statistically significant ($p=0.004$), showing more radial shortening in Group A in comparison to Group B.

At 3 months, the mean radial shortening in Group A was 3.20 ± 0.58 mm, and in Group B, it was 2.93 ± 0.04 mm. The difference was found to be statistically significant ($p=0.040$), showing more radial shortening in Group A in comparison to Group B.

At 6 months, the mean radial shortening in Group A was 3.09 ± 0.51 mm, and in Group B, it was 2.92 ± 0.04 mm. The difference was found to be statistically not significant ($p=0.147$), showing a comparable radial shortening in Group A and Group B.

The above Table 7 shows the comparison of mean loss of radial deviation at different time intervals between the two groups.

Postoperative: The mean loss of radial deviation in Group A was 8.00 ± 2.05 and in Group B it was 6.75 ± 2.09 . The difference was found to be statistically not significant ($p=0.064$), showing a comparable mean loss of radial deviation between the two groups.

At 6 weeks, the mean loss of radial deviation in Group A was 7.25 ± 2.19 and in Group B it was 6.35 ± 2.01 . The difference was found to be statistically not significant ($p=0.184$), showing a comparable mean loss of radial deviation between the two groups.

At 3 months, the mean loss of radial deviation in Group A was 5.85 ± 1.42 and in Group B it was 4.75 ± 1.69 . The difference was found to be statistically significant ($p=0.032$), showing a comparable higher mean loss of radial deviation in Group A in comparison to Group B.

Table 6: Comparison of radial shortening between the two groups at different time intervals

Time interval	Group	No.	Mean \pm SD	"t" value	p value
Postoperative	A	20	4.09 ± 1.34	3.757, df=38	0.001*
	B	20	2.97 ± 0.05		
6 weeks	A	20	3.69 ± 1.04	3.107, df=38	0.004*
	B	20	2.96 ± 0.05		
3 months	A	20	3.20 ± 0.58	2.129, df=38	0.040*
	B	20	2.93 ± 0.04		
6 months	A	20	3.09 ± 0.51	1.480, df=38	0.147, NS
	B	20	2.92 ± 0.04		

Table 7: Comparison of loss of radial deviation between the two groups at different time intervals the mean radial shortening was more prominent postoperatively, at 6 weeks and at 3 months, while it was comparable at 6 months

Time interval	Group	No.	Mean \pm SD	"t" value	p value
Postoperative	A	20	8.00 ± 2.05	1.904, df=38	0.064, NS
	B	20	6.75 ± 2.09		
6 weeks	A	20	7.25 ± 2.19	1.352, df=38	0.184, NS
	B	20	6.35 ± 2.01		
3 months	A	20	5.85 ± 1.42	2.232, df=38	0.032*
	B	20	4.75 ± 1.69		
6 months	A	20	4.55 ± 1.28	0.935, df=38	0.356, NS
	B	20	4.15 ± 1.42		

At 6 months, the mean loss of radial deviation in Group A was 4.55 ± 1.28 and in Group B it was 4.15 ± 1.42 . The difference was found to be statistically not significant ($p=0.356$), showing a comparable mean loss of radial deviation between the two groups.

Only at 3 months there was a higher mean loss of radial deviation in Group A in comparison to Group B, while at all other time intervals the mean loss of radial deviation was comparable between the two groups.

DISCUSSION

The present study was undertaken to evaluate the functional and radiological outcome of extra articular fracture distal end radius managed with two different k wire configurations. We evaluated our results and compared with those obtained by various other studies utilizing different modalities of treatment. Our analysis is as follows: In this study, 40 cases of extra articular fracture distal end radius in elderly population were treated by two techniques of k wire (divergent pinning and cross pinning) at department of orthopaedics, Sri Aurobindo Medical College and Post Graduate Institute, Indore Madhya Pradesh were included. Study was done from December 2019 to May 2021.

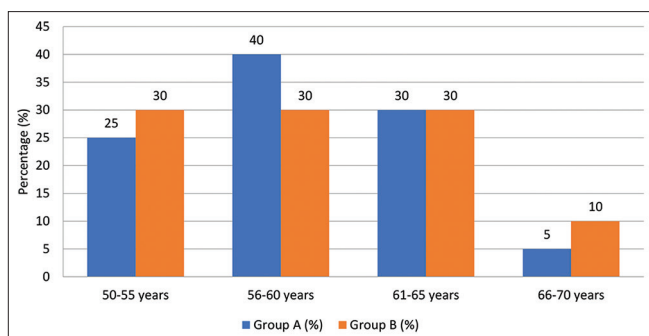
In the current study the common age in elderly group at presentation for patients treated by CRIF with K wire by divergent pinning (Configuration A) was 58 (range 50–70 years) and patients treated by divergent pinning (configuration B) was 58 with same range (50–70 years). In the current study total number of female was 22 (11 in each group) and 18 males (9 in each group). Puchalski and Zyluk reported 86% female patients compared to 14% male patients suffered from distal end radius fractures [6]. Present study was distal radius fractures in elderly are being associated with good functional results but has many confounding variables. The key aspects of the treatment is anatomical reduction and early mobilization for early rehabilitation. Our study showing the distribution of patient according to the age, shows not significant mean age group in between Group A and B. In another study is 38.46 years which is comparable to the studies of Bradway [7] and Kapoor *et al.* [8] who had an average of 40 years, 39 years respectively. Increased incidence in males is probably due to their involvement in outdoor activities, riding vehicles and heavy manual labour.

Table 8: Group B showed excellent result of 65% while Group A showed excellent result of 20% followed by 35% and 65% of good outcome

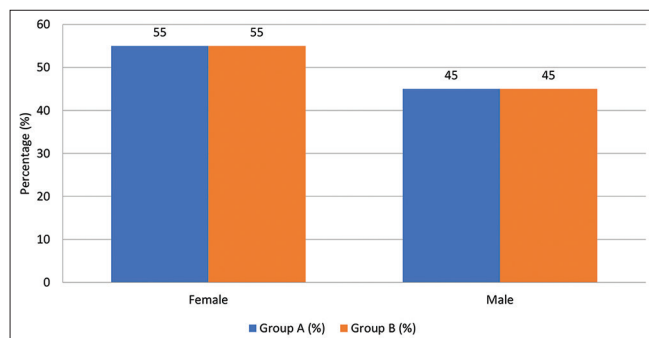
Comparison of functional evaluation - Mayo wrist score					
		Excellent (%)	Good (%)	Fair (%)	Poor (%)
Cherian Jacob <i>et al.</i> [67]	33.3	60	6.6	0	
Tanveerali <i>et al.</i> [68]	22.5	50	17.5	10	
Jirangkul p <i>et al.</i> [69]	57.14	37.50	3.56	0	
Our study					
Group A	20	65	15	0	
Group B	65	35	0	0	

Table 9: Radiological outcome of configuration B (cross pinning) is better than that of configuration A (divergent pinning). Group B showed excellent result of 65% while Group A showed excellent result of 20% followed by 35% and 80% of good outcome respectively

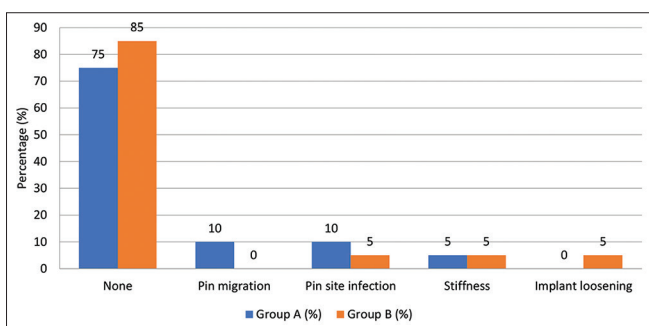
	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Prem Manohar <i>et al.</i> [70]	64.7	25.5	9.8	0
Nithin Thomas Philip <i>et al.</i> [71]	35.6	64.4	0	0
Das Abhishek <i>et al.</i> [72]	81.25	12.5	6.25	0
Our study				
Group A	20	80	0	0
Group B	65	35	0	0



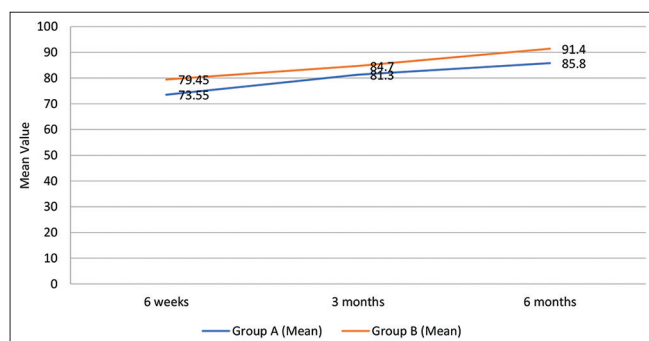
Graph 1: Distribution according to the age



Graph 2: Distribution according to the sex



Graph 3: Comparisons of complications



Graph 4: Line diagram showing comparison of mayo wrist score between the two groups at different time intervals

The common causes of distal radius fracture are road traffic accidents and fall on out stretched hand. In elderly patients simple fall on outstretched hand seems to be the most common cause and these fractures are usually extraarticular fracture of distal radius. In our study the mean radial shortening was more prominent postoperatively, at 6 weeks and at 3 months, while it was comparable at 6 months. In one of the study found, Green reported that eight patients had malunion

with significant radial shortening, wrist joint stiffness and reduced grip strength [8,9].

In our study we found the functional outcome of configuration B (cross pinning) is better than that of configuration A (divergent pinning). Group B showed excellent result of 65% while Group A showed excellent result of 20% followed by 35% and 65% of good outcome respectively. Our study showed good results more with cross pinning configuration based on mayo wrist score. In our study we found the radiological outcome of configuration B (cross pinning) is better than that of configuration A (divergent pinning). Group B showed excellent result of 65% while Group A showed excellent result of 20% followed by 35% and 80% of good outcome respectively. Our study showed good results more with cross pinning configuration based on sarmiento's modification of lindstrom criteria.

Complication were seen in total-patients in the study conducted. 5 patients were in Group A, in which 2 patients had pin migration, 2 patients had pin site infection and 1 patient had stiffness. 3 patients were in Group B, in which 1 patient had pin site infection, 1 patient had stiffness and 1 patient had implant loosening. Pin tract infections were managed by oral antibiotics (third generation cephalosporins) and good pin tract care and wrist stiffness was treated with vigorous physiotherapy. The prevalence of complications was low in Group B in comparison to the Group A. No significant complications in both groups, only minimal, quite treated with oral antibiotics and physiotherapy get relief. In one study, Subramanian *et al.* reported 2% of pin tract infection in sample size of 100 consecutive patients [10]. In one more study superficial pin tract infection, extensor tendon tethering, late fracture collapse and malunion was reported in the study done by Bhasme *et al.* [11].

In our study final result was as follows in configuration "A"- 4 patients (20%) have excellent functional outcome, 13 patients (65%) have good and 3 patients (15%) have fair functional outcome, while 4 patients (20%) have excellent radiological outcome, 16 patients (80%) have good radiological outcome. In configuration "B"- 13 patients (65%) have excellent functional outcome, 7 patients (35%) have good functional outcome, while 13 patients (65%) have excellent radiological outcome, 7 patients (35%) have good radiological outcome.

CONCLUSION

Percutaneous pinning technique is less time consuming and allows earlier rehabilitation without jeopardizing the fracture alignment. It is possible that with the large sample size and long term follow-up, the functional and radiological outcome would have more results than the present study. Therefore, more studies need to be done with large sample size and for longer duration to get a clearer picture. In the end, we found cross pinning of group B (cross pinning) is far much better than Group A (divergent pinning) and it gave excellent functional and radiological outcome compare to Group A (divergent pinning).

CONFLICT OF INTEREST

None declared.

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Nil.

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