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A retrospective comparative study between kirschner wire fixation and plating for extra articular distal end radius fracture

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Abstract
Distal radius fracture (DRF) is a common injury of the upper extremity. Owing to the favourable functional and radiological outcomes, volar-locked plating has attained immense acceptance in treating both extra- and intra-articular DRFs. This prospective study was designed to correlate between clinical and radiological outcome of post-operative extra-articular DRFs. A total of 100 subjects were enrolled in the study as per the inclusion and exclusion criteria. Majority population with DRFs were females. In patients that underwent plating: wrist dorsiflexion was >15° in 6% and >20° in 94%, wrist volar flexion was >15° in 8% and >20° in 92%; supination was >40° in 4%, >50° in 10% and >60° in 86%; pronation was >40° in 6%, >50° in 12% and >60° in 82%; mean (SD) union time was 9.56 (1.67) weeks. In patients that underwent wiring: wrist dorsiflexion was >15° in 24% and >20° in 76%; wrist volar flexion was >15° in 24% and >20° in 76%; supination was >40 in 14%, >50° in 36% and >60° in 50%; pronation was >40° in 12%, >50° in 34% and >60° in 54%; mean (SD) union time was 10.29 (1.25) weeks. Grip strength is quite good irrespective of the type of treatment received. Treatment using the k-wires takes more time for individuals to return to their normal activities compared to the plating method, and is commonly associated with complications.

Keywords: Distal radius fracture, plating, kirschner wire fixation

1. Introduction
Distal radius is the basis of wrist joint biomechanics. It is considered as an essential component of restoration of articular congruity, ligamentous support, and stable fixation decreases the incidence of post-traumatic osteoarthritis [1] Nearly 16% of all fractures treated by orthopaedic surgeons are fractures of the distal radius. It is a common injury of upper extremity. In younger individuals with good bone density, distal radius fracture (DRF) usually occur as a result of high energy trauma and are associated with substantial articular and periarticular tissue injury. Moreover, elderly osteoporotic patients showed significant association with these fractures [2, 3] In the US, DRFs are one of the most common types of fractures, reported during 2001 alone. This incidence seems to be escalating in the US in addition to other countries, but for reasons not fully understood, and likely multi-factorial. The most common societal consequences of such fractures include substantial medical expenses, declined attendance at school, loss in work hours, leading to dependence and long-term disability. Fragmented care and coding discrepancies can make it challenging to keep a track of the factual count of these fractures, probably underestimating the figures cited in the literature. The three chief populations frequently affected by distal radius fractures comprise of children and adolescents, young adults, and the elderly; of which the paediatric and elderly are at maximum risk. Within these populations, ethnicity as well as gender also contribute as distinct risk factors. By apprehending the epidemiology of these fractures, surgeons can opt for the most apt treatment options, along with targeting preventative measures concerning at-risk populations effectively [4] The incidence of DRFs is documented to escalate after menopause up to 60-70 years, particularly in women. A four-fold inferior incidence was witnessed in males with steady upsurge between 20 and 80 years.

These fractures are observed more often during winter with more cases occurring outdoors than hip fractures [5]. closed reduction and casting are ideal treatment because most fractures of the distal radius are reducible with adequate stability. However, unstable fractures or those that involve the articular surfaces may endanger the analogy and kinematics of the wrist joint. Arthroscopically-assisted surgery permits precise reduction of the articular surface and treatment of soft-tissue injuries in cases of complex intraarticular DRFs. Nevertheless, the position of arthroscopy still remains controversial in the management of these fractures [6]. The use of external fixation and percutaneous pins has been common as it aids to minimize and preserve alignment. However, due to the inherent instability of these fractures, sustained immobilization and distraction were frequently needed. Owing to the favourable functional and radiological outcomes, volar-locked plating has attained immense acceptance in treating both extra- as well as intra articular DRFs [7-10]. This retrospective study was designed to correlate between clinical and radiological outcome of post-operative extraarticular DRF. Moreover, we evaluated the alignment of fracture and post-operative range of motion of the wrist joint.

2. Materials and methods

A retrospective randomised study including 100 patients was conducted from September 2014 - September 2016. Only patients with extra articular distal end radius fractures, above the age of 18 years and willing to give consent were chosen. They were treated by either open reduction or internal fixation by volar plating or closed reduction with kirschner wire fixation after obtaining an informed and written consent. Patients with pathological fractures, intra articular fractures or compound fractures were not included in this group. Patients not fit for surgery were excluded from this study. Postoperatively patients were immobilized in a below elbow slab and active finger and shoulder exercises started immediately. The plaster was removed at day 10, a crepe bandage given and active exercises of wrist were started. The patients were followed up for a minimum of 24 weeks at periodic intervals and clinical, radiological and functional reviews were performed. Follow up for range of movement and grip strength was recorded in detail. The Gartland and Werley Scoring (G&W) system was utilised to measure patient outcome. Functional assessment was done by quantifying range of motion (using goniometer) and grip strength (using dynamometer).

3 Results

Based on the findings of the current study, we can conclude that females are more prone to undergo wrist fractures. The degrees of pronation and supination is quite satisfactory in majority of the population. Grip strength is quite good irrespective of the type of treatment received. Treatment using the k-wires takes more time for individuals to return to their normal activities compared to the plating method, and is commonly associated with complications.

The current study can be summarized as follows:

1. This retrospective randomized case-controlled study was conducted over a period of 2 years.
2. A total of 100 patients data fulfilling the eligibility criteria of the study were studied retrospectively.
3. The mean age of the patients that underwent plating was 41.67±8.05 years and of those that underwent wiring was 47.86±10.82 years.
4. Females constituted 60% of the population that underwent plating and 54% that underwent wiring; whereas 40% of the patients that underwent plating and 46% that underwent wiring were males.
5. 58% patients that underwent plating had injury on the left side and 42% had injury on the right side. 52% patients undergoing wiring had injury on the left side and 48% had injury on the right side.
6. Wrist dorsiflexion, was more than 15 degrees in 6% patients and more than 20 degrees in 94% in patients that underwent plating; while it was more than 15 degrees in 24% patients and more than 20 degrees in 76% patients that underwent wiring.
7. Wrist volar flexion, was more than 15 degrees in 8% patients and more than 20 degrees in 92% patients that underwent plating; whereas it was more than 15 degrees in 24% patients and more than 20 degrees in 76% patients that underwent wiring.
8. Supination, was noted to more than 40 degrees in 4% patients, more than 50 degrees in 10% and more than 60 degrees in 86% patients that underwent plating; whereas it was more than 40 degrees in 14% patients, more than 50 degrees in 36% patients and more than 60 degrees in 50% patients that underwent wiring.
9. Pronation, was more than 40 degrees in 6% patients, more than 50 degrees in 12% patients and more than 60 degrees in 82% patients that underwent plating; and more than 40 degrees in 12% patients, more than 50 degrees in 34% patients and more than 60 degrees in 54% patients that underwent wiring.
10. With respect to grip strength, in patients that underwent plating, 4% needed improvement, 8% had fair grip strength, 14% had good grip strength, 40% had very good grip strength and 34% had excellent grip strength; while in patients that underwent wiring, 10% needed improvement, 24% had fair grip strength, 16% had good grip strength, 24% had very good grip strength and 26% had excellent grip strength.
11. Union time was observed to be 9.56±1.67 weeks in patients that underwent plating and 10.29±1.25 weeks in patients that underwent wiring.
12. In patients that underwent plating, pin tract infection was seen in none of the cases, 6% had tendon irritation and no complications were present in 94% patients. In patients that underwent wiring, 10% patients had pin tract infection, tendon irritation was present in none of the patients and no complications were present in 90% patients.

4. Discussion and Conclusion

Fractures of the distal radius constitute of nearly 16% of the fractures treated by orthopaedic surgeons and it is a common injury of the upper extremity. Closed reduction and casting are ideal treatment because most fractures of the distal radius are reducible with adequate stability [2, 3]. However, unstable fractures or those that involve the articular surfaces may endanger the analogy and kinematics of the wrist joint. It is challenging to anatomically restore using customary techniques when encountering small, impacted, osteo articular fragments, articular congruency [7]. Owing to the favourable functional and radiological outcomes, volar-locked plating has attained immense acceptance in treating both extra- as well as intra-articular distal radius fractures. For displaced unstable intra-articular distal radius fractures, effective treatment has been reported to have achieved using the conventional non-locking technique. The use of external fixation and

percutaneous pins has been common as it aids to minimize and preserve alignment [7-10].

In our study the mean age of the patients undergoing plating was 41.67±8.05 years and that of those undergoing wiring was 47.86±10.82 years. Costa *et al* reported that the mean age of the patients were 59.7% ±16.4 years in patients undergoing wiring method and 58.3±14.9 years in patients undergoing plating method [11]. Varitimidis *et al* reported that the mean age of their patients was 44 years [6].

In our study, females constituted a majority portion of the patients undergoing plating (60.0%) and wiring (54.0%) while males constituted 40.0% of the study population undergoing plating and 46.0% undergoing wiring. Costa *et al* reported that 17% of the patients undergoing wiring were males and 83% were females whereas 15% of the patients undergoing plating were males and 85% were females [11]. Hull *et al*, from his study findings, reported that 25% males underwent plating while 20% underwent wiring [12].

It was observed in our study that 58% patients undergoing plating had injury on the left side while 42% patients had injury on the right side. In patients undergoing wiring, 52% patients had injury on the left side while 48% had injury on the right side. Costa *et al* reported that in patients undergoing wiring, 44% patients had injury on the right side and 53% patients had injury on the left side. In patients undergoing plating, 44% patients were reported to have injury on the right side and 54% of the patients had injury on the left side [11].

Our findings revealed wrist dorsiflexion in patients undergoing plating to be more than 15 degrees in 6% patients and more than 20 degrees in 94% patients, while in those undergoing wiring was more than 15 degrees in 24% patients and more than 20 degrees in 76% patients. Khatri *et al* reported in patients undergoing plating, the flexion was 46.73±7.24 degrees at six weeks and 71.91±8.08 at the final follow-up [13]. Lee *et al* reported that the flexion was 72.0 degrees in patients undergoing plating method [14]. Kumar S *et al* reported that the mean flexion to be 75.2 degrees in patients treated with locking plates and 71.6 degrees in patients that underwent the non-locking plate method [8]. Wong *et al*, from his study findings, reported flexion to be 55 degrees [1].

Among our study population, supination in patients undergoing plating was observed to be more than 40 degrees in 4% patients, more than 50 degrees in 10% patients and more than 60 degrees in 86% patients; while that in patients undergoing wiring was observed to be more than 40 degrees in 14% patients, more than 50 degrees in 36% patients and more than 60 degrees in 50% patients. Khatri *et al* reported supination in patients undergoing plating as 75.47±6.02 degrees at six weeks and 81.86±6.28 degrees at the final follow-up [13]. Lee *et al* reported that the supination was 82 degrees in patients undergoing plating [14]. Kumar S *et al* reported supination as 67.5 degrees in patients treated with locking plates and 66.7 degrees in those treated by the non-locking plate method [8]. Wong *et al* reported that supination as 98 degrees among his study patients [1].

In the current study, in patients that underwent plating, pronation was seen to be more than 40 degrees in 6% patients, more than 50 degrees in 12% patients and more than 60 degrees in 82% patients. The pronation in patients that underwent wiring was observed to be more than 40 degrees in 12% patients, more than 50 degrees in 34% patients and more than 60 degrees in 54% patients. Khatri *et al* reported pronation in patients undergoing plating as 72.04±6.28 degrees at six weeks and 77.65±6.01 degrees at the final follow-up [13]. Lee *et al* reported that pronation as 77 degrees in patients undergoing the plating method [14]. Kumar *et al* reported flexion to be 75.2 degrees in patients that underwent treatment with locking plates and 71.6 degrees in patients that were treated using the non-locking plate method [8]. *Wong et al* reported that pronation was seen to be 82 degrees amongst his study patients [1].

In the current study, we also tested the grip strength. In patients undergoing plating, 4% needed improvement, 8% had fair grip strength, 14% had good grip strength, 40% had very good grip strength and 34% had an excellent grip strength. In patients undergoing wiring, 7% patients needed improvement, 16% patients had fair grip strength, 15% patients had good grip strength, 32% patients had very good grip strength, 30% patients had an excellent grip strength. Khatri *et al* reported in patients undergoing plating, the percentage grip strength was 41.0±6.23 degrees at six weeks and 94.52±5.02 degrees at the final follow-up [13]. Wong *et al* reported that the mean grip power in injured patients was 19 kgf and in normal individuals was 28 kgf [1].

In our study, the mean union time in patients that underwent plating was 9.56 ±1.67 weeks and 10.29±1.25 weeks in those that underwent wiring. Lee *et al* reported the time to union in patients undergoing plating as 12.5 weeks [14].

In our study, pin tract infection was observed in none of the patients undergoing plating while 10% patients undergoing wiring. Tendon irritation was observed in 6% patients undergoing plating and none of the patients undergoing wiring. 94% patients undergoing plating had no complications and 90% of the patients undergoing wiring had no complications. Costa *et al* reported that in patients who underwent plating, 1% had refracture, 6% had neurological injury, 2% had tendon injury and 8% had superficial injury. In patients that underwent plating, 1% had refracture, 9% had neurological injury, 3% had tendon injury and 5% had superficial injury [11]. Hull *et al* reported that 33% patients that underwent plating had numbess or tingling and 6% had superficial infection. 11% patients each that underwent wiring were reported to have numbness or tingling and superficial infection [12]. Abramo *et al* reported that skin adherences, radial neuropraxia, pin tract infection, symptomatic malunion were the complications occurring in such conditions [9].

5. Acknowledgement

Sunil H. Shetty developed the study concept and design and also wrote the manuscript. He also provided material and technical support.

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Abhimanyu Singh, Abhay Agarwal, Akhil Shetty and Saikiran Gudala contributed to acquisition of data, analysis and interpretation of data.

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Table 1: Mean age

Mean Age					
Variables	**Group**	**N**	**Mean**	**SD**	**p- value**
Age	Plating	50	41.67	8.05	0.21
	Wiring	50	47.86	10.82	

Table 2: Gender distribution

Gender	Treatment		Total
	Plating	Wiring	
Female	30	27	57
	60.0%	54.0%	57.0%
Male	20	23	43
	40.0%	46.0%	43.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value - 0.68

Table 3: Side Affected

Side Affected	Treatment		Total
	Plating	Wiring	
Left	29	26	55
	58.0%	52.0%	55.0%
Right	21	24	45
	42.0%	48.0%	45.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value - 0.69

Table 4: Wrist Dorsiflexion

Wrist Dorsiflexion	Treatment		Total
	Plating	Wiring	
> 15 degrees	3	12	15
	6.0%	24.0%	15.0%
> 20 degrees	47	38	85
	94.0%	76.0%	85.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value <0.05

Table 5: Wrist Volar flexion

Wrist Volar flexion	Treatment		Total
	Plating	Wiring	
> 15 degrees	4	12	16
	8.0%	24.0%	16.0%
> 20 degrees	46	38	84
	92.0%	76.0%	84.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value <0.05

Table 6: Supination

Supination	Treatment		Total
	Plating	Wiring	
>40 degrees	2	7	9
	4.0%	14.0%	9.0%
>50 degrees	5	18	23
	10.0%	36.0%	23.0%
>60 degrees	43	25	68
	86.0%	50.0%	68.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value <0.05

Table 7: Pronation

Pronation	Treatment		Total
	Plating	Wiring	
>40 degrees	3	6	9
	6.0%	12.0%	9.0%
>50 degrees	6	17	23
	12.0%	34.0%	23.0%
>60 degrees	41	27	68
	82.0%	54.0%	68.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value <0.05

Table 8: Grip Strength

Grip Strength	Treatment		Total
	Plating	Wiring	
Needs Improvement	2	5	7
	4.0%	10.0%	7.0%
Fair	4	12	16
	8.0%	24.0%	16.0%
Good	7	8	15
	14.0%	16.0%	15.0%
Very Good	20	12	32
	40.0%	24.0%	32.0%
Excellent	17	13	30
	34.0%	26.0%	30.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value<0.05

Table 9: Union Time

Variables	Group	N	Mean	SD	p- value
Union Time (weeks)	Plating	50	9.56	1.67	0.352
	Wiring	50	10.29	1.25	

Table 10: Complications

Complications	Treatment		Total
	Plating	Wiring	
Pin Tract Infection	0	5	5
	0.0%	10.0%	5.0%
Tendon Irritation	3	0	3
	6.0%	0.0%	3.0%
None	47	45	92
	94.0%	90.0%	92.0%
Total	50	50	100
	100.0%	100.0%	100.0%

p- value - 0.715

Fig 1: Pre-operative xray k wire fixation

Fig 2: Post-operative xray k wire fixation

Fig 3: Pre-operative xray plating

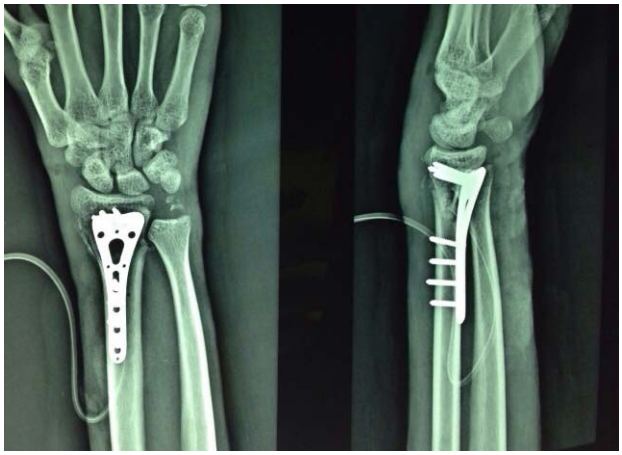

Fig 4: Post-operative xray plating

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