International Journal of Orthopaedics Research
www.orthopaedicsjournal.in
E-ISSN: 2663-0923, P-ISSN: 2663-0915
Received: 12-10-2020, Accepted: 27-10-2020; Published: 15-11-2020
Volume 2; Issue 4; 2020; Page No. 44-48

Comparitive evaluation of various treatment modalities of fracture distal end radius

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Abstract
Background: Distal end radius fracture is one of the most common fractures constituting 16% of all fractures. Mobility and wrist function is the most important aspect in the treatment. The choice of treatment should aim for minimal complications with optimal function.
Objectives: In this study we compared three surgical approaches viz. open reduction and internal fixation with volar plating (ORIF), percutaneous k wire fixation and closed reduction with external fixation (CR + EF) for treatment of distal end radius fractures.
Material and methods: Patients with fractures of distal end radius were taken for this study after obtaining their informed consent. This is a prospective study done at ESIC Hospital, Okla, New Delhi from November 2018 to November 2019. We compared radiological parameters of distal radius, duration of rehabilitation, complication and patient satisfaction of the respective methods.
Results: According to Gartland and werely scoring, we saw results better in Plating (ORIF) compared to percutaneous K-wire and external fixation. ORIF with plating showed least dorsal tilt as compared with percutaneous K-wire and external fixation. Radial deviation was equal in all three cases.
Conclusions: After comparing plating (ORIF) with CR + EF and percutaneous k wire fixation modality, results were analysed based on functional score, clinical and radiological criteria. Result is in favour of plating (ORIF) method which is a better method for treatment for these types of fractures with minimal complications.

Keywords: Closed reduction; distal radius fractures; external fixation; internal fixation; open reduction; percutaneous k wire fixation outcome

1. Introduction
Distal radius fractures have an approximate incidence of 1:10,000 people and represent 16% of skeletal and 74% of forearm fractures [1]. The characteristics of such fractures are related to the force of the trauma, wrist angle at the moment of the trauma and bone health.
More than 1000 peer-reviewed studies have been published on the subject, yet there is no consensus on which treatment is superior. Distal end radius fracture is frequently comminuted & this is responsible for slipping of the reduction, which is a rather common late feature. The present study is intended to find out and assess both conceptual and practical guidance for treatment with an expectant favourable result.

2. Materials and methods
This was a case control study conducted in the Department of Orthopaedics, ESIC Hospital, Okhla, new Delhi from November 2018 to November 2019. A total of 75 patients were analysed who were managed with surgical management of distal end radius fractures. Patients were randomly divided into 3 groups - group A (External Fixation) and group B (Percutanous k wire pinning and immobilization Technique) & group C (Internal Fixation with Volar Locking Plate) with 25 patients in each group. All the patients were between 18-65 years of age, with clinical & radiological evidence of distal end radius fracture, who presented within one week of the injury & who gave written informed consent for participation in study.
Patients excluded from the study were those with immature skeleton, congenital deformity, compound fracture cases, ongoing radiotherapy or chemotherapy, metabolic disease affecting the bone & not willing to be a part of the study. Indications for operative management were displaced intra-articular fractures with either post reduction articular step of > 2 mm, post reduction radial shortening of > 3 mm or post reduction > 15 degrees of saggital plane angulation (as measured from the anatomical volar tilted position).
Short term functional assessment of patient was assessed post-operatively on 2 weeks, 4weeks, 6 weeks, 12weeks & 24 weeks. Functional outcomes were assessed at final follow up visit at 6 months using "Demerit point rating system" of Gartland & Werley [2] {modified by Sarmiento, *et al* (1975) & further modified by Lucas & Sachtjen (1981). Results were analysed using student's t test.

3. Results
The most common fracture type in this study was C2 followed by A3 & C1.

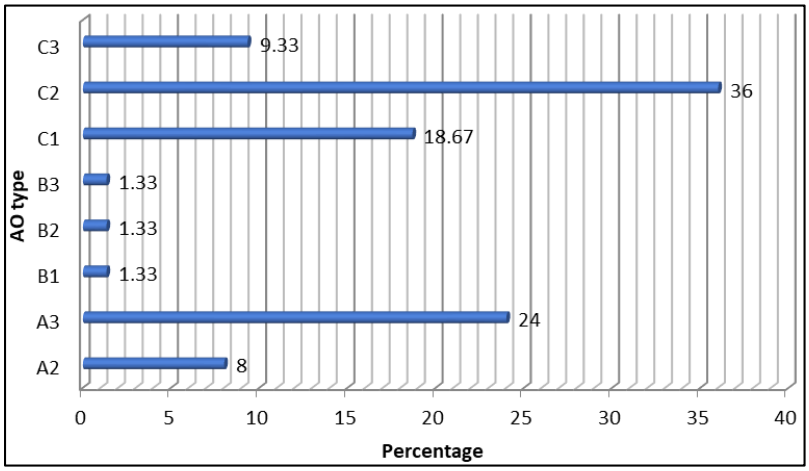


Fig-1: Graphical Representation of Percentage distribution of patients according to A.O. Type.

Age range was 18-65 years. Males were more commonly affected with male/female ratio of 1.9.

Non-dominant side was more commonly involved (62.67%) than the dominant side (37.33%).

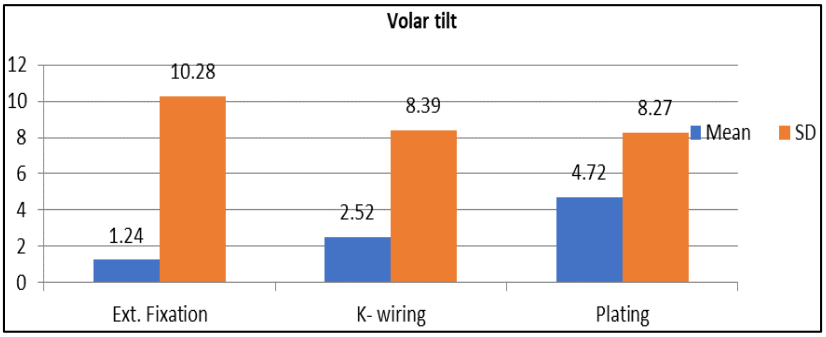


Fig 2: Graphical representation of mean and SD radiological degree of volar tilt in different treatment groups

The mean and S.D volar tilt in the external fixation group was 1.24 and 10.28 degrees. The mean and S.D for plating group is 4.72 And 8.27 degrees and for k wiring group is 2.52 and 8.39 degrees respectively.

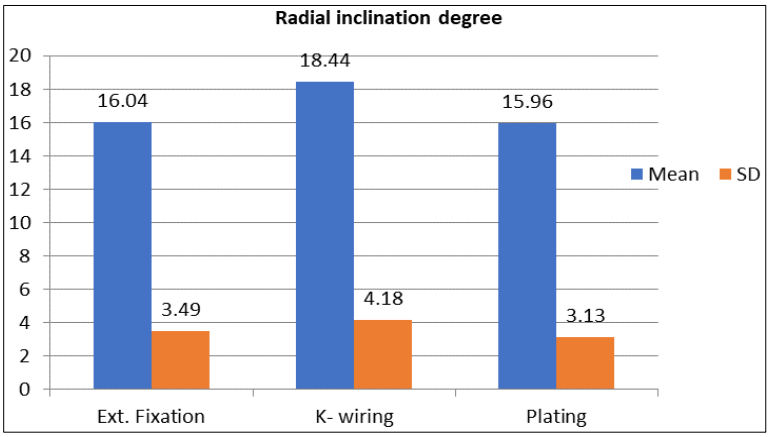


Fig 3: Graphical representation of mean and SD Radial angle degree in different treatment groups

The mean and S.D radial inclination degree is highest in the k wiring group i.e. 18.44 and 4.18 degrees whereas it is lowest in plating group i.e. 15.96 and 3.13 degrees.

Table 1: Kruskal Wallis Test for significance

Kruskal Wallis Test						
Variable	**Treatment**	**N**	**Mean Rank**	**df**	**Value**	**p-value**
Volar Tilt degree	Ext. Fixation	25	30.3	2	6.26	0.04 Significant
	K- wiring	25	38.1			
	Plating	25	45.7			
Radial inclination degree	Ext. Fixation	25	34	2	7.8	0.02 Significant
	K- wiring	25	47.9			
	Plating	25	32.1			

On applying, Kruskal Wallis test to the findings of the different study groups, Statistical significant difference was found in the volar tilt & radial inclination degree measurements.

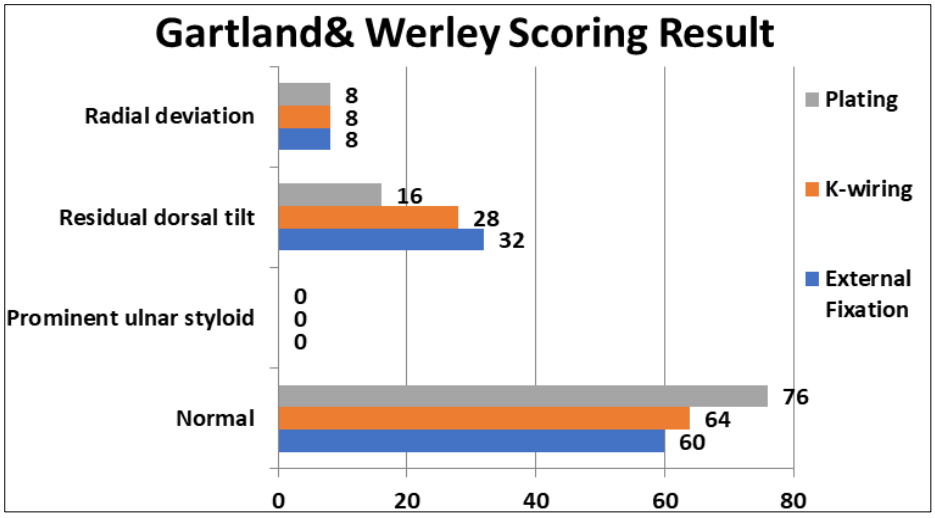


Fig 4: Graphical representation of Modified Gartland & Werley Scoring Results in different treatment groups.

According to the modified Gartland & Werley scoring the results can be summarised as normal in 60%, 64% and 76% of external fixation, K-wiring and Plating patients respectively. Whereas residual dorsal tilt was seen in most of the external fixation patients (32%) whereas K-wiring and Plating patients showed 28% and 16% respectively. Radial deviation was seen 8% of patient from each group viz. external fixation, K-wiring and Plating patients. None of the patients showed prominent ulnar styloid. Follow up of the range of movement done at 6 months is better in plating compared to k wiring and external fixator.

Follow-up X-rays

Case 1: Volar Plating

Pre-op X-ray **Post-op X-ray**

Post-operative scar

Range of Movements

Case 2: Percutaneous K-Wire fixation

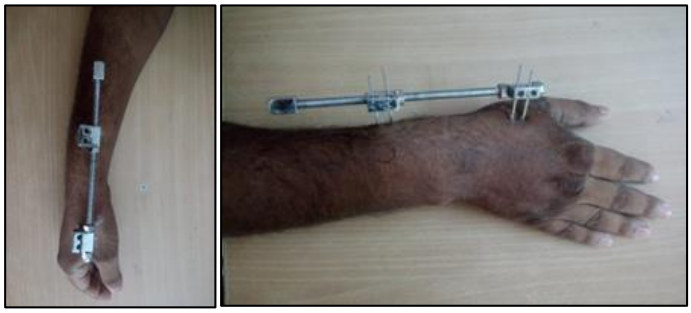
Pre-op X-ray **Post-op X-ray**

Follow-up X-rays

Clinical Pictures – Range of Movements

Case 3: External Fixation

Pre-op X-ray **Post-op X-ray**



Clinical Pictures - post-op

Clinical Pictures – Range of Movements

4. Discussion

The demerit point system was chosen for final evaluation. Functional outcome depends upon complete anatomical restoration of distal radius which has been earlier shown by several prospective studies [McQueen and Casper's (1988)] [3]. Augmented external fixator with ligamentotaxis was used in non-articular irreducible displaced fractures; articular, displaced fractures which were reducible but unstable; irreducible and complex fractures (A.O. Type- A3, C2, C3 in this study). Result were excellent in 52%, good in 20% and fair in 28% of cases. The results were comparable to other series (Good 85%, Fair 12% - Cooney WP, *et al* 1979) [4]. Trans-fixation with k-wire and immobilization was done for non-articular displaced reducible but unstable fracture and articular displaced reducible and stable fractures (A.O. Type – A2, A3, B1, C1, C2, C3 in this study). In the present series, results were excellent (48%) good (20%) and fair in 6% of cases. In a series presented by Suman R.K. (1983)[5] Excellent to Good results were in 81.1% and Fair to Poor results in 18.9% cases. Internal fixation with volar LCP system was used in 25 patients (A.O. Type-A2, A3, B2, B3, C1, C2, C3]. In the present series, results were excellent in 60%, good in 7%, fair in 3% as compared to study by Murakami K, *et al* [6] who treated 24

patients (Chiba, Japan) showed 83.3% excellent results & 16.7% good results with volar LCP. In 2002, Orbay, *et al* [7] treated 31 fractures (Miami, FL, USA), 61.3% had excellent results and 38.7% had good results with volar LCP. Kamano M, *et al* [8] treated 33 patients, 36.4% excellent results, 60.6% good results and 3% fair result were achieved with volar LCP.

Despite, our use of an early motion rehabilitation protocol, the distal end radius fracture reduction was maintained at the follow-up periods. At end of 6 months after fixation with the volar locking plating system, patients can have grip strengths and most wrist motions approximately 75% to 80 % of those on the contra-lateral, uninjured side.

The volar locking plating system was associated with some short-term complications. The infections were superficial skin problems that resolved with nonoperative care. Plate related complication did not occur in this series

In the present series, 8% patients developed arthritis because of articular incongruity. In a retrospective study by Knirk J.L., *et al* (1986) [9], it was concluded found that accurate articular restoration was the most critical factor in achieving a successful result.

According to Gartland and werely scoring, results are better in plating (ORIF) compared to percutaneous K-wire and external fixation. The range of movement was best in cases operated with plating rather than with percutaneous K-wire and external fixation. Arthritis grading was less in Plating as compared to others. In comparative study by Howard PW and co-workers (1989) they found that functional results were related more to the quality of anatomic reduction than to the method of immobilization [10]. These findings were supported by Van der Linden and Ericson (1981) [11], Porter and Stockley (1984) [12]. The present series also supports above findings.

In the present series there were no patients with nerve injuries, tendon injuries and Volkmann's ischaemic contracture. Cooney W.P. [13] reported incidence of nerve injuries 8% whereas Pool C. (1973) [11] reported 7% incidence. Cooney (1990) [13] also reported Volkmann's ischaemic contracture in about 1% patients following a tight short or long arm cast. In the present series, no patient developed finger stiffness and early dystrophy, the varying incidences of this ranges from 3% (Cooney 1980) [14] to 2% (Frykman) to 10% Lidstrorn (1959) [15]. The cases of delayed compression neuropathy and delayed rupture of long tendons were not observed in the present study.

5. Conclusion

Our study shows that volar locking compression plating is a safe and effective treatment for unstable fractures of the distal radius. It can also stabilize dorsally unstable distal radius fractures with least complications. Locking implants provide advantages in the treatment of distal radius fractures with metaphyseal comminuted zones (A3 and C2 fractures). Volar locking compression plating gave better results as patient was mobilised early in these cases. The drawback of our study was that the patients recruited were heterogeneous in terms of the type of fracture and patient demographic background.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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