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A comparative study of volar locking plate versus external fixation for displaced intra articular distal end radius fractures: A prospective study

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Abstract
Background: Distal radius fracture is more common accounting for 1/6th of the all fractures. With this background, this study was carried out to compare the functional outcome of volar locking plate and external fixator to the displaced intra-articular distal end radius fractures using Modified Mayo Wrist Score (MMWS).
Materials and methods: This study included those patients with distal radius fracture attending the Orthopaedic clinic at SIMS, during July 2018 till December 2018. Patients were randomised based on - even and odd day of the week. This included two set of group with twenty patients in each group- one with volar locking plating and other with external fixation. Patients were followed up at 6 months and 1 year. At each follow up, the pain and range of movements were assessed by MMWS score which was entered in Microsoft excel and analysed in SPSS 20.
Results: At the end of one year after surgery, we observed that external fixation technique was superior for treating displaced intra-articular comminuted distal end radius fractures than volar locking plate.
Conclusion: External fixator showed more advantageous than volar locking plates after 1year of follow up.

Keywords: Distal end radius fracture, volar locking plate, external fixator, MMWS score

Introduction
The most common fracture in daily orthopaedic practice is distal radius fracture which accounts for 1/6th of all the fractures. There were days, where fractures were treated by closed reduction and immobilization with casts, surprisingly the same is being practiced in rural set up [1-2]. Though union of these fractures progresses, there occurs many sequelae. Most common are high incidence of mal-union and wrist joint instability which is more likely among communition & intra articular extension cases. There is change in trend, where, youth are being the prey of Road Traffic Accident and trauma, leading to more complicated fractures with intra-articular extension and communition. Hence the management of distal radius fractures changed from cast immobilisation to operative interventions [4-7]. With this background, this study was conducted to compare the effect of volar plating and external fixation for distal end radius fractures with intra articular extension.
In the meta-analysis done by Zvi Margaliot and colleagues in the year 2005, which included 46 papers, with 916 patients treated by external fixation and 603 by internal fixation, the authors could find no evidence to support one treatment method superior over the other [8]. Walenkamp MM in 2013 along with his colleagues conducted a meta-analysis which observed that better functional outcome was among those patients with unstable distal radius fractures treated with a volar locking plate compared to external fixation at 3, 6 and 12 months follow-ups [9].

Objective
To compare the functional outcome of volar locking plate and external fixator to the displaced intra-articular distal end radius fractures using MMWS score.

Materials and Methods

A prospective study was planned and the protocol was presented for Institutional Ethical Committee. After ethical committee clearance, the study was carried out between July 2018 and Dec 2018, among those patients who attended the orthopaedic clinic with distal radius fractures at SIMS, Bengaluru. The study was explained to the patient and respective attenders, in the language understood by them, after obtaining the written consent, the procedure was carried out. The patient criteria for inclusion in this study were age >18 years without any other skeletal injury and with Frykman's type III, IV, VII, VIII. Patients with any other associated injury/fracture, bilateral distal radius fractures, open fractures of distal radius and associated head injury were excluded from the study.

Classification of fracture distal end of radius

Frykman's classification [10, 11].

1. Type I: Extra articular radial fracture
2. Type II: Extra articular radial fracture + Ulnarstyloid fracture
3. Type III: Intra articular fracture of the radio carpal joint.
4. Type IV: Intra articular fracture of the radio carpal joint + Ulnarstyloid fracture.
5. Type V: Fracture of the radioulnar joint
6. Type VI: Fracture of the radioulnar joint + Ulnarstyloid fracture.
7. Type VII: Intra articular fracture involving both radiocarpal and radioulnar joints.
8. Type VIII: Intra articular fracture involving both radiocarpal and radioulnar joints with an ulnar styloid fracture.

During the study period, 42 such patients were enrolled. Among whom two were lost to follow up inspite of telephonic contact after surgery. Hence 40 were in this study who were randomised based on the even and odd day of the week and Sunday was considered based on the odd and even Sunday of the month. All even day patients underwent volar plating technique and odd day patients underwent external fixator. By this technique, equal distribution of patients was found over a period of time among both the groups. All surgical procedures were performed by a single surgeon in our institute using standard protocols under general or regional anaesthesia.

The patients of both the groups were under appropriate antibiotic coverage and were regularly checked the dressing and advised for active finger movements. They were discharged after two days of surgery. The patients were followed up for check dressing for every 4th day and suture removal was done on 14th post-operative day and reduction was confirmed radiologically after 10 days. Acceptable criteria for fracture reduction were:

Radial inclination of >15°.

Radial shortening of <5 mm compared to the contralateral side.

Sagittal tilt between 15° dorsal and 20° volar tilt.

Intra-articular step-off of <2 mm.

After discharge, all these enrolled patients were followed up at 6 weeks, 3 months, 6 months and 1 year after surgery. During these visit, the pain, grip strength, wrist range of motion (ROM) and satisfaction was assessed by MMWS scoring system.

Clinical assessment was done by Modified Mayo Wrist Score [12] scoring system

MMWS is a modification of Green and O Brien score. It is a clinician completed scoring system used to evaluate the level of disability in the wrist by assessing pain, functional status [able to work], range of motion and grip strength. There is total of 100 points which are divided among evaluaters assessment of pain [25points], active flexion/extension arc as a percentage of opposite side [25 points], grip strength as percentage of opposite side [25 points] and ability to return to regular employment or activities [25 points]. Total points are added and graded as 90-100 excellent, 80-90 good, 60-80 fair, below 60 poor.

Statistical analysis

These data were entered in Microsoft Excel and analysed in SPSS 20. Appropriate statistical tests were applied.

Results

The mean age of our study sample was 45.95+ 9.23 years. We expected male to be predominant in the study but surprisingly 62.5% were females and only 37.5% were males. Majority were right-sided fracture accounting for 65%.

Among Frykman's classification 3, 4, 7 and 8 type, type 3 and 4 were 60% of the fracture, were both shared equal contribution (30% of each type of fractures).

They underwent volar locking compression plate and external fixation procedure as per the randomization method. Later these patients were followed up monthly initially and biannually data was documented. This biannual assessment was made using Mayo Modified Wrist Score (MMWS) at 6 months and 1 year follow up visits. These rating was entered in Microsoft excel and analysed in SPSS20. The overall data was categorized as excellent, good, fair and poor.

Table 1: MMWS score and percentage at 6months and 1 year.

Sl. No.		Aggregate score at 6 months		Aggregate score at 1 year	
	Categorization	Score	Percentage	Score	Percentage
1.	Excellent	2	5.0	3	7.5
2.	Good	3	7.5	16	40.0
3.	Fair	16	40.0	15	37.5
4.	Poor	19	47.5	6	15.0
	Total	40	100	40	100

Table 2: Shows MMWS score by Frykmans classification at 6months and 1year.

		Score of MMWS at 6 months					Score of MMWS at 1 year				
Sl. No.	Fracture type (according to Frykman's classification)	Excellent	Good	Fair	Poor	p	Excellent	Good	Fair	Poor	P
1.	III	0	1	8	3	0.097	1	6	4	1	0.816
2.	IV	2	0	4	6		2	4	4	2	
3.	VII	0	2	1	5		0	4	2	2	

4.	VIII	0	0	3	5		0	2	5	1	
	Total	2	3	16	19		3	16	15	6	

Table 3: MMWS score on intervention underwent at 6 months and 1 year.

	MMWS score at 6 months.						MMWS score at 1 year				
Intervention underwent	**Excellent**	**Good**	**Fair**	**Poor**		**P**	**Excellent**	**Good**	**Fair**	**Poor**	p
Volar LCP. (20)	1	0	6	13	20	0.041	1	6	8	5	0.045
External fixator (20)	1	3	10	6	20		2	10	7	1	
Total (40)	2	3	16	19	40		3	16	15	6	

Two patient in the volar locking plate group developed complex regional pain syndrome type 1 that improved within 4 to 6 months by physiotherapy and analgesics.

One year after surgery, 60% of patients treated with external fixation and 35% of patients with volar plating had an excellent or good result according to the MMWS score. And 40% of volar locking plate had fair results and 35% of external fixator had fair results.

We observed there was improvement in pain, ROM and grip strength in volar locking plate and external fixator from 6 months and the final score at 1 year follow up.

We observed a significant reduction in pain, increased ROM, grip strength, activity and final score after 1 year follow-up compared to that at 6 month follow-up in the external fixation group.

Although there was no significant difference in pain, ROM, grip strength, activity and final outcome in patients at 6 months after surgery using either of these two techniques, we observed low ROM in patients treated with volar locking plates compared to those treated by external fixation. However, at 1 year, we observed a significant increase in ROM, grip strength and final outcome in patients treated with external fixation compared to patients treated with volar locking plates.

Five patients presented with reduced ROM at 6 months post operative which gradually improve with physiotherapy. In them 4 were treated by volar locking plate and 1 was treated by external fixator.

One patient with external fixation which was removed at 10th week post operatively developed collapse of the fragment at 12th week which was later revised with volar locking plate.

Discussion

Open reduction and internal fixation has an advantage of direct visualization of fracture and manipulation of the fracture fragments, stable rigid fixation, and the possibility of immediate postoperative mobilisation. The subchondral placement of smooth pegs is useful to buttress small articular fragments and successfully control shortening and angular displacement, especially in osteoporotic bone [3].

It is difficult to have a successful outcome using the same approach and materials for different types of fractures. While mechanical characteristics are important in fixation selection, the strategic placement of the selected materials may in fact be more important than the characteristics of these materials, particularly in intra-articular fractures [13]. The best treatment option for different types of fractures may be determined by comparing different methods. External fixation is versatile in managing both intra- and extra-articular fractures with acceptable functional results. Reasons for using external fixation include the ability to achieve reduction without opening fracture site under fluoroscopic control by ligamentotaxis, and the ability to protect the reduction until healing occurs. The advantages of external fixation are the relative ease of application, minimal surgical exposure and minimal surgical expertness [14].

Kapoor *et al*. [14] reported 80 and 63% with good or excellent results in external fixation and volar plating groups, respectively, while Gradl *et al*. [13] reported 100 and 97.5% with good or excellent results in these two groups, respectively.

It is thought that volar locking plates allow faster rehabilitation than external fixators. Recent prospective randomized trials have reported rapid functional recovery after volar plate application in the early period after surgery [8]. However, at 1 year, there were no significant differences between the volar locking plate and external fixator groups based on objective and subjective functional assessments [15–20]. However, Kumbaraci *et al*. [20] showed that the radiological and functional results of the volar plate group were better than those of the external fixator group.

One patient with external fixator removed at 10th week landed in collapse of the fragment at 12th week which underwent volar locking plating, mostly because of early weight lifting and early return to work.

In conclusion, acceptable radiological reduction was achieved in all patients with minimal surgical time and surgical exposure with external fixation. Volar locking plating has superiority in case of stability and early mobilisation but had poor results in total articular comminution whereas external fixation was better for comminuted intra articular displaced distal end radius fracture. So we recommend External fixation technique for treating displaced intra-articular totally comminuted distal end radius fractures and volar plating for minimal intra articular comminution.

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