

## A COMPARATIVE AND PROSPECTIVE ANALYSIS OF EXTRAARTICULAR DISTAL RADIUS FRACTURES FIXED WITH MINIMALLY INVASIVE REDUCTION OSTEOSYNTHESIS(MIROS) VS LIGAMENTOTAXIS WITH WRIST JOINT SPANNING EXTERNAL FIXATOR(WJSEF)

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### Abstract

Distal radius fractures are one of the most common injuries encountered in orthopedic practice. Most of the fractures are caused by a fall on the outstretched hand with the wrist in dorsiflexion. MIROS is a new percutaneous pinning device which allows immediate mobilization and early return to function. Forty patients were included in our study conducted from July 2022 to June 2023. Twenty patients were treated by external fixation with MIROS and remaining with wrist joint spanning external fixator. Age, sex mode of injury, time taken for surgery, time to mobilization, time taken for union and postoperative complications were recorded. We found that fractures fixed with MIROS technique have faster union, early return to function, less postoperative complications compared with wrist joint spanning external fixator.

## INTRODUCTION

Distal radius fractures make up 8%–15% of all bony injuries in adults.<sup>[1]</sup> Abraham Colles is credited with description of the most common fracture pattern affecting distal end radius in 1814, and is classically named after him.<sup>[2]</sup> These fractures most frequently occur as a result of fall on the outstretched hand (FOOSH) injuries. Distal Radius(DR) fractures are common in the elderly as the result of low-energy falls from a standing or seated position.<sup>[3,4]</sup> Other significant risk factors for DR fractures in patients older than 50 include prior falls, prior fragility fractures after 50 years of age, corticosteroid use, and advanced age.<sup>[4]</sup> The overall incidence of DR fractures occurring each year is increasing worldwide. For example, a 1998 study by Melton et al. documented a 17% increase in DR fractures between 1945-1994.<sup>[5]</sup> Another 2017 study by Jerrhag et al., from Sweden showed a 2.0% increase in DR fractures per annum in men and a 3.4% increase in women aged 50-59 between 1999-2010.<sup>[6]</sup> Distal radius fracture is also frequently associated

with low bone mineral density. Some recent studies have more clearly defined our previous knowledge of this association, especially the relationship of a prior wrist fracture with subsequent osteoporotic fractures at other sites.<sup>[7-9]</sup> The history should focus on the mechanism of injury, duration, and quality of symptoms, dominant hand, profession and comorbid conditions. Neurovascular compromise such as numbness, tingling, weakness, or discoloration of the limb should be noted, median nerve is most commonly injured nerve in distal radius fractures and will present similarly to an acute carpal tunnel syndrome.<sup>[10,11]</sup> Coexisting DRUJ instability, carpal instability, elbow dislocations, or proximal forearm fractures are easily missed in the evaluation of distal radial fractures.<sup>[12]</sup> X-rays are the standard imaging modality in the diagnosis of distal radius fractures. X-rays examination should look for radial height, radial inclination, radial shift, volar tilt, ulnar variance, ulnar styloid fracture, and DRUJ widening. MIROS (Minimally Invasive Reduction and Osteosynthesis System) is a recently introduced device for treatment of fractures of the upper limb, MIROS might provide greater fracture

stability, early return to function and less complications with respect to traditional method of ligamentotaxis with wrist joint spanning external fixator.

## MATERIALS AND METHODS

This is a prospective hospital based study conducted in Jawaharlal Nehru Institute of Medical Sciences (JNIMS), Imphal for a period of 1 year (Jul 2022 to Jun 2023) including 40 cases of extraarticular distal radius fractures. Inclusion criteria included age more than 18, no other injury or fracture, and Extra-articular fractures [Frykman type I and II]. Exclusion criteria included poly-trauma patients, ipsilateral upper limb deformity or fractures, pathological fracture, age less than 18. Twenty patients were treated by external fixation with Minimally Invasive Reduction Osteosynthesis System(MIROS) and remaining by Wrist Joint Spanning External Fixator(WJSEF). Statistical analysis was done by using computer based software statistical package for social sciences(SPSS) version 25.0. P value of less than 0.05 was considered as significant.

**Preoperative planning:** Detailed history was taken including particulars of patient, date and time of injury, involved side, associated injuries, comorbidities, activity level of patient, occupation.

**Surgical procedure:** Surgery is performed under general or regional anesthesia.

**MIROS:** Closed reduction is achieved and checked fluoroscopically with Anteroposterior(AP) and lateral views. MIROS technique is initiated by two entry points (distal radial side of radius, distal dorso-ulnar side of radius) with small skin incisions, subsequent blunt dissection to secure soft tissues from inappropriate pinning. The semi-sharp tip of the MIROS-pin allowed cortical penetration into the medullary canal without a drill or an awl. The elastic pin was pre-bent and advanced by using a simple cannulated insertion tool. After three-point cortical contact, the elastic pins were bent perpendicular to the axis of the bone (straight out of the skin incision), where the external part of the pins was bent twice and aligned parallel over the dorsal side of the wrist. The nails were connected by a clip, which applied tension in between the nails for additional fracture stability. The elastic pins of the MIROS engage the proximal fragment and radiological evaluation throughout the procedure was performed.

**WJSEF:** Wrist joint spanning external fixator technique uses ligamentotaxis to pull the fracture fragments into better alignment. The surgeon dissects and drills threaded pins into the radius proximal to the fracture and into the index finger metacarpal distal to the fracture and spanning the carpal joint. The surgeon attaches these pins with universal clamps and rods, which can be used to apply traction in different directions to pull on the

hand to reduce the fracture fragments. Additionally, pinning may also be used to achieve reduction.

**Postoperative protocol:** In all patients of MIROS group range of motion exercises of wrist were started at the earliest after the operation and patients were encouraged to resume their functional activities at the earliest based on their occupation. In patients of WJSEF group wrist mobilization was started after removal of fixation device. Pin sites were inspected on postoperative day(POD) 5<sup>th</sup> and weekly till union of fracture after which fixation device was removed. Functional assessment was done with Mayo Wrist Score(MWS) and radiological assessment with X-ray wrist at 2 weeks, 4 weeks, 8 weeks, 3 months, 6 months and 1 year.

## RESULTS



Figure 1: showing range of motion at Post-operative day 5



Figure 2: showing range of motion at Post-operative day 5



**Figure 3: MIROS X-ray at post-operative day 14**



**Figure 4: Ligamentotaxis X-ray at post-operative day 14**

The MIROS group had a slightly younger mean age compared to WJSEF group, with females being more commonly involved than males in both groups. Most common mode of injury was fall on outstretched hand(FOOSH) in both groups followed

by RTA. Average time taken for surgery was significantly less in MIROS group than WJSEF group. Mobilization of wrist joint was faster in MIROS (avg. 5.6 days after operation) than in WJSEF group (avg. 5.4 weeks after operation). Average time taken for union was less in MIROS (4.2 weeks) than in WJSEF group (5.8 weeks). One patient in MIROS and three patients in WJSEF group had pin site infection which was resolved with short course of antibiotics. There was no long term postoperative complication in MIROS group, 4 patients in WJSEF group developed wrist joint stiffness and one patient developed complex regional pain syndrome. The mean Mayo Wrist Score(MWS) at one year was comparable in both groups.



**Figure 5: showing local pin site infection at post-operative day 13**

**Table 1: Patient demographics**

Parameters	MIROS group	WJSEF group	p value
Age	52.4 ± 6.4	54.3 ± 5.2	0.53
Sex			
Male	11	9	0.43
Female	19	21	
Mode of injury			
FOOSH	20	19	0.33
RTA	8	7	
Others	2	4	

**Table 2: Comparison of outcomes between the groups**

Parameters	MIROS group	WJSEF group	p value
Average time taken for surgery	46.7 min	62.5 min	0.03
Wrist joint mobilization postoperatively	5.6 days	5.4 weeks	0.004
Average time to union	4.2 weeks	5.8 weeks	0.05
Mayo Wrist Score(MWS) at 1 year	86.32 ± 8.48	82.67 ± 9.59	0.08
Complications			
Pin site infection	1	3	0.03
Wrist joint stiffness	Nil	4	
Complex regional pain syndrome	Nil	1	

## DISCUSSION

Distal radius fracture is a common injury in all age groups. However, there are several controversies in the operative indication, surgical approach and the best treatment method. The gold standard in the treatment of distal radius fracture remains uncertain.<sup>[13]</sup> Green suggested percutaneous pinning using K-wires as a quick and affordable method to add more support.<sup>[14]</sup> But because K-wire fixation is not rigid, patients frequently need to spend at least 4 to 6 weeks in a WJSEF following surgery to keep them immobile. The median duration of immobilization and K-wire removal has been described in the literature as six weeks.<sup>[15,16]</sup> Additionally, volar locking plates may be used but were more likely to get tendonitis, tenosynovitis, and carpal tunnel syndrome. With plating, the rates of Malunion and reoperation were reduced, but these patients frequently needed surgery to remove the plates within a few months.<sup>[17,18]</sup> whereas MIROS can be removed under local anesthesia without another operation. MIROS is a biological, patient friendly system and is applied with minimal invasion and very less blood loss. MIROS finds great use in elderly patients with osteoporotic bones, and in treating fractures in situations where the operation theatre conditions and facilities are less than adequate. MIROS might provide greater fracture stability and less complications with respect to traditional methods.

## CONCLUSION

With the findings of lesser surgical time, less blood loss, less complications, early mobilization and faster union rate, we can conclude that MIROS is better technique than WJSEF, although both have comparable functional outcome.

### Limitations

All cases were not operated by same surgeon, limited sample size and this is a quasi-experimental study without any blinding.

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