ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 04 | April - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MIROS FIXATION IN DISTAL END RADIUS FRACTURES

Orthopaedics

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ABSTRACT

Introduction: 8% to 15% of all fractures are distal radius fractures[1]. Falls on the outstretched hand with the wrist in dorsiflexion result in the majority of fractures. Minimally Invasive Reduction Osteosynthesis System (MIROS) is a type of elastic metaphyseomedullary fixation that is mostly utilized for cancellous bone fractures. It is held in place by tiny external clamps. This approach fully adheres to the contemporary idea of surgery for the conservation of soft tissue (sparing surgery tissue) by enabling a quick and non-aggressive osteosynthesis with little to no tissue injury. Our goal was to present a new method for treating distal end radius fractures using the Minimally Invasive Reduction Osteosynthesis System. **Aim:** To assess the functional and radiological outcome of MIROS in the management of distal end radius fractures. **Methods:** We carried out a prospective study of 80 patients in a tertiary care Centre who had been diagnosed with extra-articular type of distal end radius fracture (Frykman Type I and II) and been treated using MIROS external fixator system. The subjects were followed up till a period of 16 weeks and assessed for radiological union time, fracture site collapse, mechanical stability of implant, and complications associated with MIROS external fixator. Then, the results were studied. **Results:** MIROS fixator in cases of Type I and II type of distal end radius fracture gave similar results as percutaneous k wire fixation, if not better. In fact, MIROS fixation had various advantages over k wire fixation like, Immediate mobilization, no post-operative plaster cast, lower probability of wire back out, lower chance of RSD, low or no blood loss and patient compliance. The operative time, IITV radiation time was also reduced. **Conclusion:** In fractures of distal end radius Frykman type I and II, MIROS as a new modality had good outcomes and should be considered as one of the treatment modality for these fracture patterns.

KEYWORDS

Incisionless, Minimally Invasive Reduction Osteosynthesis System (MIROS), Distal end Radius fracture

INTRODUCTION

8% to 15% of all fractures are distal radius fractures [1]. Falls on the outstretched hand with the wrist in dorsiflexion result in the majority of fractures [2]. Colles' fracture is particularly described as a metaphyseal injury of the cortico-cancellous junction of the distal radius (within 2–3 cm of the articular surface) characterized by supination, impaction, dorsal tilt, and radial shift. The distal component of Smith's fractures, also known as reverse Colles' fractures, has a palmar tilt[3].

The position of the wrist at the time of impact with the ground affects the type and degree of the distal radius fracture as well as any concurrent injuries to the wrist's discoligamentary structures. The fracture progresses dorsally when bending forces create compressive pressures, leading to dorsal comminution. The radius first fails in tension on the volar side. The dorsal stability is further compromised by cancellous impaction of the metaphysis. Extra shearing forces affect the pattern of damage and cause involvement of the articular surface.

When operating to improve rotational stability, post-operative casting [4, 5] should be worn for four to six weeks. This may result in uncomfortable elbow and wrist joint stiffness and edema[6,7].

With the help of MIROS technique, surgical trauma can be significantly decreased, which has major advantages for the operated patient. In addition to less post-operative discomfort, the patient can resume movements and functions more quickly and spend less time in the hospital [8]. Certain kinds of tibial, calcaneal, and humeral[9, 10, 11] fractures have been treated with this.

Given the sheer number of classification systems proposed and their varying degrees of acceptance, it has been an incredibly difficult undertaking to classify distal radius fractures and provide optimal treatment protocols. Frykman developed a categorization scheme that distinguished between involvement of the radio-carpal and radio-ulnar joints as well as the existence or lack of an ulnar styloid process fracture[2].

MATERIALS AND METHODS

We carried out a prospective study of 80 patients in a tertiary care Centre who had been diagnosed with extra articular type of distal end radius fracture (Frykman Type I and II) and been treated using MIROS external fixator system.

In our institute, standard preoperative workup included radiographic evaluation of the fracture type along with blood, medical and anaesthetic assessments. Postoperative protocol included intravenous antibiotics given for 24 h followed by oral antibiotics. On postoperative day 1 of surgery, wrist range of movement, with finger movements were started under supervision of a physical therapist. Regular pin-tract dressings were completed every second day. All patients were sent to the same post-operative protocol.

Patients were followed up at 1st week after surgery. After which they were called at 6 weeks for removal of wires and radiological evaluation. After that follow up at 10 weeks and 16 weeks for functional and radiological evaluation.

Inclusion and Exclusion Criteria

Inclusion criteria included age more than 21, 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 21 years and Frykman type III to VIII fractures.

The patients were evaluated based on the following clinical and radiological parameters: (1) Fracture patterns according to Frykman classification; (2) Duration of surgery; (3) Time to radiological union; (4) Implant-related complications like collapse of fracture, breaking or loosening of MIROS clamp.

Table 1 – Frykman Classification

FRACTURES	DISTAL ULNA FRACTURE PRESENT	DISTAL ULNA FRACTURE ABSENT
Extra Articular	I	II
Intra Articular		
*Radio Carpal joint involved	III	IV
*Radio Ulnar joint involved	V	VI
*Radio Carpal + Radio Ulnar joint involved	VII	VIII

For functional and radiological evaluation we used two score- Anderson wrist score and modified mayo wrist score

Table 2 -Anderson Wrist Score[1]

Result	Union	Flexion and extension at wrist joint	Supination and pronation
Excellent	Present	<10° loss	<25% loss
Satisfactory	Present	<20° loss	<50% loss
Unsatisfactory	Present	<30° loss	>50% loss
Failure	Non-union with or without loss of motion		

Table 3- Modified Mayo Wrist Score

Category	Score	Findings
	25	No pain
	20	Mild pain with vigorous activities
	20	Pain only with weather changes
Pain (25 points)	15	Moderate pain with vigorous activities
	10	Mild pain with activities of daily living
	5	Moderate pain with activities of daily living
	0	Pain at rest
	25	Very satisfied
Satisfaction (25 points)	20	Moderately satisfied
	10	No satisfied, but working
	0	No satisfied, unable to work
	25	100% percentage of normal
	15	75% - 99% percentage of normal
Range of motion (25 points)	10	50% - 74% percentage of normal
	5	25% - 49% percentage of normal
	0	0% - 24% percentage of normal
	25	100% percentage of normal
	15	75% - 99% percentage of normal
Grip strength (25 points)	10	50% - 74% percentage of normal
	5	25% - 49% percentage of normal
	0	0% - 24% percentage of normal
	90 - 100	Excellent
Final result (total points)	80 - 89	Good
	65 - 79	Fair
	<65	Poor

Surgical Procedure [8]
Position of the patient: Supine position.
Anesthesia: Regional anesthesia (Supraclavicular anesthesia,) or General Anaesthesia
Wires used in Radius are 2.0mm with appropriate size clamps

Step1: Fracture Reduction:
The fracture is first reduced by closed means. The reduction is checked under a C-Arm. One must remember that accurate reduction is very important, and one must make best attempt at fracture reduction. Use of bent wire held in the MIROS spindle can be used as a joystick to fine tune the reduction in certain cases.

Step2: Oblique and Horizontalterminals:
The entry points are very specific. Lateral radial entry point is from the extra- articular part of the radial styloid, and is approached by volar flexion and ulnar deviation of the wrist. Medial radial entry is dorsal and the border of radius where it touches the radio ulnar syndesmosis. The wrist is kept in extreme volar flexion for this wire. The ulnar wire if used is inserted from the ulnar stolid laterally and approached with the wrist in radial deviation.

The wire is mounted on the spindle with the bevel towards the surgeon and tightened. With a plier the wire is bent towards the surgeon. The wrist is placed in palmar flexion and ulnar deviation.

The entry point is marked and the wire is introduced by gentle cork screw movements. Pre bending of the wire and keeping the bevel towards the surgeon ensures that the pointed end does not perforate the opposite cortex, and that the wire advances into the medulla to its furthest distance needed. The wire enters at a ninety degree angle to ensure that the skin is not pinched. Once it enters the styloid, its direction is shifted to aim towards the opposite cortex. Even as it reaches the opposite cortex, the spindle controls the direction of bevel and now the wire is negotiated into the medulla. The entry is checked under C-Arm, and the wire progress is monitored periodically. We must endure that the wire advances up to the radial neck, but does not cause intra articular perforations.

The spindle can be unlocked, with-drawn and locked again in increment-al steps to give a precise leverage while the wire is slowly advanced. The medial radial wire is now inserted following the same steps. We will find that the lateral wire abuts the medial cortex of the radial medulla and vice versa. The wrist is checked in both views and the fracture reduction accuracy is evaluated. Now using a combination of the spindle and wire pliers, the wires are bent at right angles so that the exit wires are parallel to each other

Step3: Clamp Application

The MIROS system usually does not use any power tools, and the special spindle with its quick release mounting, tightening and loosening of the wires is enough to help the surgeon to manually advance the wire to the desired distance. If two wires are used, a single Tangari Clamp is enough. For threeWires, two clamps will be needed. The clamps are snapped in position, the screw tightened and finally a grub screw locks the assembly solidly. Now the protruding wires are clamped and the forces are applied in such a manner as to make it resemble a suspension bridge. The intramedullary wire abuts against the Opposite cortex, and the transverse wire and the clamps ensure that the tension effect is maintained without loosening during the entire course of treatment.

Once the clamps are tightened and the elastic stability of the frame is checked, the protruding wire tips are cut and bent. The pin entry and exit points are now cleaned and providing ointment is applied. Sticky pores bandages are pasted from pin exit sites.

RESULTS

Total of 80 cases studied, had average age 40-60 years in the study group. Among 80 cases studied, 32 cases (40%) were male. And 48 cases (60%) were female in the study group. The average union time was 16 weeks. We had 4 case of pin site infection, 1 case of MIROS clamp loosening and 3 case had mal union (Table 6). The result was graded according to Anderson's criteria at 16 Weeks. In our series of 80 patients, 64 cases (80%) had excellent outcomes, 10 cases (12.5%) had satisfactory outcomes, 6 cases (7.5%) unsatisfactory outcomes (Table 4). According to Mayo score, wrist performance score >70 points in 37 cases, 60-70 points in 2 cases and 40-60 points in 1 case (Table 5). Various figures from our study have been shown with follow-up x-ray and functional movements at 16 weeks.

Table 4– Anderson's Criteria

Outcomes	Cases
EXCELLENT	64 (80%)
SATISFACTORY	10 (12.5%)
UNSATISFACTORY	6 (7.5%)

Table 5 – Modified Mayo Wrist Score

Wrist Performance Score	Cases
>90	74
80-89	4
65-79	2
<65	0

Table 6

COMPLICATION	NO OF CASES
Pin site infection	4 cases
Loosening of clamp	1 case
Malunion	3 case
Non union	0 case

DISCUSSION

Fractures of the distal radius are frequent clinical issues that are typically handled conservatively. Twenty to twenty-five percent of fractures are distal radius fractures [12-15]. Due to high-energy injuries in men, the incidence of distal radial fracture peaks around the age of thirty; in women, it peaks after menopause due to low-energy injuries [14]. For women, the lifetime risk of suffering a distal radius fracture is 15%, while for men it is 2% [16]. In the event that this isn't feasible, surgical fixing is necessary [17]. Green was the one who initially suggested percutaneous pinning using K-wires as a quick and affordable method to add more support [18]. For certain and accurately diagnosed fractures, treatment with a plaster cast and percutaneous wires is regarded as standard procedure and can result in a favorable functional outcome [19]. The intraoperative influence of stability, fracture pattern complexity, bone quality, and patient age all affect the likelihood of early functional treatment[20]. But because K-wire fixation is not rigid, patients frequently need to spend at least 4 to 6 weeks in a plaster cast following surgery to keep them immobile. The median duration of immobilization and K-wire removal has been described in the literature as six weeks [21,22].

The early functional recovery, the potential for an ideal restoration of the wrist anatomy, the direct viewing of the fracture, and the maintenance of the achieved reduction may be the primary theoretical benefits of plating internal fixation for distal radius fractures. Additional benefits of fixed-angle plates may include the preservation of the periosteal blood supply, support for the subchondral bone and articular fragments, application in the event of osteoporosis and metaphyseal comminution, and use of bone grafts to replace lost bone due to metaphyseal impaction [12, 13, 23-26]. Additionally, volar locking plates may be able to anchor distal radius fractures that have comminuted with favorable radiological and clinical outcomes [13,15,23,26, 27]. Lastly, early mobilization by VLP may help patients avoid joint stiffness and muscle weakening.

Conversely, individuals who had plating were more likely to get tendonitis, tenosynovitis, and carpal tunnel syndrome. Within plating, the rates of Malunion and reoperation were reduced, but these patients frequently needed surgery to remove the plates within a few months. In light of the present push for cost containment, it's crucial to assess if using pricey technology that finally yields comparable results but requires more anesthesia and longer surgical durations is worth it. Two studies [28, 29] that provided comprehensive information regarding surgical management costs were included in our systematic review.

These studies demonstrate that, although the two treatments yield identical results, the use of volar locking plates results in greater costs.

On the other hand, the MIROS approach is a fantastic option that has not received much attention. Since the wrist does not bear weight, it is a very forgiving joint. The radio carpal articulation makes up the majority of the wrist joint, with the distal ulna's extremely tiny medial portion serving just as a medial stabilizer [1].

On the other hand, there was no discernible variation in the degree of complication.

At six weeks, most of our fractures unite together. Despite the fact that MIROS is a novel and developing method, the findings of the amount of time required for radiological union are comparable to those of other investigations that used internal fixation with plating and K wire fixation.

CONCLUSION

MIROS is a novel technique that can be used as an alternative for Frykman type 1 and 2 fractures with the benefits of avoiding postoperative casting and post -operative complication with immediate post-operative mobilization of the wrist joint.

Case I – A 58Y/F had complaints of left wrist pain since 2 days. She had h/o fall on ground. X ray showed left sided distal end radius fracture and she operated with MIROS fixation.

Case 2 – A 38Y/M had complaints of left wrist pain since 1 day. He had h/o RTA. X-ray showed left sided distal end radius fracture and he was operated with MIROS fixation.

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