

Functional Outcome of Distal Radius Fracture Managed by Minimally Invasive Plate Osteosynthesis: A Prospective Study

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Abstract

Introduction: Fracture of distal radius is the most common fracture encountered by orthopedic surgeons. Many studies have associated even as little as 1 mm of incongruence of articular surface landed with worst outcome.

Aim: To evaluate functional outcome of distal radius fractures treated by minimally invasive plate osteosynthesis (MIPO).

Materials and Methods: This is a prospective study randomly selecting 23 cases of distal radius fractures treated with MIPO with age between 20 and 70 years, functional outcome was evaluated using MAYO wrist score.

Result: In our study all fracture united by 6-8 weeks. 2 patients had malunion and 2 patients had wrist stiffness and 1 patient had superficial infection.

Conclusion: MIPO can be utilized for extra-articular distal radius fracture and with minimal articular involvement, it avoids extensive soft tissue dissection, allows early mobilization, provides better functional outcome.

Key words: Distal radius fracture, Minimally invasive procedure, Plate and screws

INTRODUCTION

Fracture of the distal radius is the most common fracture encountered by orthopedic surgeons. The desire for anatomical restoration of the distal radius often is the rationale for operative treatment. Many studies have associated as little as 1 mm of incongruity of the articular surface with worse outcomes, whereas other reports have found no association between radiographic arthrosis and outcomes.¹ There are various treatment options for distal radius fractures including nonoperative, external fixation (percutaneous pinning, bridging external fixator) and internal fixation (dorsal and volar plating, fragment

specific fixation). The indications differ depending on the patient, their demands, and the type of fracture. As the prime goal of treatment is to maximize function in the hand and wrist, it is essential to consider the factors that may predict fracture instability or functional outcome, in planning treatment. In conventional plating, there is more soft tissue dissection including stripping of pronator quadratus which may lead to post-operative pain and scarring and impede the range of motion. The deep head of pronator quadratus is a dynamic stabilizer of distal radioulnar joint.² Further, the blood supply from the pronator quadratus is also disrupted which may lead to avascularity of articular fragments and delay fracture healing. In minimally invasive plate osteosynthesis (MIPO), the soft tissue dissection is limited and the implant is slid under intact pronator quadratus. The biomechanical advantages of soft tissue are left undamaged. Besides, the mini-incision provides better cosmetic results. Hence, the technique of MIPO can be utilized for extra-articular and simple type of intra-articular fractures of distal radius.³

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Aim

To evaluate functional outcome of distal radius fractures treated by MIPO.

MATERIALS AND METHODS

This is a prospective study conducted in the Department of Orthopedics, Tirunelveli Medical College Hospital. Institutional Ethics Committee approval and informed consent from the patients were obtained.

Inclusion Criteria

1. Age above 20 years
2. Closed distal radius fractures
3. Extra-articular and minimally comminuted intra-articular fractures.

Exclusion Criteria

1. Age <20 years
2. Compound fractures
3. Severely comminuted intra-articular fractures
4. Severe osteoporosis.

Procedure and Post-operative Protocol

Patient in supine position in conventional table with arm extended in arm table, under regional anesthesia, under tourniquet control, the affect limb is painted and draped. Closed reduction of fracture done under fluoroscopy guidance. If a satisfactory reduction is possible, the fracture is provisionally fixed with K-wires inserted from the styloid process to the proximal ulnar side or in reverse direction depending on the fracture pattern. In case of comminuted fractures, more than one K-wires may be needed to maintain the reduction and articular congruity. Two skin incisions of about 2 cm length were made. The position of the incision is dependent on the fracture pattern and length of the plate. In fractures within 1 cm of the articular surface, a transverse incision parallel to the proximal wrist crease was chosen. In fractures, more than 1 cm away from the articular surface, longitudinal incision parallel to the flexor carpi radialis was made. The flexor carpi radialis was retracted to the radial or ulnar side. Radial artery identified and retracted. Then, the flexor pollicis longus was identified and retracted to expose pronator quadratus. If reduction was satisfactory, plate was slid under the pronator quadratus through a small longitudinal incision. In case, where open reduction was needed, the distal part of the muscle is incised to aid visualization of fracture fragment and reduction. Under fluoroscopy guidance, 2 cm incision was made parallel to flexor carpi radialis according to the plate placement. The plate was provisionally fixed to radial shaft with a K-wire. After confirming the reduction in anteroposterior and lateral views, screws were applied in the transverse and longitudinal limbs of the plate. Stability

of the fixation was verified after removing the K-wires. In some cases, fixation was augmented with additional K-wires. Wound closed in layers.

Post-operative Protocol

After surgery, the limb was kept in elevated position. The timing of rehabilitation was based on:

1. Fracture pattern
2. Bone quality
3. Stability of the fixation
4. Patient compliance.

Second Post-operative Day

In comminuted fractures, the limb was immobilized in supportive splint for the first week. In the second post-operative day, wound inspection was done and dressing changed. Finger, elbow, and shoulder mobilization exercises were started. Exercises to maintain the tone of the finger flexors were started. After 1 week, the supportive splint was removed and wrist flexion and extension exercises were started according to patients pain tolerance. The patient was advised to review on 10th post-operative day for suture removal. On 10th day, patients understanding and compliance with exercises were evaluated and taught accordingly. The patient was reviewed on 4th post-operative week, during which rotational movements were started. Subsequent follow-ups were done on 10th week with radiological investigation to check for bony union.

RESULTS

The age group varied from 20 to 70 years with mean age of 41 years. Incidence of fracture was observed maximum between 40 and 50 years of age which accounted for approximately 39% in this study (Table 1).

This study revealed the increase in the fracture incidence in men when compared with the women, which is due to increase in longevity of men. The incidence decreased in women may be explained by the increased use of hormone replacement therapy (Table 2).

High energy injury is the cause of the majority of distal radius fractures with approximately 60% of fractures being related to the road traffic accidents in this study (Table 3).

The Frykman's classification of distal radius fracture is based on the articular surface involvement and intactness of distal ulna. This study revealed the intra-articular fractures are encountered frequently more when compared to others (Table 4).

Mayo wrist score-clinician rated outcome measure. It includes four measures of outcome: Pain intensity

(25 points), functional status (25), range of motion (25), and grip strength (25). A total of 100 points. In this study, the “Mayo wrist score” after the MIPO was found to be 80-90 which is considered as good according to the scoring system (Table 5).

DISCUSSION

The goal of surgery for unstable distal radius fracture is to obtain and maintain an anatomical reduction and to allow restoration of function.¹ Achieving fracture stability is a prerequisite for attaining a satisfactory outcome for distal radius fractures. Unstable fractures are at increased risk for loss of reduction and subsequent malunion.² Malunion

can potentially lead to a poor functional outcome with residual pain, loss of motion, decreased endurance and grip strength, midcarpal instability, and post-traumatic arthritis. MIPO techniques are commonly utilized in the management of fractures of distal femur, proximal, and distal tibia.¹ In this study, we initiated MIPO technique for distal radius fracture presuming that the advantages of MIPO may improve the functional outcome. Numerous prospective studies to evaluate the functional outcome of various treatment options including plaster immobilization, external fixation, and open reduction with internal fixation. Good or excellent results were achieved in 43%, 80%, and 63% in each group. Recent studies show further improvement in functional outcome of ORIF owing to advances in implants and surgical techniques.⁴ Wright *et al.* reported retrospective study of 21 patients treated with plating and external fixation. In this study, there was no functional difference between the two groups.⁵ Egol *et al.* conducted a prospective randomized study involving 88 cases. Although the patients treated by plating had significant early improvement in the range of movement of wrist, in absolute terms the difference in range of movement was clinically unimportant.⁶ At one year radiological, clinical and functional outcomes were similar in two groups. These studies attribute soft tissue preservation in external fixation to the good functional outcome with the technique, even though the radiological outcome was better in ORIF than external fixation.⁷ However, external fixation is associated with high risk for infection and stiffness. Incidence of pin tract infection usually with *Staphylococcus aureus* and *Staphylococcus epidermidis* has been reported between 0.5% and 30%.⁸ With MIPO both advantages of articular reduction with ORIF and soft tissue preservation with external fixation can be obtained. In our study, the functional outcome with Mayo wrist score was comparable to the results reported with conventional plating and external fixation.¹ Further, in our study, only one patient developed mild infection which is much lower compared to the external fixator. Nerve injury,⁹ commonly median nerve injury, has been reported with incidence of 0-17% in conventional plating technique. In our study, no neurovascular injuries had occurred since the incision were made on safety zones considering the neurovascular anatomy.¹⁰ In our study, malunion was reported in 2 cases. Both patients had higher comminution (Frykman classification type 5) which indicates that MIPO is not suitable for all distal radius fractures. Proper selection of patients according to the fracture characteristics will certainly decrease this complication. Average flexion and extension arc have been found to be 102 and supination/pronation arc to be 154° (Rozental and Blazer 52° flexion, 53° extension, 71° supination and 73° pronation).¹¹ Operating time and radiation exposure are not significantly higher when compared to the conventional

Table 1: Distribution of study patients in age group

Age group	Number of cases (%)
20-30	7 (31)
31-40	3 (13)
41-50	9 (39)
51-60	4 (17)

Table 2: Distribution of study patients in gender

Sex	Number of cases (%)
Male	17 (78)
Female	6 (22)

Table 3: Distribution of study patients in mode of injury

Mode of injury	Number of cases (%)
RTA	14 (61)
Accidental fall	9 (39)

RTA: Road traffic accidents

Table 4: Distribution of study patients in Frykman's classification

Frykman classification	Number of cases (%)
Type I	4 (17)
Type II	3 (13)
Type III	9 (40)
Type IV	4 (17)
Type V	3 (13)

Table 5: Distribution study patients in Mayo wrist score

Mayo wrist score	Number of cases (%)
90-100	4 (17.5)
80-90	12 (52)
70-80	4 (17.5)
60-70	3 (13)

plating technique. The limitation of this study includes small study group, short follow-up period, and absence of control group.

CONCLUSION

The results of MIPO are comparable to conventional plating technique. MIPO can be utilized for extra-articular distal radius fracture and with minimal articular involvement. It avoids extensive soft tissue dissection, provides rigid fixation, allows early mobilization, provides better functional and cosmetic outcome, and decreases the duration of hospital stay.

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