

Original Research Article

Assessment of outcome of distal radius intra-articular fractures using wrist-spanning mini-fixator in distraction

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ABSTRACT

Background: The distal radius fractures are complex injuries. There are many treatment options for these fractures. The benefits of external fixation with mini fixator have been seen in many studies. In our study, the distal radius fracture belonging to type B and C of AO classification were treated with wrist spanning mini external fixator with/without additional k wires. We wish to analyse the functional outcome and to determine any complications of this procedure.

Methods: 20 patients were included in this study and were followed up for up to 6 months postoperatively. We assessed pain using VAS score at 6 weeks follow-up and the outcome of each patient was assessed using Mayo wrist score post-operatively on follow-up at 3 months and 6 months.

Results: Predominance towards males and left upper limb was observed in our study. At the end of six months, the range of motion as assessed according to the criteria given by Mayo wrist score, excellent results (MWS \geq 90) were seen in 4 patients (20%), good results (MWS 80-89) were seen in 12 patients (60%), and fair (MWS 70-79) in 4 patient (20%). At the end of result, significant reduction in terms of pain, wellbeing, personal life, social life, lifting, travelling and sleeping was seen.

Conclusions: Predominance towards males and left upper limb was observed in our study. At the end of six months, the range of motion as assessed according to the criteria given by Mayo Wrist Score, excellent results (MWS \geq 90) were seen in 4 patients (20%), good results (MWS 80-89) were seen in 12 patients (60%), and fair (MWS 70-79) in 4 patient (20%). At the end of result, significant reduction in terms of pain, wellbeing, personal life, social life, lifting, travelling and sleeping was seen.

Keywords: Mini ex-fix, Ligamentotaxis

INTRODUCTION

Distal radius has a complex anatomy. The articular surface of distal radius is biconcave, triangular, and covered with hyaline cartilage. A smooth anteroposterior ridge divides the articular surface into two facets: a lateral triangular facet, which articulates with the scaphoid, and a medial quadrilateral facet, which articulates with the lunate. There are various classifications for the fracture of lower end radius. For this paper, we have used the AO

classification of lower end radius. In this classification, number 23 signifies distal radius and ulna fracture. 'A' is for extraarticular fractures, 'B' is for partial articular fracture of radius and 'C' is for complete articular fracture.¹

The distal radius fractures are complex injuries. The standard treatment of these fractures still remains controversial. There are specific problems in terms of stability and stiffness of wrist joint and fingers due to

immobilization. There are various treatment options such as closed reduction with cast- immobilization, external fixation with or without percutaneous pin and open reduction with internal fixation using plate screws. The benefits of external fixation over other methods are limited open incisions, early range of motion, and treatment of complex wounds.²

Newer fixator designs include non bridging applications that allow early wrist motion, because it combines a minimally invasive procedure with reduction by ligamentotaxis.³

The management of unstable distal radius fractures using the principle of ligamentotaxis through external fixation has evolved during recent times. Improved surgical technique and fixation devices like wrist expanding mini fixator have shown good results with fewer complications. For lower radius fracture displacements, there has been usage of external fixation with percutaneous Kirschner (K-) wire fixation.

The purpose of this study is to determine the functional outcome of lower end radius intraarticular fracture i.e., AO type b and c, treated with wrist spanning external fixator, in distraction mode and to determine the complications, if any.

METHODS

This study was a prospective study on 20 patients of lower end radius fractures, admitted in the department of Orthopaedics of Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India from January 2017 to August 2018 after the clearance from ethical committee (HREC). The fractures were evaluated by anteroposterior, lateral view radiographs of the shoulder and 3-D reconstruction CT scan of the wrist.

We included patients with fractures of the lower end radius classified as type 23B1, B2, B3 and 23 C1, C2, C3 according to AO classification, in which there was intra-articular involvement were included. Those patients with stable fractures which did not need internal fixation, metaphyseal fractures, diaphyseal fracture, bilateral fractures and those with a pre-existing wrist deformity were excluded.

A frank discussion with patient was held about the option of treatment and its recovery. Patient's consent was taken for surgery. Pre op investigations and PAC were done. The patient was taken up for surgery when fit for anesthesia. Preoperative IV antibiotics were given. After proper preoperative preparation, patient was taken for surgery either under brachial block or under general anaesthesia.

Fractures were fixed and stabilized with the aid of a small external mini fixator, which is a rigid device consisting of 4 threaded pins (2.5 × 150 mm), clamps and connecting

rods. After small skin incisions were made and the bones were drilled with a 2 mm drill bit, the pins were inserted manually with a T handle, two proximally to the fracture in the distal radius and one in the shaft and one in the base of the second metacarpal bone. These pins were inserted at an angle of 40-45 degree to the horizontal plane on dorsolateral aspect, the connecting rods were applied and secured firmly to the threaded pins with clamps. Distraction of the fracture with traction was done to reduce the fracture fragments by ligamentotaxis and the screws were tightened. Sometime additional k wires were used for fixation of large segments. Reduction was checked under C arm image intensifier (Figure 1 and 2).

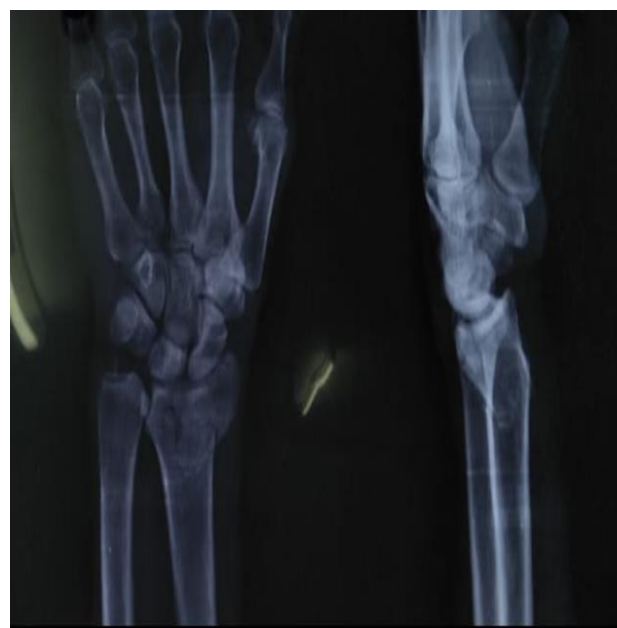


Figure 1: Preoperative radiograph of a patient.



Figure 2: Postoperative radiograph of one of the patients.

Postoperatively, a light pin tract dressing applied and forearm was kept elevated post operatively for 24 hours. Patient was discharged after having an antero-posterior and lateral view X-rays of wrist. Patient was evaluated at 6 weeks, 3 months and 6 months post operatively with antero-posterior and lateral view X-rays of wrist and functional assessment was done using Mayo wrist score at same intervals. The criteria used for assessment were pain, range of motion, grip strength and functional status. External fixator was removed after 6-8 weeks after the fracture showed signs of consolidation. Active and passive mobilization was then started. Patients were advised to use elastic crape bandage and elevation of hand in sling up till 3-4 weeks after removal of fixator for prevention of swelling.

We analyzed the pain score using only the VAS score at 6 weeks. The clinical and functional results were assessed using the parameters of pain intensity, range of motion, grip strength and functional status and the overall function using the MWS (Mayo Wrist Score) criteria at 3 months and 6 months.

RESULTS

Out of 20, 13 (65%) were male and 7 (35%) were female. 13 (65%) cases involved the left upper limb; and 7 (35%) fractures were on right side. Majority of the patients were in the age group of 31-60 year (Table 1). Out of 20 patients, 13 (65%) had injuries due to the road traffic accidents and 7 (35%) had injuries due to fall at home.

Table 1: Sex distribution.

Age (in years)	No. of case	Percentage (%)
10-30	3	15.00
31-60	14	70.00
61-90	3	15.00

Table 2: Distribution of patients according to AO classification.

Type	No. of case	Percentage (%)
23-B1	2	10
23-C1	6	30
23-C2	5	25
23-C3	7	35

Two (10%) patients were classified as type 23-B1, 6 (30%) patient were type 23-C1, 5(25%) patients were type 23-C2 and 7(35%) patients were type 23-C3 according to AO Classification (Table 2). Preoperatively, all the patients had associated soft tissue complications, ranging from swelling to bruising of overlying soft tissue cover. Out of 20 patients, 7 patients (35%) had deep abrasions over forearm and wrist.

The average duration from admission to surgery was 1 day. The average duration of surgery was 30 minutes.

Out of 20, 17 patients (85%) were operated under brachial block and 3 patients (15%) were operated under GA. There was no significant blood loss during surgery and none of the patients required blood transfusion. Out of 20, 7 (35%) patients required additional k wire fixation.

One of the patient had sustained uni-cortical ulna fracture during surgery during insertion of pin in radius that was treated with below elbow slab. None of the patients had any other major intra operative complications.

The average duration of postoperative stay of the patient was 3 days (range 1-6) and the patients were discharged between 2nd and 6th postoperative day.

At the follow up visit of 6 weeks, 3 (15%) patients had stiffness of finger joint that was relieved with physiotherapy. No other complications were observed. Most of the patients were well tolerant of the external fixator and did not find it inconvenient. At 6 weeks, since the fixator was in situ only pain assessment using VAS (Visual Analogue Score) was done. The mean VAS score at 6 weeks was 3.25.

At 3 months of follow up, the patients were radiologically and clinically assessed. The clinical assessment was done using the following parameters as given in the Mayo Scoring System and these parameters were recorded for each of the patients as below. The mean range of motion as assessed on clinical follow up visit at 3 months was found to be average of 45° dorsiflexion, 40° plamarflexion, 7° radial deviation and 25° ulnar deviation. The mayo score for the patients have been shown in above table and the mean mayo score at 3 months was found to be 73.25. The average time of fracture union was found to be 3 months (range 3-4 months).

At 6 months of follow up, the patients were radiologically and clinically assessed. The clinical assessment was done using the following parameters as given in the Mayo Scoring System and these parameters were recorded for each of the patients as below. The mean range of motion as assessed on clinical follow up visit at 6 months was found to be average of 65° dorsiflexion, 60° plamarflexion, 10° radial deviation and 40° ulnar deviation. The mayo score for the patients have been shown in above table and the mean mayo score at 6 months was found to be 87.

No complications were seen till the end of 6 months. No case of nonunion was reported at the final follow up.

At the end of six months, the range of motion as assessed according to the criteria given by Mayo Wrist Score, excellent results (MWS≥90) were seen in 4 patients (20%), good results (MWS 80-89) were seen in 12 patients (60%),and fair (MWS 70-79) in 4 patients (20%) (Figure 3). At the end of result, significant reduction in

terms of pain, wellbeing, personal life, social life, lifting, travelling and sleeping was seen.

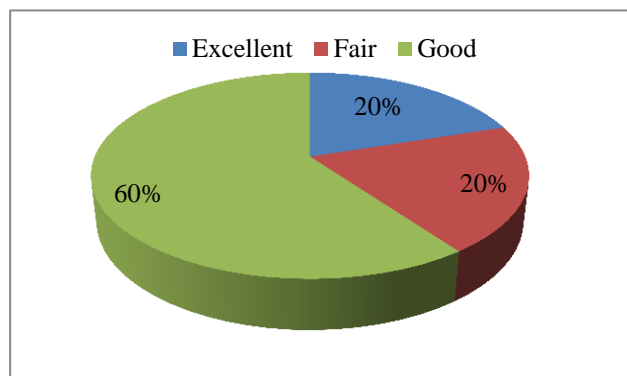


Figure 3: Result according to MWS at the end of 6 months of follow up.

DISCUSSION

The distal radius intraarticular fractures classified by AO type B and C; can be the result of high energy trauma or even due to low impact injuries in osteoporotic bones. As seen in this study, 13 of these fractures were found to be as result of road side accidents and 7 patients as a result of fall at home. So, in this study majority of the cases were the results of high impact or high energy trauma.

The prevalence of these fractures has been seen mostly in males, which shows that this injury mainly occurs in outgoing and active work-forces. Soft tissue complications such as swelling, deep bruising, etc. may be associated with these fractures. In our study, seven patients (35%) had deep abrasions around wrist and mid forearm areas.

Since these fractures are intraarticular both accurate reduction of these fractures as well as early wrist mobilization are very important in their management. Hence these fractures need to be surgically fixed and stabilized so as to achieve the above given objectives.

Conservative methods like below elbow slab have provided poor results. In a study by Kapoor et al, patients were randomly treated by one of the three methods: (1) closed reduction and plaster immobilization, (2) external fixation and (3) open reduction and internal fixation, and were followed for an average of 4 years. They concluded that overall excellent results were seen with external fixation and conservative method had the worst result amongst the three options.⁴

The principle of ligamentotaxis obtained by longitudinal traction is useful in restoring skeletal length to distal radial fractures. Following restoration of palmar tilt by palmar translation, wrist position can be adjusted into neutral or extension to help avoid finger stiffness and carpal tunnel syndrome without compromising fracture reduction.⁵

In a study by Grewal et al, two methods of surgical treatment for displaced intra-articular fractures of the distal radius: open reduction and internal fixation with dorsal plating versus mini open reduction with percutaneous K-wire and external fixation were compared. This study showed that complications like pain, weaker grip strength, etc. are much lower in wrist spanning mini external fixator as compared to dorsal plating. Few other studies have shown not so good results with internal fixation in comminuted intra articular fracture.⁶

Jenkins et al who conducted a study in patients aged less than 60 years with Colles' fractures. They were treated either by a forearm plaster or by the application of an external fixator. They concluded that the external fixator in lower end radius fractures is effective at holding the manipulated position, and the radiological loss of position during fracture union was minimal compared with that seen in patients treated in plaster.⁷

Alamgir et al in their study also concluded that wrist spanning mini external fixator had better results and lower complications as compared to ORIF with plating in intra articular lower end radius fracture. None of the patients were seen to have any significant step off in follow up radiographs.¹ We also found that in our study all the fractures had united at the end of 6 months without any significant complications using wrist spanning mini external fixator and patients were able to perform their daily activities.

As far as number of pins are considered, in a study by Werber et al, a standard four-pin external fixator was compared with the use of a five-pin fixator with the fifth pin stabilizing the distal radial articular fragment.⁸ Follow-up radiographs demonstrated significantly less loss of alignment and length with the five-pin external fixator. Pin site infections were more prevalent with the four-pin fixator. The range of motion of the wrist and forearm, the grip strength, and the Lidstrom functional ratings at six months were all significantly better after use of the five-pin fixator. However in our study we used 4 pin mini external fixator but did not encounter any significant pin tract infection.

Additional k wire fixation was used in 7 patients (35%) in our study. We did not find any wire infections in our study. However, in a study by Dienstet et al thirty adult patients with closed comminuted and mostly intraarticular fractures of the distal radius were treated by closed reduction and immobilization with a dynamic external wrist fixator and in 13 patients with severely comminuted and unstable fractures, additional Kirschner wires were used. They found that in cases with post reductive unstable fragments, additional Kirschner wires should be used to allow early mobilization of the wrist.⁹ They also found 2 major complications: 1 deep Kirschner wire tract infection and 1 index metacarpal fracture.

In our study the mayo wrist scores have been increasing during each follow up period of 6 weeks, 3 months and 6 months. While the range of motion at 3 months was an average of 45° dorsiflexion, 40° plamarflexion, 7° radial deviation and 25° ulnar deviation; at 6 months, the range of motion was an average of 65° dorsiflexion, 60° plamarflexion, 10° radial deviation and 40° ulnar deviation. The final follow up at 6 months showed an excellent functional outcome in 20% of patients and good in 70% patients, i.e., 90% of patients had either excellent or good outcome. There is a concern regarding pin tract infection and pin loosening; however in our study, none of the patients had any pin tract infections or pin loosening. But we found that one patient developed uni cortical ulna fracture due to the pin overshooting the distal cortex of radius, this was treated conservatively using below elbow slab. No major complications were seen till the end of 6 months. No case of nonunion was reported at the final follow up. Hence, treating intraarticular fractures of distal end radius using wrist spanning mini external fixator in distraction can result in a satisfactory functional outcome in patients without any major complications.

The results in this study on distal radius fractures using wrist spanning external fixator were quite satisfactory in terms of functional outcome.

CONCLUSION

Wrist spanning mini external fixator is a promising modality for surgical fixation of intraarticular fractures of lower end radius. It allows anatomical reconstruction of the articular surface, stable fixation of fracture fragments, and care of soft tissue injuries, without a high rate of complications.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Jayakumar P, Teunis T, Giménez BB, Verstreken F, Di Mascio L, Jupiter JB. AO Distal Radius Fracture Classification: Global Perspective on Observer Agreement. *J Wrist Surg.* 2016;6(1):46–53.
2. Alamgir MM, Islam MM, Haque ME, Islam MN, Kader A. Treatment of Comminuted Intra-articular Fractures of Distal Radius by External Fixator. *J Current Adv Med Res.* 2014;1(2):30-4.
3. Dodds SD, Cornelissen S, Jossan S, Wolfe SW. A biomechanical comparison of fragment-specific fixation and augmented external fixation for intra-articular distal radius fractures. *J Hand Surg.* 2002;27(6):953-64.
4. Kapoor H, Agarwal A, Dhaon BK. Displaced intra-articular fractures of distal radius: a comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation. *Injury.* 2000;31(2):75-9.
5. Agee JM. External fixation. Technical advances based upon multiplanar ligamentotaxis. *Orthop Clin North Am.* 1993;24(2):265-74.
6. Grewal R, Perey B, Wilmink M, Stothers K. A randomized prospective study on the treatment of intra-articular distal radius fractures: open reduction and internal fixation with dorsal plating versus mini open reduction, percutaneous fixation, and external fixation. *J Hand Surg.* 2005;30(4):764-72.
7. Jenkins NH, Jones DG, Johnson SR, Mintowt-Czyz WJ. External fixation of Colles' fractures. An anatomical study. *J Bone Joint Surg Br.* 1987;69(2):207-11.
8. Werber KD, Raeder F, Brauer RB, Weiss S. External fixation of distal radial fractures: four compared with five pins: a randomized prospective study. *J Bone Joint Surg Am.* 2003;85(4):660-6.
9. Dienst, Michael; Wozasek, Gerald, E.; Seligson, David Dynamic External Fixation for Distal Radius Fractures. *Clin Orthop Related Res.* 1997;338(3):160-71.

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