

Functional outcome of intra-articular fractures of distal radius using external fixator at a tertiary care centre

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ABSTRACT

Communitied intra-articular fractures of distal end of radius always poses a challenge to the treating surgeon. Inability to achieve and maintain near anatomic restoration of the fracture can cause instability, pain and reduced function. This study reported the results retrospectively of the use of standard protocol of closed reduction and external fixation of these fractures.

Methods: the study contains the 50 patients who underwent closed reduction and external fixation with or without augmentation with k-wires..

Study Design: observational prospective study at tertiary care hospital from September 2008 to august 2010.

Results: At mean of 24 months postoperatively, the mean arc of flexion-extension was 89% of that of uninjured side and mean grip strength was 90% of that of uninjured side. The mean articular step-off was 1mm and the radial length was restored to 12 mm. according to the modified Green and O'Brein rating system, 27 patients had a good or excellent result.

Keywords: distalradius, externalfixator, communitied, ligamentotaxis, fracture.

INTRODUCTION

With a share of 25%, fractures of the distal radius are counted among the most frequent fractures in adults¹. Distal end fractures form one sixth of fractures treated in emergency department². The incidence of this injury appears to be both gender and age specific. There are three main peaks of fracture distribution: one in children age 5-14, the second in males under age 50, and the third in females over the age of 40 years. Overall incidence rates about 24-27 per 10,000 persons/year have been reported³. There is a female dominance in the occurrence of fractures of the distal radius. The female-male ratio is about 3:1⁴. There is no gender predominance under the age of 40 years, and incidence rates of about 10-15 per 10,000 persons have been reported. After the age of 40 years, the incidence rate increases rapidly in women who then outnumber men. At the age of 50 years, women have a life-time risk of 17% compared with only 3% in men⁵. Restoration of congruity of the articular surface is the most critical factor for a good functional result. 2-8 Restoration of radial length (the distance from the radial styloid process to the distal head of the ulna), radial tilt angle, and volar tilt angle is also important^{6,7}. Failure to achieve and maintain nearly anatomic restoration can lead to degenerative arthritis, distal radioulnar and midcarpal instability, and ulnar impaction syndrome, with resultant pain, decreased motion and strength, and poor function.

External fixator is based on ligamentotaxis⁸, in which the fracture fragments are moulded by traction forces across the ligaments. External fixation is unable to prevent dorsal collapse of the radius or maintain the normal palmar tilt of the radiocarpal joint surface. This complication may predispose to post-traumatic wrist instability and arthritis.

We report the results of a prospective study of the use of closed reduction and external fixation of intra-articular fractures in fifty patients who were followed for a minimum of two years.

MATERIALS AND METHODS

This study was conducted in Government medical college Aurangabad from September 2008 to August 2010. This prospective randomized observational study consisted 30 cases who underwent ligament to tibia with external fixation. Patients included in the study were adults (Age 20 –60), patient with intra articular fractures of distal end of radius (AO Type B/C), all closed and Grade I (Gustillo and Anderson) compound fractures and presenting within 72 hours of injury. Patients with Grade II and III open fracture distal radius, pathological fractures, rheumatoid arthritis, concomitant injuries of same limb, bilateral distal end radius fractures and neurovascular injuries were excluded. The specific radiographic criterion for considering closed reduction as acceptable was more than a 2- mm step-off of the distal articular surface of the radius. The fractures were assessed preoperatively by wrist radiographs (PA and LATERAL) and were classified according to the AO/ASIF classification system. Seven patients (14%) had 23.B2 type of fracture, seventeen patients (34%) had 23.B3 type of fracture, ten patients (20%) had 23.C1, eight patients (16%) had 23.C2 type of fracture and eight patients (16%) had 23.C3 type of fracture. Demographic Data The fifty patients who were included in the study consisted of twenty-nine men and twenty- one women who ranged in age from eighteen to fifty nine years (mean, thirty-eight years). Thirty patients presented initially at our institution, and twenty was referred secondarily. The dominant wrist was injured in 28 patients and the non dominant wrist, in 22. The initial injury resulted from a high-energy mechanism in forty patients: fifteen were injured in a fall from a height; while as twenty-five had injury during a road traffic accident. The injury resulted from a lower-energy mechanism in ten patients: seven fell while walking or running, three were injured while doing household activity.

OPERATIVE TECHNIQUE⁹

The patient was placed supine on operation table. intravenous antibiotics were used before the start of procedure. Thorough scrubbing was done and part painted with betadine and then draped. The limb was placed on sideboard. The limb was placed on sideboard with limb abducted 90° at shoulder and elbow and forearm pronated. Under C arm control, preliminary close reduction of fracture was carried out. A longitudinal stab incision was made over the dorso-lateral of the radius, proximal to the muscle bellies of APL and EPB and between the bellies of EDC and ECRB followed by blunt dissection. The proximal pin was then inserted engaging both cortices of the radius at an angle of 30-40° with respect to sagittal plane, as shown in figure 2 A. Distal pin was inserted proximal to the transition In order to avoid transfixing the extensor tendon hood the 1st metacarpophalangeal joint was passively flexed to 90° so that extensor tendon hood move slightly distally and the tendons are of 2nd metacarpal head into the shaft of the 2nd metacarpal. The pin was then inserted engaging both cortices of the 2nd metacarpal at an angle of 30-40° with respect to sagittal plane pulled in ulnar direction⁶⁷ The fixator was assembled but not tightened. Reduction of the fracture was then achieved and checked under C-ARM of 30-40° with respect to sagittal plane⁶⁵. Both pins were connected to the fixator rod. Whole assembly was tightened final reduction and pin sizes were checked under C-ARM.

RESULTS

1) AGE

The mean age was 38.28 years

Table 1 Sex distribution

	NO. OF PATIENTS	PERCENTAGE
MALE	20	40
FEMALE	30	60
TOTAL	50	100

Table 2 Side Distribution

GROUP	RIGHT	LEFT
	21(43.30%)	29(56.70%)

Table 4 Dominant Side Distribution

RIGHT(DOMINANT)	LEFT(NON DOMINANT)
25(50%)	25(50%)

MODE OF INJURY: The distribution of mode of injury in our study is given in the following table. The road traffic accidents (RTA), fall on outstretched hand (FOSH) and fall from height (FFH) were the different modes of injury.

Table 5 Mode of Injury

RTA	FOSH	FFH
25(50%)	10(20%)	15(30%)

Average time taken for radiological union was 15(\pm 3.23) WEEKS

The mean range of motion six months and at final follow up was as follows

TABLE 6

Range of motion	6 months (Degrees)	2 years (Degrees)
Dorsi flexion	69.8	72.5
Palmer flexion	63.1	69.3
Ulnar deviation	35	27
Radial deviation	11.87	12
Supination	70	78
Pronation	77	82

The radiological parameters are shown in the following table

TABLE 7

RADIAL HEIGHT(MM)	VOLARTILT($^{\circ}$)	RADIAL INCLINATION($^{\circ}$)
6 \pm 1.79	8.73 \pm 4	16.81 \pm 6.1

Grip Strenght: Mean grip strength at final follow up was 90 % of the opposite side.

TABLE 8

60-70	71-80	81-90	91-100	MEAN
4(13%)	03(10%)	27(90%)	0	90%

Table 9 Functional Outcome at Final Follow-up Visit

PARAMETERS	NJURED W RIST	NJURED W RIST	%OF INURED SIDE VSUNJURED SIDE
EXTENSION	68 $^{\circ}$ \pm 10 $^{\circ}$	75 $^{\circ}$ \pm 13 $^{\circ}$	90%
FLEXION	69 $^{\circ}$ \pm 8 $^{\circ}$	75 $^{\circ}$ \pm 8 $^{\circ}$	92%
ARCOFFLEXION EXT.	134 $^{\circ}$ \pm 22 $^{\circ}$	148 $^{\circ}$ \pm 21 $^{\circ}$	90.5%
SUPINATION	78 $^{\circ}$ \pm 15 $^{\circ}$	86 $^{\circ}$ \pm 7 $^{\circ}$	90.%
PRONATION	86 $^{\circ}$ \pm 6 $^{\circ}$	89 $^{\circ}$ \pm 15 $^{\circ}$	96.6%
ARC OF PRONATIONSUPI NATION	168 $^{\circ}$ \pm 21 $^{\circ}$	174 $^{\circ}$ \pm 23 $^{\circ}$	96.5%
RADIAL DEVIATION	24 $^{\circ}$ \pm 6 $^{\circ}$	32 $^{\circ}$ \pm 7 $^{\circ}$	75%
ULNAR DEVIATION	38 $^{\circ}$ \pm 6 $^{\circ}$	45 $^{\circ}$ \pm 8 $^{\circ}$	84.44%
ARC OF RADIOULNARDE VIATION	62 $^{\circ}$ \pm 11 $^{\circ}$	77 $^{\circ}$ \pm 13 $^{\circ}$	80.5%
GRIPSTRENTH	42 \pm 6kg	47 \pm 7kg	89.3%

Quick dash Score: The final functional outcome was evaluated using quick dash score. The result at 6 months follow up was 10.92 \pm 8 at final follow up at 2 years, it improved to 8.76 \pm 7

DISCUSSION

The findings of our retrospective study confirm the observation by others that anatomic restoration of the articular surface is a critical part of the operative treatment of intra-articular fractures of distal radius and has a direct influence on the final outcome.^{13,14,15,16} Bradway et al. and Knirk and Jupiter showed that >2 mm of articular incongruity (step-off) was associated with a high prevalence of post-traumatic arthritis and poorer functional results. The treatment of distal radius fractures has undergone changes owing to the advances in technology. Improved imaging methods providing better understanding of fractures and elucidation of the effects of injury type on fracture formation and factors leading to instability have given way to new fixing methods and materials appropriate for the fracture. Distal radius is important in the kinematics of radiocarpal and radioulnar joints. Hence, anatomical reduction of the articular surface, stable fixation, restoration of the radial length, volar angulation and radial inclination are the prerequisite for good clinical outcome. All this reduces the incidence of post-traumatic osteoarthritis and allow early functional rehabilitation¹⁷

The use of an external fixator alone or in conjunction with percutaneous or limited internal fixation, for unstable fractures of the distal end of the radius has produced good or excellent results. We attribute to these good or excellent results to the early removal of the fixator that allows early range-of-motion exercises and to avoid complications commonly associated with the prolonged use of external fixators¹⁸. We believe that intra-articular (AO type-B/C) fractures of the distal part of the radius can be treated by closed reduction and external fixation. Our series demonstrates that this technique, supplemented by k-wires as needed, is a satisfactory treatment that can lead to a high rate of return to work and sports, a high level of patient satisfaction, and a low rate of complications.

Outcome of Evaluations with Clinical Rating Systems According to the modified clinical scoring system of Green and O'Brien¹⁹, the functional result was excellent for 2 patient and good for six, the result was fair for eight patients and poor for 3. The mean score (and standard deviation) was 72.5 ± 17.3 points (range, 25 to 90 points). The mean pain score was 23 points (range, 0 to 25 points), and the mean return-to-work score was 21 points (range, 0 to 25 points). The quickdash score at the final follow up was 8.76 ± 7 . The findings of our retrospective study confirm the observation by others that anatomic restoration of the articular surface is a critical part of the operative treatment of intra-articular fractures of distal radius and has a direct influence on the final outcome. Bradway et al.¹⁹ and Knirk and Jupiter showed that >2 mm of articular incongruity (step-off) was associated with a high prevalence of post-traumatic arthritis and poorer functional results. The treatment of distal radius fractures has undergone changes owing to the advances in technology. Improved imaging methods providing better understanding of fractures and elucidation of the effects of injury type on fracture formation and factors leading to instability have given way to new fixing methods and materials appropriate for the fracture. Distal radius is important in the kinematics of radiocarpal and radioulnar joints. Hence, anatomical reduction of the articular surface, stable fixation, restoration of the radial length, volar angulation and radial inclination are the prerequisite for good clinical outcome. All this reduces the incidence of post-traumatic osteoarthritis and allow early functional rehabilitation. The degree of disability after distal end radius fracture has been seen to correlate with the amount of residual deformity. Treatment options include closed reduction and pinning, bridging and non-bridging external fixation and open reduction with dynamic compression plate (DCP), precontoured locking and non locking plates and screw fixation through a variety of approaches²⁰. Failure to reduce intra-articular fractures of the distal radius predisposes to pain, restricted movement and degenerative arthritis. Mal position is related to the radial height, radial angle, volar tilt and the accuracy of intra-articular reduction. In the treatment of comminuted distal radius intra articular fractures, surgeons may encounter serious complications such as difficult reduction and stabilization, loss of reduction, limitation of range of movement, post traumatic arthritis of the wrist. A brief classification should be made before treating the distal radius fractures. Among various classification systems, the AO classification system is the most suitable one because it reflects the severity of the fracture and helps the surgeon and the patient to know the possible outcomes. The use of an external fixator alone or in conjunction with percutaneous or limited internal fixation, for unstable fractures of the distal end of the radius has produced good or excellent results. We attribute to these good or excellent results to the early removal of the fixator that allows early range-of-motion exercises and to avoid complications commonly associated with the prolonged use of external fixators.

CONCLUSION

We believe that intra-articular (AO type-B/C) fractures of the distal part of the radius can be treated by closed reduction and external fixation. Our series demonstrates that this technique, supplemented by k-wires as needed, is a satisfactory treatment that can lead to a high rate of return to work and sports, a high level of patient satisfaction, and a low rate of complications.

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