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ASSESSMENT OF CLINICO-RADIOLOGICAL OUTCOMES OF OPERATED CASES OF INTRA-ARTICULAR LOWER END RADIUS FRACTURES

Prashanth G¹, Karan Mehta², Shiblee S. Siddiqui³

HOW TO CITE THIS ARTICLE:

Prashanth G, Karan Mehta, Shiblee S. Siddiqui. "Assessment of Clinico-Radiological Outcomes of Operated Cases of Intra-Articular Lower End Radius Fractures". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 02, January 05; Page: 263-272, DOI: 10.14260/jemds/2015/41

ABSTRACT: BACKGROUND: Distal radius fractures with intra-articular extension are complex injuries which have been treated by various methods. The study was to evaluate the outcome of operative management of distal radius fractures with intraarticular extension with the published literature. **AIM AND OBJECTIVES:** The aim is to study the outcome in 50 cases of intraarticular fractures of lower end of radius in adults treated with different modalities such as Kirschner wire and casting, external fixation and open reduction and internal fixation with plate osteosynthesis. **STUDY DESIGN:** Prospective type. **MATERIALS AND METHODS:** The study was conducted at New Civil Hospital, Surat between August 2010 and August 2012 with intraarticular fractures of lower end of the radius treated at the Department of Orthopaedics, New Civil hospital, Surat were included in the study with the Ethical committee approval. They were evaluated to assess their clinical and functional results using Demerit point system of Gartland and Werley and compared with the available literature. The results were analysed using different parameters; male vs. female, age distribution, mode of trauma, functional outcomes and complications etc. **RESULTS AND CONCLUSION:** The results obtained were 10% excellent, 56% good, 28%, fair and 6% poor result. The average age was 38.46 years with the fracture being more common in the 3rd to 5th decades with male to female ratio of 4.5:1. More number of patients had fracture of left radius. 54 % sustained fracture due to road traffic accident. 68% of the patients had Frykman type VII and type VIII fractures. 12% patients had open injuries. K wire fixation was done in 17 patients, external fixation was done in 9 patients and plate osteosynthesis was done in 24 patients. 6 patients had cosmetic deformity. 11 patients had complications. One patient had deep infection. Though described in literature fortunately none of the patients had median nerve complication or reflex sympathetic dystrophy in present series.

KEYWORDS: Intraarticular fractures of lower end of the radius, Frykman classification, functional outcome, K wire, volar plating.

INTRODUCTION: Fractures of distal end of the radius are the most common fractures that orthopaedic surgeons have to treat. Range of fracture extends from simple extraarticular to highly comminuted intraarticular fractures. Nearly 16% of all fractures that are treated in emergency departments involve the distal end of the radius.^[1] It comprises 75% of all forearm fractures.^[2] In young adult the fractures are usually resulting from high energy injuries and in elderly population the fractures are usually resulting from low energy injuries.^[3] Many fractures of the distal end of radius are in fact relatively uncomplicated and are effectively treated with closed reduction and immobilization in a plaster cast. However, fractures that are either unstable and/or involve the articular surfaces can jeopardize the integrity of the articular congruence and/or the kinematics of these articulations.^[1] Treatment of such injuries is difficult. These fractures often are unstable, are

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difficult to reduce anatomically, and are associated with a high prevalence of complications of post-traumatic osteoarthritis. It is also known that extra-articular malalignment can lead to decreased grip strength and endurance as well as limited motion and carpal instability.^[4] Restoration of wrist function is the primary goal in the treatment of unstable distal radius fractures. The results of closed reduction, percutaneous pin fixation, pins and plaster and internal and external fixation have been variable and have been determined largely by the pattern of the fracture. Open reduction and internal fixation is indicated to address the unstable radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligament axis, provided sufficient bone stock is present to permit early range of motion.^[4] The method of immobilization that maintains reduction with least amount of surgical morbidity is the ideal treatment.^[1] Published clinical trials directly comparing different treatment regimens are lacking. The results of the current published data are difficult to compare, most studies are retrospective in nature and use various classification and inconsistent outcome results, especially in regard to comminuted fractures with joint congruity.^[5]

AIMS AND OBJECTIVES: The aim is to study the outcome in 50 cases of intraarticular fractures of lower end of radius in adults treated with different modalities such as Kirschner wire and casting, external fixation and open reduction and internal fixation with plate osteosynthesis.

MATERIAL AND METHODS: The present study was conducted at New Civil Hospital, Surat between August 2010 and August 2012 with intraarticular fractures of lower end of the radius treated at the Department of Orthopaedics, New Civil hospital, Surat were included in the study with the Ethical committee approval.

STUDY DESIGN: Prospective study.

SOURCE OF DATA: Patients operated for intraarticular fractures of lower end of the radius in the Department of Orthopaedics, New civil hospital, Surat during the period of two year from August 2010 and August 2012.

SAMPLE SIZE: All patients with intraarticular fractures of lower end of the radius who underwent operative procedure from August 2010 and August 2012 were selected for the study.

SELECTION CRITERIA:

INCLUSION CRITERIA: All patients with age above 18 years having intraarticular fractures of lower end of the radius with an indication for surgical management.

EXCLUSION CRITERIA:

- Pathological fractures
- Patients treated conservatively
- Patients with severe life threatening medical problems

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PROCEDURE: The study was approved by Ethical and Research committee of Government medical college, Surat. After finding suitability of inclusion and exclusion criteria patients were selected for study and briefed about the nature of the study, the interventions used and written informed consent was obtained. The consented patients were enrolled into present study. Further descriptive data of the participant's like name, age, sex, detailed history were obtained by interviewing the participants and clinical examination and necessary investigations were recorded.

Local part was examined in detail including local skin condition, deformity and neurovascular status of the limb. Movements of the wrist forearm and elbow were checked and recorded. All patients received tetanus prophylaxis, broad spectrum antibiotics and analgesics as per need. In open fractures wound was cleaned and dressed aseptically before definitive debridement was done at the earliest, swab was sent for microbial culture and sensitivity testing.

The patients were given cuff and collar sling and PA and Lateral radiographs of forearm with wrist were taken, and posterior plaster of paris splint was applied. All patients were treated as indoor patients.

Standard radiographs in postero anterior view and lateral views of wrist and forearm of the affected limb were taken for confirmation of the diagnosis and also to know the type of fracture. The fracture fragments were analysed and involvement of radiocarpal and distal radioulnar joints were assessed and classified according to the Frykman's classification.

In the present series out of 50 cases, 11(22%) patients had associated injuries with 6(12%) open fractures. 17 cases were treated with closed reduction and percutaneous pinning and plastercast. 9 cases were treated with external fixation. 7 cases were treated with external fixator and 2 cases with external fixator and K wire with augmentation. 15 patients were treated with volar plating, 7 patients were treated with dorsal plating, 1 patient was treated with both volar and dorsal plating and one patient was treated with dorsal plate and external fixator. K wire augmentation was used in selected cases. The acceptable criteria for fixation are:

1. Radial shortening <5 mm at distal radioulnar joint.
2. Radial inclination on posteroanterior radiographs >15 degrees.
3. Sagittal tilt on lateral projection between 15 degrees dorsal tilt and 20 degree volar tilt.
4. Intraarticular step off or gap < 2mm of radiocarpal joint.
5. Articular incongruity <2mm are of sigmoid notch of distal radius.

For patients treated with Open Reduction and Internal Fixation, after the surgery, the operated limb was supported with an above elbow posterior splint. Wound was inspected on the 2nd and 5th post-operative day and discharged and called for suture removal. Sutures were removed on the 12th post-operative day. The splints were discarded and replaced by an elastocrepe bandage and patients were advised to avoid strenuous activities within the elastocrepe bandage.

After discharge, all patients were reviewed fortnightly for the first 6 weeks. Patients were assessed subjectively for pain at the fracture site, clinically for tenderness. Pronation and supination of the forearm and active movement of the elbow and shoulder were advised throughout the period of healing. Physiotherapy was started. The range of wrist movements was recorded and any deformity was assessed. The grip strength was compared with normal hand and recorded. The patients were followed regularly at 3 month, 6 month, 1 year and 2 year and were recorded as per the proforma. The results were assessed at 3 month after the procedures and further follow up using the

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demerit point system of Gartland and Werley.^[6] Based on objective and subjective criteria, residual deformity and complications.

Demerit point system of Gartland and Werley.^[6]

EXCELLENT - (0-2) GOOD - (3-8) FAIR - (9-20) POOR - (>21)

OBSERVATION AND RESULTS: Out of 50 patients, there is male preponderance in our series with the M:F ratio being 4.5:1. Age: In the present series 78% of patients were below 50 yrs. The youngest patient was 20 years old and the oldest 65 years old. The average age was 38.46 years.

MODE OF INJURY: The Road traffic accident was the most common mode of injury in the present series. About 54% patients had sustained road traffic accidents, remaining 46% were due to fall from height or domestic falls. The delay in discharge was due to associated injuries or infection. We had 88% closed fracture and 12% of open fractures according to Gustilo Andersen classification In the present series most of the fractures were of Frykman class VII & class VIII(68%) as evident in table number 5. Our series is comparable to Kapoor series^[7] as it was done in the Indian set up had the same findings for age and sex incidence, involved wrist and mode of injury, as that of ours. It is evident from the study that involvement of both radiocarpal and radioulnar joint is common in displaced intraarticular fractures of lower end of the radius which is usually seen in high energy trauma.

In our series we have used the Demerit system of Gartland and Werley.^[6] As per this system we had 10% excellent, 56% good, 28%, fair and 6% poor result. In the present series we had less excellent results, but the combined excellent to good results are comparable to Bradway,^[6] Kapoor^[7] and Jupiter^[8] series. This is probably because of subjective component in the evaluation and also the less movement that was achieved in Indian patients due to lack of physiotherapy and non-compliance. Patients, who obtained excellent results, had no residual deformities or pain.

Range of motion was within the normal functional range.

COMPLICATIONS: In the present series 11(22%) patients had complications. The incidence of complications in Bradway^[6] series, Jupiter^[8] series and Kapoor^[7] series are 35%, 40% and 8% respectively with 1(2%) patient who underwent closed reduction and external fixation had pin tract infection which was controlled with appropriate antibiotics based on culture and sensitivity report. There was 1 (2%) case of loosening of K wire. 2(4%) patient had dorsal tendon tenosynovitis who had undergone dorsal plating and 1(2%) patient who initially had fixation with K wire there was loss of reduction and was reoperated with external fixation and K wire augmentation 4 days later. 4(8%) patients developed radiocarpal arthritis grade 1 as described by Knirk and Jupiter.^[8]

One (2%) patient who underwent plate osteosynthesis had superficial infection which was controlled by antibiotics and local dressing. One of the patient had deep infection which was related to delayed union and poor outcome and was controlled with antibiotics. None of the patients had median nerve complications fortunately. The complications in our series is higher than Kapoor^[7] series and is lower than Bradway^[6] and Jupiter^[8] series. Bradway and Jupiter had longer follow up and included late complications which is not seen in our case and hence lower complication rate. Among the patients who had poor result, one patient (case no 4) was operated on 5 day of injury, he

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had Frykman type VIII distal radius fracture, had collapse of fracture, non-compliant to regular follow up. He had limitation, disability and weakness. Most of his movements were not within the range required for normal function. He was non-compliant with regard to post-operative physiotherapy. One patient (case no 14) had RTA Frykman type viii distal radius fracture treated with K wire and casting the patient had associated subtrochanteric and intertrochanteric femur fractures, the pain persisted and he was non-compliant for physiotherapy and regular follow up resulted in deformity and painful restricted movements at wrist.

One patient (case no 33) had fall from height with associated open fracture shaft femur. He had deep infection of both operated site of femur and lower end radius. He had deformity, weakness and disability. Most of his movements were not within the range required for normal function. He was non-compliant with regard to post-operative physiotherapy.

DISCUSSION: The prognostic factors for lower end radius fracture include age, intra articular involvement, method of treatment, timing of joint mobilisation etc.

Multiple articles have been published documenting superior functional results using internal fixation (Bradway series,^[6] Jupiter series,^[8] Catalano series^[9] and Kapoor series^[7]). The result and observation of the present study is compared with the other similar studies which are depicted in table no 1-13.

There were 14(28%) fair and 3(6%) poor results in this study which was higher when compared to the study by Bradway series,^[6] Jupiter series,^[8] Catalano series^[9] and Kapoor series.^[7]

Major contributing factors were:

1. Improper fixation due to complexity of comminution or surgical technique.
2. Elderly age group constituted majority, who were less motivated than young people to initiate exercises. Their bones were osteoporotic with very low osteogenic potential.
3. Delay in surgery was a factor which resulted in bad results.

CONCLUSION: Though the series is small and period of follow up is small to draw definitive conclusions it appears that a detailed history regarding mechanism and duration of injury is very important. Complete physical examination is most vital. Radiographic examination with good quality x-rays are required for classification and to decide on the management and for post-operative follow up. Preoperative and postoperative examination of neurovascular status of injured limb is of paramount importance. Early adequate debridement and judicious use of antibiotics and good post-operative care will reduce the chance of infection in open injuries. Possibility of associated injuries must be kept in mind in high velocity trauma. Fractures with extreme communication are best treated with traction and external fixation. A good surgical technique, respect for soft tissue will minimize intra and post-operative complications. The choice of surgical approach for plate osteosynthesis should be based on direction of displacement of fracture fragments. Open reduction and internal fixation of displaced and comminuted intraarticular fracture of distal end of the radius appears to be the treatment of choice where alignment of articular surface cannot be obtained by closed means. A strong association exists between the development of osteoarthritis and residual displacement of articular fragments at the time of osseous union. Clinically patient can have excellent or good functional outcome irrespective of radiographic evidence of osteoarthritis. Factors such as

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size, number and location of articular fracture fragments may be more important prognostically. Displacement of fracture fragments is always a possibility following treatment. Fracture healing is usually not a problem and fracture is through metaphyseal cancellous bone with plenty of blood supply. A good postoperative physiotherapy is of help in gaining better functional results.

ACKNOWLEDGEMENT: The author did not receive any grants or outside funding for support of the research or preparation of the manuscripts. No funding was received for this work from any of the organizations.

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AGE IN YEARS	PRESENT SERIES NUMBER OF CASES (PERCENTAGE)	BRADWAY SERIES ^[6] NUMBER OF CASES (PERCENTG E)	JUPITER SERIES ^[8] NUMBER OF CASES (PERCENTAGE)	KAPOOR SERIES ^[7] NUMBER OF CASES (PERCENTAGE)
16-29	16(32%)	6(37.5%)	20(41%)	
30-39	12(24%)	1(6.25%)	2(4%)	
40-49	11(22%)	2(12.5%)	5(10%)	
50-59	05(10%)	3(18.75%)	10(20%)	
>60	06(12%)	4(25%)	12(25%)	
MINIMUM AGE	20	18	16	

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MAXIMUM AGE	65	73	76	
AVERAGE AGE	38.46	42	43	39

TABLE 1: SHOWS AGE INCIDENCE

GENDER	PRESENT SERIES NUMBER OF CASES (PERCENTAGE)	BRADWAY SERIES ^[6] CASES (PERCENTAGE)	JUPITER SERIES ^[8] CASES (PERCENTAGE)	CATALANO SERIES ^[9] CASES (PERCENTAGE)	KAPOOR SERIES ^[7] CASES (PERCENTAGE)
MALE	41(82%)	9(56%)	29(60%)	14(67%)	65(72%)
FEMALE	9(18%)	7(44%)	20(40%)	7(33%)	25(28%)

TABLE 2: GENDER DISTRIBUTION

SIDE INVOLVEMENT	PRESENT SERIES NUMBER OF CASES (PERCENT)	BRADWAY SERIES ^[6] NUMBER OF CASES (PERCENT)	JUPIR SERIES ^[8] NUMBER OF CASES (PERCENT)	CATALANO SERIES ^[9] NUMBER OF CASES (PERCENT)	KAPOOR SERIES ^[7] NUMBER OF CASES (PERCENT)
RIGHT	20(40%)	8(50%)	32(65%)	8(38%)	58(65%)
LEFT	30(60%)	8(50%)	17(35%)	13(62%)	32(35%)

TABLE 3: LATERALITY

MECHANISM OF INJURY	PRESENT SERIES NUMBER OF CASES (PERCENT)	BRADWAY SERIES ^[6] NUMBER OF CASES (PERCENT)	JUPITER SERIES ^[8] NUMBER OF CASES(PERCENT)	KAPOOR SERIES ^[7] NUMBER OF CASES (PERCENT)
ROAD TRAFFIC INCIDENT	27(54%)	5(31%)	33(67%)	63(70%)
FALL ON OUTSTRETCHED HAND	23(46%)	11(69%)	16(32%)	27(30%)

TABLE 4: MECHANISM OF INJURY

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TYPE	PRESENT SERIES NUMBER OF CASES (PERCENT)	CATALANO SERIES ^[9] NUMBER OF CASES(PERCENT)	KAPOOR SERIES ^[7] NUMBER OF PATIENTS (PERCENT)
I	0(0%)	0(0%)	0(0%)
II	0(0%)	0(0%)	0(0%)
III	6(12%)	0(0%)	9(10%)
IV	3(6%)	0(0%)	21(23%)
V	6(12%)	0(0%)	0(0%)
VI	1(2%)	0(0%)	0(0%)
VII	13(26%)	10(47%)	15(17%)
VIII	21(42%)	11(53%)	45(50%)

TABLE 5: NUMBER OF PATIENTS ACCORDING TO FRYKMANN CLASSIFICATION

TYPE OF FIXATION	PRESENT SERIES NUMBER OF CASES (PERC ENT)	BRADWAY SERIES ^[6] NUMBER OF CASES (PERCENT)	CATALANO SERIES ^[9] NUMBER OF CASES (PERCENT)	KAPOOR SERIES ^[7] NUMBER OF CASES (PERCENT)
K WIRE FIXATION	17(34%)	5(32%)	12(57%)	
EXTERNAL FIXATION AND LIGAMENTOTAXIS	9(18%)	5(32%)	6(29%)	28(31%)
OPEN REDUCTION AND INTERNAL FIXATION WITH PLATE OSTEOSYNTHESIS	23(46%)	6(36%)	3(14%)	29(32%)
COMBINED EXTERNAL FIXATOR AND PLATE	1(2%)			
TOTAL	50(100%)	16(100%)	21(100%)	

TABLE 6: THE VARIOUS TYPES OF FIXATION

TIME FOR FRACTURE HEALING	PRESENT SERIES NUMBER OF CASES (PERCENT)	BRADWAY SERIES ^[6]	CATALANO SERIES ^[9]
<3 MONTHS	49(98%)		
3-4 MONTHS	01(2%)		
FRACTURE HEALING	WITHIN 16 WEEKS	WITHIN 9	WITHIN 9 WEEKS

TABLE NO 7: DEPICTS THE DURATION FOR FRACTURE HEALING

DEFORMITY	PRESENT SERIES NUMBER OF CASES (PERCENT)	KAPOOR SERIES ^[7] NUMBER OF CASES (PERCENT)
PROMINENT ULNAR STYLOID	4(8%)	

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RADIAL DEVIATION	2(4%)	
TOTAL	6 (12%)	2(3%)

TABLE 8: THE DEFORMITY OBSERVED

RADIOLOGICAL CRITERIA	NUMBER OF CASES
RADIAL SHORTENING >5MM SHORTENING	1
RADIAL ANGLE <15 DEGREE	6
VOLAR TILT <-15 DEGREE AND >20 DEGREE	0
ARTICULAR STEP OFF>2MM	4

TABLE 9: MALUNITED FRACTURES ACCORDING TO RADIOLOGICAL ACCEPTABLE CRITERIA

MOVEMENT	PRESENT SERIES AVERAGE MOVEMENT	BRADWAY SERIES ^[6] AVERAGE MOVEMENT	JUPITER SERIES ^[8] AVERAGE MOVEMENT IN DEGREES	CATALANO SERIES ^[9] AVERAGE MOVEMENT IN SERIES
PALMAR FLEXION	43.70	550	660	750
DORSIFLEXION	54.10	550	580	620
ULNAR	21.10	320	420	210
RADIAL	13.1	210	220	140
SUPINATION	72.60		780	850
PRONATION	71.60		720	820

TABLE 10: AVERAGE MOVEMENT AT WRIST JOINT

Movement (within minimum functional range)	No Of cases	Percentage
Dorsiflexion(min 45)	42	84
Palmar flexion(min 300)	42	84
Pronation (min 50°)	48	96
Supination (min 50°)	47	94
Radial deviation (min 15°)	24	48
Ulnar deviation (min 15°)	44	88
Pain in distal radioulnar joint	08	12
Grip strength (60% or less than on opposite side)	03	06

TABLE 11: RANGE OF MOTION WITHIN THE MINIMUM FUNCTIONAL RANGE IS ASSESSED BY GARTLAND AND WERLEY DEMERIT

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Result	PRESENT SERIES NUMBER OF CASES (PERCENT)	BRADWAY SERIES ^[6] NUMBER OF CASES (PERCENT)	JUPITER SERIES ^[8] NUMBER OF CASES (PERCENT)	KAPOOR SERIES ^[7] NUMBER OF CASES (PERCENT)
Excellent	05(10%)	7(56%)	31(63%)	21(36%)
Good	28(56%)	5(25%)	10(21%)	20(35%)
Fair	14(28%)	4(19%)	8(16%)	10(17%)
Poor	03(06%)	0(0%)	0(0%)	7(12%)

TABLE 12: THE FINAL RESULT OF STUDY

Modality of treatment	Present Series in percent				Bradway Series ^[6] in percent				Jupiter Series ^[8] in percent				Kapoor Series ^[7] in percent			
	Exce	Good	Fair	Poor	Exce	Good	Fair	Poor	Exce	Good	Fair	Poor	Exce	Good	Fair	Poor
K WIRE	30 %	47 %	18 %	5%	60 %	20 %	20 %	0 %	0 %	0 %	0 %	0 %	0%	0 %	0 %	0%
EXTERNAL FIXATOR	0%	33 %	67 %	0%	80 %	0%	20 %	0 %	0 %	0 %	0 %	0 %	40 %	40 %	10 %	10 %
PLATE OSTEOSYNTHESIS	0%	70 %	21 %	9%	33 %	50 %	17 %	0 %	63 %	21 %	16 %	0 %	32 %	31 %	26 %	11 %

TABLE 13: EVALUATION OF RESULT WITH DIFFERENT MODALITIES OF TREATMENT

AUTHORS:

1. Prashanth G.
2. Karan Mehta
3. Shiblee S. Siddiqui

PARTICULARS OF CONTRIBUTORS:

1. Senior Resident, Department of Orthopaedics, Mandya Institute of Medical Sciences, Mandya.
2. Spine and Trauma Consultant, D. N. Mehta Hospital, Navsari, Gujarat.
3. Senior Resident, Department of Orthopaedics, Bombay Hospital, Mumbai.

NAME ADDRESS EMAIL ID OF CORRESPONDING AUTHOR:

Dr. Prashanth G,
1023, 1st Main,
4th Cross, Srirampura 2nd Stage,
Mysore-570023, Karnataka.
E-mail: gprashanth2005@gmail.com

Date of Submission: 06/12/2014.
Date of Peer Review: 08/12/2014.
Date of Acceptance: 29/12/2014.
Date of Publishing: 03/01/2015.