DOI: 10.14260/jemds/2015/451

ORIGINAL ARTICLE

CLINICAL OUTCOME OF INTRA-ARTICULAR DISTAL RADIUS FRACTURES TREATED WITH PLATE AND SCREWS

Girish K. R[1], Hosangadi A. A[2], Suresh Korlhalli[3], Suryakanth K[4]

HOW TO CITE THIS ARTICLE:
Girish K. R, Hosangadi A. A, Suresh Korlhalli, Suryakanth K. "Clinical Outcome of Intra-Articular Distal Radius Fractures Treated with Plate and Screws". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 18, March 02; Page: 3110-3123, DOI: 10.14260/jemds/2015/451

ABSTRACT: BACKGROUND: Incidence of fractures of distal radius are increasing due to more geriatric population and road traffic accidents. The fundamental goal of distal radius fractures treatment is restoration of normal or near normal alignment and articular congruity. Restoration of the anatomy and articular surface may prevent the onset of arthritis and improve function. **AIMS:** To determine clinical outcome of intra-articular distal radius fractures treated with plate and screws. **METHOD:** 20 patients of intra-articular distal radius fracture treated with open reduction and internal fixation with plate and screws between November 2012 and October 2014 were evaluated. Clinical and radiological evaluation was done at 3 weeks, 3 months, 6 months and one year after surgery. Fractures were classified according to Melone fracture classification. There were 8 type-2 fractures, 5 type-3 fractures,4 type- 4 fractures, 2 type-5 and 1 type-1 fracture. There were 19 (95%) males and 1 (5%) females. Age range was between 24 to 50 years with average of 34 years. Fracture was stabilized with the plate and screws at an average of 5 to 7 days post trauma. **RESULTS:** All fractures had sound clinical and radiological union with an average radiological union time of 14 weeks (range between 2.5 – 6 months). Average palmar flexion of wrist was 56deg, dorsi-flexion was 59deg, radial deviation was17deg, ulnar deviation was 23deg, pronation was 65deg and supination was 72degrees. Gartland and Werley system was used to evaluate the function, 80% of patients had excellent to good results out of which 20% were excellent and 60% were good results, and 15% had fair results and poor results were found in 5%. Average radial inclination was 21 degrees and palmar tilt was 9.5 degrees. **CONCLUSION:** Open reduction and internal fixation with plate and screws is an excellent, and effective technique in management of intra-articular distal radius fractures in terms of high union rate, anatomical reduction, maintenance of articular congruity and early mobilization and best functional outcome.

KEYWORDS: Open reduction and internal fixation, Plates & Screws, Gartland and Werley system.

INTRODUCTION: Distal radius fractures represent approximately one-sixth of all fractures treated in emergency departments. The majority of fractures in the elderly are extra-articular, whereas there is a much higher incidence of intra-articular fractures in younger patients. The majority of osteoporotic fractures occur as the result of a fall, while the majority of injuries in the younger patients are secondary to motor vehicle accidents and sports.[1]

Fractures of the distal end of the radius continue to pose a therapeutic challenge. Intra articular and extra articular malalignment can lead to various complications like post traumatic arthrosis, decreased grip strength and endurance, as well as limited motion and carpal instability.[2]

Restoration of radial length, radial tilt angle and congruity of articular surfaces is important for good functional results.[3]

DOI: 10.14260/jemds/2015/451

They are often treated with closed reduction and immobilisation but the difficulty here is the possibility that displacement may persist even in the least complex fractures. Other problem with this method is immobilisation of wrist and forearm for at least 6 weeks and the further time required to regain the functions of forearm wrist and hand by physiotherapy. During this entire time duration, patient's ability to carry out day to day activities are hampered. The need of the hour is treatment modality that restores and maintains anatomy and allows early functional mobility which allows patient to carry out his activities of day to day life with minimal discomfort. Numerous other methods of treating injuries of this nature like closed percutaneous pinning, external fixation, buttress plating have enjoyed recognition from time to time, testifying the fact that there is no ideal modality of treatment.[4]

Internal fixation of metaphyseal bending fractures has become increasingly popular primarily due to (a) directly control and maintain physiologic palmar tilt, (b) prevent collapse, and (c) avoid bridging the radiocarpal joint. The distal fragment typically has sufficient size and integrity to provide adequate purchase and may be approached from either a dorsal or a volar approach.[5]

Internal fixation of periarticular fractures has many potential advantages including direct fixation of articular fragments, early range of motion of the joint, and avoidance of constrictive dressings or casts. A better understanding of wrist anatomy and functioning through the studies conducted in the recent years, as well as the increasing expectations of patients have expanded the borders of surgical treatment.

This fixation technique of using plate for treating intra-articular distal end radius fracture shows promise in terms of stable intraoperative fixation and restoration of acceptable anatomy, resulting in early mobilisation and good recovery of function. This holds true even for osteopenic bones.

There are many ways to surgically stabilize the fracture and there are various forms of surgical stabilization devices available for surgical management of intra–articular fractures of distal end radius. Of all those forms of devices used, percutaneous direct pining, plate fixation, bone grafting, bone cementing, Wrist arthroscopy and combined methods. This study is taken up to analyse the open reduction and internal fixation of intraarticular fractures using various plate and screws.

MATERIALS AND METHODS: A total of 20 patients of intra-articular distal end radius fracture treated with open reduction and plate fixation between November 2012 and October 2014. These 20 patients were studied in terms of early mobilisation and recovery of function, maintenance of reduction and evidence of any immediate, early or late complication. The fractures were classified according to the Melone classification. There were 8 type-2 fractures, 5 type-3 fractures, 4 type- 4 fractures, 2 type-5 and 1 type-1 fractures.

INCLUSION CRITERIA'S:

1. Fracture of distal end of radius without fracture of distal ulna.
2. Age greater than 18 years.
3. Patients who had regular follow up at 3 weeks, 3 months, 6 months and one year.
4. Patients who are medically fit and willing for surgery.
5. Radiological findings confirming intra-articular fracture of distal end radius classified according to Melone classification.

DOI: 10.14260/jemds/2015/451

EXCLUSION CRITERIA'S:

1. Compound injuries.
2. Patient's with open physis.
3. Patients who did not follow up regularly.
4. Pathological fractures.
5. Patients with existing disorders having a relevant effect on the healing process, such as multiple sclerosis or paraplegia.

The study included 19 male and 1 female patients who had an average age of 51 years. The youngest patient was a 24 year old male, while the oldest was an 50 year old male. The mechanisms of injury included road traffic accidents (14 patients), fall on outstretched hand (4 patients) and fall from height (2 patients). A simple fall was considered a low-energy injury and fall from height and road traffic accident resulted in high-energy injury. One was a revision surgery following a failed pinning attempt. The follow-up period was of minimum one year duration.

Occupation of our patients were student (1 patient), housewife (1 patient), occupation involving heavy work (12 patients), occupation involving light work (6 patients).

Eighteen fractures were accessed through volar approach and two fractures through dorsal approach. All were fixed with plate and screws. All Surgeries were carried by the same surgeon. The average time from injury to operative fixation was approximately 5.75 days (range - one to eight days). During post op period patients were given liberal doses of analgesics to reduce post op pain and limb immobilised with above elbow slab immobilisation for 2 weeks. Immediate post op X-rays were evaluated quantitatively for radial inclination, volar tilt of radius and qualitatively for presence or absence of articular step. Patients were encouraged to start active finger and shoulder movements from the 1st postoperative day. Wrist range of movement exercises and start using operated limb for day to day activities from fifteenth post op day. Patients were followed up regularly at 3 weeks, 6 weeks and 12 weeks.

At final follow up (6months-10 months) patients were followed up and evaluated radiologically and clinically. On X-ray radial inclination and palmar angulation were measured. Any presence of articular step and radio-ulnar variance was also noted. These 2 criteria's were not measured quantitatively because X-rays of our patients were digital X-rays with variable magnification. Clinically patients were evaluated for pain, range of movement (compared to opposite wrist), grip strength (compared to opposite wrist) and ability to return to previous employment. Range of movement was measured with goniometer and grip strength was measured with commercially available dynamometer. Both of these parameters were recorded as percentage of range of movement and grip strength of non-operated limb respectively. Gartland and Werley score was utilised for quantifying the functional outcome.

RESULTS: We recorded or findings as analysis of functional results, analysis of radiological parameters and incidence of any complication. In our study 20 patients were treated with plates for intra-articular fractures of distal end of radius, followed up for a minimum of 6 months, were analyzed according to the criteria of demerit point system of Gartland and Werley. 4 patients had excellent results (20%), 12 patients had good results (60%), 3 patients had fair results (15%) and 1 patient had poor result (5%).

DOI: 10.14260/jemds/2015/451

In our series 16 patients were below the age of 40 years, 3 patients were between 40-50 years and 1 patient were between 50-60 years. The average age of 20 patients was 34.1 years. In our study involvement of left side (65%) was more than the right (35%). In our series the mode of injury in 14 patients were due to RTA (70%), 4 patients sustained injury due to fall on outstretched hand (20%), 2 due to fall from height (10%).

The final result in our series after an average follow up of 6.75 months (6-10 months) showed that 4 patients (20%) had excellent result. Of these 3patients was below 30 years and 1 patient was 45 years of age. 2 patients had Melone type II,1 patient had type III fractures and 1 patient had type IV. 3 patients had their trauma due to RTA, 1 patient had sustained injury due to fall on outstretched hand.

12 patients (60%) in our series had good result. 4 patients were below 30 years, 6 patient was below 40 years, 1 patient was below 50 years, 1 patient was below 60 years. Of these 4 patients had Melone type III injury, 3 had type II, 3 had type IV, 1 had type I and 1 had type V. The mode of injury in 10 patients were due to RTA, 1 patient had fall on outstretched hand, 1 had injury due to fall from height.

3 patients (15%) in our series had fair results. 3 patients were below 40 years. 2 patients sustained injury due to fall on the outstretched hand and 1 due to fall from height. All 3 were Melone type 2. One patient had poor result in our series (5%). 1 patient was 45 years of age. Mode of injury was due to RTA and that patient had Melone type V.

Analyzing the results as per the age, revealed that 16 patients (80%) were below 40 years of age, of these 3 had excellent result (18.75%), 10 had good results (62.5%), 3 had fair results. 4 patients were above 40 years of age of which 1 had excellent results(25%), 2 had good results (50%) and 1 had poor result. This reveals that younger the patients better is the result. This may be due to better quality of the bone, high motivation to get back pre-injury status and better patient compliance.

At final follow up 17 patients were pain free, had achieved near to pre fall employment status and all of them had grip strength >80% compared to opposite hand. 3 patient had occasional pain, limitation of motion and activities slightly restricted. Excellent to good results about 50 % seen among Melone types 2 and 3.

Average palmar flexion of wrist was 56 degrees, dorsi-flexion was 59 degrees, supination was 72 degrees, pronation was 65 degrees, radial deviation was 17 degrees and ulnar deviation was 23 degrees. Average radial inclination was 21 degrees and palmar tilt was 9.5 degrees. None of our patients had articular step in immediate post op or 3 weeks or 3 months or final follow up X-ray. And none of them had gross change in radio ulnar variance.

COMPLICATIONS: Three patients had restriction of wrist movements and stifness of fingers. Neither early complications such as median nerve and radius superficial nerve injury, not late complications like carpal instability, arthritis and iatrogenic radial aneurysm, tendon rupture or implant loosening were reported.

This study demonstrates that open reduction with plating is a safe and effective treatment for acute, intra-articular fractures of the distal radius, giving adequate stability and allowing early mobility.

DOI: 10.14260/jemds/2015/451

DISCUSSION: Fractures of the distal radius are one of the most common injuries in orthopaedics. In cases of displaced, intra-articular fractures, repair focuses on precise anatomic reduction and articular alignment. Restoration of the anatomy and articular surface may prevent the onset of arthritis and improve function. Therefore, there is the need for studies that substantiate specific treatment protocols to ensure that surgeons have the necessary information to effectively restore function to their patients.

Charles melone (1986) is one of the proponents of open reduction of displaced intra articular fracture of the distal radius. He has proved in his series the maximal functional recovery following such fractures is dependent to a great extent on accurate and stable restoration of articular surfaces.[6]

In our study conducted between November 2012 to September 2014, 20 patients with intra articular fracture distal end of radius were managed by open reduction and internal fixation by plate and screws. There were 95% males and 5% females and average age was 34.1 years. The commonest mechanism of injury was RTA i.e. 70%. The aim of the surgery was to buttress the fractures which allows for reconstruction of the lower end of radius and prevents dorsal or volar collapse of the fragments.

Use of plates in distal radius fractures provide good to excellent results and are effective in the correction and maintenance of distal radius anatomy. By using these plates, joint motions and daily functioning is recovered in a shorter time.

A study was conducted by Dr. Ujjawal Pradhan, Dr. Atulagarwalet. al on 15 patients with intraarticular fractures of distal radius treated with locked plate, with a mean follow up of 2 years. The evaluation was based on the criteria of Garland and Werley. They had 60% of their patients rated excellent, 40% good results.[7]

A study was conducted by John K. Bradway and William P Cooney on 16 patients with comminuted intraarticular fractures of distal radius, with a mean follow up of 5.7 years. The evaluation was based on the criteria of Gartland and Werley and also by Green and O'Brien scoring system. They had 56% of their patients rated excellent, 25% good and 19% fair. They had no poor results. This high percentage of excellent and good results compared to our study may be due to fact that the follow up was of longer duration and they had better patient's compliance. The average age of the 16 patients were 40 years. The youngest being 18 years and oldest being 75 years.[8]

Knirk and Jupiter in the year 1986 suggested restoration of articular congruency is the most critical factor in preventing late wrist osteoarthritis and in obtaining a good functional result after a distal radius intra articular fracture. Obtaining and maintaining radial length and reduction of dorsal tilt of the articular surface are of less importance. Failure to restore articular congruency, particularly of the lunate facet fragment was the cause of osteoarthritis in 75% of the fractures in their series. Residual displacement of greater than 2mm resulted in osteoarthritis in all (100%) wrists versus an 11% incidence of this problem in the wrists that healed with joint congruency.[9]

T.S. Axelrod et al. in the year 1990 studied 17 patients treated by open reduction and internal fixation for intra articular fractures. All patients achieved a functional range of motion, with greater than 45 degrees of wrist extension, 10 degrees of wrist flexion, and 50 degrees of pronation and supination. Grip strength averaged 83% of the uninjured side. Radiographically 15 of 17 achieved a congruent distal radial joint surface.[10]

DOI: 10.14260/jemds/2015/451

Fitoussi F, Chow S P in the year 1997 studied 34 displaced intra articular fracture distal end radius who were treated with plates and screws rated as 82% good or excellent results according to Gartland and Werley.[2]

The technique also proved to be useful for the elderly patients with osteopenic bones, showing early range of mobility and function. Other than this, early recovery was associated with negligible complications, which is established in other studies as well.[11]

Though the final results might be same with use of plate or any other modality of treatment, maximal improvement in function occurs by 6 months after surgery as (evidenced in other studies as well) most of the patients treated with locking plate, which is quite early as compared to other modalities of treatment which take at least an year for maximal improvement.

Incidence of complications is far less with use of locking plate as compared to other modalities. We believe that restoration of the joints and the articular anatomy led to desired results of range of movement, grip strength, pain intensity and functional status. Consequently, it seems rational to use Plates for intra-articular fracture of distal end radius as an effective treatment method in terms of early functional mobilisation compared to other available methods.

Thus open reduction and internal fixation by plate and screws provides better functional results in intra articular fractures of distal end of radius. So this procedure can be used as alternative to other procedures in treating intra-articular fractures of distal end radius.

CONCLUSION: Excellent to good results were seen in 80% of patients by using plate and screws for fixation of intra-articular fractures of distal end radius. Thus open reduction and internal fixation by plate and screws provides better functional results in intra-articular fractures of distal end of radius.

REFERENCES:

1. Rockwood and green's fractures in adults. 6th Edition; Page 910-964.
2. Fitoussi F and Chow S P, "Treatment of displaced Intra articular fractures of distal end radius with plates", J Bone Joint surg (A) Sep. 1997, vol. 79-A no.9: 1303-1311pp.
3. Jupiter JB. Current concepts review fracture of distal end radius. J Bone Joint Surg (Am) 1991; 292: 48-61.
4. Nana AD, Joshi A, Lichtman DM. Plating of the distal radius. J Am Acad Orthop Surg. 2005; 13(3): 159-171.
5. Ruch David S. Fractures of the distal radius and ulna, Chapter 26 in Rockwood and Green's Fractures in Adults, Philadelphia: Lippincott Williams & Wikins; 2006. 6th Ed: 909-964pp.
6. Melone CP; Melone C Open treatment for displaced articular fractures of the distal radius. Clin.orthop 1986; 202: 103-111.
7. "Clinico- Radiological and functional outcome after surgical fixation of intraarticular fractures of distal end of radius by external fixator verses locked volar plate: A prospective randomised study." DrUjjawal Pradhan1, DrAtul Agrawal2, DrPurushottam Prasad3, DrVijendra Chauhan4, Dr Rajesh Maheshwari5, Dr Anil Juyal6. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 6, Issue 3 (May.- Jun. 2013), PP 20-26.
8. "Open Reduction and Internal Fixation of Displaced, Comminuted Intra-Articular Fractures of the Distal End Radius" Dr. John K. Bradway, M.D.Peter, William P. Cooney et.al. The Journal of Bone and Joint Surgery- 1989.

DOI: 10.14260/jemds/2015/451

9. KnirkJL,Jupiter JB(1986).Intra-articular fractures of the distal end of the radius in young adults. Journal of Bone and Joint Surgery, 68A: 647-659.
10. T.S. Axelrod, R.Y. McMurthy. Open reduction and internal fixation of comminuted, intra articular fractures of the distal radius. J Hand Surg 1990; 15A; 1-11.
11. Orbay J, Fernandez D. Volar fixed-angle plate fixation for unstable distal radius fractures in the elderly patient. J Hand Surg. 2004; 29(1): 96- 102.

Age in year	No. of patients	Percentage. %
20-29	6	30
30-39	10	50
40-49	3	15
50-59	1	5

Table 1: Age distribution

Youngest patients in this series was 24 years and eldest was 50 years old.

Sex	No. of patients	Percentage %
Male	19	95
Female	1	5

Table 2: Sex distribution

Male patients > female patients.

Side involved	No of patients	Percentage. %
Right	7	35
Left	13	65

Table 3: Side of fracture

Distal end radius fractures were seen more commonly on left side.

Mechanism	No of patients	Percentage. %
R T A	14	70
Fall on outstretched hand	4	20
Fall from height	2	10

Table 4: Mode of injury

In our study the most common mode of injury causing distal end radius fractures was Road traffic accident (RTA) 70%, followed by fall on outstretched hand with incidence of 20%.

DOI: 10.14260/jemds/2015/451

Degrees	No. of cases	Percentage
61-80	8	40
41-60	8	40
<40	4	20

Table 5: Palmar Flexion achieved in present study

Average Palmar flexion achieved in this study was 56 degrees.

Degrees	No. of cases	Percentage
61-75	7	35
46-60	9	45
<45	4	20

Table 6: Dorsi-Flexion achieved in present study

Average Dorsi-flexion achieved in this study was 59 degrees.

Degrees	No. of cases	Percentage
71-85	9	45
56-70	10	50
<55	1	5

Table 7: Supination achieved in present study

Average supination achieved in this study was 72 degrees.

Degrees	No. of cases	Percentage
61-70	10	50
51-60	9	45
<50	1	5

Table 8: Pronation achieved in present study

Average pronation achieved in this study was 65 degrees.

Results	No. of patients	Percentage
Excellent	4	20
Good	12	60
Fair	3	15
Poor	1	5

Table 9: Results according to Gartland and Werley System.

DOI: 10.14260/jemds/2015/451

RESULTS	MELONE TYPE					TOTAL
	I	II	III	IV	V	
EXCELLENT	-	2	1	1	-	4
GOOD	1	3	4	3	1	12
FAIR	-	3	-	-	-	3
POOR	-	-	-	-	1	1

Table 10: Evaluation of results in Melone types

MODE OF INJURY	RESULTS				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
RTA	3	10	1	-	14
FALL ON OUTSTRETCHED HAND	1	1	2	-	4
FALL FROM HEIGHT		1	1	-	2

Table 11: Evaluation of results among various modes of injury:

AGE GROUP	RESULTS				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
20-29	2	4	-	-	6
30-39	1	6	3	-	10
40-49	1	1	-	1	3
50-59	-	1	-	-	1

Table 12: Evaluation of results among various age groups

These results show that Excellent and Good results were more commonly seen in patients of age group 20 to 40 years.

Radiological Parameters	Degrees
1. Radial Inclination	21 deg
2. Palmar Tilt	9.5 deg

Table 13: Average Radiological parameters achieved in this study

DOI: 10.14260/jemds/2015/451

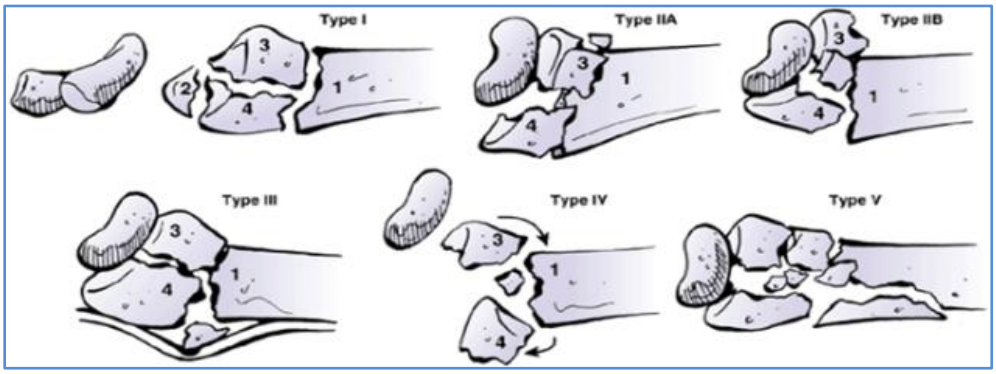

Fig. 1: Melone classification (Rockwood and Green's Fractures in Adults. 6th Edition)

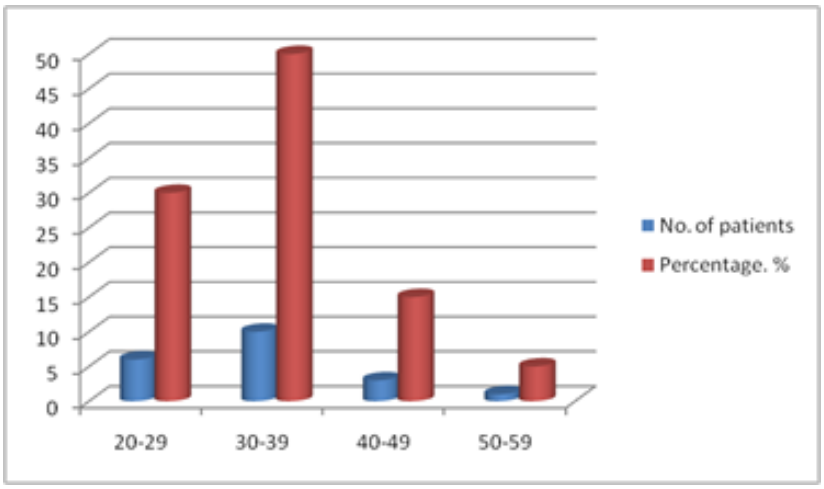

Fig. 2: Graph showing Age distribution

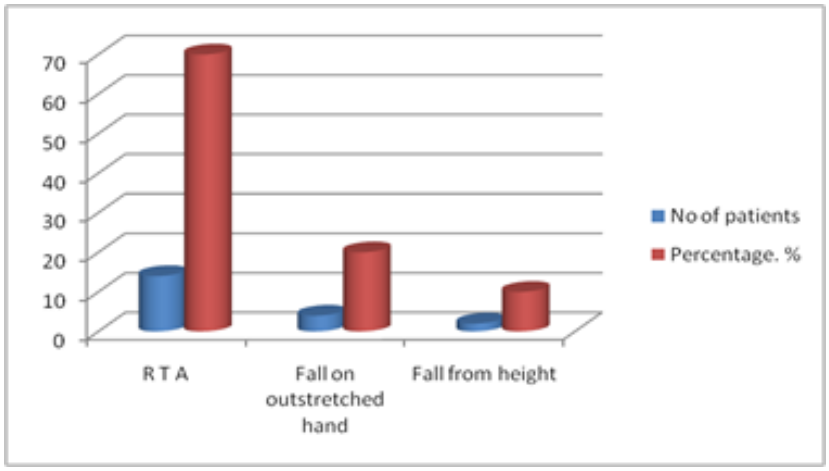

Fig. 3: Graph showing mechanism of injury. RTA- Road Traffic Accident

DOI: 10.14260/jemds/2015/451

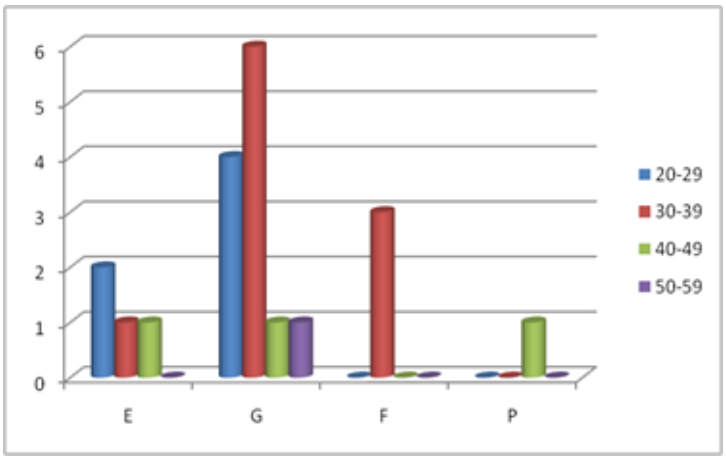

Fig. 4: Graph showing results in various age groups. E- excellent, G-good, F-fair, P-poor

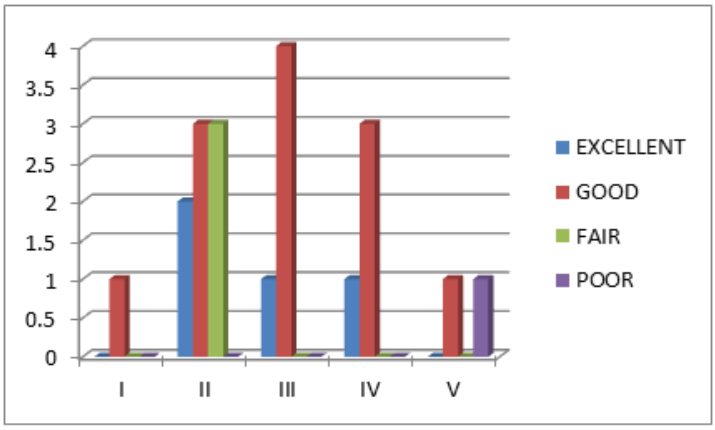

Fig. 5: Graph showing results in various Melone types

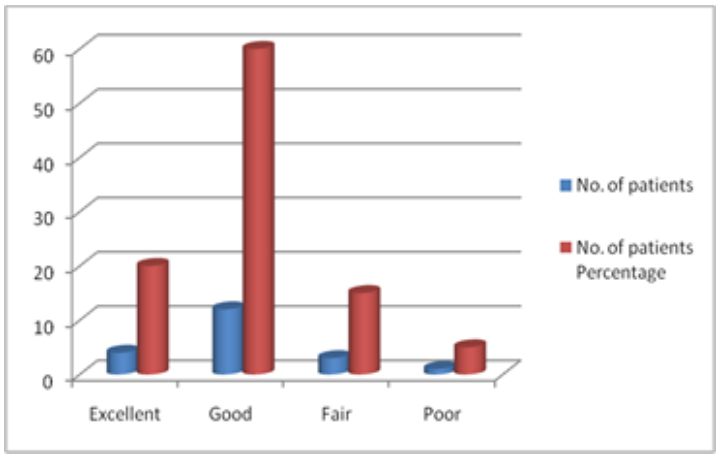

Fig. 6: Graph showing results of the study

DOI: 10.14260/jemds/2015/451

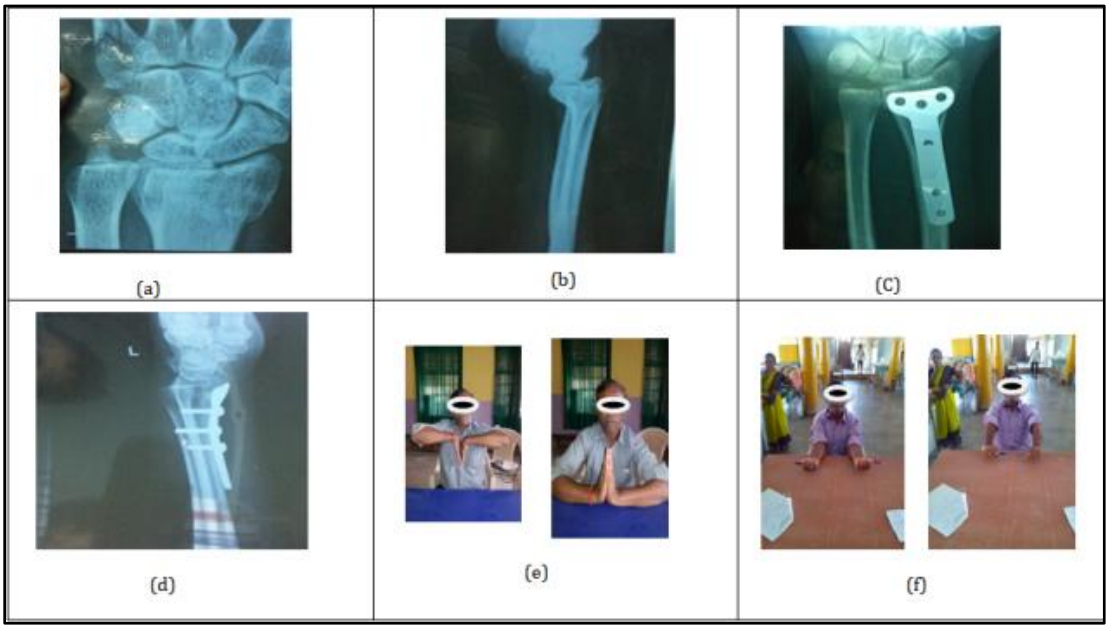

Fig. 7: of patient with excellent result: (a,b)-pre-op X-ray. (c,d)- final follow up X-ray. (e,f)- Clinical Photos

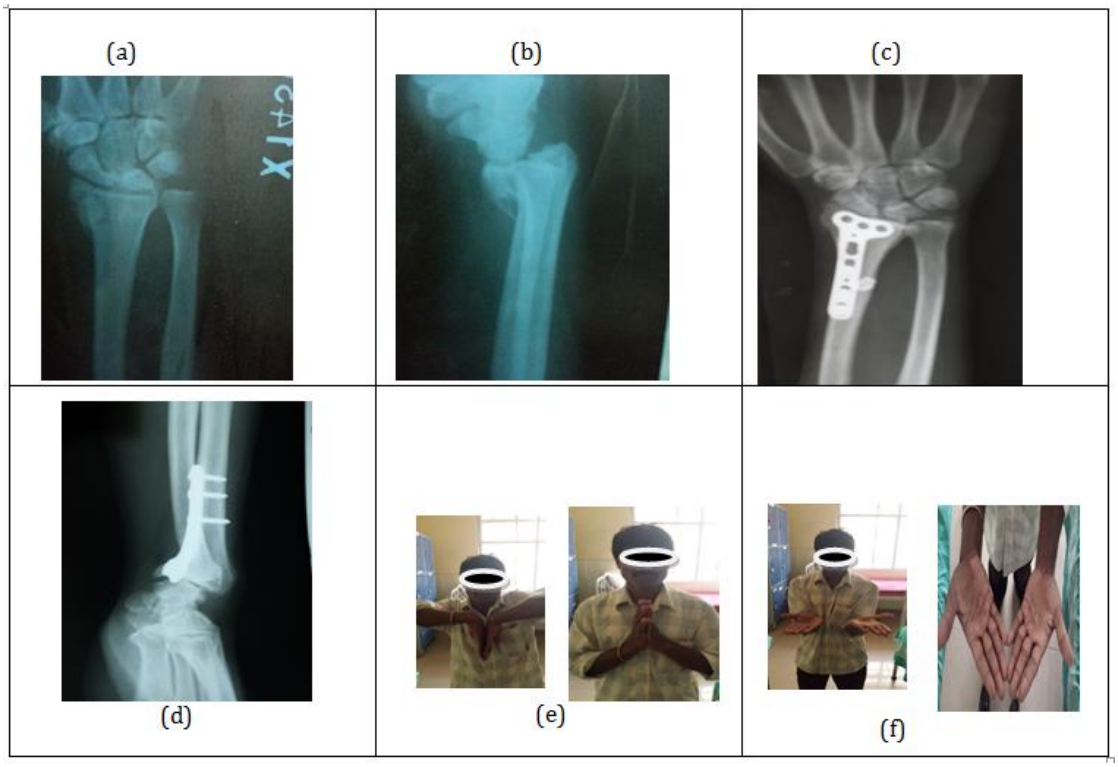

Fig. 8: of patient with excellent result: (a, b)-preop X-ray. (c, d)- final follow up Xray. (e, f)- Clinical Photos

DOI: 10.14260/jemds/2015/451

Fig. 9: patient with good result: (a,b)-pre-op X-ray. (c, d)- final follow up X-ray. (e, f)- Clinical Photos

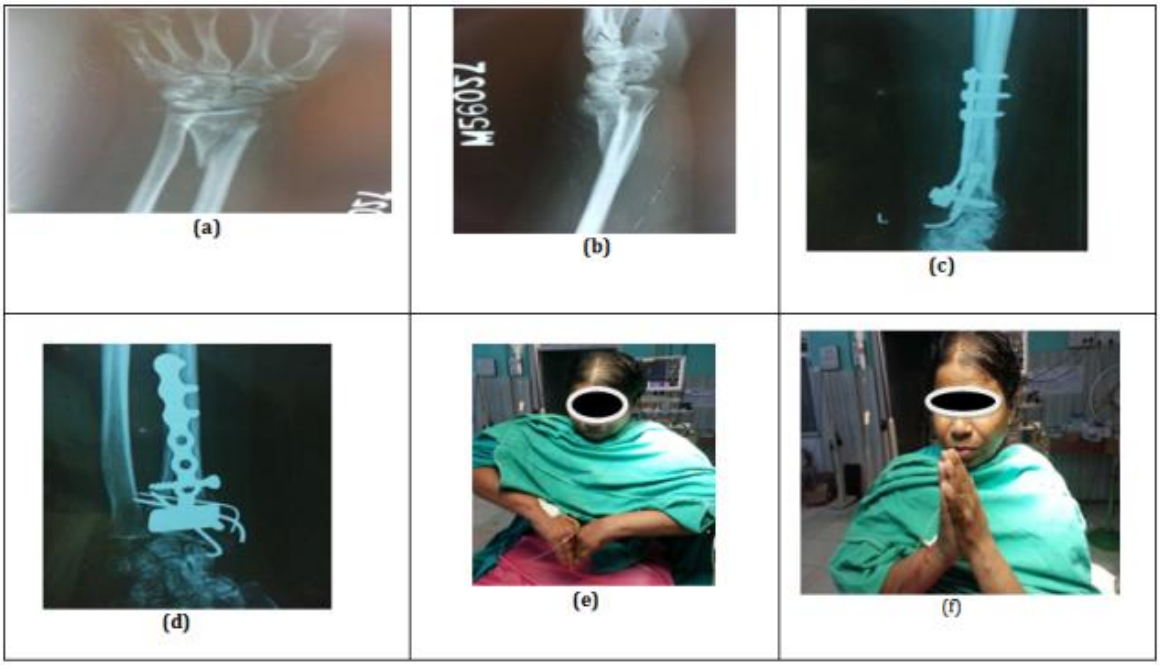

Fig. 10: Patient with poor result: (a, b)-pre-op X-ray. (c, d)- final follow up X-ray. (e, f)- Clinical Photos

DOI: 10.14260/jemds/2015/451

ORIGINAL ARTICLE

AUTHORS:

1. Girish K. R.
2. Hosangadi A. A.
3. Suresh Korlhalli
4. Suryakanth K.

PARTICULARS OF CONTRIBUTORS:

1. Post Graduate, Department of Orthopaedics, KIMS, Hubli.
2. Associate Professor, Department of Orthopaedics, KIMS, Hubli.
3. Professor & HOD, Department of Orthopaedics, KIMS, Hubli.
4. Professor, Department of Orthopaedics, KIMS, Hubli.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Girish K. R,
102, Sriranga Dhama,
Devamma Badavane,
Chennapatna, Hassan,
Karnataka, India.
E-mail: girishsandeep@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None

Date of Submission: 24/01/2015.
Date of Peer Review: 27/01/2015.
Date of Acceptance: 21/02/2015.
Date of Publishing: 28/02/2015.