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ORIGINAL ARTICLE

A COMPARATIVE STUDY BETWEEN "CLOSED REDUCTION, CAST IMMOBILISATION "AND "CLOSED REDUCTION, PERCUTANEOUS K-WIRE FIXATION, CAST IMMOBILISATION" IN DISTAL RADIUS FRACTURES

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Subramaniam M. H, Karthick Anand K, Narayana Reddy M. "A Comparative Study between "Closed Reduction and Cast Immobilisation "And" Closed Reduction, Percutaneous K-Wire Fixation, Cast Immobilisation" In Distal Radius Fractures". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 67, August 20; Page: 11714-11723, DOI: 10.14260/jemds/2015/1689

ABSTRACT: BACKGROUND DATA: Distal radius fracture is a common fracture encountered by an orthopaedic surgeon. Various treatment modalities exist for the same. K-wire fixation being one among them. The traditional closed reduction and cast immobilization also provides fair results. Hence the need to know which among the two provides cost effective treatment for the patient. **MATERIALS AND METHODS:** prospective study done between the periods July 2005 to June 2007. Dorsally displaced distal radius fractures with or without intra articular involvement were included in the study. 42 patients were involved in the study. They were randomly divided into two groups of 21 each. Closed reduction and below elbow immobilization were done in 21 patients, and closed reduction, percutaneous k-wire fixation were done in another 21 patients. 6 patients were lost to follow up in both the groups. Parameters assessed at the end of one year are- clinical: pain, any evidence for pin tract infection, evidence for nerve lesion, evidence of reflex sympathetic dystrophy, evidence of tendon rupture, mobility of wrist joint–palmar flexion, dorsiflexion, pronation, supination, grip strength assessment using jamar dynamometer. **RADIOLOGICAL:** dorsal angle of radius and radial shortening were assessed. **RESULTS:** statistical analysis was computed using mean and standard deviation, between the two groups. 't' test was used to compare the mean values. $p<0.05$ was considered statistically significant. Closed reduction, percutaneous k-wire fixation showed statistically significant value $p<0.05$ with postoperative grip strength. Intra articular fractures showed significantly higher mean pain scale score compared to extra articular freactues. Extra articular fractures showed significantly higher mean values in range of motion – palmar flexion, dorsiflexion, rotations and in grip strength. **CONCLUSION:** Closed reduction and percutnaeus k-wire fixation showed superior functional result when compared to closed reduction and below elbow pop immobilization. K-wire fixation prevents displacement of fracture fragments and improves postoperative grip strength.

KEYWORDS: K-wire fixation, Grip strength, Distal radius fractures.
MESHTERMS: Distal radius fractures, K-wire fixation, Closed reduction, Range of motion, Grip strength.

INTRODUCTION: He Who Wishes To Be Surgeon Should Go To War – Hippocrates.

Fractures were the last part of our specialty to be wrenched from General Surgeons and with good reason. Fractures were common and paid the bills. The transformation could be seen in the content of our journals. In 1940-15% of papers were about trauma, but by 1959 this had risen to 50%.[1] Goal of treatment of distal radius fracture is – Anatomic Reconstruction, Good Hand Function and Grip Strength. Displaced distal radius fractures were initially managed by closed reduction and cast immobilization.

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They are reduced initially, but frequently lose position, because cast immobilization is an inefficient means of stabilization, this results in malunion. In this study–we have compared between "closed reduction and below elbow pop immobilization" and "closed reduction, percutaneous–k wire fixation, below elbow pop immobilization".

AIMS AND OBJECTIVES: To compare the clinical and functional results of Closed reduction, below elbow pop immobilization and Closed reduction, percutaneous k-wire fixation, below elbow pop immobilization used in the management of displaced distal radius fractures.

To compare the clinical and functional results of patients who sustained extra articular and intra articular distal radius fractures.

Review of Literature: Closed reduction and cast immobilization has been advocated as the treatment of choice for most stable extra-articular fractures.[1,2] Loss of reduction is a common problem associated with cast immobilization. Although cast immobilization is successful in young patients with strong cortical and metaphyseal bone, collapse is more frequent in older, osteoportic patients. Malunion has been reported in up to 60% if patients[2]. In a study evaluating redisplacement after closed reduction and splint immobilization, Abbaszadegan and associates[3] reported that loss of reduction frequently occurred between weeks 1 and 3.

In a another study, these authors evaluated factors that predicted a poor result with re-reduction and found the amount of radial axial shortening and patient age were major prognostic factors.[3] McQueen and associates[4] noted that after re-reduction in patients older than age 60 years, the mean dorsal angle improved on average less than 1*. Other complications associated with this technique are soft tissue necrosis, compartment syndrome, and neurovascular injury. Skin necrosis can be avoided by appropriate cast padding, delay of circumferential cast placement, and proper cast application technique.[5]

K-wire fixation has been an effective means of treating distal radius fractures since its initial description in 1908.[6] It has been advocated in the treatment of unstable, extra articular, and minimally displaced intra articular distal radius fractures. The cortical bone should be primarily intact because the metaphyseal bone provides minimal stability.[7] Pin fixation has been shown to provide more stability, including both torsional rigidity and bending stiffness, than cast immobilization alone.[8]

Complications associated with k-wire fixation include cutaneous nerve and vessel injury, attritional rupture of tendons, chronic regional pain syndrome, pin migration, pin fracture, irritation and loss of reduction.[9-12] In an invitro biomechanical study evaluating the size and configuration of pins, Naidu et al[8] reported that after evaluating six different constructs, two radial styloid pins and one ulnar corner pin proided the most rigid construct. Average time for pin removal ranged from 6 to 8 weeks, however Rayhack[6] cautions that union may not be present in patients with dorsal communition due to osteoporosis even at 8 weeks.

MATERIALS AND METHODS: Between July 2005 to June 2007, 42 patients were included in the study. Their age ranged from 19 to 81 years [average 48 years]. Dorsally displaced distal radius fractures with or without intra-articular involvement were included in the study. All the patients were randomly allocated into both the groups.

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Age	Male	Female
20 to 30 years: 17	14	03
31 to 40 years: 07	05	02
41 to 50 years: 02	01	01
51 to 60 years: 04	02	02
61 to 70 years: 10	03	07
71 to 80 years: 02	01	01

Table 1: age incidence

Overall sex ratio: Male/ Female: 28/14.
Total number of patients in winter [July to December] - 22.
Total number of patients in summer [January to June] - 20.

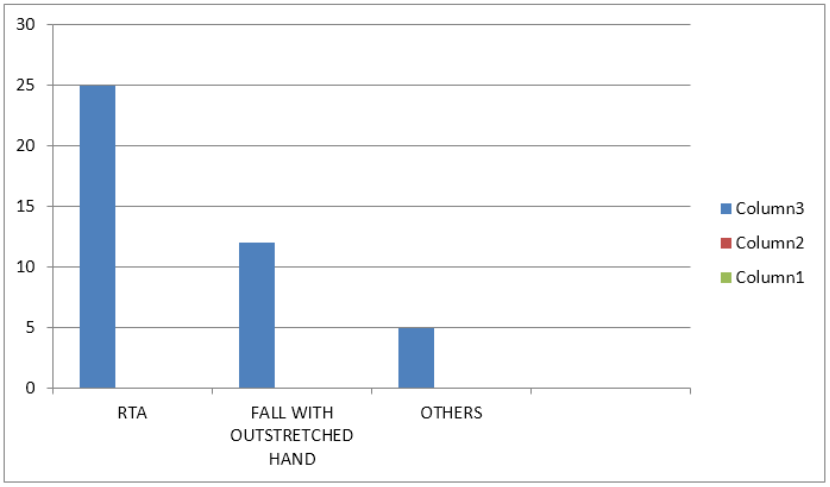

Fig. 1: MODE OF INJURY

All 42 patients had closed fractures, 5 patients were lost to follow up, 2 patients moved from the area, 5 patients refused to come to follow up after 3 months. 19 patients had intra-articular communition. 30 patients were left in the study with a follow up of one year. There were 20 women and 10 men.

TYPE	NUMBER OF PATIENTS
TYPE 1	10
TYPE 2	10
TYPE 3	06
TYPE 4	06
TYPE 5	02
TYPE 6	01
TYPE 7	03
TYPE 8	04

Table 2: Frykmann Classification

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Two patients had associated upper limb fracture on the same side. Both of these were fractures of surgical neck [undisplaced] humerus. Both surgical neck fractures were treated conservatively. 10 patients had other lower limb fractures. 9 patients were manipulated under haematoma block, 2 patients were manipulated under axillary block, and 10 patients were treated under GA. Closed reduction is done by traction–countertraction, fracture site was disimpacted, once radial length was restored, dorsal tilt was corrected.Below elbow dorsal plaster pop was applied extending just below elbow upto mcp joint in 20* palmar flexion and 20* ulnar deviation.

K-wiring involved the insertion of radial styloid [between 1st and 2nd extensor compartment] and between 4th and 5th extensor compartment passing through two cortices of radius. 0.0625 inch kirschner wires were used. 12 patients had an additional kirschner wire inserted on the radial side of the radius. The wrist was immobilized in below elbow plaster for 6 weeks.

Clinical review was on 3rd postop day, 1st week, 2nd week, 4th week, 3rd month, 6th month and at one year.

At each visit the following Parameters were assessed:

1. Pain: using a scale of 1 to 10. Where 1 represents mild discomfort, and 10 represents agonizing pain.
2. Whether there was any evidence of pin tract infection.
3. Evidence of nerve lesion.
4. Evidence of reflex sympathetic dystrophy.
5. Evidence of tendon rupture.
6. Mobility of wrist–palmarflexion, dorsiflexion, pronation, supination which were compared to opposite wrist.
7. Grip strength was measured using jamar dynamometer and compared to uninvolved side. Additionally, the grip strength ratio was corrected using a factor 1.07 as the effect of dominance [jamar dynamometer – therapeutic equipment corporation, Clinton, New jersey].
8. Radiographic measurements–dorsal angle of the radius, radial shortening. These measurements were made from AP and LATERAL films obtained at presentation, at 6months, at one year following surgery or cast immobilization.

OBSERVATION/RESULT:

Name	Frykmann class	Pain scale score	Palmar Flexion	Dorsi Flexion	Pronation/ Supination	Grip strength	Dorsal angle in degrees	Radial short Ening in mm
Selvi	EA	2	58	65	70	70	3	2
Ramayammal	EA	3	60	62	65	65	3	2
Murugan	EA	1	60	62	65	65	2	2
Kumar	EA	1.5	65	58	70	75	3	2
Govindan kutty	EA	2	65	65	65	73	2	1
Sujatha	EA	1.5	70	70	70	72	5	1
Girija	EA	1.5	65	65	60	75	2	2
Veni	IA	4	50	55	55	68	2	3

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Periyannan	IA	5	52	60	55	70	3	2
Ravindran	IA	4	50	50	50	68	4	2
Venkatesh	EA	1	65	70	65	70	2	2
Obuli khanna	EA	1	62	67	70	75	3	1
Deen sundaram	EA	1.5	65	65	55	73	3	2
Renuka	IA	4	55	50	55	70	1	1
Gnanasekhar	IA	5	58	55	55	67	5	2

Table 3: Closed Reduction – Cast Immobilisation

Name	Frykmann class	Pain scale score	Palmar Flexion	Dorsi Flexion	Pronation/ Supination	Grip strenth	Dorsal angle in deg.	Radial short ening in mm
		1	60	68	70	85	1	1
Kundhan	IA	3.5	60	60	60	80	2	1
Karruppusamy	EA	0.5	70	62	60	90	1	2
K.p.raja	EA	1.5	65	65	65	85	0	1
Rama devi	EA	1	70	75	60	85	2	1
Muruganand	EA	1.5	60	70	60	90	2	2
Nirmala	IA	3.5	55	55	60	75	3	2
Jayakumar	EA	1.5	65	70	62	95	0	1
Saravanan	EA	2.0	65	62	68	85	1	1
Gomathy	IA	3.5	60	55	55	80	0	2
Senthil kumar	EA	1.5	60	64	60	85	0	1
Ravi anand	IA	5	50	55	60	70	0	2
Lakshmi devi	IA	3	60	60	60	75	1	2
Prasad	EA	1	60	62	65	85	1	1
Narayanan	EA	1.5	65	65	62	85	1	1

Table 4: Closed reduction, k-wire fixation and cast immobilisation

At the end of one year	Closed reduction and cast immobilisation	Closed reduction, k-wire fixtion, cast immobilisation
Mean grip strength	71.06%	83.33%
Mean pain scale score	2.53	2.1
Mean dorsiflexion[in degrees]	61	63
Mean palmar flexion[in degrees]	60	61
Mean rotations[in degrees]	62	61
Mean dorsal tilt[degrees]	2.86	1.0
Mean radial shortening[in mm]	1.82	1.33

Table 5

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All patients had returned to performing their activities of daily living. 80% had resumed their hobbies and sports by one year after the procedures in the both the categories. Out of 21 patients, who were managed by closed reduction, cast immobilization, 3 patients [14.5%] fractures got displaced on their clinical review on the first week post reduction, which were subsequently managed by re- reduction and cast immobilization. Low grade pin tract infections, mild parasethesia and pain in the distribution of superficial radial nerve were noticed in patients managed with closed reduction, k-wire fixation, cast immobilization in two patients. Low grade pin tract infections, were managed with 7 day course of oral Amoxycillin and Clavulinic acid, with resolution of infection. The pins were removed at the planned date for 6 weeks. Mild parasethesia along distribution of superficial radial nerve resolved spontaneously at the end of 3 months after k-wire removal.

STATISTICAL ANALYSIS: Statistical analysis was computed using mean and standard deviation, between patients treated in both groups. 't' test was used to compare the mean values. $p < 0.05$ was considered as statistically significant.

		Number	Mean	Std. Deviation	't' value	'p' value
Pain scale score	Closed reduction and cast immobilisation.	15	2.53	1.48		
	Closed reduction, percutaneous k-wire fixation	15	2.10	1.28	0.856	0.399
Palmar flexion	Closed reduction, cast immobilisation	15	60.0	6.12		
	Closed reduction, percutaneous k-wire fixation	15	61.33	5.16	-0.64	0.525
Dorsi flexion	Closed reduction, cast immobilisation	15	61.26	6.47		
	Closed reduction, percutaneous k-wire fixation	15	63.20	5.90	-0.854	0.400
Rotations	Closed reduction, cast immobilistion	15	62.33	6.77		
	Closed reduction, percutaneous k-wire fixation	15	61.66	3.79	0.332	0.742
Grip strength	Closed reduction, cast immobilisation	15	71.06	4.19		
	Closed reduction, percutaneous k-wire fixation	15	83.33	6.45	-6.169	0.000

Table 6

Closed reduction, percutaneous k-wire fixation, cast immobilization show statistically significant value $p<0.05$ with postoperative grip strength.Intra articular fractures showed significantly higher mean pain scale score compared to extra articular fractures. Extra articular fractures show significantly higher mean values in range of motion – palmar flexion, dorsiflexion, rotations and in grip strength.

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ILLUSTRATIVE CASES: Closed Reduction and Cast Immobilisation

Fig. 2: Pre Op X-ray

Fig. 3: Post op Clinical Photo

Fig. 4: At One Year Follow-up

FIG. 4: Closed Reduction, Percutaneous K-Wire Fixation and Cast Immobilization.

Fig. 5: Pre Op X-ray – AP View

Fig. 6: Pre op X-ray – LAT View

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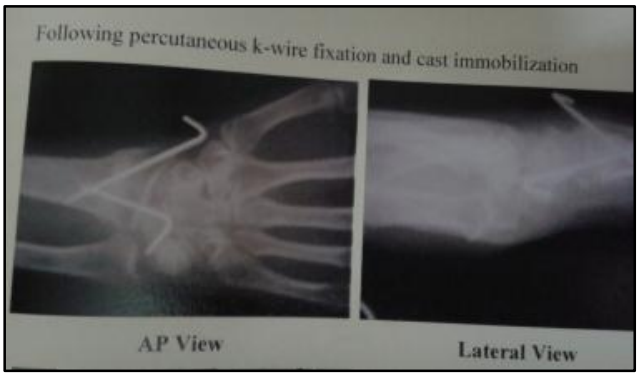

Fig. 7: Post op X-ray

Fig. 8: At One Year Follow up

DISCUSSION: There is no Indian study in the literature which has compared the two procedures in distal radius fractures. Quite a few international authors have compared the two procedures in distal radius fractures. Clancey e.al[13] in his study states that 2 of his study patients had a minor loss of reduction following k-wire fixation. He showed that additional k-wire fixation improved both functional and anatomical results after distal radius fractures. T. Azzopardi et al.[14] concludes that percutaneous pinning of unstable, extra articular fracture of distal radius, provides only marginal improvement in radiological parameters compared with immobilization in cast alone. Rodruguez et.al[15] states that best anatomic and functional results obtained by pinning and justifies slight increase in treatment cost to positive end result. T. barton et. Al[16] in his study of k-wire fixation states that radial height should be reduced to zero during reduction itself. If not done may compromise the functional outcome. Abbaszadegan H. et.al[3] in his study of late displacement of distal radius fractures has shown that 17% of fractures managed by closed reduction, cast immobilization got displaced. The displacement occurred mostly during 1 to 3 weeks. In the present study 14.5% of fractures treated by closed reduction and cast immobilization got displaced. I. A. Karnezis et.al [17] have showed that fractures with intra articular communition is associated with restricted wrist palmar flexion, dorsiflexion, and increased patient rated wrist evaluation score. In our series also, the same result was seen.

CONCLUSION: In my comparative study in management of distal radius fractures between closed reduction and cast immobilization,[1], and closed reduction, k-wire fixtion and cast immobilization,[2] closed reduction, k-wire fixation and cast immobilistion[2] showed a superior functional result than closed reduction and cast immobilization.[1]

Percutaneous k-wire fixation[2] prevents displacement of fracture fragments and improves postoperative grip strength, when compared to closed reduction, cast immobilization.

Intra articular fractures are associated with decreased range of motion at wrist joint and increased postoperative pain scale score when compared to extra articular fractures.

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REFERENCES:

1. Bacorn RW et.al, colles' fracture: A study of two thousand cases from the New York state workmen's compensation board. JBJS [AM] 1953; 35: 643 – 658.
2. Gartland JJ JRet.al: evaluation of healed colles' fractures. JBJS [AM] 1951: 33: 895-207.
3. Abbaszadegan H: late displacement of colles' fractures. Int orthop 1988:12:197-199.
4. McQueen MM et.al: The value of remanipulating colles" fractures. JBJS [BR] 1986: 68:232-233.
5. Kozin SH et.al: Early soft tissue complication after fractures of the distal part of the radius JBJS [AM] 1993:75:144-153.
6. Rayhack JM: The history and evolution of percutaneous pinning of displaced distal radius fractures. Orthop Clin North AM 1993:24: 287-300.
7. Simic PM et.al: Fractures of the distal aspect of the radius: Changes in the treatment over the past two decades. Instr Course Lect 2003: 52185 – 195.
8. Naidu SH et.al: percutaneous pinning of distal radius fractures: A biomechanical study. J Hand Surg [am] 1997; 22: 252-257.
9. Collicut J et.al: A biomechanical analysis of percutaneous pinning for unstable extra –articular fractures of the distal radius. JBJS [BR] 1992: 76[SUPPL]: 23.
10. Dowdy PA et.al: Intrafocal pinning of unstable fractures of the distal radius. Orthop Clin North Am 1993: 24: 301-307.
11. Greatting MD et.al: Intrafocal pinning of unstable fractures of the distal radius. Orthop Clin North Am 1993; 24: 301 – 307.
12. Munson GO et.al: Percutaneous pinning of distal radius fractures. Jtrauma 1981: 21: 1032-1035.
13. Clancey G. Percutaneous k-wire fixation of Colles'fractures. JBJS [AM] 1984; 66-A [7]: 1008 – 14.
14. T. Azzopardi et. al–unstable extra-articular fracture of the distal radius. A prospective randomized study – immobilization in a cast versus supplementary pinning. JBJS [AM] 1992; 77: 1140-80.
15. Rodriguez–Merchan et.al: plaster cast versus percutaneous pin fixation for communited fracture of the distal radius in patients between 46 and 65 years of age. J of Orthop trauma 11[3]: 212-217: April 1997.
16. T. Barton et.al: Do kirschner wires maintain reduction of displaced Colles'fractures? Injury [2005] 36, 1431-34.
17. A. Karnezis et.al: Correlation between radiological parameters and patient rated wrist dysfunction following fractures of distal radius. Injury 2005:36, 1435 -39.

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