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DISTAL END RADIUS FRACTURE TREATED BY EXTRA FOCAL PERCUTANEOUS PINNING AND CLOSED REDUCTION AND PLASTER APPLICATION

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ABSTRACT: BACKGROUND: Distal radius fracture is one of the most common fractures. Acute distal radius fracture results in pain, tenderness, swelling and potential deformity. Patients may be faced with substantial morbidity if fracture healing is delayed. The recovery period for distal radius fracture can be substantial and the impact of the method of fixation on activities and daily living can be significant. The majority of osteoporotic fractures in old age occur as the result of a fall, while the majority of injuries in the younger patients are secondary to motor vehicle accidents and sports. The Purpose of this study was to assess the functional outcome of stable distal end radius fractures treated by extra focal percutaneous pinning versus closed reduction and plaster application. **METHOD:** A comparative randomized study of functional outcome of Distal End Radius fracture treated by extra focal percutaneous pinning and closed reduction and plaster application of 12 months duration and comprised of 50 subjects 25 from each group, who were evaluated on second week, sixth week & after six months. The functional outcome of both groups was assessed at end of 6 months from the initiation of the treatment as per patient rated wrist evaluation criteria. Stable types of distal end radius fractures were taken into consideration for this study. **RESULTS:** Patients who were treated by extra focal percutaneous pinning had no better functional outcome than the patients who were treated by closed reduction and plaster application the average scores for both the groups that is closed reduction and cast was 127.28 at the end of two weeks, 74.68 at the end of six weeks and 26.68 at the end of six months. As for the group treated by closed reduction and percutaneous pinning and slab application was 103.52 at the end of second week, 69.80 at the end of six weeks and 23.64 at the end of six months. **CONCLUSION:** Both methods are equally effective method in treatment of Stable distal end radius fractures as functional outcome is nearly same.

KEYWORDS: Distal end Radius fracture, Closed reduction.

INTRODUCTION: Distal end radius fractures are the commonest occurring fractures occurring in upper extremity they represent one-sixth of all fractures treated in emergency department.¹ Although it was described more than 199 years ago controversies still exist regarding the best mode of treatment, immobilization & prediction of results.

Closed reduction and cast immobilization has been the mainstay of treatment of these fractures, but invariably it results in malunion, poor functional and cosmetic outcome.² The treatment options for the displaced distal radius fracture are closed reduction with plaster cast immobilization,³ pins and Plaster.⁴ and by closed reduction.⁵

In younger patients (those under 40 years of age), considerable forces are necessary to cause this fracture, which is defined as being localized within 3 cm of the distal end of the radius as described by Bacorn and Kurtzke.^{6,7}

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There is a sharp increase in incidence above the age of 30 years, which apparently is associated with postmenopausal and age-related osteopenia. In the USA and northern Europe, this fracture is the most common one in women under 75 years old.^{8,9} Studies looking at radial bone density failed to demonstrate significant reductions in bone density when radius fracture patients were compared with age-matched control subjects.⁸

Sparado et al¹⁰ showed that both the cortical and the trabecular bone contribute to the overall strength of the osteopenic distal radius. In effect, both the cortical comminution and the metaphyseal cancellous bone defect may contribute to the inherent instability of a distal radius fracture.

The residual deformity of the wrist as a result of malunion is unsightly. It adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic hand musculature.^{11, 12, 13}

In many cases there is weakness of handgrip and return to pre injury activity level becomes impossible.

Closed reduction and cast immobilization^{15,16} often leads to collapse of the radius. Percutaneous K-wire fixation provides additional stability and is one of the earliest forms of internal fixation.^{17,18, 19}

Depalma described ulno-radial pinning drilled at 45° angle, 4 cm proximal to ulnar styloid. Kapandji²⁰ described double intrafocal pinning into the fracture surface and Rayhack²¹ described ulno-radial pinning with fixation of distal radioulnar joint.

Bridging external fixators^{22, 23} and ligamentotaxis indirectly reduce the fracture. Ruch et al²⁴ and many others described open reduction and internal fixation of distal radius fracture. Doi et al. recommended it for comminuted intra-articular fractures.²⁵

Most of the work done with percutaneous pinning emphasizes that there is significant residual stiffness of the hand and wrist.^{26, 27} The acute palmar flexed position of the wrist during the postoperative immobilization period was blamed as the main reason for stiffness.²⁸

Some surgeons advocate treatment by manipulation and plaster immobilization.²⁹ Many recommend operative intervention as the only methods to obtain anatomical reduction, and some have proposed that the best functional result will only be achieved by obtaining as near an anatomical radiographic result as possible.³⁰

Although a study by Young and Rayan³¹ found favorable outcomes in low-demand older-aged patients despite deformity, most authors agreed that radial shortening more than 4 mm and radial dorsal angulation of more than 11° would reduce range of motion of the wrist. Furthermore, wrist pain was the most complaint among those patients.^{30, 32, 33}

MATERIALS AND METHODS: The present study comprised of 50 subjects 25 from each group.

One group consisted of patients who were treated by closed reduction and percutaneous pinning and dorsoradial slab application and other group consisted of patients treated by closed reduction and cast immobilization. These patients were evaluated on second week, sixth week & after six months for functional outcome.

METHOD OF REDUCTION: All procedures were done in the operating room using either regional or general anesthesia. Local anesthesia was not used. The upper extremity was prepared and draped.

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As a principle, the first step in reduction is to disimpact the distal fragment by increasing the dorsal angulation, this was achieved by using a so called handshake grip to distract the fracture while counter traction was applied proximal to elbow by the assistant.

Then, with traction applied, the distal fragment is pushed distally, and flexed, in order to reduce the palmar cortex and to restore palmar inclination. Any traction is then released.

The grip is changed to allow free application of the plaster. One hand holds the thumb fully extended. The other holds three fingers (avoiding cupping of the hand) maintaining slight traction.

The limb should be in full pronation, full ulnar deviation at the wrist and slight palmar flexion

The application of 3-point moulding of the cast, as shown, will serve to resist late redisplacement. The wrist should be placed in 20-30° of flexion, 15° ulnar deviation and 20° pronation. A below elbow cast is applied as above elbow cast has no advantage.

If a surgical procedure has been chosen, percutaneous fixation is preferred for fractures which can be reduced by closed manipulation.

In this study cross pinning was used to stabilize the distal end radius fracture, the first Kirschner wire is loaded on the drill and radial styloid is palpated clinically and under fluoroscopic guidance the wire is inserted through the radial styloid just dorsal to the first extensor compartment, aiming to cross the fracture line in both the planes.

This requires about 45 degrees angle with the long axis of the radius on the postero anterior view and aiming the wire 10 degrees dorsally on the lateral view and is extended till it crosses the medial cortex of the radius shaft.

The second Kirschner wire was inserted into the dorsal ulnar column of the distal radius between the fourth and fifth extensor compartment. This required about a 45 degrees angle with the fracture line on the postero anterior view and 30 degree volarward on the lateral view into the anterior cortex of the radial shaft.

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The accuracy of reduction and of the placement of the Kirschner wires was assessed and the wires were then bend and cut.

A sterile dressing using the povidone iodine solution was kept at pin site, well-padded volar splint was applied while keeping wrist in neutral position. The splint extended from metacarpophalangeal joint to proximal part of the forearm.

Postoperatively limb elevation for about 12 hours was advised with monitoring of the distal neuro vascular status.

Early mobilization of the digits, elbow and shoulder was encouraged. Patient was discharged and followed up at the end of second week, sixth week and six months.

At the end of second week the surgical site was inspected and cleaning and dressing was done.

At the end of six weeks the splint and Kirschner wires were removed after doing radiological evaluation and active range of motion exercises for wrist were started, exercises consisted of wrist movements, supination, pronation, finger grip were started.

OUTCOMES CONSIDERED: Only patient oriented outcomes were included, and surrogate /intermediate outcomes were not considered. Surrogate outcome measures are laboratory measurements or another physical sign used as substitutes for a clinically meaningful end point that measures directly how a patient feels, functions, or survives.

Radiographic results are an example of a surrogate outcome.

Outcomes were being measured using:

- Patient - Rated Wrist Evaluation³⁴

OBSERVATION & RESULTS:

Age group	No. of Subject	
	CR + Cast	CR + K wire + slab
20-29	5	6
30-39	8	6
40-49	8	7
50-59	2	2
60-69	2	4

Table 1: Distribution of subject according of age

Graphical representation of the age groups involved in the study.

This graph clearly shows that 29 out of 50 patients i.e. 58% of the patients belonged to age group between 30 and 50 years of age.

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	Group	N	Mean	Std. Deviation	Std. Error Mean
PRWE score on first follow-up after 2 wks.	CR + Cast	25	127.28	6.761	1.352
	CR + K wire + slab	25	103.52	5.157	1.031

Table 2: PRWE Score on first follow up

$t=13.97$ $p<0.0001$.

There is a significant difference in the score after end of two weeks and it is statistically significant.

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	Group	N	Mean	Std. Deviation	Std. Error Mean
PRWE score on second follow-up after 6 wks.	CR + Cast	25	74.68	11.029	2.206
	CR + K wire + slab	25	69.80	8.139	1.628

Table 3: Significance of PRWE Score on second follow-up after 6 week

$t=1.78$ $p=0.081$

At the end of six weeks there is still a difference in the score but it is not statistically significant.

	Group	N	Mean	Std. Deviation	Std. Error Mean
PRWE Score on third follow-up after 6 months	CR + Cast	25	26.68	6.355	1.271
	CR + K wire + slab	25	23.64	8.892	1.778

Table 4: Significance of PRWE Score on third follow-up after 6 months

$t=1.39$ $p=0.17$

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Variable	CR + Cast	CR + K wire + slab	p value
Complication	5	5	1
Infection	0	3	0.117
Excessive swelling	5	2	0.209
Revision of surgery	2	0	0.245

Table 7: Significance of Complication

Fisher exact test

DISCUSSION: Percutaneous pinning techniques are an attempt to bridge the therapeutic gap between various modality of treatment available for distal end radius fracture. Although there is no doubt that other mode of treatment of distal end radius fracture such as external fixator, plates have a role in treatment of unstable distal end radius fracture but stable distal end radius fractures can be treated adequately with far less complicated and intrusive methods.

Accurate reduction of the fracture is the first step in the treatment of distal radial fractures. The most common traditional method is closed reduction and cast immobilization, but this often fails to prevent early radial collapse and is associated with a high risk of malunion, joint stiffness and painful wrist. Hence, this method is for low-demand elderly patients.^{35 36}

Percutaneous pinning with K-wires was first recommended by Green³⁷ as a simple and inexpensive procedure. Various techniques of percutaneous pinning are available. Most studies attribute poor results of this technique to radial shortening, wrist stiffness and reflex sympathetic dystrophy.^{26, 27}

In the present series the number of males was equal to the number of females may be indicative of the fact that distal end radius fractures are more commonly due to high energy trauma such as in motor vehicular accidents so there is no male or female predominance.

There was a right sided dominance of the fractures as compared to the left side in our series.

The mean age of patients in our series was 39.8 years as compared to 41.4 years in study conducted by Das et al,³⁸ the decreasing age group may be suggestive of the fact that there is an increase in number of patients who had this fracture due to high energy trauma such as motor vehicular accidents.

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Various types of casts and positions have been recommended^{39,40} the maximally flexed and ulnar deviated position of the wrist impairs the function of the hand and increases pressure in the carpal tunnel. Neuropathies, ischemic complications and stiffness are most often related to the type and position of the cast. There were negligible complications in this study.

All the patients were followed for duration of 6 months and were reviewed on second week afterwards on sixth week and six months.

At each visit patient was evaluated clinically and PRWE questionnaire was given to evaluate about the functional outcome. Patients in our study were not evaluated radiologically as only functional outcome was compared.

Out of 50 patients of this study which were evaluated on the basis of functional outcome the average scores for both the groups that is closed reduction and cast was 127.28 at the end of two weeks, 74.68 at the end of six weeks and 26.68 at the end of six months. As for the group treated by closed reduction and percutaneous pinning and slab application was 103.52 at the end of second week, 69.80 at the end of six weeks and 23.64 at the end of six months.

P value at the end of six months was 0.17 which is statistically not significant, hence proving that in stable distal end radius fracture closed reduction with cast application has a functional outcome similar to closed reduction percutaneous pinning and slab application, which is comparable with the results published by Warwick et al⁴¹ in 1993, Stoffelen and Broos⁴² in 1998, Simic and Weiland,⁴³ Beumer and McQueen,⁴⁴ Handoll and Madhok⁴⁵ in 2003. Similar results were shown by Anzarut et al⁴⁶ in 2004, Wong et al⁴⁷ in 2010, Mirhamidi and Bayat⁴⁸ in 2013 & by Kvernmo and Krukhaug⁴⁹ in 2013.

Gartland and Werley³⁶ obtained a 68.3% satisfactory result, and Sarmiento et al. reported an 82% satisfactory result treated with the casting technique. In our study we found that closed reduction and cast application had good results in the six months in which they were evaluated.

Closed reduction and percutaneous pinning relies on manual traction, reduction, and pinning, to hold the fracture in an appropriate anatomic alignment. In our study the functional outcome of the patients treated with pinning showed better results as compared to the closed reduction and plaster application but this difference was not statistically significant.

As for the complications, there were 10 cases in which complication occurred there were 5 cases in each group which had complication, in the group of patients who were treated by closed reduction and cast application there were 5 cases which developed excessive swelling for which in 2 cases recasting was done.

In the other group who were treated by closed reduction and percutaneous pinning 3 patients developed pin tract infection and 2 developed excessive swelling. In none of the patients revision surgery was required and infection subsided with regular dressings.

There was no incidence of breakage of Kirschner wire, carpal tunnel syndrome, tendon rupture. In none of the patients there was loss of reduction and none of them developed sudeck's osteodystrophy.

The elbow, fingers, and the thumb should be left free to avoid stiffness.

As concluded by Handoll HH, Vaghela MV, Madhok R⁵⁰ in their Cochrane review of 2007 for stable distal; end radius fractures no one modality can be accepted as guidelines for treatment as both the modality of treatment shows good result.

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From the patient's point of view, the final result is largely determined by the presence or absence of pain while performing daily living activities. In patients, the pain level was significantly less in the group treated non operatively in the study published by Arora et al⁵¹ in 2011, in our study both the groups had good results at the end of six months

Many papers have been published on the treatment of distal radius fractures, but the quality of the studies is variable. A general problem is that they often include very heterogeneous groups. The patients may range from 18 to 100 years of age without differentiation between younger and older patient groups.

There are also many different classification systems for distal radius fractures, and the fractures are grouped somewhat differently. Different measuring methods are used for outcomes in some of the comparisons. Grading systems commonly used for functional testing frequently include anatomical and clinical outcomes, and modified versions of existing grading systems are often used.

The Shortcoming of this study are as it is a short term study, long term randomized control studies with a large pool of patients is recommended for more statistically significant result.

Heterogeneity reduces the strength of the outcomes and conclusions are difficult to draw. This is the reason why none of the included studies was able to provide an unambiguous answer to the question of which patient groups benefit from surgical rather than conservative treatment

Results in this study suggest that in either of the group of patients of stable distal end radius fracture there was very little change in the functional outcome in patient in terms of modality of treatment as the patient treated with percutaneous pinning showed slightly better results as compared to the patients who were treated conservatively, but they were statistically not significant.

Rather than yet more small, single-centre studies that do not satisfy the requirements for high quality evidence, good prospective randomized, controlled, multi-centre trials are needed. There is also a need to establish registers and analyze register data to capture changes in the incidence of complications when new methods are introduced.

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