

Prospective study on outcome of distal radius treated with closed reduction and percutaneous pinning

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Abstract

Background: Vast majority of fractures of distal radius are articular injuries that result in disruption of both radiocarpal and radioulnar joints. Therefore, this study evaluates the functional and radiological outcomes of distal radius fractures treated by percutaneous pinning in ulno-carpal joint and distal radius.

Methodology: A Prospective Interventional Study conducted at Department of Orthopaedics, N.S.C.B. Medical College and Hospital, Jabalpur (M.P.) with the study population of patients attending OPD and casualty diagnosed with distal Radius fracture from the duration of 1st March 2021 to 31st June 2022. Total of 50 Sample size was taken estimated through the formula $n = z^2 * pq / d^2$. Data analysis was done through the IBM software SPSS and the statistical association was found with the Confidence Interval of 95% and p -value > 0.5 .

Results: Total of 50 patients, 30 were male, and 20 were females, who were assessed through follow-up. According to Sarmiento score of range of motion, 6 Patients have excellent score (0-2), 12 patients have good score (3-8), 12 patients have fair (9-20), and 5 patients have poor (above 21).

Conclusion: Closed reduction and percutaneous K-wire fixation is a less intrusive, safer, and successful approach to preserve the reduction, avoid radial collapse during healing, and maintain DRUJ stability even when the fracture is extensively comminuted, intra-articular, or unstable.

Keywords: Prospective Interventional Study, Percutaneous Pinning technique, Distal Radius fracture, Sarmiento score.

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Introduction

The development of knowledge about a variety of orthopaedic trauma diseases can be seen in the history of distal radius fractures. Prior to Petit, Pouteau, and Colles, it was thought that a dislocation of the distal radio-ulnar joint (DRUJ) or a carpal injury was the underlying nature of distal radial injury. After writing his thoughts in "On the Fractures of the Carpal Extremity of the Radius" in 1814, Abraham Colles became the first author to describe distal radius fractures in English literature. [1] Although 20% of all fractures treated in

emergency rooms are distal radial fractures, many are not "totally exempt from discomfort" following treatment. More than 1000 peer-reviewed papers have been published on the topic over the previous few decades, yet there is no agreement on the best treatment. The extent to which the anatomy is restored, the quality of the bone, the development of new techniques and devices, the experience and skill of the surgeon, and the results in older populations are just a few of the many confounding factors that exist. [2] The early technique of cast immobilisation and closed reduction has led to malunion, rigid joints, and

deformity. By interfering with the extrinsic hand musculature's mechanical advantage, it has a negative impact on how the wrist and hand work. [3-5] Radius collapse and DRUJ subluxation are frequently caused by closed reduction and POP immobility. [6]

One of the first methods of fixation, percutaneous pinning adds more stability. Depalma described a 45° angle in ulno-radial pinning. [7] Stein recommends adding a second, 2-mm dorsal K-wire with radio-ulnar pinning. [8] Raycheck advised ulno-radial pinning in addition to the fixation of the DRUJ, while Kapandji described double intrafocal pinning into the fracture surface using 2-mm K-wires. [10]

Ligamentotaxis and joint-spanning external fixation immediately neutralize the axial load over the radius and minimize the impacted articular fragments indirectly. [11] For unstable intra-articular fractures, Ruch and Ginn, Schumr, and numerous others described open reduction and internal fixation of the distal radius. [12] Doi et al provided an explanation of arthroscopically guided fracture reduction. [13] Therefore, this study evaluates the functional and radiological outcomes of distal radius fractures treated by percutaneous pinning in ulno-carpal joint and distal radius.

Methodology

The present study was conducted at the department of orthopaedics, N.S.C.B. Medical College and hospital, Jabalpur (M.P.), after obtaining informed and written consent from the study subjects. Study Design was prospective interventional and study period was from 1st March 2021 to 31st June 2022. Study Population was all the patient attending OPD and casualty of Orthopaedic department with diagnosed distal radius fracture. Convenient sampling method was used and sample size was of 50 patients.

The adequate required sample size was estimated using following formula:

$$n = z^2pq / d^2, \text{ where } -$$

$$n = \text{sample size}$$

$z = 1.96$ (considering 0.05 alpha, 95% confidence limits and 80%beta) $p =$ assumed probability of occurrence or concordance of results

$q = 1 - p$; and $d =$ marginal error (precession)

Inclusion Criteria was patients with fracture of the distal radius (comminuted extra-articular and intraarticular), patients age is of over 55years and fracture should be operated within 14 days of trauma. Exclusion Criteria was fractures which require open reduction, pathological fractures are ruled out and if there is evidence that the patient will be unable to adhere to trial procedures or complete questionnaires, such as in cognitive impairment.

Base line data collection done by radiological, Biochemical and pathological investigations like X-ray forearm with wrist joint true anteroposterior view and lateral view, complete blood counts, random blood Sugar, serum Uric Acid, serum Creatinine, Liver function tests: SGOT, SGPT, ESR, CRP, Chest X Ray and ECG and HIV/HBsAg/HCV.

The patient was positioned supine on the OT table, with the limb on a side table. Under Regional Anaesthesia (If unsuccessful then it was converted to General Anaesthesia at the discretion of the anaesthetist), the parts were painted and draped. The fracture alignment was achieved by traction – counter traction, and the reduction confirmed by the image intensifier. 1.5- or 2-mm k-wires were passed from the radius styloid crossing the fracture site obliquely to exit the dorso-ulnar cortex of the radius shaft. Another K-wire was passed from the dorso-ulnar aspect of the distal radius between the 4th and 5th extensor compartments and directed to engage the volar radius cortex of the proximal fragment. The exposed ends of the K-wires were then either bent or the ends were inserted into metal balls. The pin sites were then dressed. Then a below elbow slab was applied on the volar surface with the wrist in neutral position.

The limb was raised for 3 days after surgery. After anesthetic wore off, the patient was urged to move his fingers. Three days later, patient allowed to move elbow. Inspection and

dressing of pin locations was done. The patient was discharged, if pin sites and mobilization were good. Weekly pin site inspection and follow-up was required. At four weeks, the pins and slab were withdrawn if there were sufficient symptoms of union, and the patient was given a crepe bandage. Patient was told to gently move his wrist at home. If the union wasn't adequate after four weeks, the patient was observed at five and six weeks. After removing the k-wires, the patient was instructed to move his wrist. No cases showed insufficient union at 6 weeks. After a month, the patient's wrist range of motion was evaluated. If patient's range of motion wasn't adequate, physiotherapist was consulted.

The study was conducted after getting ethical permission taken from the IEC committee of the medical college. Also, the written informed consent from the patients were taken prior to enrolling them for the study.

Results

Table 1 depicts the Socio-demographic characteristics and clinical presentation of participants, the mean age of participant was 59 ± 4.5 years, where there is predominance of male gender (60%), and 40% were female. Most of the fracture i.e., 56% were in right side while 44% in left side. According to AO classification, 56% were extra articular, 32% were partially articular and only 12 % were completely articular.

Table 1: Demographic characteristic and clinical presentation of study participant

Particulars	Sub particulars	N
Mean Age (in years)	Mean \pm Std Deviation	59 ± 4.5
Sex	Female	20
	Male	30
Affected Side	Left	22
	Right	28
Fracture type (AO Classification)	Extra Articular A	28
	Partially Articular B	16
	Completely Articular C	6

The Table 2 presents the distribution of Sarmiento score with Mean \pm SD of various groups, where Group A: 1.68 ± 1.156 , Group B: 10.94 ± 4.864 and Group C: 23.5 ± 1.049 . While comparing among three groups, however,

there was statistically significant difference between three groups ($p > 0.5$)

Table 2: Distribution of Mean Sarmiento Score

Variable	Group	N	Mean	SD	p-value
SARMIENTO SCORE	A	28	1.68	1.156	0.001
	B	16	10.94	4.864	
	C	6	23.5	1.049	
	Total	50	7.26	7.912	

*ANOVA TEST

Table 3 concluded the distribution of Excellent Percentage of Sarmiento's Modification of Lindstrom Criteria. In Group A: 89.3%, Group B: 12.5% and Group C: 0%. Distribution of Percentage of Fair Sarmiento's Modification of Lindstrom Criteria in Group A: 75%, Group B: 0% and Group C: 24%. Distribution of Good Percentage of Sarmiento's Modification of Lindstrom Criteria in Group A: 10.7%, Group B: 12.5% and Group C: 0%. Distribution of Poor Percentage of Sarmiento's Modification of Lindstrom Criteria in Group A: 0%, Group B: 0% and Group C: 100%. Meanwhile, there was Statistically highly significant difference between all groups ($p < 0.001$).

Table 3: Distribution of Sarmiento's Modification of Lindstrom Criteria among Subjects

Variable	Group			Total
	A	B	C	
Excellent	25	2	0	27
	89.3%	12.5%	0%	54%
Fair	0	12	0	12
	0%	75%	0%	24%
Good	3	2	0	5
	10.7%	12.5%	0%	10%
Poor	0	0	6	6
	0%	0%	100%	12%
Total	28	16	6	50
	100%	100%	100%	100%

*Pearson Chi-square value: 85.013a;

*p-value < 0.001 (highly significant)

Table 4 depicts the demerit point system of Gartland and Werley with Sarmiento et al.'s modification in which 42% (21) participant were having excellent score, 24% (12) cases were having good score and 24% (12) were having fair score and only 8% (05) were having poor score.

Table 4: Distribution based on demerit point system of Gartland and Werley with Sarmiento modification.

Particulars	Score	No. of cases
Excellent	0-2	21
Good	3-8	12
Fair	9-20	12
Poor	>21	05

Discussion

All the fifty cases of distal radius fractures united in an average period of 6.8 weeks. Excellent results were observed in 21 patients (42%), good results in 12 cases (24%), while 12 cases (24%) had fair results and 5 cases (10%) were having poor results. The duration from the date of injury to the date of operation ranged from 1 to 14 days (average 5.50 days).

Our study's consequences included wrist post traumatic arthritis (n = 2), inferior radio-ulnar joint subluxation (n = 2), Sudeck's osteodystrophy (n = 1), and malunion (n = 2). Due to a lack of infrastructure, closed reduction and POP immobilization are still used in many areas. However, because it cannot stop early radial collapse and its associated consequences of malunion, wrist discomfort, and stiffness, this treatment has a high failure probability in unstable distal radius fractures. [15] According to Sarmiento, it is appropriate for stable extra-articular distal radius fractures.

An intra-articular incongruity greater than 2 mm is primarily associated with misalignment and unsatisfactory results. Loss of wrist flexibility and function is linked to dorsal angulation more than 20 degrees. Loss of forearm rotation is linked to radial shortening of > 4 mm, while ulnar wrist pain is linked to radial shortening of > 5 mm. [16]

Therefore, a sustained decrease with 1-2 mm of articular displacement, 10o of dorsal angulation, and 2-3 mm of radial shortening are appropriate treatment objectives for an active person. [16] By using ligamentotaxis, external fixation can maintain the radial length and inclination but not the palmar tilt. According to Sanders et al. (1991) and Chang (1999), complications like infection and tendon injury are directly attributable to the pin placement in as many as 55% of cases.

The well-known procedure of closed reduction and percutaneous pinning was first described by Kapandji in 1976. [9] He has backed traditional double intrafocal pinning for distal radius fractures that are unstable. The identical fracture was pinched by Nonnenmaclor and Kempfe in 1988 and then Green in 1992, both of whom reported successful outcomes. [17] In 1997, Naidu et al. discovered that the cross pinning of a distal radius fracture is a biomechanically robust construct in both torsion and cantilever bending stresses. [18] Depalma described ulno-radial pinning drilled at a 45° angle, 4 cm proximal to the ulnar styloid, in cases of distal radius fracture with unstable DRUJ. [7]

Ulna-radial pinning with DRUJ fixation was described by Rayhack. [10] While Py and Desmanet have recommended elastic pinning for comminuted unstable distal radius fractures to successfully stop the secondary displacement of shattered pieces. In the previous decade, orthopaedic surgeons worldwide advocated open reduction and internal fixation for comminuted, intra-articular distal radius fractures. Volar and dorsal plating with newer implants and procedures gives secure fixation and early functional improvement. Tamara D. Rozental's investigations reveal that percutaneous pinning and plating are both effective in long-term functional outcome. [19]

Conclusion

Closed reduction and percutaneous K-wire fixation is a less intrusive, safer, and successful approach to preserve the reduction, avoid radial collapse during healing, and maintain DRUJ stability even when the fracture is extensively comminuted, intra-articular, or unstable. Patients treated with closed reduction and percutaneous pinning for distal radius fractures had excellent range of motion, normal range of the Arm, Shoulder, and Hand scores and no significant differences in the radiographic parameters between fracture fixation and fracture healing. Complications were few. Furthermore, Pinning is an efficacious, low-cost treatment option for 2- and 3-part distal radius fractures with excellent long-term results.

As the study was done in public sector hospital setting, all the strata of community not available in equal size, most of participants were either from lower or lower middle class. There was a smaller number of follow-up patients as some of them were went-through the loss to follow-up, and also minimal sample size could not make the results to get generalized on the larger scale.

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