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ORIGINAL ARTICLE

FUNCTIONAL OUTCOME OF UNSTABLE DISTAL RADIUS FRACTURES - TREATED BY PERCUTANEOUS K-WIRE FIXATION

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ABSTRACT: BACKGROUND: Distal radius fractures are very common and increasing in incidence, especially in older age group. There are various methods of treatment available each one has its own merits and demerits. Our technique involves closed reduction, percutaneous K-wire fixation, and POP immobilzation of the unstable distal radius fracture for 4-6 weeks. This study aims to examine the functional outcome of percutaneous pinning of these unstable distal radius fractures. **MATERIAL AND METHODS:** This is a prospective study of 48 patients aged between 35years to 74years, with unstable distal radius fracture. Patients were treated by closed reduction, percutaneous pinning using two to three k-wires. The wires are cut and bent to the outside. A posterior below elbow POP slab was applied for 4-6 weeks. All the patients were fallowed up at regular intervals of 3weeks, 6 weeks, 12 weeks and 24 weeks. The functional evaluation was done at 24 weeks follow-up. We used Sarmiento's modification of Lindstrom criteria and Gartland & Warley's criteria for evaluation of results. **RESULTS:** Excellent to good results were seen in 91.66% of cases, fair results in 8.34%. **CONCLUSION:** Percutaneous pinning is a simple, functionally effective, safe method to maintain the fracture reduction and prevent stiffness of wrist and hand.

KEYWORDS: Distal Radius Fractures, K-Wire Fixation.

INTRODUCTION: The management of Distal Radius Fracture has changed significantly since Colle's proclamation 1814. Fractures of the distal radius constitute 20 % of all the fracture cases treated in the Emergency Orthopaedics department.(1) It is second to the hip fracture in old people. There are various methods evolved, over the period of many years.

The early method of closed reduction and cast immobilization has resulted in malunion, joint stiffness and deformity. It adversely affects the wrist and hand function by interfering with the mechanical advantage of the extrinsic hand musculature.(2,3,4) Closed reduction and POP immobilization often leads to collapse of the radius and subluxation of distal radio-ulnar joint.(5)

Percutaneous pinning provides additional stability and is one of the earliest methods of fixation. Depalma described ulno-radial pinning at 45º angle.(6) Stein advocates an additional dorsal 2mm k-wire with radio-ulnar pinning.(7) Kapandji described double Intrafocal pinning into the fracture surface using 2mm k-wires.(8) and Raycheck recommended ulno-radial pinning along with the fixation of the distal radio-ulnar joint.(9)

Spanning external fixation and ligamentotaxis indirectly reduce the impacted articular fragments and directly neutralizes the axial load in the radius.(10) Rush etal, Schumr, and many others described open reduction and internal fixation of the distal radius unstable intraarticular fractures.(11) Doi atal described arthroscopic guided fracture reduction.(12)

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MARERIAL AND METHODS: 48 patients with unstable distal radius fracture were prospectively selected for the study between 2012 to 2014 in Osmania General Hospital Orthopaedic department. Males cases were 27 and 21 cases are females. The mean age of the patients was 51years. In 36 patients dominant hand was fractured.

All the fractures were unstable comminutted and intra-articular, presenting within one to three days of injury. All 48 patients were under regular fallow up. The common cause of injury was fall on outstretched hand in 36 patients, and 10 cases were due to road traffic accident and remaining two cases the fracture was sustained due to sports related injury.

All are closed fracture and classified according to AO/OTA using AP and Lateral view X-rays (Figure 1). 22 cases were A3 and 18 cases were B2 and 8 cases are B3. Additionally radial length, palmer tilt and radial angulations were measured.

MEASUREMENT OF VARIOUS ANGLES: The various angles measured were as described.

Palmar Tilt (RT): This is measured in a true lateral X-ray of the wrist. A line perpendicular to the central axis of the radius is drawn through the dorsal rim of the distal radius. Another line joins the dorsal and ventral rim of the radius. The angle of palmar tilt is 0–22°.

Radial Length (RL): In true anteroposterior x-ray of the wrist, two lines are drawn perpendicular to the long axis of radius, one joining the tip of the radius styloid and the other joining the distal articular surface of the ulna. The distance between these two lines is called radial length and should be 11–12mm.

Radial Angulation (Ra): In true AP X-ray of the wrist, a line perpendicular to the central axis of the radius is drawn. Another line joins the distal tip of the radial styloid and the ulnar corner of the ulnar fossa. The angle between lines 1 and 3 normally measures 16–28° (In true AP skiagram of wrist).

OPERATIVE PROCEDURE: All cases were given either short general anaesthesia or axillary block. The wrist fracture was reduced by longitudinal traction along the long axis of forearm with wrist in 30 degrees of supination. The displaced distal fragments are gently manipulated under the guidance of image intensifier for anatomical reduction.

Later, as the assistant is holding the fracture in reduced position, the first 2mm k-wire is introduced from the dorso radial aspect of the distal radius fragment across the fracture into the proximal fragment of the radius under the control of image intensifier. A second k-wire is passed dorso medial aspect of distal fragment to the proximal fragment.

In few cases of comminutted intraarticular fractures radio ulnar pinning was done to stabilize the articular fragments and also the distal radioulnar joint as described by Stein.[6] The wires are drilled across the outer cortice for better fixation. The fracture is finally checked once again for stability in anteroposterior and lateral views.

The k-wires are cut and bent to the outside for easy removal at a later date. A sterile dressing with pad was applied at the pin insertion site to prevent skin irritation. The wrist is immobilized in neutral position with above elbow pop slab. Post operatively the limb is elevated for 24 hours and then given a sling support. Active finger and shoulder exercises started at the earliest. Patients are discharged next day with an advice for regular fallow up.

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At 3 weeks fallow up wrist x-ray are taken to check for the fracture position, pin displacement. Above elbow POP slab is converted to below elbow pop slab and advised elbow ROM exercises along with shoulder and finger exercises.

At 6 weeks fallow up, POP slab is removed and wrist x-rays are repeated to confirm the fracture union. The K- wires are then removed under local anaesthesia, and patient is advised regular wrist ROM and hand grip exercises for another 2-4weeks.

Results are evaluated clinically and radiologically at 3 and 6months respectively, using Sarmientos modification of LIndstorm criteria (Table 1) and functional evaluation is by the demerit point system of Gartland and Werley"s scoring (Table 2).

RESULTS: All the 48 cases of distal radius fractures have united in an average period of 6.4 weeks. Excellent anatomical results are observed in 35patients (72.91%), good result in 9 cases (18.75%), while 4 cases (8.34%) had fair result.

As per the functional assessment 38 cases (79.16%) had excellent wrist and hand function, 6 cases (12.5%) had good functional outcome, while 4 cases (8.33%) had fair outcome due to wrist stiffness and residual deformity (Table 3 & 4).

The complications encountered in our study were, pin loosening (n=4),

Pin tract infection (n=2), joint stiffness (n=2), malunion (n=2), Sudeck's osteodystrophy (n=1), post traumatic arthritis (n=2), superficial radial nerve paraesthesia (n=1).

	Residual Deformity	**Loss of palmar tilt (degrees)**	**Radial Shortening (mm)**	**Loss of Radial deviation (degrees)**
Excellent	Not significant	0	<3	5º
Good	Slight	1-10º	3-6	5-9º
Fair	Moderate	11-14º	7-11	10-14º
Poor	Severe	At least 15º	At least 12	>14º

Table 1: Sarmiento's modification of Lindstrom criteria

Residual deformity	Prominent ulnar styloid	1
	Residual dorsal tilt	2
	Radial deviation of hand	3-3
Subjective evaluation		
	Excellent: No pain, disability, or limitation of motion	0
	Good: Occasional pain, slight limitation of motion, no disability	2
	Fair: Occasional pain, some limitation of motion, feeling of weakness in wrist, no particular disability if careful, activities slightly restricted	4

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	Poor: Pain, limitation of motion, disability, and activities more or less markedly restricted.	6
Objective evaluation[1]	Loss of dorsiflexion	5
	Loss of ulnar deviation	3
	Loss of supination	2
	Loss of palmar flexion	1
	Loss of radial deviation	1
	Loss of circumduction	1
	Pain in distal radio-ulnar joint	1
Complications		
	Arthritis change	
	Minimal	1
	Minimal with pain	3
	Moderate	2
	Moderate with pain	4
	Severe	3
	Severe with pain	5
	Nerve complications(median)	1-3
	Poor finger function due to cast	1-3
Result	0-2	excellent
	3-8	good
	9-20	fair
	>20	poor

Table 2: Demerit point system of Gartland & Werley with Sarmiento et al modification (Functional evaluation).[21]

The objective evaluation is based upon the following ranges of motion as being the minimum for normal function: dorsiflexion 45°; palmar flexion 30°; radial deviation 15°; ulnar deviation 15°; pronation 50°; supination 50°.

DISCUSSION: Unstable, intraarticular distal radius fractures are complicated and challenging for the surgeon. The ideal method of treatment is still an enigma.

	Residual deformity (%)	**Loss of palmar tilt (%)**	**Radial shortening (%)**	**Loss of radial deviation (%)**	**Mean (%)**
Excellent	40(83.3%)	36(75%)	36(75%)	28(58.33%)	36(72.91%)
Good	5(10.41%)	8(16.66%)	10(20.83%)	13(27.08%)	9(18.75%)
Fair	3(6.25%)	4(8.33%)	2(4.16%)	7(14.58%)	4(8.34%)
Poor	0	0	0	0	0

Table 3: Results based on Sarmiento's modification of Lindstrom criteria

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	Score	Number of cases (%)
Excellent	0-2	38(79.16%)
Good	3-8	6(12.5%)
Fair	9-20	4(8.34%).
Poor	21 and above	0

Table 4: Results based on demerit point system of Gartland & Werley with Sarmiento et al modification

Closed reduction and POP immobilization is still practiced in many parts due to limited facilities. But, this method has a high failure rate in unstable distal radius fracture as it cannot prevent early radial collapse and consequent complications of malunion, wrist pain and stiffness.[13] It's ideal for stable extraarticular distal radius fracture as described by Sarmiento.

Malalignment and poor outcome are most highly correlated with an intra-articular incongruity exceeding 2mm. Dorsal angulation of more than 20º is associated with loss of wrist flexion and function. Radial shortening of more than 4mm is associated with loss of forearm rotation, and radial shortening of more than 5mm is associated with ulnar wrist pain.

Therefore, reasonable treatment goals for an active person include a sustained reduction with less than 1–2mm of articular displacement, 10º of dorsal angulation, and 2–3mm of radial shortening.

External fixation can maintain the radial length and radial inclination by ligamentotaxis, but cannot effectively maintain the palmar tilt. Complications are as high as 55% are directly related to the pin insertion as reported by Sanders RA etal.1991, Chang BK 1999.

Closed reduction and percutaneous pinning is a well-known method described as early as 1976 by Kapandji.[8] He has advocated classical double Intrafocal pinning of unstable, distal radius fracture. Nonnenmaclor and Kempfe in 1988, later Green in 1992 have described pinning for the same fracture and found good results.[14]

Naidu etal in 1997 has found that cross pinning of distal radius fracture is biomechanically rigid construct in both torsion and cantilever bending forces.[15] In distal radius fracture with unstable DRUJ, Depalma described ulno-radial pinning drilled at 45° angle, 4cm proximal to ulnar styloid.[6]

Rayhack described ulno-radial pinning with fixation of distal radioulnar joint.[9] Whereas, in comminutted unstable distal radius fractures Py & Desmanet have advocated elastic pinning to effectively prevent the secondary displacement of fractured fragments.[16]

In the last one decade many young orthopaedic surgeons across the world had published many articles advocating a method of open reduction and internal fixation for comminutted, intraarticular distal radius fractures. Volar and dorsal plating with newer designs of implants, and techniques are found to be quite promising for giving stable fixation and functional improvement in the early post-operative period.

But long term fallow up have shown that both percutaneous pinning and plating methods have found to be efficient in functional outcome as shown in studies of Tamara D. Rozental. Randomized Controlled Trial by Alexia Karantana, FRCS (Orth) 2013 JBJS.[16]

A study by Kenneth J. Koval, MD; published in JBJS 2008.[17] found a striking shift in fixation strategy for distal radial fractures has occurred in the United States over a brief period of time among younger orthopaedic surgeons.

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This shift has occurred despite a lack of improvement in surgeon-perceived functional outcomes. Regardless of the fixation method (Percutaneous or open), the rate of complications associated with operative fracture treatment was 12% to 14%.

Additional studies should be performed to determine the optimum type of fixation for the treatment of distal radial fractures. More Evidence That Volar Locked Plating for Distal Radial Fractures Does Not Offer a Functional Advantage over Traditional Treatment Options.

Recent study by Martin Boyer, MD, MSc, FRCSC; published in JBJS 2015(18), have found a borderline difference between groups was seen for the DASH score, favoring the locking-plate group; no differences were seen for the EQ-5D. The locking-plate and Kirschner-wire groups had similar rates of complications.

CONCLUSION: The closed reduction and percutaneous K-wire fixation is least invasive, safer and functionally effective method for treating AO/ATP type A2, A3, B2 & B3 distal radius fractures. We have observed an overall excellent to good result in 91.66% of cases, while 8.34% of cases had fewer results due to non-compliant with the physiotherapy.

Figure 1: (A) Pre operative AP View and (B) Pre operative lateral View of the AO type A3 fracture

Figure 2: Post- Operative x-ray showing good reduction, K-wires in situ and back slab.

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Figure 3: Clinical Photographs at 6 months follow -up showing (A) Dorsiflexion at the wrist (B) Palmar flexion at the wrist

Figure 4: Clinical Photographs at 6 months follow -up showing (A) Pronation at the wrist (B) Supination at the wrist

REFERENCES:

1. S. Terry Canale, MD, James H Beaty, MD, Campbell's Operative Orthopaedics 12th Edition, Part 15, Fractures and Dislocations in Adults. Distal Radius Fracture Page 3147.
2. Zemel NP. The prevention and treatment of complications from fractures of the distal radius and ulna. Hand Clin 1987; 3:1-11.
3. Gofton W, Liew A. Distal radius fractures: Non-operative and percutaneous pinning treatment options. Orthop Clin North Am 2007; 38:175-85.
4. Fernandez DL, Jupiter JB, editors. Fractures of the distal radius: A practical approach to management. New York, NY: Springer- Verlag; 1996.
5. Arora J, Kapoor H, Malik A, Bansal M. Closed reduction and plaster cast immobilization Vs. external fixation in communited intra-articular fractures of distal radius. Indian J Orthop 2004; 38:113-7.
6. De Palma A. Comminuted fractures of the distal end of the radius treated by ulnar pinning. J Bone Joint Surg Am 1952; 34:651-62.
7. Stein A, Katz S. Stabilization of comminuted fractures of distal inch of the radius: percutaneous pinning. Clin Orthop Relat Res 1975; 108:174-81.
8. Kapandji A. Internal fixation by double intrafocal pinning: Functional treatment of non-articular fractures of the distal radius [French]. Ann Chir Main 1987; 6:57.

9. Rayhack J, Langworthy J, Belsole R. Transulnar percutaneous pinning of displaced distal radial fractures: A preliminary report. J Orthop Trauma 1989; 3:107.
10. Nagi ON, Dhillon MS, Aggarwal S, Deogaonkar KJ. External fixators for intra-articular distal radius fractures. Indian J Orthop 2004; 38:19-22.
11. Ruch DS, Ginn TA. Open reduction and internal fixation of distal radius fractures. Op Tech Orthop 2000; 13:138-43.
12. Doi K, Hattori Y, Otsuka K, Abe Y, Yamamoto H. Intra-articular fractures of the distal aspect of the radius: Arthoscopically assisted reduction compared with open reduction and internal fixation. J Bone Joint Surg Am 1999; 81:1093-110.
13. J Hand Surg Am. 2014 Oct; 39(10):1921-5. doi: 10.1016/j.jhsa.2014.07.008. Epub 2014 Sep 4.Percutaneous distal radius-ulna pinning of distal radius fractures to prevent settling. Kim JY1, Tae SK2.
14. Green DP. Pins and plaster treatment of communited fractures of distal end radius. J Bone Joint Surg Am 1975; 57:304-10.
15. Naidu SH1, Capo JT, Moulton M, Ciccone W 2nd, Radin A. Percutaneous pinning of distal radius fractures: a biomechanical study. J Hand Surg Am. 1997 Mar; 22(2):252-7.
16. Alexa O1, Popia I. Py-Desmanet pinning in distal radius fractures. Rev Med Chir Soc Med Nat Iasi. 2009 Oct-Dec; 113(4):1155-9.
17. Charles S. Day, MD, MBA; Keiichiro Maniwa, MD; Wei Kang Wu, BA. "Surgical Treatment of Distal Radial Fractures with a Volar Locking Plate versus Conventional Percutaneous Methods. A Randomized Controlled Trial". J Bone Joint Surg Am, 2013 Oct 02; 95(19): e147. http://dx.doi.org/10.2106/JBJS.M.01064.
18. Kenneth J. Koval, MD; John J. Harrast, MS; Jeffrey O. Anglen, MD; James N. Weinstein, DO, MS. Fractures of the Distal Part of the Radius. The Evolution of Practice over Time. Where's the Evidence? J Bone Joint Surg Am, 2008 Sep 01; 90(9): 1855 -1861.
19. Martin Boyer, MD, MSc, and FRCSC. Volar Locking-Plate and Kirschner-Wire Fixation Did Not Differ in Terms of Functional Outcomes after Dorsally Displaced Distal Radial Fracture. J Bone Joint Surg Am, 2015 May 20; 97(10): 859.

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