

Clinical Outcome of Distal Radius Fractures Fixed with Volar PlatingVishwa Mohan Priyadarshi¹, Manish Ranjan², Rajeev Anand³¹Senior Resident, Department of Orthopaedics, PMCH, Patna²Assistant Professor, Department of Orthopaedics, PMCH, Patna³Associate Professor, Department of Orthopaedics, PMCH, Patna

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Conflict of interest: Nil

Abstract:

Background: Distal radius fractures are one of the most common injuries treated by an orthopaedic surgeon, accounting for approximately one sixth of all fractures. Due to increase in incidence of high velocity trauma, the injury is seen occurring in young patients more often. A displaced fracture deranges the wrist anatomy causing deformity and loss of function at the wrist joint.

Objectives: To Study the clinical outcome of intra and extra-articular fracture of distal end of radius treated with open reduction and internal fixation by plating through a volar approach.

Material and Methods: Our study was a hospital-based study conducted during the Two Years. At PMCH, Patna. A total of 30 patients who visited the OPD or ER of our hospital, diagnosed with distal radius fracture and met the said criteria were included in the study. They were treated with ORIF with a volar plate. They were followed up and clinical and radiological outcomes were evaluated.

Conclusion: From this study we conclude that ORIF with volar plating can provide good clinical and functional outcome in distal radius fractures. Anatomical reduction of the fracture fragments is the key in achieving good results.

Keywords: Distal radius fracture, ORIF, volar plating

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Introduction

There is an increase in the incidence of fracture of distal radius with the increase in life expectancy and also in young due to increased incidence of road traffic accidents and sports related trauma. [1] They account for approximately one sixth of all fractures seen and treated. [2]

The ultimate goal of outcome [3] in these fractures has frequently been revisited as newer methods of treatment have been developed. The preservation of integrity of the three columns of distal radius, each with distinct function, restores radial length, radial tilt angle and congruity of articular surfaces for good functional results [4,5] in the form of normal anatomy with early functional recovery, full and painless motion of the wrist and prevention of late osteoarthritis. [6]

With ongoing controversies and differences regarding the optimal surgical treatment for unstable distal radius intra and extra articular fractures, [7] methods like percutaneous direct pinning, external fixator and internal fixation with plates and screws do not have standard protocols or definitive indications. Moreover they have their own complica-

tions ranging from infection to superficial nerve neuropraxias, [8] a cumbersome external frame, pin track infection, pin loosening and loss of fracture reduction, neuropathies involving the radial and median nerves, tendon rupture, metacarpal fractures, reflex sympathetic dystrophy and non-union. [9] ORIF with plate osteosynthesis promises to be a good option allowing accurate fracture reduction and early mobilization. Hence this study is intended to analyse the clinical outcome of open reduction and internal fixation of fractures using volar plate and screws.

Material and Methods

Prospective study, Our study is a hospital based study conducted in Patna Medical College and Hospital Patna, Bihar. Study duration of Two Years. Patients attending to the Department of Orthopaedics in PMCH Patna, who are diagnosed with distal radius fracture, and fulfilling the said criteria and willing for the surgery & study, will be included in the study.

A total of 30 patients were included in the study.

The initial basic details of those patients who fulfil the basic criteria's for the study will be collected from the patient and patient's attendant who visits the department of Orthopaedics at PMC Hospital along with the patient. Case history will be recorded in a specially designed Case Record Form (CRF) by taking history of illness and by doing detailed clinical examination, radiological examination and relevant investigations. Finally after the diagnosis patients are selected for the study depending on the inclusion and exclusion criteria. Post operative evaluation of clinical and functional outcome using the demerit system of Gartland and Werley with Sarmiento et al's modification will be done. Post operatively all the cases are followed for the minimum period of 12 months, at 6 weeks, 6 months and 12 months. Results are analyzed both clinically & radiologically using appropriate statistical methods.

Inclusion Criteria

Patients with intraarticular and extraarticular distal radius fractures.

Patient aged more than 18 years.

Exclusion criteria

Open fractures

Fracture beyond 3 cm from distal articular surfaces of radius (diaphyseal extension).

Fractures with history of trauma > 3 weeks. Associated Carpal fractures. Neurovascular injury.

After admission to the hospital, a careful history was taken from the patients and / or relatives to reveal the mechanism of injury and the severity of trauma. Patients were thoroughly examined for their general condition, associated systemic diseases and associated injuries were noted. All the findings were recorded in the patient proforma. All patients given adequate analgesics and the injured wrist was immobilised in a radio-opaque splint temporarily. They were evaluated with plain radiographs of the wrist and forearm, AP and lat-

eral views. They were classified based on Frykman's classification of distal radius fractures. Once evaluated they were immobilised in a below elbow volar slab for volar Barton fractures and above elbow slab for unstable fractures, Using Henry's volar approach to the wrist, incision taken over the FCR tendon or just lateral to it. FCR sheath was opened. Plane created between the brachioradialis and the FCR. The FCR and the median nerve were retracted medially. The radial artery along with the brachioradialis was retracted laterally, exposing the pronator quadratus muscle. The PQ muscle was elevated from its radial origin and reflected ulnarly to expose the distal radius. The volar aspect of the radius was exposed subperiosteally.

The average number of distal radius fracture volar plating being done in our OT is about 15-16 cases per year. Our study period is of 2 years duration. Minimum of 30 cases satisfying the inclusion and exclusion, including a minimum 1 year of postoperative follow up period will be included in the study.

Results

A total of 30 patients were included in the study. Among them 24 patients completed the intended one year follow up. The other 6 patients were followed up for a period of at least eight months. Patients were evaluated in terms of clinical outcome and by radiological parameters. Gartland and Werley scoring has been used to assess the functional scoring of 30 patients. Radiological outcome was measured according to Sarmiento's modification of Lind Storm Criteria. The data obtained was analyzed to study the final clinical and functional outcome, correlation between clinical and radiological outcome, incidence of complications, correlation between age and clinical outcome, correlation between Frykman's classification and clinical/radiological outcome.

Table 1: Sex wise distribution of patients

Sex	No of patients	% of patients
Male	25	83.33
Female	5	16.67
Total	30	100.00

A total of 30 patients were analysed. 83.33 % (25) of them were males and 16.67% were females.

Table 2: Age wise distribution of patients

Age groups	No of patients	% of patients
<=30yrs	10	33.33
31-40yrs	12	40.00
>=41yrs	8	26.67
Total	30	100.00
Mean age	36.23	
SD age	10.39	

Age wise distribution showed that 33.33% of the patients were among the age group between 18 and 30. 40% of them were between the age of 31 and 40. 26.67% of them were over the age of 40 years.

Table 3: Mode of injury wise distribution of patients

Mode of injury	No of patients	% of patients
RTA	25	83.33
Fall from height	1	3.33
Slip and fall	4	13.33
Total	30	100.00

83.33% of the injuries occurred due to road traffic accidents. 13.33% of them slipped and fell injuring the wrist and one patient fell from a height (3.33%).

Table 4: Implant status wise distribution of patients

Implant status	No of patients	% of patients
Locking	27	90.00
Non locking	3	10.00
Total	30	100.00

A fixed angle locking plate was used in 27(90%) patients and a non-locking buttress plate was used in the remaining 3(10%) of them.

Table 5: Clinical results - distribution of patients

Clinical results	No of patients	% of patients
Excellent	15	50.00
Good	13	43.33
Fair	2	6.67
Total	30	100.00

When the results were analysed 50% of the patients had excellent result as per the Gartland and Werley demerit scoring system, 43.33% of the patients had good results and 6.67% of them had fair results.

Table 6: Incidence of complications

Complications	No of patients	% of patients
Arthritis	1	3.33
Implant failure	1	3.33
Nil	28	93.33
Total	30	100.00

Among the 30 patients studied one of them had arthritic changes and one of them had an implant failure

Table 7: Weight agreement between clinical and radiological results by kappa statistic

Agreement	Expected Agreement	Kappa	Std. Err.	Z-value	p-value
93.33%	71.67%	0.7647	0.1611	4.7500	0.0001*

*p<0.05

The correlation between the radiological and the clinical outcome was made using kappa statistics, which showed a 93.33% agreement between the two and with a p value of 0.0001.

Table 8: Association between clinical results with status of implant

Result-clinical	Locking	%	Non locking	%	Total	%
Excellent	13	48.15	2	66.67	15	50.00
Good	12	44.44	1	33.33	13	43.33
Fair	2	7.41	0	0.00	2	6.67
Total	27	100.00	3	100.00	30	100.00
Chi-square=0.4842 P = 0.7851						

Chi square test applied to study the correlation of implant used and the clinical outcome showed a p value of 0.7851

Table 9: Association between radiological results with status of implant

Radiological -clinical	Locking	%	Non locking	%	Total	%
Excellent	13	48.15	2	66.67	15	50.00
Good	14	51.85	1	33.33	15	50.00
Fair	0	0.00	0	0.00	0	0.00
Total	27	100.00	3	100.00	30	100.00

Chi-square with Yates's correction = 0.0001 P = 1.0000

Chi-square test applied to correlate the implant used and the radiological outcome. The p value was 1.0.

Discussion

Distal radial fractures are one of the most common injuries encountered in orthopaedic practice. Up until a few decades ago, distal radius fractures were usually regarded as 'Colles' fracture. The treatment was mainly manipulation and casting, proposed by Abraham Colles' in 1814 [10], however they would heal with a deformity but with acceptable functional deficits. The expected and acceptable outcome of the fractures would be based on various factors such as age of the patient, occupation and hand dominance. Fracture union is no longer the only goal, as the restoration of normal anatomy with early functional recovery, and restoration of full range of motion of wrist and forearm are the ultimate goals of treatment. With better understanding of the various fracture types, classification such as Frykman [11], Melone [12], and AO [13] were developed. There was a need for better modality of treatment according to individual fracture pattern to obtain better functional results.

The different modalities of treatment available, although usually dictated by fracture pattern itself are;

- Closed reduction and casting (non-operative)
- Closed reduction and fixation with percutaneous pinning(k-wires)

- External fixation
- Open reduction and internal fixation with plates and screws.

Our study was a prospective study into determining the clinical outcome of distal radius fractures fixed with volar plating. The objective was to determine the clinical, functional and radiological outcome of distal radius fractures fixed with volar plating and to analyse the possible correlation between them. Both intra and extra articular fractures of the distal end of radius were included in the study. However there were only 2 extra articular fractures among 30 patients studied. All fractures in our study were approached using the Henry's volar approach to the distal radius and fixed with either a fixed angle locking plate or a non-locking buttress plate. The clinical-functional outcome in our study was assessed by Gartland and Werley demerit scoring system. The scoring system consists of subscales that evaluate objective findings, subjective assessment in addition to complications and residual deformity [14,15]. The radiological outcome was assessed based on Sarmiento et al modification of the Lind Storm criteria. It takes into account the radial inclination, radial length, residual dorsal (radial tilt) and residual deformity [16].

Comparison Of Mechanism of Injury

Study	High Velocity Injury	Low Velocity Injury
Gruber et al (Austria)	8	46
Jesse B. Jupiter et al. (USA/Switzerland)	64	86
Tamara D. Rosental et al. (Austria)	8	33
P. RaviShankar et al. (India)	20	4
Our study	26	4

The mean age of patients in our study was 36.23 years with highest demographical distribution was between 31 to 40 years (12) (40%). And another 10 patients were below 30 years of age. The western studies showed a higher mean age group (51 to 68 years) and the Indian studies including our study showed a lower mean age group (36 to 39 years). This maybe because the most common mechanism of injury Indian studies was high velocity injury (RTA). 83.33% of the patients in our study were males and 16.67% were females. This might be correlated to the mode of injury, RTA being the most common mode of injury at 83.33%, most of them were due to motorcycle accidents. The asso-

ciation between age and clinical outcome based on Gartland and Werley criteria was analysed using chi square test. Patients were divided into three age groups. 30 years or less, 31 to 40 years, 41 or more years. The chi square value was 2.963 and P value was 0.564. Hence there was no statistically significant association between age and clinical outcome in our study.

The chi square value for association of type of fracture based on Frykman's classification and clinical outcome was 1.131 and the P value was a statistically insignificant 0.980. Association between type of fracture and radiological outcome had a chi

square value of 2.8 and P value of 0.423, which was again statistically insignificant. Hence we did not find any correlation between type of fractures and clinical or radiological outcome.

Conclusion

Distal radius fractures occur most commonly among the young adults, who are of the working age group. There has been a change in demographics, with high velocity trauma i.e RTA being the most common mechanism in our geographical distribution. Perhaps that is also the reason why males are injured more often than females. There is a strong correlation between the radiological results and the clinical-functional outcome in our study group, who have undergone open reduction and plate osteosynthesis. However, we did not find any statistically significant association between age, type of fracture and clinical and radiological outcome.

References

1. Nellans K, Kowalski E, Chung K. The Epidemiology of Distal Radius Fractures. *Hand Clinics*. 2012;28(2):113-125.2.
2. Jakim I, Pieter HS, Sweet MBE. External fixation for intraarticular fractures of distal radius. *J Bone Joint Surg (Br)*.1991; 73:302-6.
3. Leung F, Kwan K, Fang C. Distal radius fracture: current concepts and management. *The British Editorial Society of Bone and Joint Surgery*; 2013[<http://www.boneandjoint.org.uk/sites/default/files/Distal%20radius%20fracture.pdf> (Access date= August 2014)].
4. Jakob M, Rikli D, Regazzoni P. Fractures of the distal radius treated by internal fixation and early function. *J Bone Joint Surg [Br]* 1996;78-B:588-92.
5. Jupiter JB. Current concepts review fracture of distal end radius. *J Bone Joint Surg. (Am)* 1991; 292: 48-61.
6. Trumble TE, Culp RW, Hanel DP, Geissler WB, Berger RA. Intra-articular fractures of the distal aspect of the radius. *Instr Course Lect*. 1999; 48:465-80.
7. Rao S, Raju S, Sagar S. Comparison of Outcome of Unstable Distal Radius Fractures Treated with Internal Fixation or External Fixation in Indian Population – A Series of 40 Cases. *IOSR Journal of Dental and Medical Sciences*. 2014;13(12):04-07.
8. Rizzo M, Katt B, Carothers J. Comparison of Locked Volar Plating Versus Pinning and External Fixation in the Treatment of Unstable Intraarticular Distal Radius Fractures. *HAND*. 2007;3(2):111-117.
9. T. Anderson J, L. Lucas G, R. Buhr B. Complications of treating distal radius fractures with external fixation: a community experience. *The Iowa Orthopaedic Journal*. 1997; 24:53-59.
10. Colles A. On the fracture of the carpal extremity of the radius. *Edinb Med Surg J*. 1814; 10:181. *Clin Orthop Relat Res*. 2006; (445):5-7.
11. Frykman G. Fracture of the distal radius including sequelae--shoulder-hand-finger syndrome, disturbance in the distal radio-ulnar joint and impairment of nerve function. A clinical and experimental study. *Acta Orthop Scand*. 1967; Suppl 108:3.
12. Melone CP, Jr. Open treatment for displaced articular fractures of the distal radius. *Clin Orthop Relat Res* 1986-202:103-11.
13. Muller ME, Nazarian S, Koch P. *AO Classification of fractures*. Springer-Verlag, Berlin, 1987.
14. Changulani M, Okonkwo U, Keswani T, Kalairajah Y. Outcome evaluation measures for wrist and hand – which one to choose? *International Orthopaedics (SICOT)*; 2008 (32): 1–6.
15. Kwok I, Leung F, Yuen G. Assessing Results After Distal Radius Fracture Treatment: A Comparison of Objective and Subjective Tools. *Geriatric Orthopaedic Surgery & Rehabilitation*. 2011;2(4):155-160.
16. Bohra A K, Vijayvergiya S C, Malav R, Jhanwar P. A prospective comparative study of operative treatment of distal radius fracture by using locking and non-locking volar T- plate *JPBMS*, 2012; 20(14).