ORIGINAL ARTICLE

OUTCOME OF DISTAL RADIAL FRACTURES MANAGED BY OPEN REDUCTION AND INTERNAL FIXATION WITH VOLAR PLATING: A CLINICAL STUDY

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HOW TO CITE THIS ARTICLE:
P. Ravi Shankar, Y. Badrish, K. Satish, G. Suresh Babu. "Outcome of Distal Radial Fractures Managed By Open Reduction and Internal Fixation with Volar Plating: A Clinical Study". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 17, April 27, 2015; Page: 2573-2584.

ABSTRACT: BACKGROUND AND OBJECTIVE: Incidence of fractures of distal radius are increasing due to more geriatric population and road traffic accidents and at the same time surgical treatment option for the same are modified continuously. The fundamental goal in the treatment of distal radial fractures is restoration of normal or near normal alignment and articular congruity. **METHODS:** 24 patients with fracture of distal radius were selected who were admitted in S.V.R.R.G.G. Hospital, Tirupati between December 2011 and October 2013. Patients were treated with open reduction and internal fixation using volar plate through a volar approach and followed up till functional recovery and assessed clinico radiologically. **RESULT:** The study comprised of 16 male and 8 female patients aged from 21 to 65 years with mean age of 39.25 years. The average duration from date of injury to date of surgery was 2.7 days. The follow up ranged from 6 to 14 months. Using the demerit scoring system of Gartland and Werley we had 41.6% excellent 50% good, 8.4% fair and 0 poor results. **INTERPRETATION AND CONCLUSION:** In selected patients, fixation of distal radial fractures with a volar plate has satisfactory outcome and may be considered as part of a surgeons armamentarium in the contemporary treatment for fractures of distal radius even in osteoporotic bones.
KEYWORDS: Distal Radial, Volar plating, fractures.

INTRODUCTION: Fractures of distal end of radius are the most common fractures of the upper extremity, constituting 17% of all fractures and 75% of all forearm fractures.[1]

Closed reduction and cast immobilization has been the mainstay of treatment of these fractures. Malunion of the fracture and subluxation or dislocation of distal radioulnar joint results in a poor out-come both functional and cosmetically.[2]

The residual deformity of wrist adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic musculature of the hand.[3] It may cause pain, limitation of forearm motion, and decreased grip strength as a result of arthrosis of the radiocarpal and distal radioulnar joints.[4]

Distal radial fractures are treated by wide arrays of technique apart from closed manipulation reduction like percutaneous pins, pin and plaster, external fixation & internal fixation. Open reduction and internal fixation is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, provided sufficient bone stock is present to permit early range of motion.

Internal fixation of metaphyseal bending fractures has become increasingly popular due to primarily (a) directly control and maintain physiologic palmar tilt, (b) prevent collapse with external fixation, and (c) avoid bridging the radiocarpal joint. The distal fragment typically has sufficient size and integrity to provide adequate purchase. Palmar plating is preferred, as the screws directly buttress against collapse and loss of palmar tilt. Volar buttress is used in younger individuals and locking compression plate in old and osteoporotic individuals.

As open reduction and volar plating ensures more consistent correction of displacement and maintenance of reduction, this study evaluates the anatomical and functional outcome of open reduction and plate fixation in the management of fracture distal end of radius.

MATERIALS AND METHODS: The present study consists of 24 cases of distal radius fractures treated with open reduction and internal fixation with volar plating at the department of Orthopaedics, S.V.R.R.G.G. Hospital from December 2011 to April 2013. All these cases were followed up till October 2013, for a minimum of 6 months to a maximum duration of 14 months.

Inclusion Criteria included all patients over 18 years of age, both male and female with unstable, comminuted and/or intra articular fractures of distal end of radius classified according to Frykman and A.O classifications. Exclusion Criteria included Patients aged below 18 years, Patients medically unfit for surgery, Compound fractures associated with vascular injuries, Patients not willing for surgery, Medical disorders that have impact on bone physiology (malignant tumour, hyperparathyroidism etc.)

As soon as the patient with suspected distal radius fracture was seen, necessary clinical and radiological evaluation was done and admitted to ward after necessary resuscitation and the involved forearm was immobilized in a below elbow POP slab and kept elevated. Pain and inflammation were managed with analgesics. All the routine investigations were done as follows haemogram, blood urea, serum creatinine, urine routine, microscopy, blood sugar level, serum electrolytes, blood group, HIV, HBsAg, HCV, Chest X-ray and ECG. All the patients were evaluated for associated medical problems and were referred to respective department and treated accordingly. Associated injuries were evaluated and treated simultaneously. The patients were operated on elective basis after overcoming the avoidable anaesthetic risks.

The assessment of functional results were made using demerit score system of Gartland and werely based on objective and subjective criteria, residual criteria and complications.

RESULTS: The present study consists of 24 cases of distal radius fractures treated with an open reduction and internal fixation with volar plating at the department of Orthopaedics, S.V.R.R.G.G. Hospital from December 2011 to April 2013. All these cases were followed up till October 2013, for a minimum of 6 months to a maximum duration of 14 months. The following observations were drawn from the compiled data as shown in the table.

AGE GROUP	MALES (%)	FEMALE (%)	Total No of Cases (%)
21-30	5 (20.8%)	1(4.2%)	6(25)
31-40	6(25%)	1(4.2%)	7(29.2)

41-50	3(12.5%)	4(16.2%)	7(29.2)
51-60	1(4.2%)	1(4.2%)	2(8.4)
61-70	1(4.2%)	1(4.2%)	2(8.4)
TOTAL	16(66.67%)	8(33.3%)	24(100%)

Age & Gender Distribution

In our series, most of males (45.8%) among 67% are in younger age group (20-40) and females are mostly above 40 years (25%) among 33% indicating risk of post-menopausal osteoporosis.

Out of 24 patients, 16 (66.7%) were males and 8(33.3%) were females with male preponderance of 2:1.

LATERALITY: Right side (dominant wrist) was involved in 16(66.67%) patients and the left side was involved in 8(33.33%) patients

MODE OF INJURY: In our study there were 19(79.2%) patients with road traffic accidents and 4(16.6%) patients fall on outstretched hands (FOOSH) and 1(4.2%) assault.

TYPE	NO OF CASES	PERCENTAGE (%)
I	5	20.8
II	5	20.8
III	9	37.6
IV	0	0
V	1	4.2
VI	0	0
VII	0	0
VIII	4	16.6

Fracture pattern according to Frykman`s classification

Out of 24 patients, most of the fractures are type I, II, III indicates occurrence of extra articular and radiocarpal dislocations.

AO TYPE	NO.	%
A1	0	0
A2	8	33.3
A3	3	12.5
B1	2	8.4
B2	3	12.5
B3	5	20.8
C1	2	8.4
C2	1	4.2
C3	0	0

TYPE of fracture according to AO classification

In our study, most of the fractures are of extra articular and partial articular in nature. Of the 24 cases there were 11(45.8%) intra articular and 13(54.2%) are intra articular according to A.O classification.

Type	No.	%
Extra articular	11	45.8
Intra articular	13	54.2
Intra & Extra Articular's		

CLOSED OR OPEN FRACTURE:

TYPE	NO.	%
CLOSED	23	95.8
OPEN	1	4.2
According to Gustilo and Anderson classification		

Associated injuries	No. of cases	Percentage (%)
# Femur	1	4.2
Head injury	1	4.2
Nil	22	91.6
Associated injuries		

Of the 24 patients 2 patients has associated injuries.

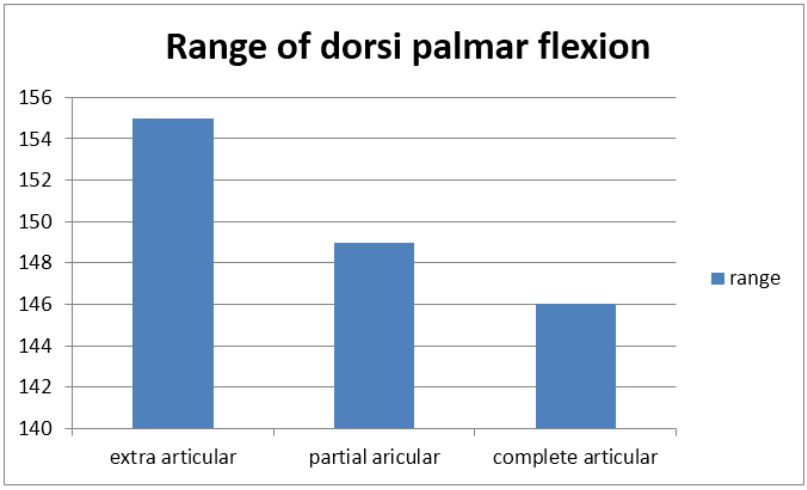
Duration(days)	No. of cases	Percentage (%)
1-2	12	50
3-4	8	33.33
5-6	4	16.66
Duration of operation from date of admission		

Surgery was done in 1-6 days in all cases from the time of admission after getting clearance from the anaesthetist. All procedures were carried as elective procedure except one, which was done in emergency as it was compound.

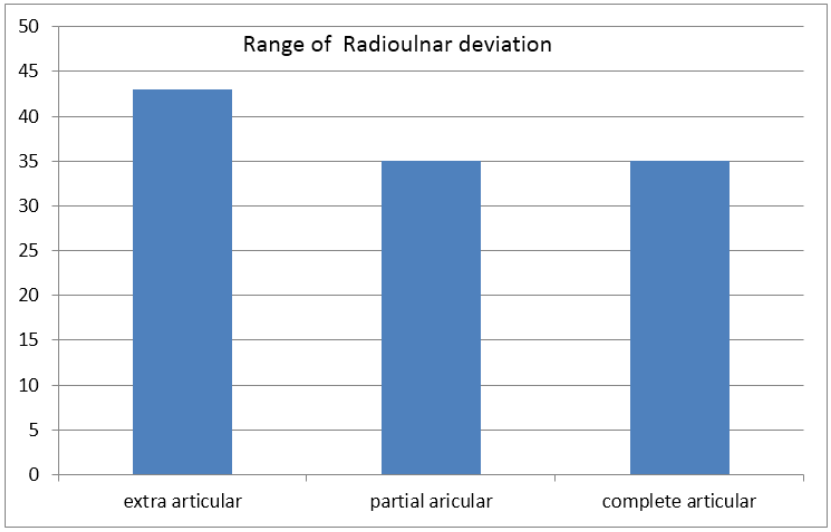
Time of Union	No. of Cases	Percentage
2-3 months	20	83.33
3-4 months	04	16.67
Duration of Fracture Union		

In the present study, 20 (83.33%) patients had union within 2-3 months and 04 (16.67%) patients had union in 3-4 months.

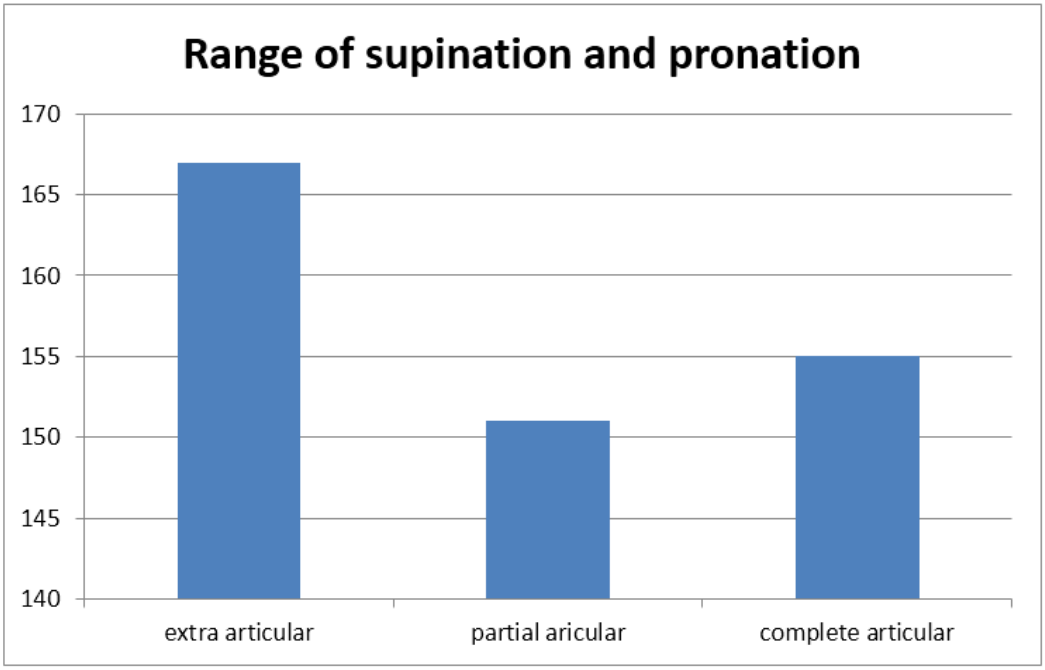
RANGE OF MOTION: Normal range of dorsi-palmar flexion is nearly achieved in extra articular fractures (155%), partial articular fractures (149%), complete articular fractures (146%).



Radioulnar deviation in extra articular fractures are 43 degrees, in partial and complete articular 35 degrees.



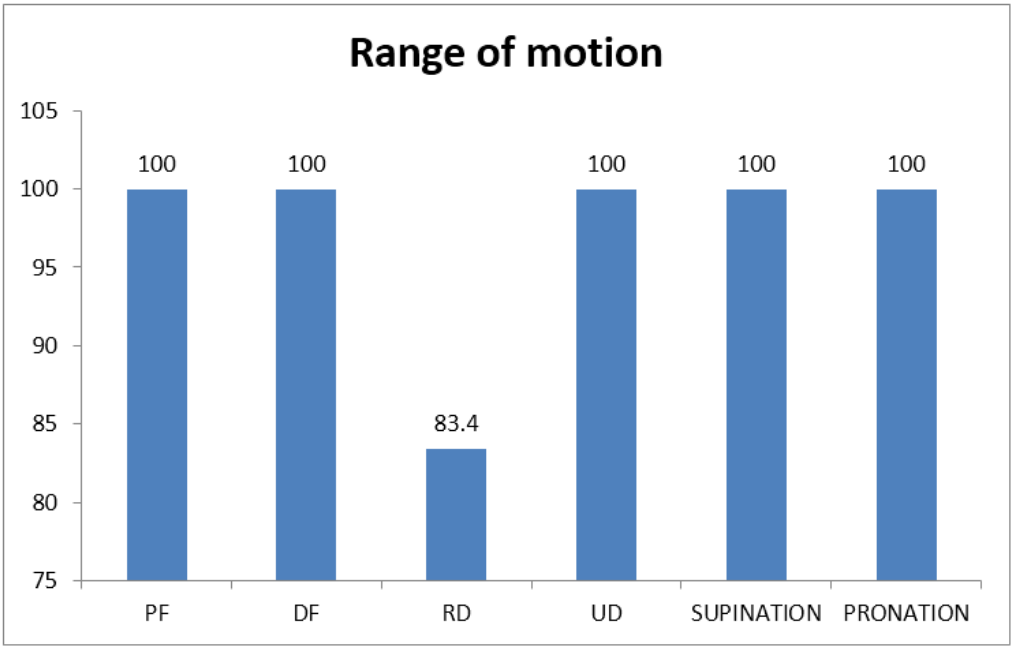
Range of supination and pronation are 167 degrees in extra articular fracures, 151 degrees in partial articular and 155 in complete articular fractures.



As wrist joint carries out all functions of daily activity within the following range 30° of palmar flexion to 45° of dorsiflexion, radioulnar deviation of 15° each and supination and pronation of 50° each. The following are the findings of functional range of motion.

Movement (with in normal functional range)	No. of Cases	Percentage (%)
Palmarflexion (30^0)	24	100
Dorsiflexion(45^0)	24	100
Radial deviation(15^0)	20	83.33
Ulnar deviation(15^0)	24	100
Supination(50^0)	24	100
Pronation(50^0)	24	100
Pain in distal radio ulnar joint	0	
Grip strength (60% or less than opposite side)	1	4.2

In our study 24 (100%) patients had dorsiflexion within the normal functional range (minimum 45°), 24(100%) had palmar flexion within the normal functional range (minimum 30°), 24(100%) had pronation within the normal functional range (minimum 50°), 24 (100%) had supination within the normal functional range (minimum 50°), 20(83.33%) had radial deviation within the normal functional range (minimum 15°) and 24(100%) patients had ulnar deviation within the normal functional range (minimum 15°). 23(95.8%) patients had grip strength more than 60% compared to the opposite side. 1(4.2%) had significant loss of grip strength (<60% compared to the opposite side) one of the patients had mild stiffness of the wrist.



Complications	No. of Cases	Percentage
Stiffness	1	4.2
Arthritis	1	4.2
K wire Irritation*	1	4.2
Nil	21	87.4

1(4.2%) patient had stiffness, 1(4.2%) patient had developed arthritis due to articular step in 1(4.2%) patient had k wire irritation which is an one month old fracture treated for deformity of Frykman II/A.O A2 with open reduction and internal fixation with ELLIS plate and k wire is used as the fragment is fragile and screw cannot be placed and was removed subsequently in the I follow up.

EVALUATION OF RESULTS:

- **RADIAL LENGTH:** Normal radial length of 8-18mm is maintained in 22 cases decreased in 2 cases.
- **PALMAR TILT:** Palmar tilt from 0 to 20^0(avg 11^0) is maintained in 23 cases, as in one cases there is $5^0$of, Dorsal tilt as further increase >20^0causes radiocarpal malalignment and increase of loads.
- **ARTICULAR STEP:** Articular step of >2mm is reported in one case,other cases had acceptable reduction

ANATOMICAL RESULTS: The results were assessed based on Lidstorm's criteria based on anatomical end result.

EXCELLENT	No significant deformity. Dorsal angulation not exceeding neutral position. Radial shortening less than 3mm.
GOOD	Mild deformity. Dorsal angulation 1 to 10 degrees. Radial shortening 3 to 6 mm.
FAIR	Moderate deformity. Dorsal angulation 11 to 14 degres. Radial shortening 7 to 11mm.
POOR	Severe deformity. Dorsal angulation> 15 degrees. Radial shortening >12mm.

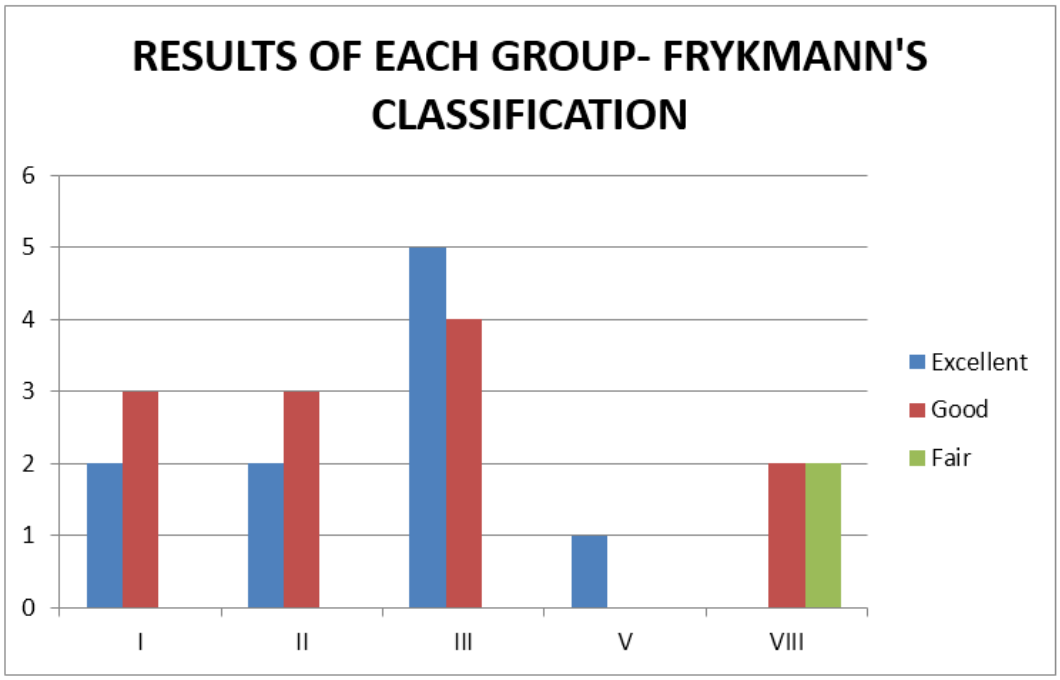
Anatomical end result	No. of cases	Percentage
Excellent	21	87.5
Good	3	12.5
Fair	0	

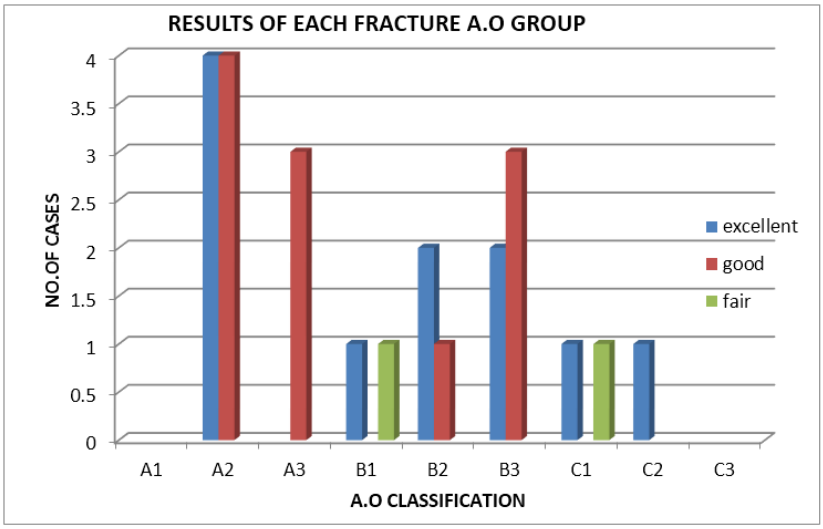
FUNCTIONAL RESULTS: The assessment of functional results were made using demerit score system of Gartland and Werely based on objective and subjective criteria, residual criteria and complications.

Points		
Deformity	Prominent ulnar styloid	1
	Radial deviation	1-2
	Dinner fork deformity	1-3
	Maximum	6
Subjective	No pain, no limitation of motion	0
	Occasional pain, some limitation of motion, weakness, pain, limitation of motion,	4
	Activities restricted	6
	Maximum	6
Range of	Limitation of motion<20%	0
Motion	Limitation of motion<50%	2
	Limitation of motion<50%	6
	Stiffness of wrist	6
	Maximum	6
Complications	None or minimal	0
	Slight crepitation	1-2

	Severe crepitation	3-4
	Median nerve compression	1-3
	Pulp-palm distance 1 cm	3
	Pulp-palm distance > 2cm	5
	Pain in distal radioulnar joint	1-3
	Maximum	15
	Excellent	0-2
	Good	3-7
	Fair	8-18
	Poor	19-33

Evaluation of results	No. of cases	Percentage (%)
Excellent	10	41.6
Good	12	50
Fair	2	8.4
Poor	0	0





Excellent results were obtained in mostly A2, B2, B3 which includes extra articular fractures and partial articular fractures and good results obtained in the same. Fair results are obtained complete comminuted articular fractures.

DISCUSSION: More than 190 years have passed since Colles' described the fracture of the distal end of the radius. It is remarkable that this common fracture remains one of the most challenging of the fractures to treat. There is no consensus regarding the description of the condition and the appropriate outcome.

Distal radius fractures are the most frequently seen upper extremity fracture. The main objective of its treatment is the re-establishment of anatomic integrity and functioning. In unstable intra-articular fractures, re-establishment of inter-articular integrity of the wrist and maintaining the radial length are often not possible with closed methods. In such cases, where an open positioning is required, various surgical methods and fixation materials can be used. A better understanding of wrist anatomy and functioning, through the studies conducted in the recent years, as well as the increasing expectations of patients have expanded the borders of surgical treatment. Besides, improvements in fixation materials have provided new opportunities.

Due to their intra-articular and unstable nature, B and C type were classified AO system distal radius fractures are treated surgically. Today, open positioning and plate fixation are the widely recognized surgical methods. Locked plates are in the progress of replacing conventional support plates. There is no consensus neither about how to approach to distal radius nor the positioning of the plate. During the recent years, volar approach has become more popular. The present study was undertaken to assess the functional outcome of operative management of distal radial fractures using a volar plate.

We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment. Our analysis is as follows.

All patients treated with open reduction and internal fixation with a volar plate. The follow-up ranged from 6-14 months. The average age was 39.25 years with the fracture being more common in the 3 to 5th decades.

Males were predominant with right wrist affection more than left. All fractures were either due to road traffic accidents or fall on the outstretched hand, with road traffic accidents being more common of the two. Most of the fractures were of Frykman Type I, II, and III. The average duration from the date of injury to the date of surgery was 2.7 days.

Maximum number of patients had their range of motion within the normal functional range. One (4.2%) of the patient had wrist stiffness.

Excellent results were obtained in mostly A2, B2, B3 which includes extra articular fractures and partial articular fractures and good results obtained in the same. Fair results are obtained complete comminuted articular fractures which is better than poor results which occur with other method of treatment.

Though we had 13(54%) cases of intra articular fracture, the complication of post traumatic arthritis was in only one (4.2%) case. Long term follow up is needed to assess the arthritic changes.

CONCLUSION: The present study was undertaken to assess the functional outcome of operative management of distal radial fractures in adults by a volar plate and the following conclusions were drawn.

Volar plates that are widely used provide successful results especially for the treatment of intraarticular unstable fractures of distal radius. This method, which is effective in anatomic realignment, allows early joint motion, owing to its fixation strength. Close placement to joint interface and screwing capability in different orders are its biomechanical superiorities. Volar approach provides both access with minimal surgical trauma on distal radius and fixation with a better adaptation to surrounding tissues. In the subjects of our study, a successful anatomic alignment was acquired with volar approach, regardless of the direction of fracture angulation. The patients who were young adults in majority, went back to their daily activities with 90% recovery. Complications are less (12.6%), one is stiffness, can be prevented by physiotherapy regularly, another is arthritis due to step that can be overcome by good operative technique once the surgeon gets adapted to the procedure and last one due to supplemental fixation used in old fracture and removed which can be overcome by early intervention.

Use of volar plates in distal radius fractures provide good to excellent results and are effective in the correction arid maintenance of distal radius anatomy. By using these plates, joint motions and daily functioning is recovered in a shorter time.

REFERENCES:

1. Colles A. On the fracture of the carpal extremity of the radius. Edinburgh Med Surg 1814; 10: 182–6.
2. Bacorn RW, Kurkutke JF: Colles' Fracture: A study of two thousand cases from the New York states Compensation Board. J Bone Joint Surg 1953; 35A: 643-658.
3. Fernandez DL: Correction of posttraumatic wrist deformity in adults by osteotomy, bone grafting and internal fixation. J Bone Joint Surg 1982; 64A: 1164 – 1178.
4. Zemel NP: The prevention and treatment of complications from fractures of the distal radius and ulna. Hand Clin. 1987; 3: 1 – 11.

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Date of Submission: 14/04/2015.
Date of Peer Review: 15/04/2015.
Date of Acceptance: 18/04/2015.
Date of Publishing: 27/04/2015.