Original article

Study of outcome of various modalities for treatment for distal end radius fracture

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Abstract:

Since Abraham Colles first described fracture of distal radius end radius in1814; two centuries ago, still there is no consensus regarding description, management and its assessment. The outcome of various treatment modalities has been described in this study. Total 40 patients with fractured distal end of radius presenting in Department of Orthopedics of Rural Medical College & Pravara Rural Hospital, Loni subjected to various treatment modalities have been included in the study. The study was conducted from September 2013 to September 2015. The patients have been clinically and functionally evaluated with demerit point system of Gartland and Werley with sarmiento's modification & radiological evaluation done with stewart et al criteria. Among all modalities operative treatment gives good result than non-operative. Closed manual reduction and cast is good for undisplaced extra articular fractures. Open reduction and plate fixation is good for displaced intrarticular fractures.

Keywords: Fracture of distal end radius, external fixator, volar plate, percutaneous pinning

Introduction:

Fractures of distal end radius are not uncommon in elderlies[1-3]. The increased incidence of this fracture can be attributed to aging population due to increased life expectency and the growing participation of people in outdoor pursuits[4, 5]. In order to prevent long standing disability and to restore function proper management is important. Management of such fractures depends on their individual characteristics[6-9]; with treatment options ranging from immediate functional bracing[6] to open reduction and plate fixation[5-10].

Fernandez Classification - In 1993, Fernandez proposed a mechanism-based classification system that would address the potential for ligamentous injury and thereby assist in treatment recommendations. We have used this classification in our study.

Type I: fractures are extra-articular metaphyseal bending fractures, such as Colles' (dorsal angulations) or Smith (volar angulations) fractures. One cortex fails in tension, and the opposite cortex is comminuted and impacted.

Type II: fractures are intra-articular and are produced by shearing. These include volar Barton, dorsal Barton and radial styloid fractures.

Type III: fractures result from compression injuries that cause intra- articular fractures and impaction of metaphyseal bone. These include complex articular fractures and radial pilon fractures.

Type IV: fractures are avulsion fractures of ligament attachments that occur with radio carpal fracture-dislocations.

Type V: Combined injuries with significant soft tissue involvement due to the high-energy nature of these fractures.

The treatment option depends upon radiological appearance, reducibility and stability of the fracture. At the same time the age and the demands of the patient is taken into consideration[11].

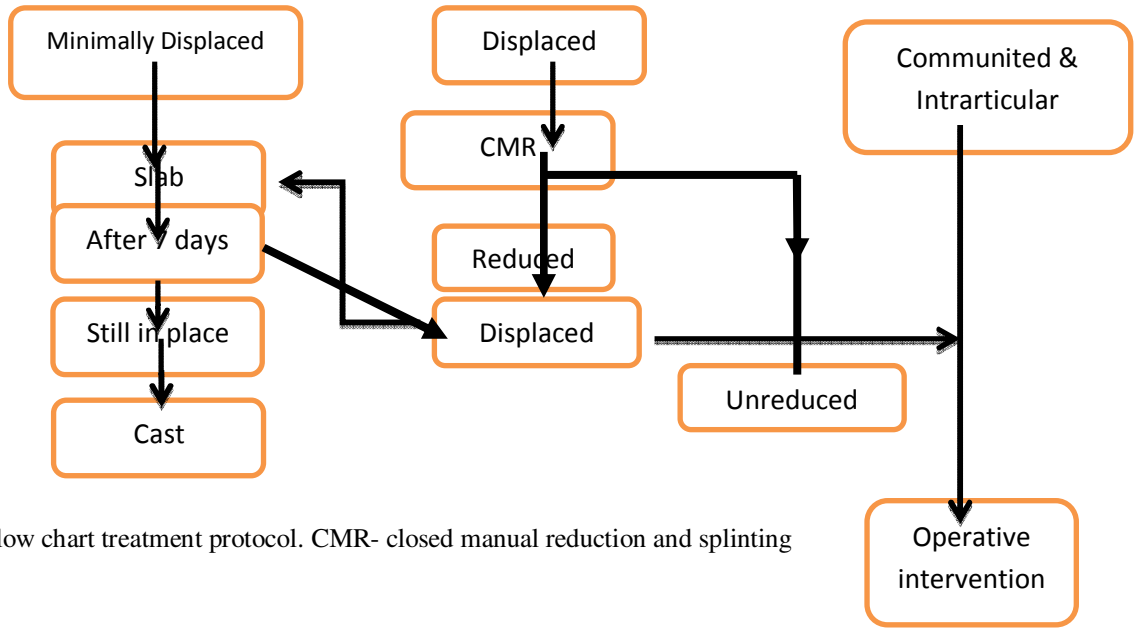

Fig 1:- Flow chart treatment protocol. CMR- closed manual reduction and splinting

Long back since its description two centuries ago by Colles' in 1814[12] there has been no clear consensus regarding treatment of these fractures[1], various treatment modalities has been described in this observational study.

Material and Methods:

This longitudinal observational study included 40 patients with fracture of distal end radius presenting to emergency room and outpatient department of orthopedics, Rural Medical College and Pravara Rural Hospital, Loni. Demographic data was also recorded. An informed consent was taken from all the patients. Approval from Ethics and Scientific Committee of PIMS Loni was taken before conducting study. Patients were regularly followed up at 2, 4, 6 and 8 weeks and thereafter at 6 months. Anteroposterior and lateral X-rays were taken to determine union and if any residual deformity was present.

Inclusion Criteria required for patients to fulfill are:

1) Age >18 years of either sex
2) Presenting within 2 weeks after injury
3) Closed fractures

Exclusion criteria being patients with:

1) Pathological fractures
2) Associated carpal/ulnar fractures
3) Refracture at same site were excluded from the study
4) Refusal for follow up
5) Denial of consent.

The patient was given treatment accordingly to the type of fracture. All procedures were carried out under general anesthesia or brachial plexus block. viz 1) Closed manual reduction and cast application 2)

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Closed manual reduction and percutaneous pinning 3) Closed reduction External fixator application and 4) Open reduction and plate fixation.

Closed manual reduction and cast application- Closed reduction was achieved under fluoroscope for minimally displaced fractures with standard protocol of disimpaction with traction and counter traction, then reduction and locking the reduction with pronation of distal fragment and ulnar deviation of the hand. A well moulded, short arm cast with three point fixation was given.

Closed manual reduction and percutaneous pinning- The fracture was reduced under fluoroscopy guidance with the standard and is fixed with two smooth 1.5mm to 2mm k-wires. The first Kirschner wire is inserted at the tip of the radial styloid process just dorsal to the first extensor canal, in anatomical snuffbox proximal to the radial artery; aiming to cross the fracture line in both planes under image intensifier. This requires about a 45-degree angle with the long axis of the radius on postero-anterior view, and aiming the wire 10 degrees dorsally on the lateral view. The second Kirschner wire is inserted into the dorsal ulnar comer of the distal part of the radius between the fourth and fifth extensor canals. The correct line of aim that is required to cross the fracture is about 45 degrees on the postero- anterior view, and 30 degrees on the lateral view. Both Kirschner wires are advanced to just penetrate the cortex of the proximal fragment. The Kirschner wire was cut after bending and leaving about 1 cm out of the skin. Benzoin seal was applied and sterile pads were kept below and above the protruding pins. A bandage was applied to incorporate the wrist joints.

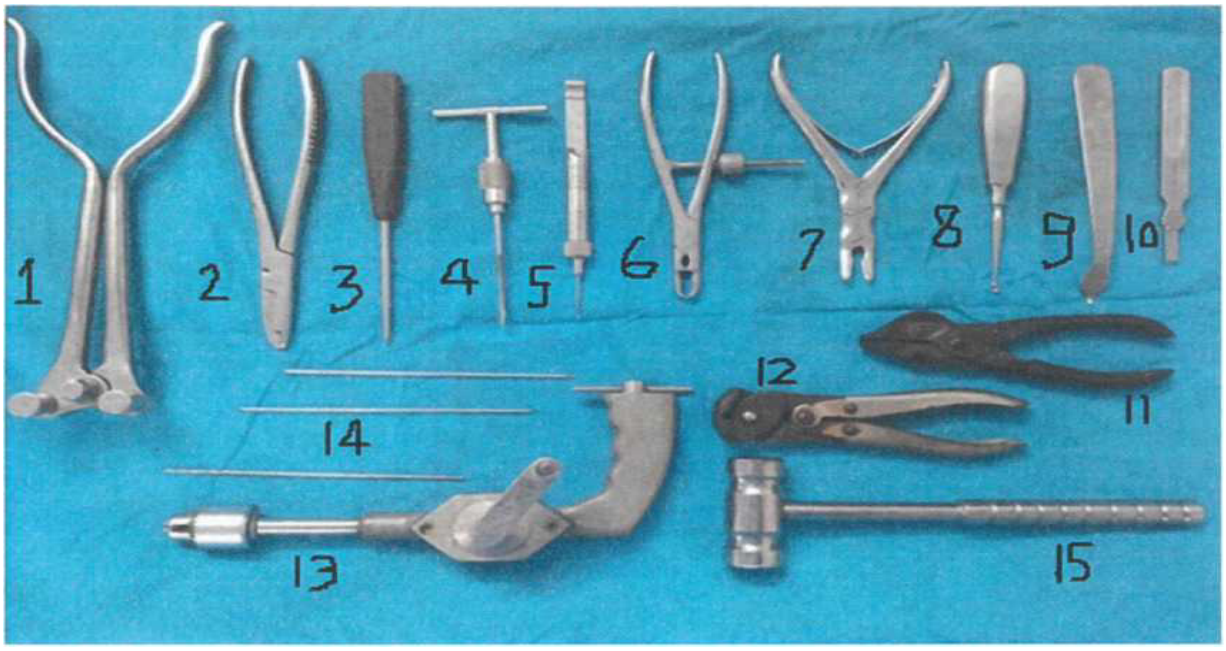

Fig 2:- instruments required in surgery. 1) plate bender, 2) k-wire bender/cutter, 3) Screw driver, 4) Bone tap, 5) Depth guage, 6) Bone holding clamp, 7) Bone nibbler, 8) Curette, 9) Homan's retractor, 10) Parabeauf periosteum elevater, 11) Plier, 12) k-wire cutter, 13) Universal bone drill, 14) kirschner wires, and 15) Mallet

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Closed reduction External fixator application- 3.5mm Schanz pins were put in radius at musculotendineous junction after pre-drilling and by semi open method to avoid entrapment of tendons in Schanz pin. They were drilled at 20° dorsolateral position using the distractor clamp as a guide. Similarly 2.5 mm Schanz pins were drilled in 2nd and 3id metacarpals. Special care was taken to displace 1st dorsal introssei ventrally and keeping fingers completely flexed to avoid tendon entrapment. If required; unstable, displaced fragment was pin-downed by using k wire. Distraction was used for finer adjustments; reduction was checked under c-arm followed by pin tract dressing.

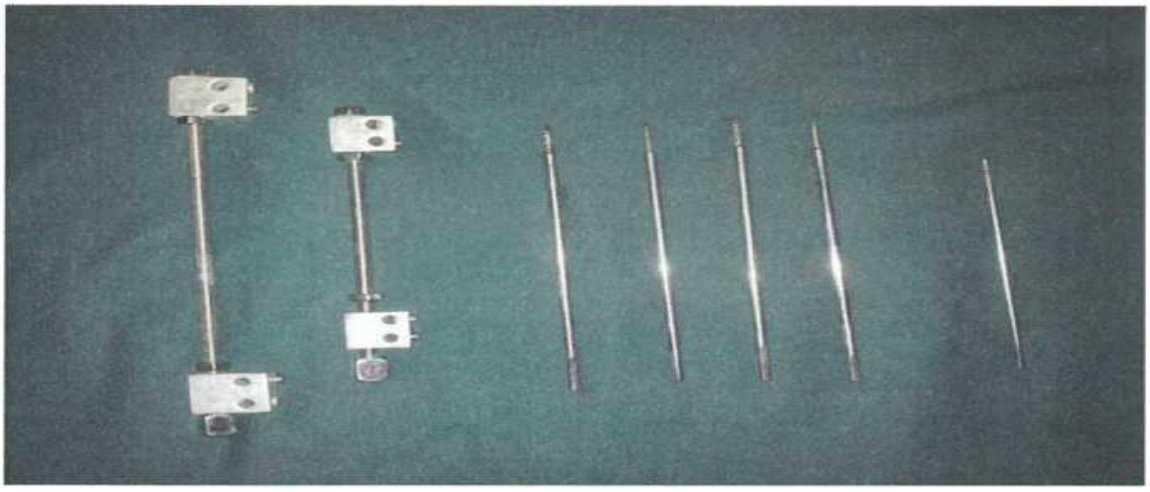

Fig 3:- external fixator with shanz pins

Open reduction and plate fixation- The standard volar (Henry's) approach was undertaken to fix the fragments. Make a longitudinal incision about 7.5 cm long on the radiovolar aspect of the distal forearm. Develop the plane between the flexor Carpi radial is and the Palmaris longus. Retract the flexor pollicis longus tendon radial ward and the median nerve and the other tendons ulnarward sever the fibers of the pronator quadratus from their origin on the radius, and expose the fracture. Reduce the fracture and contour a T- plate so that, when it is applied and fixed to the proximal fragment, the distal transverse part acts as a buttress and holds the fracture reduced. Two screws are usually all that is required in the proximal fragment, and usually no screw is inserted through the distal part of the plate into the fracture fragments. The reduction of the fracture and restoration of the articular surface are confirmed by direct observation and by anteroposterior and lateral radiographs. Replace the pronator quadratus over the plate to its origin on the radius and close the wound.

Fig 4: - Ellis plate

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Post operative protocol -

0–2 weeks **-** Movements of the fingers, elbow and shoulder were encouraged in the first 2 weeks. Elevation of the forearm was maintained during the first 2 days to avoid edema.

2–4 weeks **-** In extraarticular fractures, wrist (dorsiflexion and palmarflexion), finger (flexion and extension) and forearm (pronation and supination) mobilization were started. In intraarticular fractures, where the comminution was significant, a below elbow splint was used for 2–3 weeks.

After 4 weeks - Range of motion exercises was continued with gradually progressive use of the wrist being permitted. Follow up record was maintained at 2, 4, 6 and 8 weeks and thereafter 6 months.

Patients were evaluated using the demerit point system of Gartland and Werley and stewart et al criteria at final follow up of 6 months.

Parameters for observation-

Clinically-

1. Pain
2. Range of movement at wrist joint
3. Deformity assessment
4. Functional evaluation
5. Both side hand grip strength

Radiological evaluation-

1. Palmer tilt
2. Radial length
3. Radial inclination

Table 1: Criteria for radiological evaluation of end result of distal radius fractures- (Stewart et al)

Dorsal angle	Loss of radial length (mm)	Loss of radial angle (degrees)	Score
Neutral	0-2	0-4	0
1-10	3-6	5-9	1
11-14	7-11	10-14	2
>15	>12	>15	4
Excellent = 0, Good= 1-3, Fair = 4-6 and Poor =>7			

Table 2: Demerit point system of gartland and werley with sarmiento et al modification

FUNCTIONAL (Demerit Point System)	Score
Prominent ulnar styloid	1
Residual dorsal tilt	2
Radial deviation of hand	2-3
SUBJECTIVE EVALUATION	
Excellent: no pain, disability or limitation of motion	0
Good: occasional pain, light limitation of motion, no disability	2
Fair: occasional pain, some limitation of motion, feeling of weakness	

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In wrist, no particular disability, slightly restricted activities	4
Poor: pain, limitation of motion, disability, activities markedly	6
OBJECTIVE EVALUATION	
Pain in distal radio ulnar joint	1
Grip strength <60% of normal side	1
Loss of circumduction	1
Loss of radial deviation <15%	1
Loss of palmar flexion <30*	1
Loss of pronation <50*	2
Loss of supination <50*	2
Loss of ulnar deviation<15*	3
Loss of dorsiflexion <45*	5
COMPLICATIONS	
Arthritic changes	
No changes	0
Minimum	1
Minimum with pain	3
Moderate	2
Moderate with pain	4
Severe	3
Severe with pain	5
nerve complications	1-3
poor finger function due to cast	1-2
The overall scoring was graded as follows: excellent= 0 – 2, good= 3 – 8, fair= 9 – 20 and poor= 21 & above	

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Results:

Total 40 cases admitted in PIMS, RMC were considered for the study. The following observations were made from the data collected during the study and the data was tabulated as follows. Out of 40 cases, 20 were males and 20 were females. In this study, right sided fractures were commoner than the left sided fractures. History of fall was main cause of injury. Fernandez type I was the commonest fracture pattern in our study. One patient had associated injury calcaneum fracture.

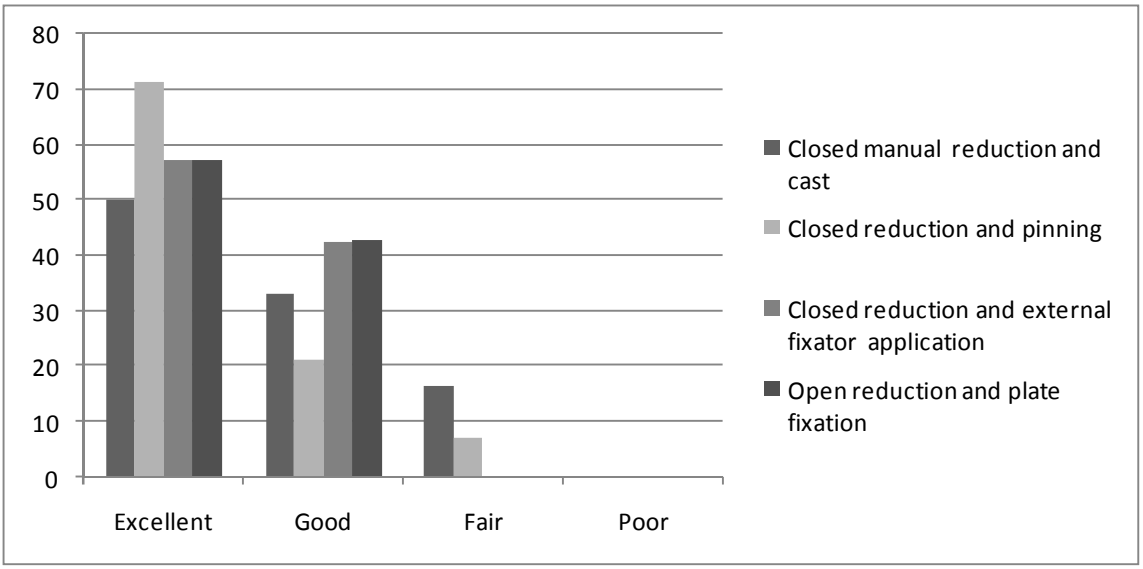

Fig 5: Result at final follow up

OBSERVATION CHART

Sr. No.	Names	Age	Sex	Side	MOT	Classi-fication	Modality	DF	PF	RD	UD	PRO	SUP	LOP	RS	LORD	AER	RER	Complication
1	FP	55	M	L	Fall	I	CMRC	70	75	20	30	75	80	0	0	0	Excellent	0	-
2	YU	52	F	R	Fall	I	CMRC	70	70	20	30	70	80	0	0	1	Excellent	0	-
3	PR	45	F	R	Fall	I	CMRC	70	70	20	30	70	75	0	1	3	Excellent	0	-
4	MP	75	M	R	Fall	I	CMRC	70	65	20	25	65	75	0	1	3	Excellent	0	SORE
5	OG	40	M	R	Fall	I	CMRC	65	60	15	25	65	75	0	2	4	Excellent	0	-
6	ST	60	M	L	Fall	I	CMRC	60	60	15	20	65	60	0	2	4	Excellent	0	-
7	DB	40	F	L	Fall	I	CMRC	60	55	15	20	60	60	2	3	5	Good	1	-
8	MT	57	F	R	Fall	I	CMRC	55	50	15	20	60	60	2	5	6	Good	2	SORE
9	GV	65	F	R	Fall	I	CMRC	50	50	15	20	55	60	3	5	8	Good	3	-
10	VW	62	F	R	Fall	II	CMRC	50	45	15	20	55	55	4	6	9	Good	3	-
11	SM	61	M	L	Fall	I	CMRC	45	40	15	15	55	50	14	8	10	Fair	5	-

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12	RG	59	M	R	Fall	II	CMRC	45	40	10	10	55	50	11	9	10	Fair	6	-
13	TT	60	F	R	Fall	I	PP	70	75	20	30	70	75	0	0	1	Excellent	0	-
14	NJ	50	M	R	Fall	I	PP	70	70	20	30	70	75	0	0	1	Excellent	0	-
15	DM	50	M	R	Fall	II	PP	70	70	20	25	65	70	0	0	2	Excellent	0	PL
16	BG	55	M	R	Fall	I	PP	65	65	15	25	65	70	0	1	2	Excellent	0	-
17	AG	62	F	L	Fall	I	PP	60	65	15	25	60	65	0	1	2	Excellent	0	-
18	YS	47	F	L	Fall	I	PP	60	60	15	25	60	65	0	1	4	Excellent	0	-
19	SK	51	F	L	rta	II	PP	55	55	15	25	55	65	0	1	4	Excellent	0	PL
20	SK	56	F	R	rta	II	PP	55	40	15	20	55	60	0	2	4	Excellent	0	-
21	CR	42	M	L	rta	II	PP	55	40	15	20	55	60	0	2	4	Excellent	0	
22	HS	57	M	R	rta	I	PP	45	40	10	20	50	55	0	2	4	Excellent	0	-
23	JM	40	F	R	Fall	II	PP	50	35	10	10	50	55	2	4	6	Good	2	PL
24	SP	62	F	R	Fall	II	PP	50	35	10	10	50	50	4	5	8	Good	3	
25	MB	64	M	R	Fall	II	PP	40	35	10	10	50	50	4	5	8	Good	3	-
26	KD	40	F	R	Fall	I	PP	40	30	10	10	50	50	12	9	12	Fair	5	-
27	MD	60	F	R	Fall	III	EF	70	70	20	30	70	80	0	0	1	Excellent	0	PTI
28	SS	30	M	L	rta	III	EF	65	60	15	25	70	75	0	1	2	Excellent	0	-
29	PM	49	M	R	rta	II	EF	65	55	15	20	70	70	0	1	4	Excellent	0	-
30	AK	40	F	L	rta	V	EF	55	45	15	15	65	65	2	3	6	Good	2	-
31	DD	20	F	R	Fall	III	EF	50	40	10	10	65	60	2	5	8	Good	3	-
32	BG	54	M	L	rta	V	EF	50	30	10	10	50	55	4	5	8	Good	3	PTI
33	SM	42	F	R	Fall	III	EF	45	35	10	10	50	50	4	6	9	Good	3	-
34	GJ	53	M	R	rta	III	PL	70	70	20	30	70	75	0	0	1	Excellent	0	-
35	LM	40	F	R	Fall	III	PL	70	60	15	25	65	70	0	1	1	Excellent	0	-
36	NK	52	M	R	rta	V	PL	65	70	15	25	65	70	0	2	2	Excellent	0	-
37	SD	24	F	L	rta	III	PL	65	65	15	20	65	65	0	2	4	Excellent	0	-
38	SM	54	M	R	Fall	II	PL	55	45	10	10	60	55	3	4	7	Good	2	-
39	RK	63	M	R	Fall	II	PL	45	40	10	10	55	55	2	6	8	Good	3	-
40	RS	36	M	R	Fall	II	PL	40	40	10	10	40	50	4	6	8	Good	3	-

Table 4: – observation table M- male, F- female, rta- road traffic accident, CMRC- closed manual reduction and cast, PP- percutaneous plating, EF- external fixator, PL- open reduction and plate fixation, MOT- mechanism of trauma, UD- ulnar deviation, RD- radial deviation, PF- palmer flexion, DF- dorsiflexion, PRO- pronation, SUP-

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supination, LOP- lss of palmer tilt, RS- radial shortening, LORD- loss of radial deviation, AER- anatomical end result, RER- radiological end result, SORE- plaster sore, PL- pin lossening, PTI- pin tract infection.

Discussion:

Fractures of distal radius are commonly encountered in orthopaedic practice[1]. Many studies suggest the direct relation anatomic result and functional outcome. The main aim in treating these fractures is anatomical reduction and early mobilization[13-17]. To achieve these aims, several options are available. Most distal radius fractures, including those are intrarticular; do not require Open reduction and plate fixation to restore joint anatomy. Using classical principles of closed manual reduction and alignment[18] can be maintained by immobilization with spica cast, percutaneous pins or external fixator[19]. However there are significant group of fracture caused by high energy trauma that requires Open reduction and plate fixation. Amongst the benefits of plate fixation is the direct visualization of fracture and fixation and also that it shortens immobilization period and speedy functional recover[20].

In our study, mean age of cases was 50.6 years. This shows that distal radius fracture is common in geriatric age group. Though, the incidence of distal radius fractures is increasing in the younger age group. W P Cooney, in his study of 65 patients of unstable Colles' fracture found that 50 patients sustained injury due to fall on outstretched hand. 6 patients sustained a motor vehicle accident. No specific mechanism of injury was recorded in 4 patients[21]. In our study, 27.5% of the patients sustained distal radius fracture following RTA. 72.5% of patients were injured following fall on out stretched hand. This leads us to conclude that self-fall as the major cause for distal radius fractures. All patients were followed for a minimum period of 6 months. For each visit, patient was evaluated clinically and radiologically and the final results were analysed. Despite wide spread enthusiasm for plating, current literature does not demonstrate the clear benefit of plating. When a fracture is well reduced either technique will provide similar good results. In this study 30% of the patients were treated by closed manual reduction and cast, 35% by closed reduction and pinning 17.5% each by external fixator and Open reduction and plate fixation.

A number of studies have reported favorable results with external fixation, although most of the studies were retrospective and, thus are difficult to interpret due to the heterogeneous group of patients with a variety of skeletal and soft tissue injuries. In a study by Jesse B. Jupiter[22], the incidence of complications was high ranging from 20 to 60%[23]. The complications included infection of pin track, radial sensory neuritis, reflex sympathetic dystrophy, stiffness of the wrist and fracture through the pin sites. Although improved techniques of insertion of pins, pre-drilling have reduced the problems related to pins, the potential for wrist stiffness still remains a concern. In a landmark study in 1979, Cooney et al, reported only a slight loss of motion in patients who were followed for two years or more[23].

Conclusion:

In our study, 40 patients fracture of distal end radius treated by various modalities September 2013 to September 2014 at Pravara Rural Medical College and Hospital, Loni.

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We have concluded:-

1. Fracture of distal end of radius is one of the commonest fractures occurring in all age groups. The youngest patient in our study is 18 years of age, while the eldest is of 75 years, with the mean age being 50.6 years.
2. It is common in females more than 60 years of age, suggestive of postmenopausal osteoporosis.
3. Fall is still the common mode of injury than road traffic accident. Among which females were more common in sustaining this type of fracture, due to domestic fall, while road traffic accident was common in males.
4. From Fernandez classification, we have concluded that bending type of injury is most common, followed by shearing and compression type.
5. Among the modalities of treatment, operative treatment gives excellent results than non-operative method.
6. Closed manual reduction and cast application modality gives good functional results in undisplaced, extra-articular distal radius fractures, but at a later stage. It has given poor results in displaced extra- articular, and in intra-articular fractures.
7. Among the operative treatment, percutaneous pinning has given us excellent results in displaced extra-articular fractures and intra-articular fractures where the radial styloid is the major fragment.
8. External fixator has given us good results by the principle of ligamentotaxis in complex fractures sustained by high velocity injuries. Though anatomical results were good and functional results were delayed due to prolong immobilization of wrist in external fixator.
9. Open reduction and internal fixation with plates and screws in our study has given excellent anatomical and functional results in displaced extra-articular, intra-articular and complex fractures sustained by high velocity trauma. With this treatment modality the patient can start mobilization of wrist immediately after surgery, and attain full range of motion in 6 weeks post-operatively, with no loss of grip strength.

Hence, to achieve good anatomical reduction and stable fixation and for early functional recovery with negligible complications we recommend open reduction and internal fixation treatment modality is best suited among others.

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