DISSERTATION ON

SHORTTERM COMPARATIVE STUDY OF EXTERNAL FIXATION VERSUS VOLAR LOCKING COMPRESSION PLATE IN THE TREATMENT OF UNSTABLE DISTAL RADIUS FRACTURES

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CERTIFICATE

This is to certify that this dissertation entitled "**SHORTTERM COMPARATIVE STUDY OF EXTERNAL FIXATION VERSUS VOLAR LOCKING COMPRESSION PLATE IN THE TREATMENT OF UNSTABLE DISTAL RADIUS FRACTURES** *submitted by* ***Dr. S.RAJASEKARAN*** *appearing for Part II, M.S. Branch II - Orthopaedics degree examination in March 2010 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfilment of regulations of The Tamil Nadu Dr. M.G.R. Medical University, Chennai.*

I forward this to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India.

Prof. MAYIL VAHANAN NATARAJAN
M.S.Ortho., M.Ch. Ortho (Liverpool) .Ph.D. (Orthopaedic Oncology).,
D.Sc.,FAMS.,FRCS(Eng)
Director ,Institute of Orthopaedics and Traumatology
Madras Medical College &
Government General Hospital
Chennai- 600 003

DEAN,
Madras Medical College,
Govt. General Hospital,
Chennai - 600 003.

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FIGURE 16: ILLUSTRATIVE CASE 1

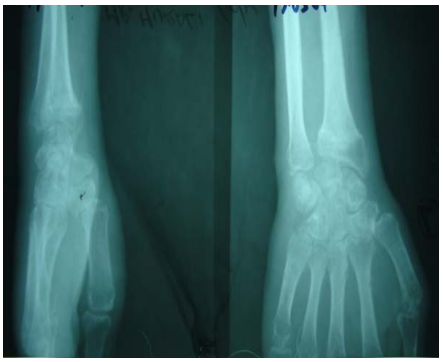
Pre operative

Post operative

Ex-fix in situ

6 months follow up

Good consolidation

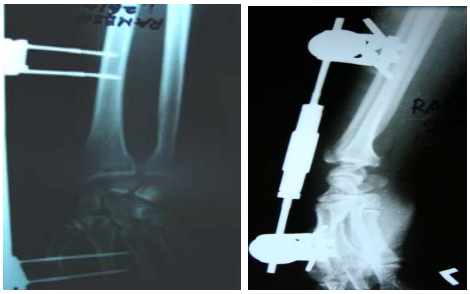


Functional movement

FIGURE 17 : ILLUSTRATIVE CASE 2

Pre operative

Post operative
Ex.fix in situ



10 M0NTHS FOLLOW UP
Good consolidation

Functional movements

FIGURE 18 :ILLUSTRATIVE CASE 3

Pre operative **Post operative**

10 months follow up : Good consolidation

Functional movements

FIGURE 19:ILLUSTRATIVE CASE 4

Pre operative **Post operative**




6 months follow up **movements**



Pin tract infection

FIGURE 20: ILLUSTRATIVE CASE 5

Pre operative **Post operative- Volar LCP**

10 months follow up : Functional Movements - wrist stiffness

Good consolidation

INTRODUCTION

Distal Radius fractures account for 14% of all extremity fractures, and 17% of all fractures treated in emergency department. As life expectancy increases, the incidence of distal radius fractures can be expected to increase as well[7].

There appears to be a Bimodal distribution of distal radius fractures consisting of a younger group who sustains relatively high energy trauma to the upper extremity and an elderly group who sustains both high energy and low energy injuries. In older age groups ,more women are affected than men. The majority of fracture in older population are due to fall , while in younger these fractures are due to motor vehicle accidents.

Over past 20 years more sophisticated internal and External fixation technique[6] , and devices have been developed. Specifically the use of percutaneous pin fixation , External fixation devices that permit distraction and palmar translation , Low profile internal fixation plates with locking screws ,and arthroscopically assisted reduction have improved the management of distal radius fractures[8].

AIM OF THE STUDY

This prospective study was to compare the clinical , functional and radiological outcome of two groups of patients treated by External fixation with supplementary ‘K’ wire fixation and by Volar locked plating for a Unstable distal radius fractures.

HISTORICAL REVIEW

467-300 BC	:	Hippocrates diagnosed distal radius fracture as dislocation of wrist
1783	:	Pouteau described this fractures
1814	:	Abraham colles clinically diagnosed and treated with closed manipulation
1847	:	Barton described anatomy of Colles fracture
1850	:	Mathjrem described Plaster application
1898	:	Beck & Cottan described displacement pattern
1908	:	First pinning for Radial styloid fractures
1928	:	Bohler published his results using reduction by Longitudinal fixed traction
1934	:	Anderson used External fixators
1939	:	Nissen – Lie classification system introduced
1951	:	Gartland & Werely classification system published
1965	:	Ellis used buttress plates for Barton's fractures
1967	:	Frykman introduced classification system
1975	:	Stein &Katz modified pinning technique
1976	:	Lorttaxt & Jacob described radial styloid pinning & fixation of posteromedial fragment

1976	:	Kapandji introduced intra focal pinning technique
1978	:	Jaques vidal coined Ligamentotaxis
1984	:	Melone introduced classification
1990	:	Lc-Dcp introduced
1993	:	Mayo introduced his classification
2000	:	Locking compression plates introduced

HISTORY OF PLATING:

The date that a bone plate was first used on bone is reported to be 1565 (300 years before general anesthesia). That plate was used to repair a cleft palate and was made out of molded gold. The late 1880's brought the next major change in bone plating; surgeons began burying the bone screws below the skin. There were many designs and ideas that developed over the next 70 years. Unfortunately, malunions, nonunions and bone infections were issues due to lack of sterile techniques, and bone plates that were biomechanically unable to provide rigid fixation. Robert Danis (1880-1962) developed the ideas of compression plating and experimented with many different designs during his lifetime. Modern bone plating started in the 1950's when a group of 15 surgeons lead by Maurice Muller formed AO/ASIF (Albeitgemeinshaft fur osteosynthenfragen/ Association for the study of internal fixation) to

improve the principles of bone plating. AO remains purely a medical organization to advance the study of fracture treatment while Synthes is the commercial arm of the AO.

The original plates had round holes. If compression was needed for the fracture, a separate device was needed to accomplish this. The Dynamic Compression Plate (Fig.9) (DCP was introduced in 1969 and was the standard AO plate until a few years ago. The holes are shaped like an inclined and transverse cylinder. The screw head can slide down the incline when tightened in a vertical direction. The horizontal force of the screw head as it impacts the side of the angled hole results in movement of the bone fragment.

In an effort to balance rigid fixation and preservation of blood supply to the bone, the Limited Contact Dynamic Compression Plate (LC-DCP) (Fig.10) was developed and released in 1990. The plate had many design features that improved the biomechanics and use of the plate such as, thinner design while maintaining equal stiffness at the screw hole interface and between them, better hole design and of course the ability not to contact the periosteum in between the holes. At the same time when this plate was released, surgeons were looking for methods to place plates that did not require large muscle dissection and therefore

destruction of the blood supply to bone (MIPO -minimally invasive plate osteosynthesis). Systems such as the Less Invasive Stabilization System (LISS) , Point Contact Fixator (PC-Fix) and Schuhlis systems used principles of external fixation, internally and locking technology theory. What resulted in 2000 was the Locking Compression Plate (LCP) (Fig.11) with a Combi hole so that the techniques of conventional and locked screw technology could be used in one plate.

The original AO principles were:

- Anatomic fracture reduction & fixation (as we know not always possible).
- Rigid fracture stability (not always possible).
- Preservation of blood supply through careful soft tissue approaches and fracture reduction techniques (sometimes the blood supply is damaged from the injury).
- Early return to function of the plated limb (difficult in veterinary patients to control the amount of use).

With the understanding that not all fractures can be reconstructed, the "rules" have been somewhat modified to:

- Long bones must have axial re-alignment but not necessarily anatomic perfection. Anatomic reduction is still necessary for joints.

- Appropriate construct stability to ensure fracture healing via direct or indirect healing.

- Atraumatic approaches and fracture reduction or minimally invasive approaches.

- Early return to mobility.

Fractures can and will heal under both conditions but that is if the appropriate condition is chosen for the appropriate fracture situation!

APPLIED ANATOMY

The distal aspect of radius functions as articular Foundation of the wrist joint .At the metaphyseal flare ,the thickness of Cortical bone decreases and the amount of cancellous bone increases, Predisposed to fracture[7].

Articular surface : (Figure 1)

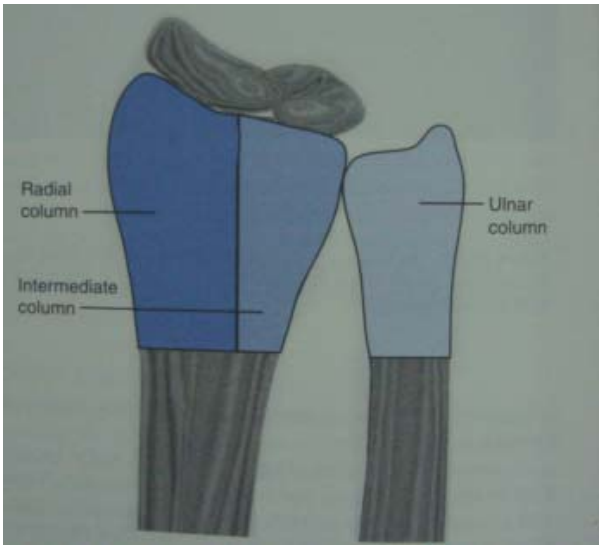
It has three concave surfaces

1.Scaphoid fossa

2.Lunate fossa

3.Sigmoid fossa

Figure 1: Three column of articular surface



Lateral column is an osseous buttress for the carpus and is an attachment point for intracapsular ligaments .Due to the radial Inclination of 22degrees ,impaction of the scaphoid on the articular surface Results in a shear moment on radial styloid causing failure laterally at radial Cortex[8].

The Intermediate column functions in primary load transmission. It consists of lunate fossa & sigmoid notch.This column is important for articular congruity & Distal radioulnar joint function.

The medial column (ulnar) column serves as an axis for forearm and wrist rotation as well as a post for secondary load transmission. .It includes the Triangular Fibro Cartillage Complex(TFCC) & Ulno carpal ligaments.

Distally the radius has a somewhat trapezoidal space.

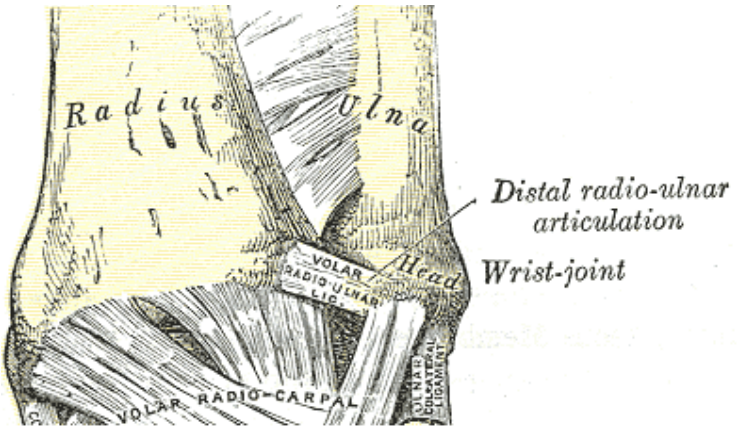
The dorsal approach is difficult,because the styloid rotates palmarly 15 degrees off the axis of the radius[14].

Supporting ligaments arising from dorsal surface include (Figure 2B)

1.Radioscaphoid ligament

2.Radio triquetral ligament

Figure 2A: Shows Ligaments of distal radius



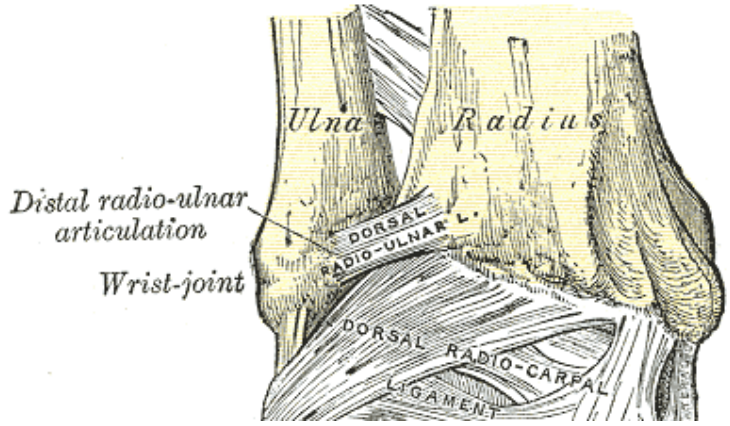


Figure 2B

Ligaments arising from palmar aspect(Figure 2A)

1.Radial collateral ligament

2.Radiocapitate

3.Radiotriquetral

Triangular fibro cartilage complex:

Extends from the rim of sigmoid notch of radius to ulnar styloid process .The thickened dorsal and volar margins of Triangular fibro cartilage complex became the dorsal and volar radioulnar ligaments.

In addition to the extrinsic ligaments , the scapho lunate, interroseous and lunotriquetral ligaments maintain the scaphoid, lunate, and triquetrum in a smooth articular unit that comes into contact with distal aspect of radius and Triangular fibro cartilage complex.

Only the brachioradialis tendon inserts on to the distal aspect of radius .The other tendons of wrist pass across the distal aspect of radius to insert onto the carpal bones or bases of metacarpals.

Blood supply to distal radius:(Figure 3)

It is mainly from Anterior Interroseous Artery and Radial artery. The ulnar artery& Posterior interroseous artery are involved Only indirectly via the anastomosis between the carpal arteries.

As for all long bones the vascularity arises from three sources, mainly Nutrient artery, Metaphyseal artery and Periosteal plexus.

Anterior interroseous artery plays important role and mainly covers anterior And medial aspect of distal radius.Radial artery supplies the posterolateral aspect and lateral part of anterior aspect of distal radius . Small musculoperiosteal branches arise distal to pronator teres from radial artery to supply the FPL & Pronator quadratus. These branches pass across the radial attachments of muscles to vascularise the postero

and anterolateral aspect of radius and communicates with the musculoperiosteal branches of Anterior interroseous artery.

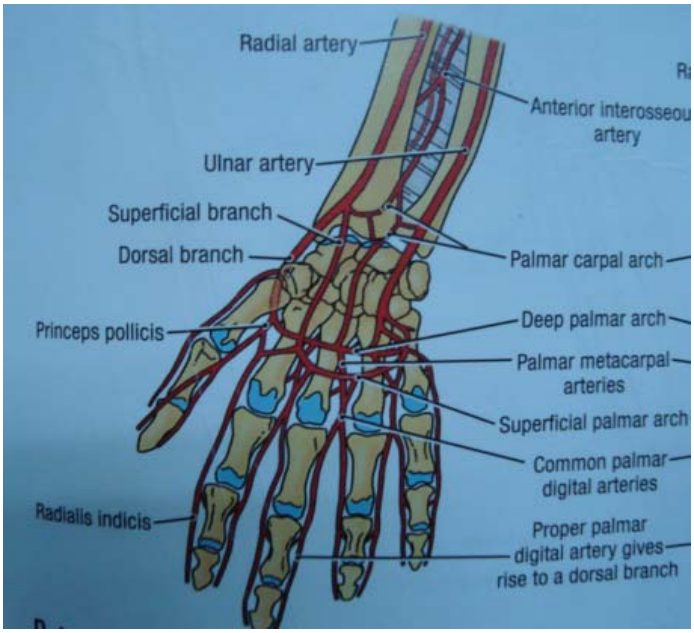


Figure 3: Arterial supply of wrist & fingers

BIOMECHANICS[7] OF DISTAL RADIOULNAR JOINT

Anatomically , the ulna is stable axis of rotation of the forearm around which the radius moves.If there is a dislocation , it is technically the radius that displaced dorsally or palmarly with respect to the ulna.The distal radioulnar joint has both rotational and translational components of motion and does not have a single center of rotation.Four structures play main role in stabilizing the distal radio ulnar joint in different positions of forearm rotation[7].

They are 1. Dorsal radioulnar ligaments

2.Palmar radioulnar ligaments

3.Pronator quadrates

4.Interosseous membrane

The palmar ligaments become maximally tightened and stabilize the joint in forearm supination, whereas the dorsal ligaments become maximally tightened and stabilize the joint in forearm supination.

Fractures involving the distal radioulnar joint and the distal radius change the biomechanics of the triangular fibro cartilage complex. Incongruency of distal radio ulnar joint results with increasing dorsal tilt of distal radius.Dorsal angulation limits forearm rotation.

Compression and axial loading across the wrist are primarily transmitted to distal radius ,but the force is partially transmitted throughthe triangular fibro cartilage complex to the ulna head. As ulnar length increases from -2.5 to+2.5 mm,the load borne by distal ulna increases from 4% to 42%**.**

CLASSIFICATION OF DISTAL RADIUS FRACTURES

I. Fernandaz classification:(Figure 4)[6]

Type-I :Bending fractures-Extra articular,Metaphyseal

Type-II:Shearing-Intraarticular fracture

TypeIII: Compression –complex articular fracture

TypeIV:Avulsion fracture with radiocarpal dislocation

TypeV :High velocity injury

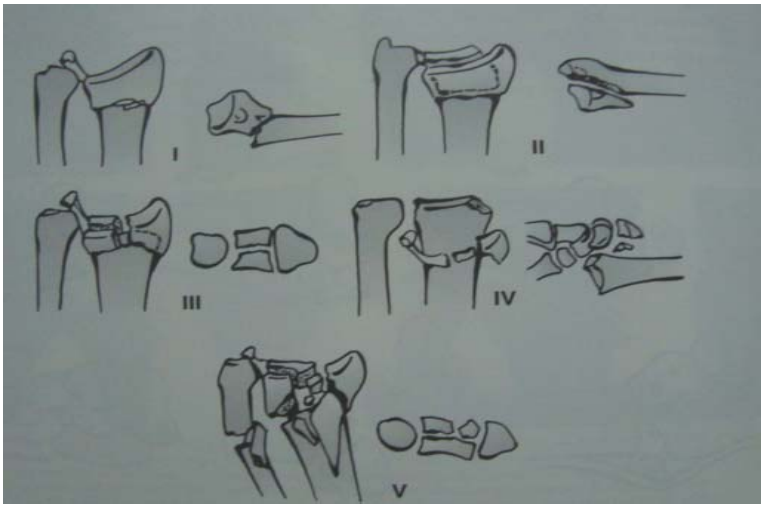


Figure 4: Fernandaz classification

FRYKMAN CLASSIFICATION: (Figure 5)

	Ulnar styloid fracture	**Ulna styloid fracture**
	ABSENT	**PRESENT**
EXTRA ARTICULAR	I	II
INTRA ARTICULAR		
RADIO CARPAL JOINT	III	IV
RADIO ULNAR JOINT	V	VI
RADIO CARPAL& RADIO ULNAR JOINT	VII	VIII

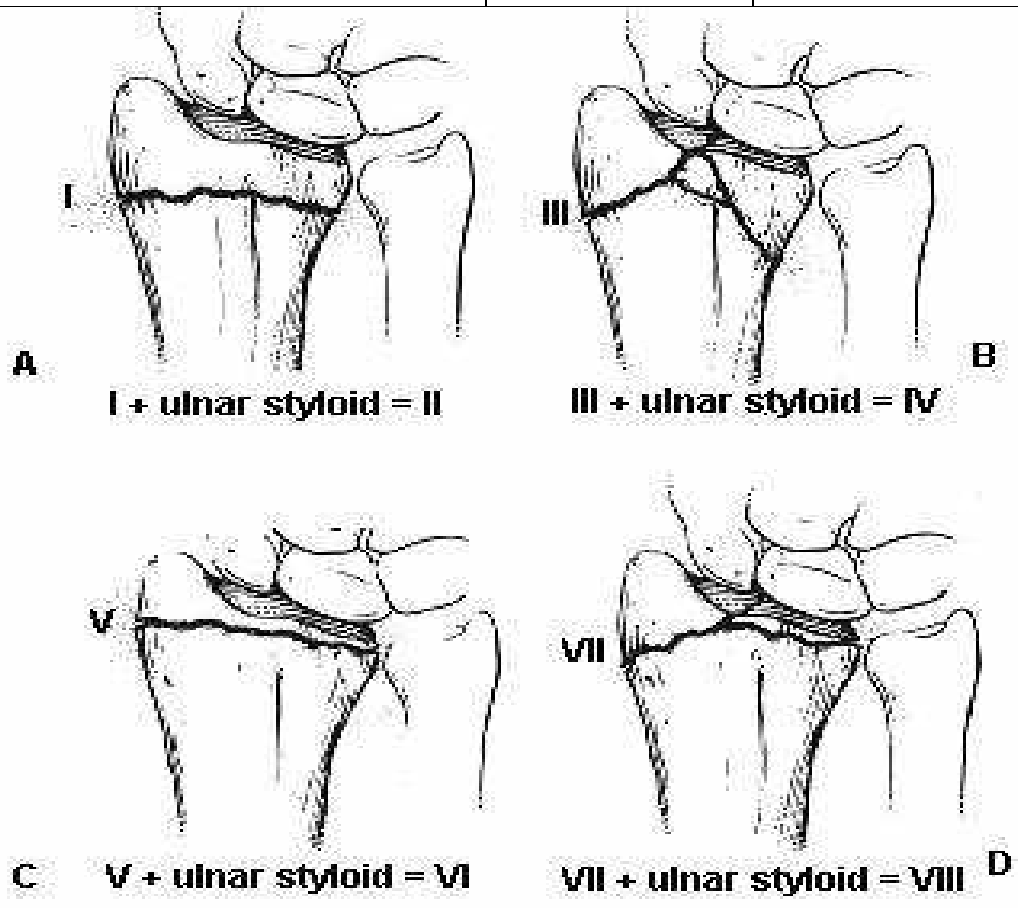


Figure 5: Frykman classification

III - Malone's :(Figure 6)

Type- I :Intra articular undisplaced

Type-II :Lunate fossa,Die punch fracture

TypeIII : A radial shaft component & previous fracture

TypeIV :Transverse fracture with articular rotation.

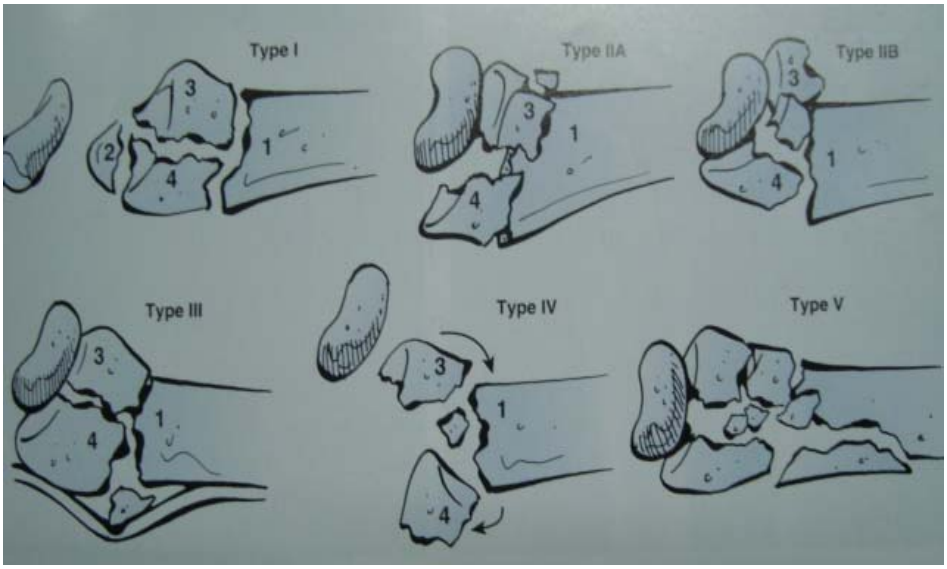


Figure 6: Malone's classification

IV- Mayo's:

Type- I :Intraarticular, Undisplaced.

Type-II :Scaphoid articular surface involvement.

Type-III: Lunate & Scaphoid notch involvement

Type-IV: Two or more articular surfaces involved.

V- Universal classification :(Figure 7)

Type I : Nonarticular, Nondisplaced

TypeII: Nonarticular,Displaced

A-Reducible,stable

B-Reducible,Unstable

C-Irreducible

TypeIII: Articular ,Nondisplaced

TypeIV: Articular, Displaced.

A-Reducible Stable

B-Reducible, Unstable

C-Irreducible.

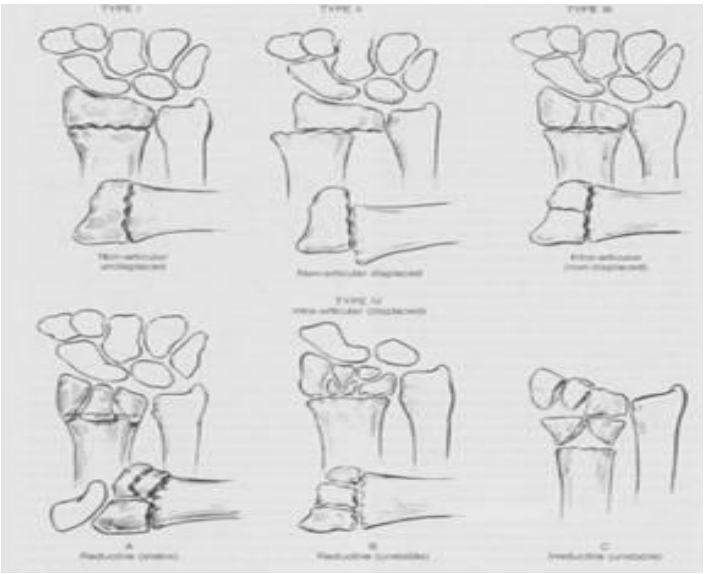


Figure 7: Universal classification

Modified AO classification:

A- Extra articular

B- Partial articular

B1-Radial styloid

B2-Dorsal rim fracture

B3-Volar rim fracture

B4- Die punch fracture

C-Completely articular

VI – Gartland & Werley Classification:(Figure 8)

Type I-A : Extra articular ,Undisplaced.

Type I-B :Extra articular,Displaced

TypeII-A :Intraarticular,Undisplaced

TypeII-B :Intra articular,Displaced

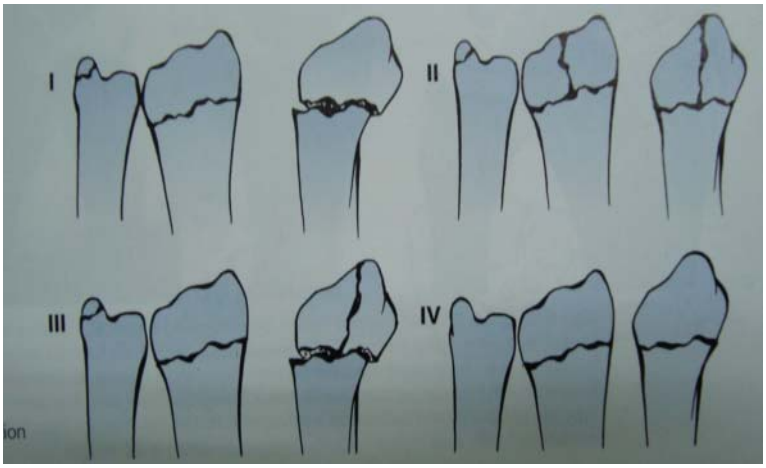


Figure 8: Gartland classification for Distal radius fracture

RADIOGRAPHIC EVALUATION[14]

Preoperative evaluation is of vital importance to successful treatment.

Following radiographic views are required to study the anatomy of fracture

1.POSTEROANTERIOR VIEW

2.LATERAL VIEW

3. OBLIQUE VIEW

Posteroanterior view allows visualization of Radial styloid Oblique view reveals intra articular involvement Lareal view reveals dorsal or volar displacement.

Important Radiographic measurements useful in analysis of outcome Are[8]

1. Volar tilt (Figure 9)- normal value 11 degrees

2. Radial inclination (Figure 10)- normal value 23 degrees

3. Radial height (Figure 11)-normal value 12mm

4.Ulnar variance(Figure12)-normal value 0 to -2mm

5.Reduction of distal radio ulnar joint.

These measurements are useful to check the reduction

In post operative period.

FIGURE 9: PALMAR TILT

NORMAL VOLAR TILT: 11 DEGREES

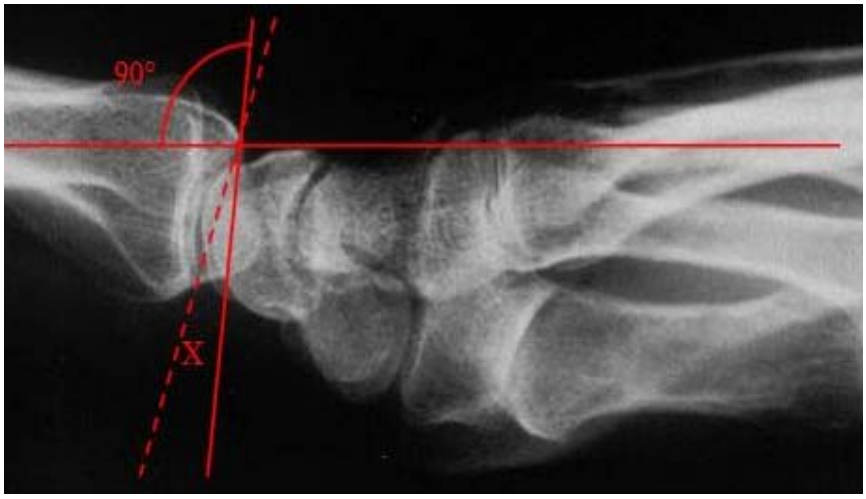


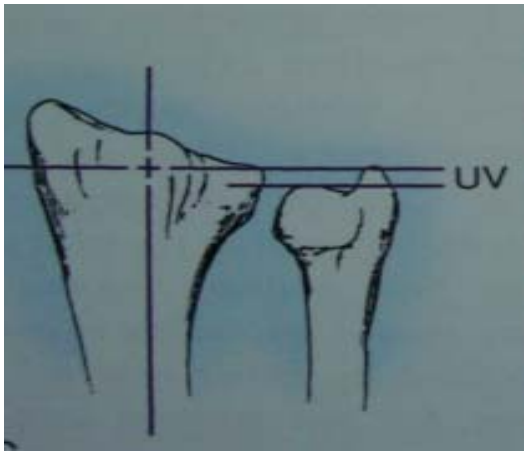
FIGURE 10: RADIAL INCLINATION NORMAL VALUE - 23 DEGREES

FIGURE 11: RADIAL LENGTH

NORMAL VALUE 12 MM

FIGURE 12 :ULNA VARIANCE

NORMAL VALUE : 0 TO -2MM



Computed tomogram (CT-Scan) : Useful in determining articular congruity, the operative approach,fracture of lunate and fractures of styloid process.

FUNCTIONAL EVALUATION [12]:

Patient is evaluated by using DASH Score (Disability Arm Shoulder Hand score) in follow up period. The patients must have good hand grip and functional movements to get reasonable score . High DASH score indicates poor outcome.

Following questionnaire are included

1.Difficulty in opening a tight jar.

2.Difficulty in doing heavy households (eg wash walls)

3.Difficulty in carrying a bag or briefcase

4.Difficulty in washing your back

5.Difficulty in recreational activities (eg hammering, tennis)

6.Interference of arm, shoulder,and hand with normal social activity

7.Interference with work pattern

8.Difficulty in using knife to cut food

9.Severity of Arm ,shoulder,or hand pain

10.Tingling (pins or needles) in arm ,shoulder or hand

11.Disturbance of sleeping due to pain.

Each one is graded from 1 to 5.

$$\text{DASH score} = \frac{(\text{sum of responces} - 1) \times 25}{n}$$

TREATMENT PROTOCOL

Various modalities of treatment available for Fractures of Distal Radius. Stable fractures are treated by closed reduction.

Unstable fractures are treated by surgical Intervention to allow early motion and rehabilitation[6].

Criterias required to diagnose Unstable fracture are[5]

1.Displaced after initial treatment with closed reduction & splinting .

2.Lagontaine criterias[16] (any of three criterias required)

A. Dorsal angulation > 20 degrees

B.Dorsal communition

C.Intraarticular fracture

D.An associated ulnar styloid fracture

E.Age of >60 years.

Closed Reduction :

It is the mainstay of treatment for

1.Non displaced fractures

2.Minimally displaced fractures

3.Bending fractures in good bone

Percutaneous pinning[5] :

Useful in

1.Displaced extra articular fractures with or without

Dorsal Communition

2.Early loss of reduction after closed reduction

3.Communited Intra articular fractures when adequate closed reduction is able to obtain but likely not maintained without additional support.

External fixation[23] :

Useful in

1.Extra articular fractures with an unstable metaphysis

2.Intra articular radial styloid fractures

3.Intra articular fractures with depression or communition

Not useful in

1.Marked metaphyseal communition

2. Volar or Dorsal Barton Fractures

Ligamentotaxis[1] :

Bridging external fixation typically relies on this principle

To obtain and maintain a reduction of fracture fragments. As longitutional Traction is applied to the carpus ,the tension is transmitted mostly through Radioscaphocapitate and long Radiolunate ligaments to restore Radial length

Complications :

The use of external fixation[24] to treat distal radius fractures has Reported complication rate from 6 to 60%. Many complications of distal Radius fractures are seen regardless of treatment, and some are directly related to treatment with an external fixator and or supplemental pins.

1.Overdistraction : Produces worse digital motion,worse functional outcome and high pain scores after fracture treatment.

2. Injury to superficial radial nerve was reported more in percutaneous half pin insertion than in open technique.

3.Pin tract infections[2] .

Internal fixation :

The ability to secure both large extra articular fragments as Well as small Intra articular fragments is necessary in many complex Fractures . Internal fixation with Ellis buttress plates or Volar locking plates Yields good results in these complex fractures[4.]

Volar locking plates are better than conventional plates [17] because

1.Works by biomechanical principle of external fixator

2.Does not require friction between plate and bone

3.Locking plates are precontoured for anatomical fit

4.Locking screws offer a fixed angle construct to support The articular surface.

5. Obtain good fixation in osteoporotic bones

Volar plate fixation is better when compare to Dorsal plating[22], because

A. More space available

B. Volar scars are better tolerated

C. Volar cortex is less communited which makes fracture Reduction easier

D. Blood supply to distal radius is less likely to be Disturbed.

Complications[3] :

1.Screw penetration into articular surface.

2.Neurovascular injury

3.Compartment syndrome.

MATERIALS AND METHODS

Prospective study of 20 cases of Distal Radius fractures at Government General Hospital from June 2008 to October 2009.

INCLUSION CRETERIAS ;

Unstable Extra or Intra articular fractures of Distal Radius were included in this study. Cases were selected in random manner. In our study following cases were selected for external fixation:

1. Unstable extra articular fractures (Type I Fernandaz)
2. Compression- complex articular fractures(Type III Fernandaz)

In Our study ,following cases were selected for Volar plating:

1. Unstable extra articular fractures (Type I Fernandaz)
2. Shearing fractures (Type II Fernandaz)
3. Compression- complex articular fractures(TypeIII Fernandaz)

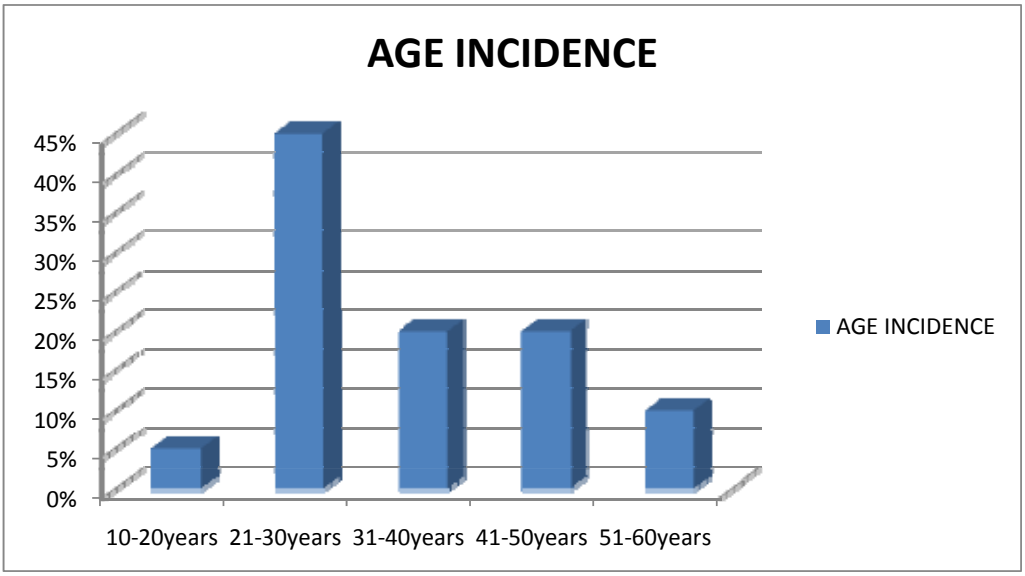
EXCLUSION CRETERIAS:

Type IV & Type V Fernandaz types of Distal Radius Fractures. Compound injuries are excluded from the study. Elderly people & osteoporotic fractures were excluded.

AGE INCIDENCE :

Table 1: Age incidence

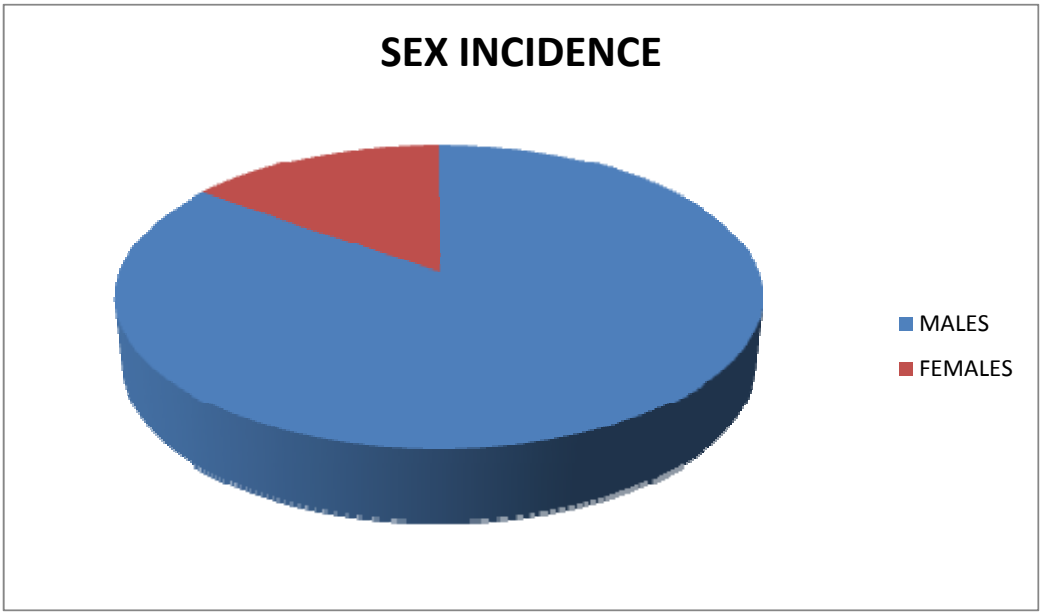
AGE	NUMBER OF PATIENTS	PERCENTAGE
10-20	1	5%
21-30	9	45%
31-40	4	20%
41-50	4	20%
51-60	2	10%
Total	20	



SEX INCIDENCE:

Table 2: Sex incidence

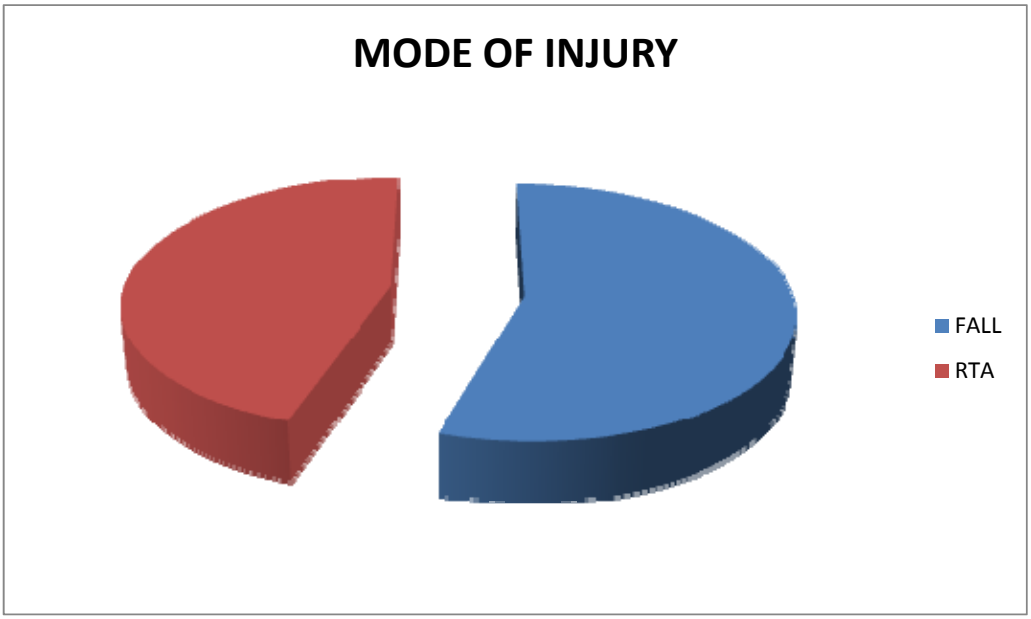
SEX	NUMBER OF PATIENTS	PERCENTAGE
Males	17	85%
Females	3	15%



MODE OF INJURY :

Table 3 :Mode of injury

MODE OF INJURY	NUMBER OF PATIENTS
Fall from height	11
Road traffic accident	9



CLASSIFICATION:

Table 4: Classification

FERNANDAZ TYPES	NUMBER OF PATIENTS
Type I	7
Type II	3
Type III	10

INVESTIGATIONS:

Clinical signs were recorded

Radiographs were taken

1.Postero anterior view

2. Lateral view

3.Oblique view

IMPLANTS & SURGICAL PROCEDURE:

All 20 cases were treated initially by closed reduction under general anaesthesia and position of fracture was checked by radiographs. All fractures in our study lost reduction after manipulation. 11 cases were randomly selected for external fixation and 9 cases were selected for internal fixation.

11 Cases were treated with external fixation devices. In 4 cases "K" wire is additionally used for maintaining reduction. External fixation was done for 5 Type I & 6 Type III (Fernandaz) cases.

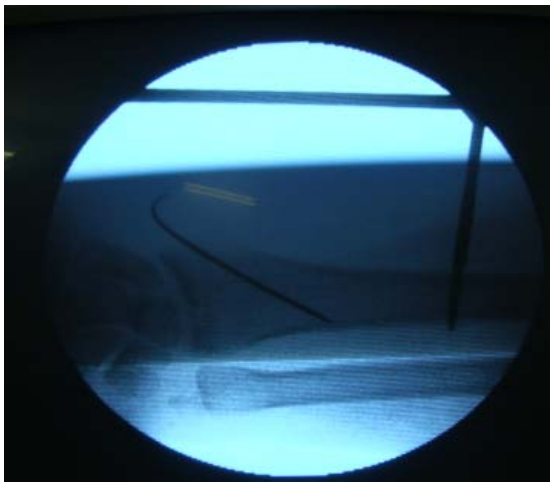
9 Cases were treated by open reduction & internal fixation with Volar locking compression plate. This was done for 2 Type I, 3 Type II and 4 Type III cases.

External fixation[24]:

4 schanz pins were used in all cases. Two Distal pins were fixed in base & shaft of second metacarpal in percutaneous technique. Two Proximal pins were inserted in the standard mid lateral position by retracting the brachioradialis tendon & superficial radial nerve in open technique to avoid injury to that tendon & nerve.

Superficial Radial nerve exit from under brachio radialis approximately 5cm proximal to the radial styloid and bifurcates into major volar and dorsal branch at a distance of 4.2 cm proximal to radial styloid. Reduction of fracture is done under C- arm(Figure 13). “K’ wires were used in 5 cases. Blood loss was around 20 ml. Post operative pain responded well analgesics

FIGURE 13:Reduction & fixation of fracture under C-arm



Post operative period :

Patient was advised finger ,elbow and shoulder mobilization inimmediate post operative period[27]. Patients were treated with Intravenous antibiotics for first two weeks and oral antibiotics for further four weeks. Suture removal was done on 12th day. Pin tract care was given till the removal of fixator.

External fixator was removed at an average of 6-8 weeks after confirming the radiological union . Wrist mobilization was started after fixator removal. Patients were protected by detachable below elbow splint for two weeks after removal of fixator. They were allowed to do light works after 3 months. Heavy works were allowed after 5 months.

Volar locking plate fixation:

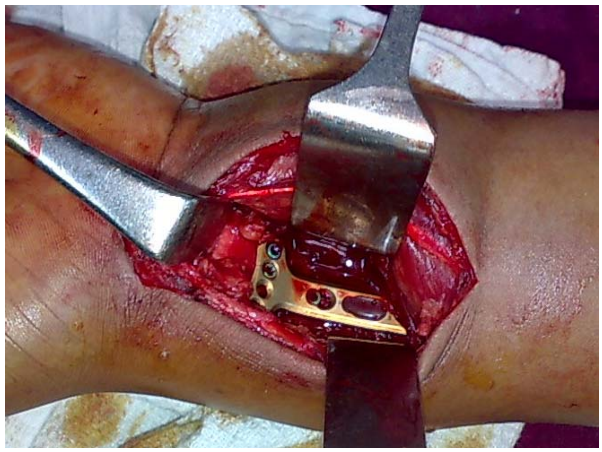
Approach : Volar Henry's approach[11] (Figure 14)

The plane between Radial artery and the Flexor carpi radialis Was exposed. Elevation of pronator quadratus from the distal aspect of Radius provides the necessary exposure for placement of locking plate.

The incision can be extended distally for release of carpal tunnel. 2.4 mm locking screws were used in distal portion and 2.7mm locking screws were used in proximal portion of plate(figure 15). Blood loss was around 200ml. Tourniquet was not used during surgery. Bone grafting was not done in our study.

FIGURE 14: shows Volar Henry's approach

FIGURE 15: shows Volar locking plate in situ



Post operative period:

Patients were protected by detachable below elbow brace for two weeks. Drain removal on second post operative day. Mobilization of wrist, finger, elbow, and shoulder was started in immediate post operative period. Suture removal was done 12 th post operative day.

Patients were treated with Intravenous antibiotics for first two weeks and oral antibiotics for further two weeks.

They were allowed to do light works like writing after 3 weeks. After 6 weeks vigorous occupational therapy was started. Patients were allowed to do heavy works after 3 months. Patients were encouraged to do mobilization exercises throughout the follow up period.

Follow up:

X-rays were taken in immediate post operative , 2weeks, 6weeks, 3 months , 6 months and 10 months. Radiological assessment at each post operative visit was done from AP and lateral radiographs and included assessment of union of fracture and loss of reduction .At six months & 10 months radiographs were observed for arthritic changes. Functional outcome measure , Disability Arm Shoulder Hand questionnaire was done at 6 & 10 months.

ASSOCIATED INJURIES:

1.One case had L1 anterior wedge compression fracture with para paresis which was treated conservatively (Case number 8 in master chart). Paraparesis improved after 6 months.

2.One patient had fracture II &III Metatarsal right foot which was treated Conservatively.(Case number: 7)

3.One patient had both bone fracture both legs which was treated surgically.(Case number :6)

OBSERVATIONS

1. In this study , majority of patients were in age group of 21-30 years.

2. Male predominance in this study.

3. Fall from height was the most common mode of injury.

4. Most of patients had Intra articular extension

5. Type III Fernandaz type is most common.

6. Mean duration of union - 6 to 8 weeks.

7. Mobilization started in immediate post op period in all Cases. Wrist mobilization was started after external fixator removal

8.Complications :

A. Two patients developed pin tract infections which was treated with Antibiotics.

B.One patient developed shoulder stiffness& decreased metacarpophalangeal joint flexion

C.Wrist stiffness in one case of volar plated group and in one case of External Fixator group.

CASE ILLUSTRATIONS

CASE NO 1 (Figure 16):

NAME	:	Murali
AGE/SEX	:	59 years /male
MODE OF INJURY	:	Fall from bike
SIDE INVOLVED	:	Left wrist
RADIOLOGICAL FINDINGS	:	Type III Fernandaz fracture
DATE OF ADMISSION	:	17.01.09
DATE OF PROCEDURE	:	18.01.09
PROCEDURE DONE	:	Closed reduction & External fixation Augmented with 'K' wires (Middle column was stabilized with 'K' Wire)
POST OPERATIVE PERIOD	:	Uneventful
FOLLOW UP	:	months follow up shows good union And good range of movements
RESULTS	:	Good

CASE NO 2:FIGURE17

NAME	:	Ramesh
AGE/SEX	:	25 years /male
MODE OF INJURY	:	Fall from height
SIDE INVOLVED	:	Right wrist
RADIOLOGICAL FINDINGS	:	Type III Fernandaz fracture with >2mm articular depression.
DATE OF ADMISSION	:	30.11.08
DATE OF PROCEDURE	:	10.12.08
PROCEDURE DONE	:	Closed reduction & External fixation
POST OPERATIVE PERIOD	:	No distraction applied
FOLLOW UP	:	10 months follow up shows good union And good range of movements
RESULTS	:	Good

CASE NO 3:FIGURE18

NAME	:	Raja
AGE/SEX	:	30 years /male
MODE OF INJURY	:	Road traffic accident
SIDE INVOLVED	:	Left wrist
RADIOLOGICAL FINDINGS	:	Type II Fernandaz fracture
DATE OF ADMISSION	:	17.11.08
DATE OF PROCEDURE	:	18.11.08
PROCEDURE DONE	:	ORIF with Volar LCP
POST OPERATIVE PERIOD	:	Uneventful
FOLLOW UP	:	10 months follow up shows good union And good range of movements
RESULTS	:	Good

CASE NO 4: **FIGURE19**

NAME	:	Balu
AGE/SEX	:	15 years /male
MODE OF INJURY	:	Fall
SIDE INVOLVED	:	Left wrist
RADIOLOGICAL FINDINGS	:	Type I Fernandaz fracture
DATE OF ADMISSION	:	15.11.08
DATE OF PROCEDURE	:	01.12.08
PROCEDURE DONE	:	Closed reduction & Ex.fix
POST OPERATIVE PERIOD	:	Pin tract infection treated with antibiotics
FOLLOW UP	:	6 months follow up shows fracture union And fair range of movements
RESULTS	:	fair

CASE NO 5:**FIGURE20**

NAME	: Vinoth
AGE/SEX	:23 years /male
MODE OF INJURY	:Road traffic accident
SIDE INVOLVED	:Right wrist
RADIOLOGICAL FINDINGS	:Type II Fernandaz fracture
DATE OF ADMISSION	:16.11.08
DATE OF PROCEDURE	:25.11.08
PROCEDURE DONE	:ORIF with Volar LCP
POST OPERATIVE PERIOD	:Uneventful
FOLLOW UP	:10 months follow up shows good union And wrist stiffness
RESULTS	:Fair

ANALYSIS OF RESULTS

Patients were evaluated with

1. Functional outcome based on DASH scoring system.

2. Radiological outcome.

3. Range of movements in wrist joint.

Results:

1. Good radiological and clinical union is evidenced at 6-8 weeks although minimal dorsal tilt was seen in one case of external fixator group

2. DASH score is higher in external fixator group than in volar plated group. In two volar plated group cases the score was higher because of fracture geomentry, improper reduction and poor compliance to physiotherapy.

3. Early improvement in range of movements in volar plated group. In the external fixator group patients had fair range of movements in initial period. But these patients gained reasonable range movements after intense physiotherapy.

4. No iatrogenic neuro vascular injury reported.

5. No post traumatic arthritis reported in our series.

6. Pin tract infection was reported in two cases.

7. Stiffness in shoulder was reported in one case of external fixator group because of poor compliance.

8. Grip strength was found to be better in volar plated group.

DETAILS	**EXTERNAL FIXATION**	**VOLAR PLATING**
1. Stiffness	Shoulder & MCP joint in one case. Wrist stiffness - one case	Wrist stiffness reported in one case.
2. Non union	Nil	Nil
3. Infection	Pin tract infection in Two cases	Nil
4. Bone grafting	Not required	Not required
5. Post traumatic arthritis	Nil	Nil
6. Union duration	6-8 weeks	6-8 weeks
7. DASH score	Fair outcome	Better outcome

RADIOLOGICAL EVALUATION	**VOLAR PLATING GROUP(range)**	**EXTERNAL FIXATOR GROUP(range)**
Radial inclination	12-19 deg	10-17deg
Radial length	7-10mm	6-10mm
Palmar tilt	8-10 deg	7-9deg
Ulna variance	-1 to1mm	0 to 1mm

DISCUSSION

The goal of surgery for unstable distal radius fracture is to Obtain and maintain an acceptable reduction and to allow restoration of Function. Achieving fracture stability is a prerequisite for attaining a satisfactory outcome for distal radius fractures.

Unstable fractures [16]are at increased risk for loss of reduction and subsequent malunion. Malunion can potentially lead to a poor functional outcome with residual pain, loss of motion, decreased endurance and grip strength, midcarpal instability, and post-traumatic arthritis .

Parameters[7] associated with an improved outcome include The minimization of post operative fracture gap, step and restoration of radial length.

Historically closed reduction has been the mainstay of Treatment .Now many treatment modalities available.Each has advantages and disadvantages. External fixation is used to maintain axial length[1] while reduction is attained by manipulation of fracture fragments with supplemental ‘K’ wires and ligamentotaxis in intraarticular and extra articular fracture patterns[26].

However , external fixation alone is limited by the inability to directly reduce intraarticular fracture fragments in complex unstable fracture patterns.

The advantages of open reduction and internal fixation include direct visualization and manipulation of fracture fragments[20] .

In this study we compared the outcome between External fixation and Volar locking plate in evaluating following parameters, namely clinical , radiological and functional outcome in Type I, Type II and Type III Fernandes fractures.

In regard to the external fixation device we used , we choose a Joint spanning construct because it could be applied in most distal fractures. In four cases we did augmentation with 'K' wires[23].

The mechanism of fracture reduction using indirect methods is ligamentotaxis of dorsal and volar capsule which realigns fracture with respect to length,inclination and tilt we prefer Volar locking plate for fixation[22] ,because in Dorsal plating there is a risk of extensor tendon irritation and rupture.There is clinical and biomechanical evidence that Volar locking plating is an improvement over dorsal ,non locked plating

for unstable fracture because of its stiffer construct and lower rates of complication.

Time period of this study is very short .Within this stipulated time ,the exact long term outcome could not be evaluated.

In our study blood loss in external fixation group was 20 ml ,but in volar locked plating cases was around 200ml.Post operative pain was equal in both groups responded well to analgesics.

In this study, we found that the external fixator is equally Effective in maitaining length when compared to volar locking plate in Type I and Type III Fernandaz . But in communited fractures external fixation had given good alignment of fracture than volar locking plate. However radiological outcome such asLength maintainence and union are equal in both groups, although in one case of external fixator group, there was minimal dorsal tilt .In Type II Fernandaz fractures external fixation is not much effective , volar plating had been done .

Patients who received volar plate fixation had better palmar flexion and radial deviation than those treated with external fixation device at 6 and 10 months follow up.Improved wrist movements was demonstrated early in volar locking plate group.This is because volar plated group was

mobilized in immediate post operative period than the external fixator group in whom wrist mobilization started after fixator removal. However these patients needed close monitoring vigorous physiotherapy [27]than in volar plated group. If these patients failed to come or in doing physiotherapy , the movement restriction was severe.

Functional outcome[25] is assessed by DASH scoring system. DASH score is better in volar locked patients than in external fixation group Patients. In two patients who undergone volar locked plates had high DASH score due to inadequate surgical reduction, poor fracture Geomentry and poor compliance to physiotherapy. Currently there is little information on a direct comparision of external and volar locking plating.

Wright, Horodyski and Smith[28] retrospectively resported 21 Patients who had been treated by a Volar locked plate and compared them With 11 patients who had been treated by External fixation. In this study, there was no functional difference between the two groups, but good radiological outcome were reported with volar loking plated group.

Egol, Walsh, Tejwani et al conducted a prospective randomized study in 88 cases[9].Although the patients treated by volar plating had statistically significant early improvement in the range of movement of wrist , this advantage diminished with time and in absolute terms the

difference in range of movement was clinically unimportant. At one year radiological, clinical and functional outcome were similar in two groups. No clear advantage could be demonstrated with either treatment, but fewer reoperations were required in external fixator group ,according to their study.

In our study , Although the External fixation group regain the movements a after vigorous physiotherapy ,the early recovery and movement in volar locked plating group gives better working capacity and yielded good functional outcome. Although Two groups in our study have shown similar radiological and clinical outcome, the functional outcome which was evaluated by DASH scoring system is better in volar plated group patients than in external fixator group.

This evidence indicates that locked volar plates may be advantageous for a patient who desires an accelerated return of function.

CONCLUSION

- External fixation or Internal fixation with volar locking plate yield better radiological and clinical outcome in unstable distal radius fracture in a short term follow up of 10 months.

- The movements in conventional External fixation improves with intense physiotherapy after period of 6-8 weeks (early immobilization period) in our cases.

- Use of locked volar plate predictably yields better patient reported outcome as per DASH score and allows earlier range of wrist motion which yields accelerated return of function.

MASTER CHART

SL NO	NAME	AGE/SEX	IP.NO	D.O.A	D.O.S	MODE OF INJURY	DIAGNOSIS	SURGERY	COMPLICATIONS	DASH
1	VINOTH	23/M	85378	16.11.08	25.11.08	RTA	TYPE II	ORIF-LCP	WRIST STIFFNESS	27
2	RAJA	30/M	85851	17.11.08	18.11.08	RTA	TYPE II	ORIF-LCP	NIL	15
3	PERUMAL	45/M	86938	19.11.08	20.11.08	FALL	TYPE III	EX.FIX	NIL	38
4	BALU	15/M	85285	15.11.08	01.12.08	FALL	TYPE I	EX.FIX	PIN TRACT INFECTION	34
5	SHYAM	23/M	89887	03.12.08	03.12.08	RTA	TYPE I	EX.FIX	WRIST STIFFNESS	54
6	MANI	35/M	77685	19.10.08	23.10.08	FALL	TYPE I	EX.FIX	NIL	41
7	RAMESH	25/M	88937	30.11.08	10.12.08	FALL	TYPE III	EX.FIX	NIL	21
8	MARIMUTHU	45/M	91483	11.12.08	29.12.08	FALL	TYPE III	EX.FIX	NIL	45
9	RAMU AMMAL	45/F	11582	11.02.09	11.02.09	FALL	TYPE III	EX.FIX	SHOULDER STIFFNESS	29

10	MURALI	59/M	3672	17.01.09	18.01.09	FALL	TYPE III	EX.FIX	NIL	32
11	RAMALINGAM	46/M	94714	20.12.08	21.12.08	RTA	TYPE I B/L	EX.FIX	NIL	44
12	MADAV DOSS	28/M	19586	11.03.09	11.03.09	FALL	TYPE III	EX.FIX	NIL	50
13	PONNARASU	23/M	6963	27.01.09	28.01.09	RTA	TYPE I	ORIF-LCP	NIL	10
14	REVATHY	24/F	12588	25.02.09	12.03.09	RTA	TYPE III	ORIF-LCP	NIL	35
15	LOGENTRAN	30/M	36569	12.05.09	02.06.09	RTA	TYPE II	ORIF-LCP	NIL	33
16	RAVEENDRAN	51/M	19286	04.03.09	05.03.09	RTA	TYPE III	ORIF-LCP	NIL	14
17	SELVI	35/F	89851	03.12.08	03.12.08	FALL	TYPE I	EX.FIX	PIN TRACT INFECTION	47
18	SATHYA	27/M	78751	01.09.08	02.09.08	FALL	TYPE III	ORIF-LCP	NIL	13
19	ARUL MURUGAN	31/M	19388	14.03.09	15.03.08	RTA	TYPE I	ORIF-LCP	NIL	12
20	KUMAR	28/M	6872	13.01.09	14.01.09	RTA	TYPE III	ORIF-LCP	NIL	10