"A PROSPECTIVE STUDY OF SURGICAL MANAGEMENT OF DIAPHYSEAL FRACTURES OF BOTH BONES OF FOREARM USING LIMITED CONTACT DYNAMIC COMPRESSION PLATE"

By

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Dissertation submitted to

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

ORTHOPAEDICS

Under the guidance of

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2015

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I hereby declare that this dissertation entitled **"A PROSPECTIVE STUDY OF SURGICAL MANAGEMENT OF DIAPHYSEAL FRACTURES OF BOTH BONES OF FOREARM USING LIMITED CONTACT DYNAMIC COMPRESSION PLATE"** is a bonafide and genuine research work carried out by me under the guidance of **DR. O.B. PATTANASHETTY,** Professor and HOD, Department of Orthopaedics, Shri. B.M. Patil Medical College, Hospital and Research centre, Vijayapur.

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ABSTRACT

BACKGROUND AND OBJECTIVES:

The forearm has a unique surgical anatomy and this leads to problems in treatment of forearm fractures such as achieving primary osseous union and restoration of normal function. Open reduction and internal fixation with a plate is the treatment of choice. This study is to analyse the functional outcome of ORIF with LC-DCP in diaphyseal fracture of forearm in adults.

METHODS:

The present study includes treatment of 28 cases of fracture of both bones of forearm with 3.5 mm LC-DCP between October 2013 and April 2015 at the Department of Orthopaedics in B.L.D.E.A's Shri B.M.Patil Medical College, Hospital and Research Center, Vijayapur. Adults, both males and females above the age of 18 were included in the study whereas patients medically unfit for surgery were excluded.

RESULTS:

In our study, fixation of fracture of both bones of forearm with LC-DCP showed excellent results and functional outcome (75%) with very less complications.

CONCLUSION:

Open reduction and internal fixation of fractures of both bones of forearm with a 3.5mm LC-DCP is an excellent choice as it provides stable fixation and good compression at fracture site. Adherence to principle of fracture fixation, strict asepsis and early rehabilitation are key to early functional recovery while treating these fractures.

KEYWORDS:

Open reduction and internal fixation, limited contact dynamic compression plate, fracture of both bones of forearm

LIST OF ABBREVIATIONS

DOA	-	Date of admission
M	-	Male
ROM	-	Range of movement
F	-	Female
DOA	-	Date of admission
DOD	-	Date of discharge
R	-	Right
RTA	–	Road traffic accident
L	-	Left
Med	-	Medial
Lat	–	Lateral
INF	-	Infection
CR	-	Closed reduction
ORIF	-	Open reduction and internal fixation
F/U	-	Follow up
WK	-	Weeks
EV	-	Elevation
DOM	–	Domestic
Fig.	-	Figure
DCP	-	Dynamic compression plate
LCDCP	-	Limited contact dynamic compression plate
LCP	-	Locking compression plate
IOM	-	Interosseus membrane

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INTRODUCTION

The forearm has an important role in the functioning of the upper extremity, facilitating positioning of the hand in space thus providing the upper limb with unique mobility[1]. The dexterity of the upper limb depends on a combination of hand and wrist function and forearm rotation.

Fractures of forearm bones can lead to severe loss of function, if inadequately treated. Exacting and decisive management is required after a fracture of the shaft of radius and ulna, if function is to be restored.

In addition to restoration of length and opposition, rotational alignment must also be achieved if a good range of pronation and supination is to be achieved. In today's world, expectations of full functional recovery are more owing to the increase in complex jobs. Non operative methods have yielded poor outcomes in terms of fracture alignment[2]. It is difficult to reduce both bones in the presence of pronating and supinating muscles which exerts angular as well as rotatory forces. Since this fracture is associated with high risk of non-union, the aim of the treatment should be to prevent these complications and to facilitate early mobilization.

The accepted management of fractures of both bones of forearm is open reduction and internal fixation using compression plating and due to its good functional recovery, has become the standard in management of diaphyseal fractures of both bones of forearm[3].

With the understanding of the concept of biological fixation, it was found that DCP has some drawbacks. The LC-DCP was developed in order to overcome these disadvantages by preserving the periosteal blood supply and thus resulting in early active movements of the limb[4].

In view of these considerations, we undertook a study to analyze the surgical management of fractures of both bones of forearm with Limited contact dynamic compression plate, and identify its advantages and complications.

OBJECTIVES

The objectives of the present study was

To identify the advantages and complications of diaphyseal fractures of both bones of forearm treated with Limited Contact Dynamic Compression plate.

REVIEW OF LITERATURE

➢ Introduction

The bony skeleton of the body has a very important function in helping the body movements. The forearm is a complex functional articular unit consisting of the radius and ulna which are connected by the proximal and distal radioulnar joints, the interosseous membrane and several muscles. The forearm movements are the most commonly used function among all movements in daily life. The forearm movements can be restricted due to various diseases that affect it and fracture of forearm is the commonest among them.

➢ History of both bone fracture [5-9]

Hagert, in his study making comparisons to bones of hominid's fossils, non-human primates, fishes, amphibians and the like, the hand and forearm of humans are considered most superior in its kinematics [5] .

Treatment of these fractures is not a new concept. There are documents as to how fracture were treated in the ancient times like the alexandrian surgeons who used various methods of reduction for dislocations and fractures. In archeological surveys there have been found evidences for setting and splinting and samples of healed fractures in prehistoric human bones, suggesting setting and splinting[6].

According to Spanish texts reduction of fractured bones included in the many treatments used by the Aztecs during the conquest of Mexico, was the reduction of fractured bones: "the ancient scriptures and texts have documentation of a branch of fir being inserted into the cavity of the medulla of the broken bone when the fracture could not be reduced adequately with a splint which is the counter part of the modern 20th century's medullary fixation.

Edwin Smith Papyrus described reduction by traction followed by bandaging with linen as the standard modality for fracture treatment

In **Corpus Hippocraticum** [7]the maneuver of reduction was described as the use of bandages made of linen soaked in cerate and oil and applied followed by splinting after a week.

Celsus is credited with the detailed description of different fracture patterns, including transverse, oblique, and multi-fragmented fractures.

In the **5th century Smith** and his co-workers found cases of forearm and femur treated with splints. But until the invention of radiography the most common way to treat both bone fractures included the use of two wooden splints.

The need for adequate immobilization, perfect reduction and adequate time for splints **was** shown by **Carrel** who claimed that proper traction gave satisfactory results.

Plaster of Paris [8]was first introduced by **Mathysen** and was popularized by **Bohler Cowe.** He studied 54 cases of fracture forearm bones and concluded that open reduction and plating give excellent results except when severe injury or comminuted fracture or both occurred.

Egger stressed the importance of control of rotating stress by restoration of bony continuity. He used medullary fixation for the radius and a narrow slotted plate for ulna with bone grafts as the need demanded.

Figure 1: Corpus Hippocraticum the maneuver of reduction

- **Anatomy of forearm [10-11]**

The forearm is one of the complex anatomical structure which exists between the elbow and the wrist and serves an important function of the upper extremity.

The forearm consists of

- Two parallel bones,
  - The radius and
  - The ulna.
- Two joints
  - The distal radio-ulnar joint
  - The proximal radio-ulnar joint
- Two stabilizing ligaments proximally
  - The capsule of the elbow joint and

- The annular ligament

❖ Two stabilizing ligaments distally

- Dorsal radio-ulnar stabilizing ligaments
- Volar radio-ulnar stabilizing ligaments

❖ Interosseus membrane

Embryology [12-13]

The complexity of the forearm joint starts in utero itself. The forearm is differentiated from several different cell types, including bone, cartilage, tendon, muscle and nerve

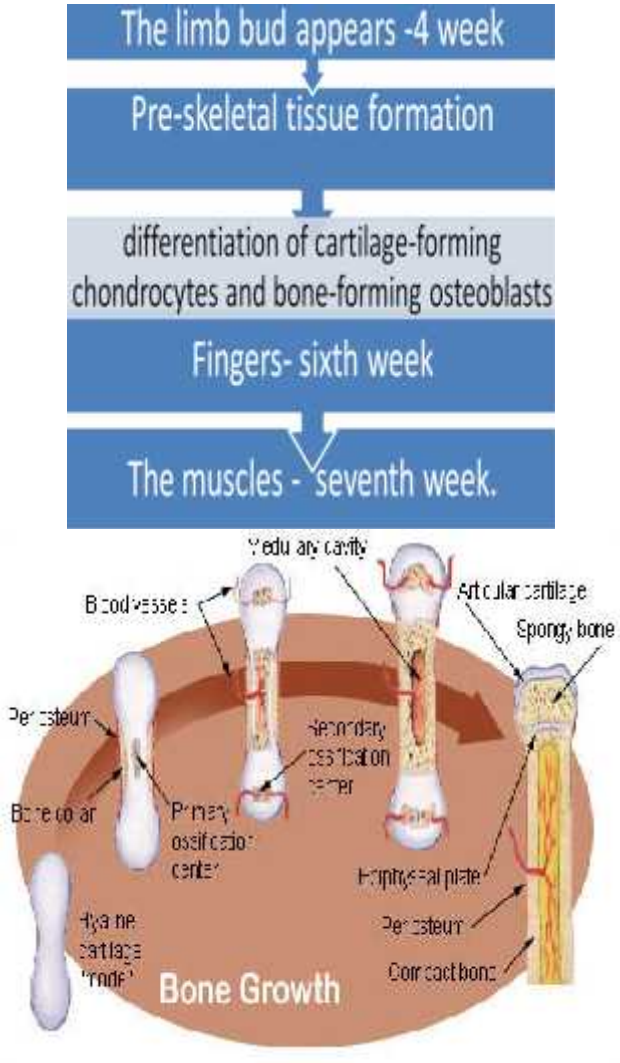


Figure 2: **Forearm Embryology stages**

The radius and ulna ossify in the eighth week of gestation, from the primary ossification centres.

The forearm bones continue to develop and grow after birth by endochondral and membranous periosteal development.

- **Ossification of Radius**

The secondary ossification centre at the distal part of the radius, the radial epiphysis becomes visible via chondro-osseal transformation at the age of approximately one year.

There may be a separate ossification centre at the tip of the radial styloid process. Proximally, a secondary radial epiphysis appears at 4–7 years of age .

75% of the radial growth occurs at the distal physis.

- **Ossification of Ulna**

The distal secondary ossification centre of the ulna begin to ossify at about four to six years of age.

Proximally, the ossification centre of the olecranon appears at 9–10 years of age. Bone development is mostly controlled by local factors in response to mechanical stress.

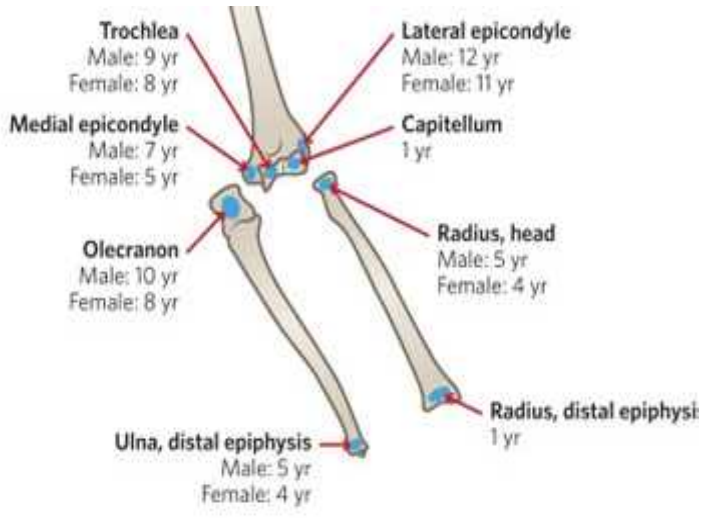
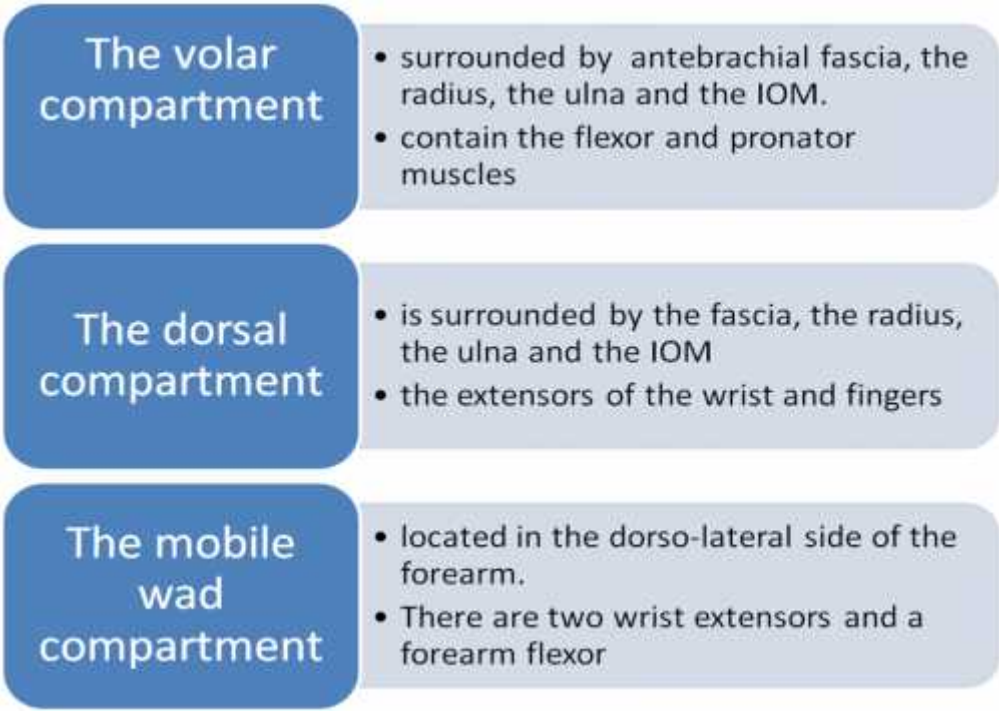


Figure 3 : Time of appearance of secondary ossification

❖ **Soft Tissue Anatomy of the Forearm**[14-16]

There are three muscle compartments in the forearm



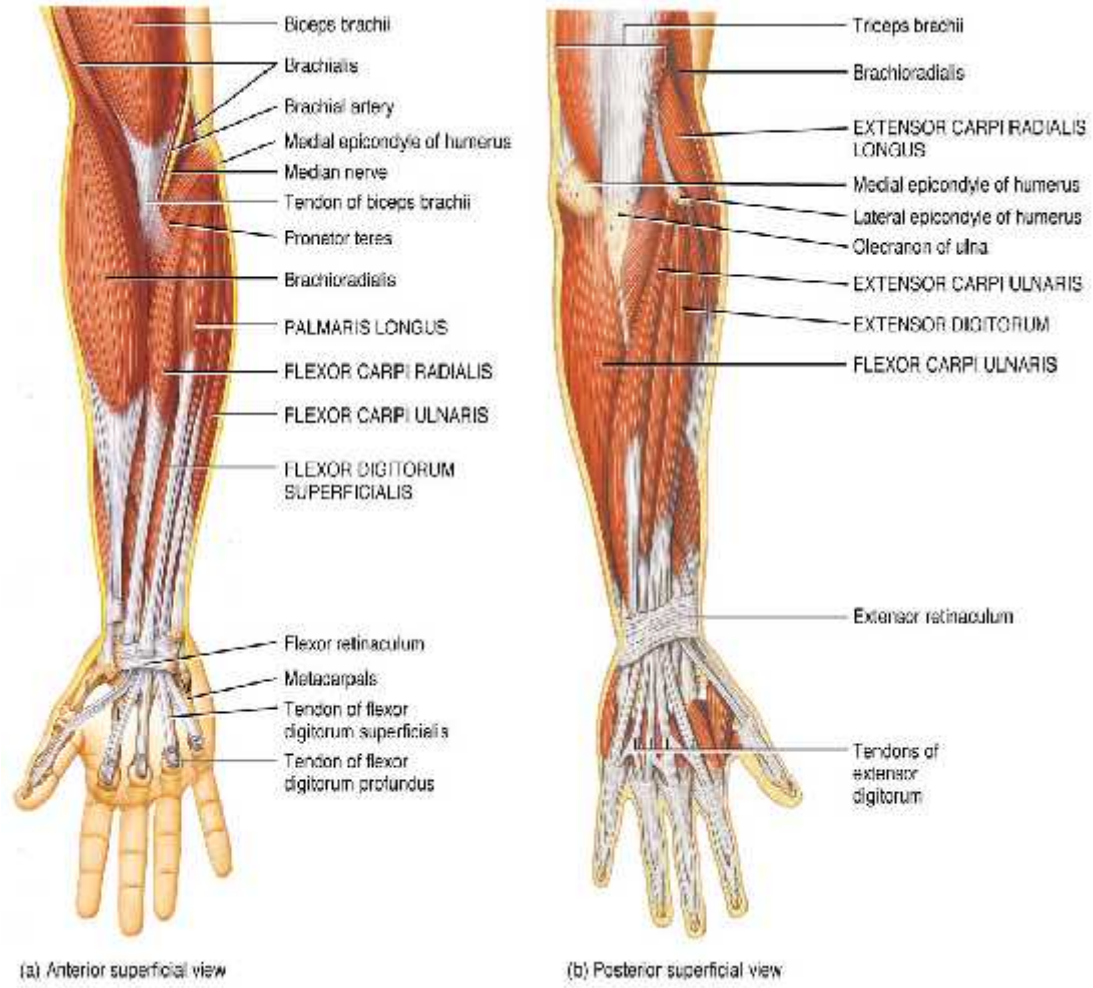


Figure 4 : Muscles of forearm

❖ **Osseous Anatomy of the Forearm** [14-16]

The forearm consists of two bones, the radius and the ulna which are united by the interosseous membrane

❖ **Radius**

The radius is laterally placed and shorter than the ulna with a lateral bowing known as the radial bow of approximately ten degrees along its length which continuous to increase during the growth of the radius . This curve is significant as it needs to be maintained by treatment, if a fracture occurs.

The parts of the radius

- Proximally the radius has a medially directed bicipital tuberosity for the biceps tendon.
- The distal radial styloid.
- The radius apex curves volarly, proximally.

The diameter of the radial shaft enlarges in a proximal to distal direction, thinnest at the level of the neck of the radius.

In cross section, the shaft of the radius is triangular with a sharp side Distally, the radius forms the radiocarpal joint (wrist).

- **Ulna**

The ulna is medially placed and longer than the radius and it contributes to stability of the forearm.

Towards the distal end it decreases in diameter.,

The ulna is strongly connected to the humerus and it forms an uniaxial hinge joint in the elbow with flexion-extension range of motion .

The middle third of the ulna is critical with regard to the intra-osseal vascular supply of the ulnar shaft The ulna is close to being straight .

There is a slight apex dorsal bow just distally from the olecranon.

- **Periosteum**

The forearm bones are covered by a thick periosteum in all parts expect for joint surfaces.

The parts of the periosteum

The periosteum consists of

- An outer fibroblast layer and
- An inner osteogenetic layer or the cambium layer

The periosteum plays a critical role in bone healing as it has the blood and lymph vessels and nerves in the periosteum .In children, periosteum has greater osteogenic potential than in adults which allows pediatric fractures to be treated more conservatively than adults' fractures

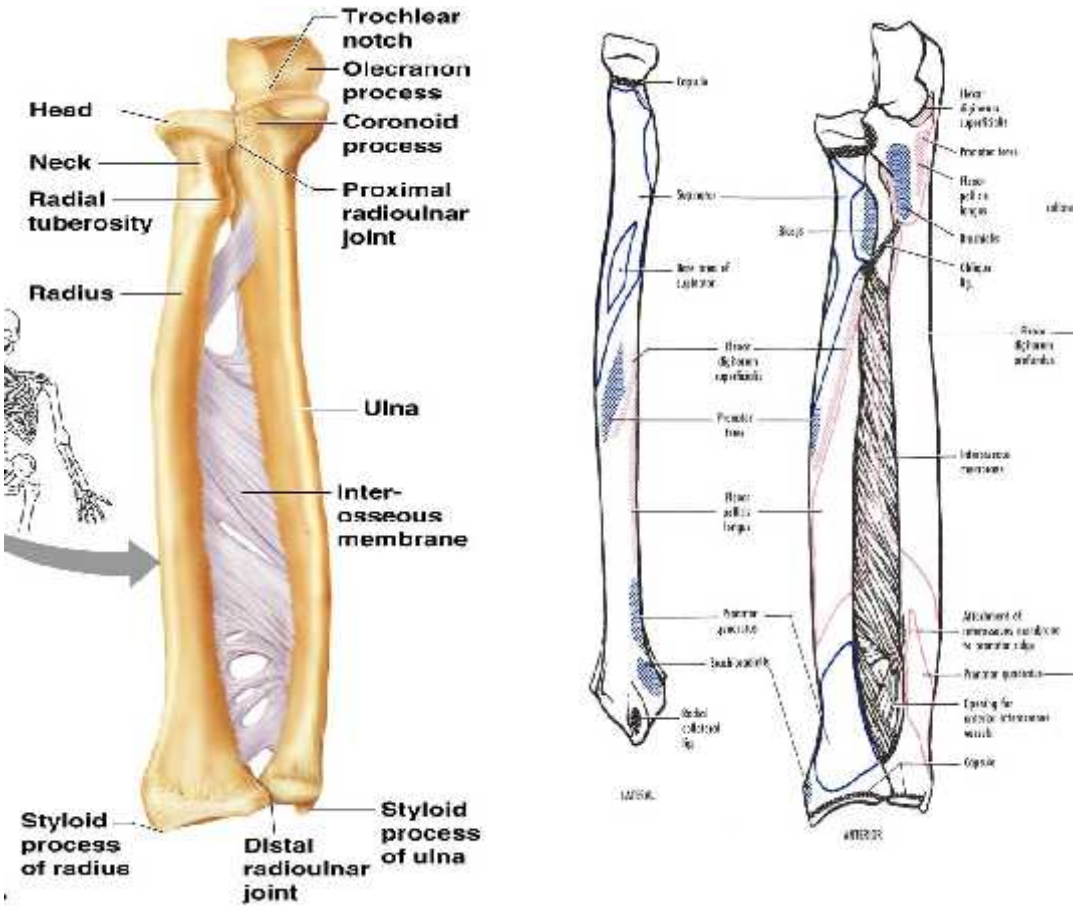


Figure 5 : Osseous anatomy of the radis and ulna

- **Interosseus membrane** [15]

There is an interosseus membrane between the shafts of the radius and ulna. It is important in increasing stability of the forearm, axial stability while the forearm is in rotation.

The parts are

- A central band,
- Several accessory bands,
- The proximal band and
- Thin membraneous component

The central band runs between the bones in an oblique position and it is the thickest part of the membrane .The IOM has a very limited physiologic ability to heal.

Poitevin et al [16] described the IOM as having two sides to it, an anterior and a posterior one.

Interosseous membrane complex,[17,18]

The central band, the proximal reverse fibres and the thin membranous portion are shown below

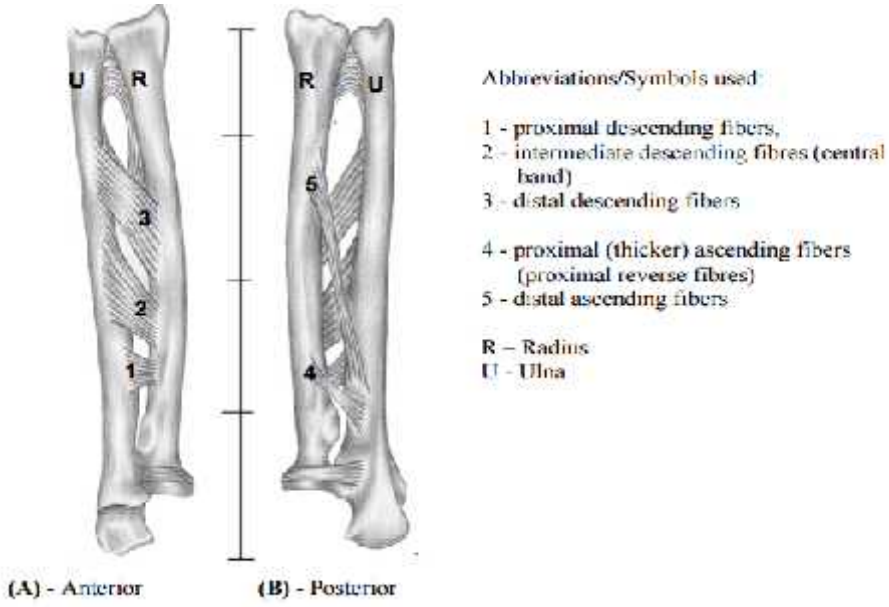


Figure 6: Interosseous membrane

Biomechanics of the Forearm[19]

The forearm is considered to be a functional unit and has the ability to act both as an axis and a nonsynovial joint

The two condyles of this joint are represented by the distal radio-ulnar joint and the proximal radioulnar joint.

Axis of Forearm movements[20]

The axis has been represented as a longitudinal line extending from the centre of the radial head proximally and through the middle of the ulnar head distally, transcribing a conical range of movement for the hand.

The distal pole of the axis of pronation and supination intersects the transverse plane of the articular pole of the ulna close to the fovea.

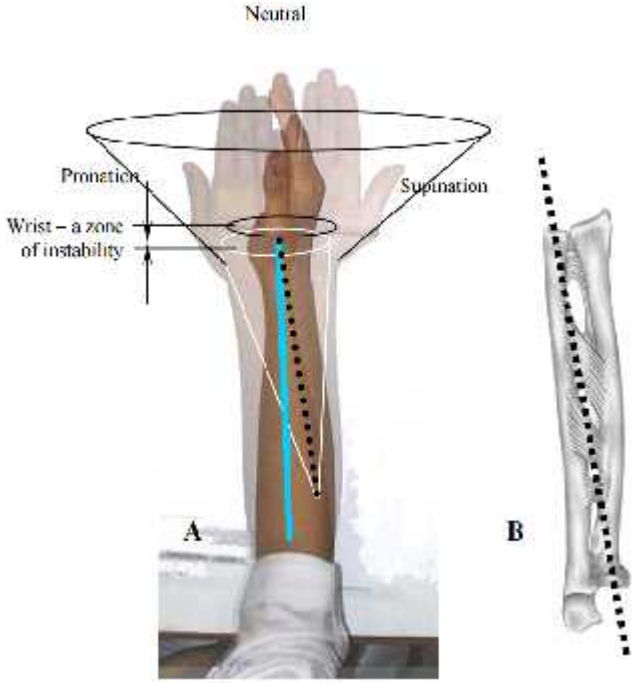


Figure 7: Range of motion of forearm with the corresponding axles in elbow movements

- **Movements**

The primary movement occurs when the radius revolves about the ulna, with the rotation axis in the plane along the length of the forearm, between the two bones. Kapandji describes the rotation in the forearm as, “one bone rotating\about the other” where both bones are like a rectangular frame.

Elbow flexion and extension are normally between 0-degrees and 140 to 160 degrees.

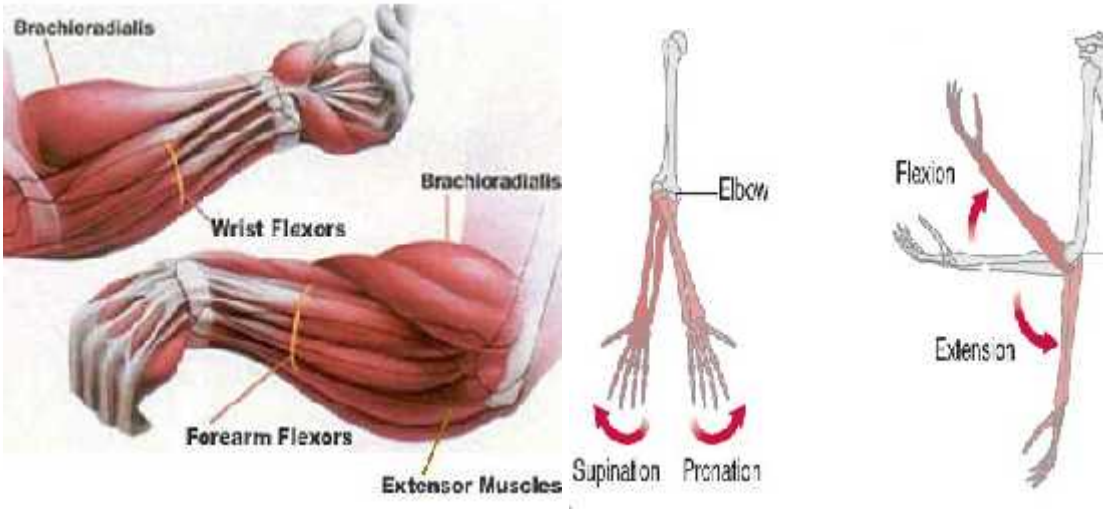


Figure 8 : Movements of Forearm

a) Forearm rotation can be described with respect to

The ulna, where internal rotation of the radius is taken as pronation; and the external rotation as supination,

b) The position of the palm, where with the palm facing up is supination; and the palm facing down being pronation.

In pronation, the head of the radius rotates within the annular ligament whereas the distal end of the radius along with the hand moves bodily forward. The ulnar notch of the radius moves around the circumference of the head of ulna. In addition, the distal end of ulna moves laterally.

- **Load transmission**[22-23]

Longitudinal load transmission from the hand to the elbow is a complex interaction that involves the radius, the IOM and the ulna. The central band of the IOM functions in sharing load from proximal radius to distal ulna.

Due to its oblique structure from the distal part of the ulna to the proximal part of the radius, the membrane transmits compressing forces received by the hand and radius to the ulna for further transmission upwards to the humerus.

In a normal human around 65-85% of the load from the distal radius is delivered to the ulna and lighter loads reaches the radiocapitellar joint directly.

The carrying angle of the upper extremity affects load transmission between the forearm and the elbow. The normal carrying angle is around 6–12 degrees of valgus in children and it increases with increasing age.

If the carrying angle increases, more load from the distal radius is transmitted directly to the radiocapitellar joint. In the case of cubitus rectus or cubitus varus, direct load transmission between the radius and the humerus decreases

- **Remodelling**[24-25]

There are special characteristics of an immature forearm in its response to trauma. Remaining bone growth in children reflects great osteogenic potential and remodelling capacity . Remodelling continues after the fracture has healed until the physes close . This makes it important to determine the stage of growth plate closure when considering an acceptable fracture position .

Remodelling at the fracture site occurs by resorption of the bone on the convex side and generation of new bone on the concave side. On the convex side, the bone is under tension which stimulates resorption . In the forearm shaft, spontaneous correction of malunion is about one degree per year. At the radial epiphysis, the correction is around ten degrees in a year. Rotational deformity does not remodel.

- **Diaphyseal fractures of both bones of forearm**

❖ **Epidemiology** [26-27]

In a study by Chung[26] he found that estimated cases of hand/forearm fractures, accounting for 1.5% of all emergency department cases. Radius and/or ulna fractures comprised the largest proportion of fractures (44%). These fractures more common in men than in women

The ratio of open to closed fractures in forearm is higher than for any other bone except tibia.

❖ **Riskfactors** [28,29]

- Osteoporosis
- More common in women than in men
- Malignancy
- Pathological fractures

❖ **Mechanism Of Injury** [30-31]

Usually injury due to a significant force

- Direct trauma
  - while protecting one's head
  - Fall onto an outstretched hand.
- Indirect trauma
  - Motor vehicle accidents
  - Fall from height
  - Athletic competition particularly in-line skating, skateboarding, scooter riding, mountain biking, and contact sports
  - Blow with a blunt object

❖ **Classification of both bone fracture** [32-35]

- Location
  - Proximal,
  - Middle or
  - Distal third

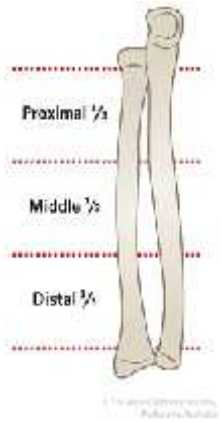


Figure 9 : Classification based on location

- Descriptive
  - Closed versus open
  - Comminuted, segmental, multifragmented
  - Displacement
  - Angulation
  - Rotational alignment
- OTA classification
  - radial and ulna diaphyseal fractures
    - Type A
      - simple fracture of ulna (A1), radius (A2), or both bones (A3)
    - Type B
      - wedge fracture of ulna (B1), radius (B2), or both bones (B3)
    - Type C
      - complex fractures

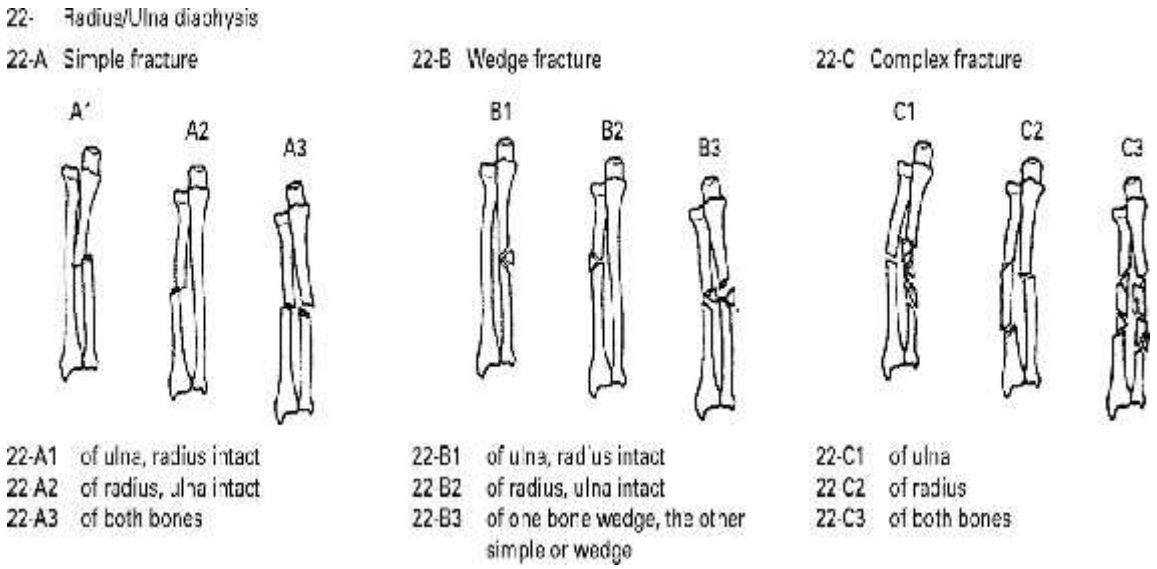


Figure 10 : AO Classification

- Based on displacement the both bone fractures are classified as
  - Non-displaced:
  - Displaced

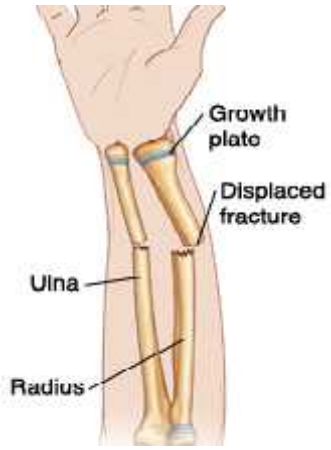


Figure 11 : Displaced Forearm shaft fractures

- Forearm shaft fractures based on the type
  - Complete fractures
  - Transverse
  - Oblique
  - Spiral
  - Butterfly
  - Comminuted.

Figure 12 : Classification based on Type of Fracture.

- Fractures are based on associated soft tissue injury
  - Closed or
  - Open.
- Unique types of fractures in children
  - Torus fractures
  - Greenstick fracture,
  - Plastic deformation

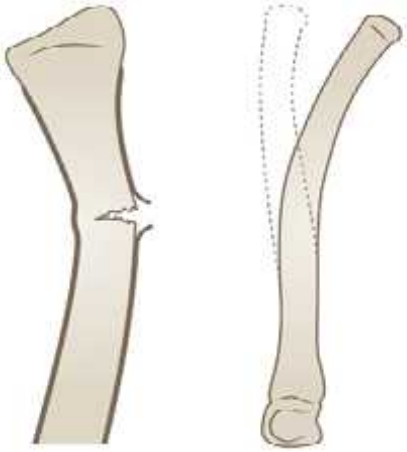


Figure 13: Greenstick fracture, Plastic deformation

- **Presentation**[36]
- Signs

In displaced fractures, there may be

- Gross deformity,
- Tenderness directly over the fracture site
- Swelling
- Loss of forearm and hand function and limited range of forearm rotation

Figure 14: presentation of fracture both bone fracture forearm

- Examination
  - Open injuries
  - Check for tense forearm compartments
  - Neurovascular exam
  - Assess radial and ulnar pulses
  - Pain with passive stretch of digits
- **Imaging**[36-38]
  - **Radiographs**
  - AP and lateral views of the forearm and/or oblique forearm views for further fracture definition including the ipsilateral wrist and elbow

Figure 15: lateral views of the forearm

To evaluate for associated fractures or dislocation

Radial head must be aligned with the capitellum in all views

- **Complications**[32,33,39-41]

❖ **Malunion**

Malunion is common in the forearm because reduction can easily fail. Malunion may disturb the sensitive geometry of the forearm skeleton, leading to restriction of motion

Figure 16: Malunion

❖ **Loss of motion**

Loss of motion maybe related to length discrepancy, residual malangulation,malrotation deformity, narrowing of the interosseus space and soft tissue scarring of interosseus membrane.

Diaphyseal fractures are more often associated with loss of range than fractures in the distal forearm.

❖ **Delayed union and nonunion**

Normally, new periosteal bone on the radius or the ulna is present four weeks after a fracture in children. Forearm fractures usually show complete callus over the fracture site in four cortices by two to three months. A fracture that does not show consolidation of the fracture line within the first 4–6 months is considered nonunion .

- **Re-fracture**[41]

Re-fracture is a well-known complication in the forearm. A typical time of re-fracture of the forearm is 4–6 months after cast removal .There is an 8-fold risk of re-fracture in diaphyseal fractures compared with metaphyseal fractures

- **Compartment syndrome**[42]

Pressure elevation in a forearm muscle compartment is an emergency that warrants urgent intervention if it progresses.

Figure 17 : Compartment syndrome

- **Treatment options of Diaphyseal both-bone forearm fractures**

Treatment of forearm shaft fractures aims to achieve and maintain acceptable reduction until bone union occurs. Because of the unique feature of the forearm as a joint, and unlike other diaphyseal fractures, fractures of the radius and the ulna must be approached like other articular fractures. It is not only a question of fracture healing but also of function of a broken joint.

- **Indications for non-operative and operative treatments**

Special considerations in the Pediatric group

Most of paediatric forearm shaft fractures are traditionally treated by means of closed reduction and cast immobilization. In general, non-invasive treatment should be attempted primarily under general anaesthesia in the operation theatre.Treatment of Diaphyseal both-bone forearm fractures include conservative and surgical options.

❖ **Conservative**[32]

Non-displaced stable fractures can always be managed by using long arm casts.

Complete fractures often show bayonet shortening and they are controlled by gentle, sustained longitudinal traction over the fracture site.

Casting is aimed at neutralising deforming muscle forces around the fracture until it has healed.

❖ **Surgical options**[43]

Historically, operative fracture treatment has been greatly affected by four scientific revolutions: advance in anaesthesia and in antisepsis, the discovery of X-rays and the development of inert implants

Primary operative treatment is supported in cases that evidently show a high risk of complications

Treatment modalities for diaphyseal both-bone forearm fractures

- Casting without reduction,
- Closed reduction with casting,
- Closed reduction with intramedullary nailing, and
- Open reduction with intramedullary nailing or plate fixation.

The aims of fracture treatment [44]

Up to 45 degrees of rotation is acceptable. However, as rotation is very difficult/impossible to quantify on x-rays, any fracture with demonstrable rotation should be assessed.

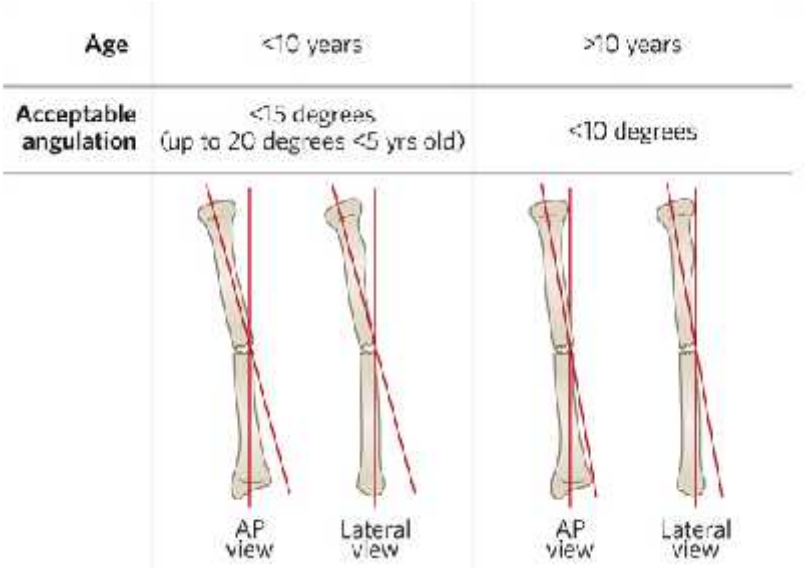


Figure 18: Degrees of rotation is acceptable

Open reduction and internal fixation[45]

The procedure

- ❖ Provisional reduction
- ❖ Fracture with the least comminution fixed first.
- ❖ Pronation and supination are examined
- ❖ If adequate, definitive fixation is performed.
- ❖ Plates should be contoured to fit the bone
- ❖ The plate accurately centered over the fracture site

Intramedullary nailing[46]

The first successful medullary forearm nail system was developed **by Sage** in 1959[47].

The indications for intramedullary nailing are

- Segmental fractures
- Poor skin condition
- Selected nonunions or failed compression platings
- Multiple injuries

- Diaphyseal fractures in osteopenic patients

➢ **Dynamic Compression plate.**

A dynamic compression plate refers to a metallic plate used for internal fixation of bone designed to exert dynamic pressure between the bone fragments to be transfixed.

➢ **History of Compression plate[48]**

Plates for internal fixation of fractures have been used for more than 100 years. Plating of fractures began in 1895 when Lane first introduced a metal plate for use in internal fixation eventually abandoned because it caused corrosion.

Lambotte and then Sherman introduced their versions of the internal fracture fixation plate.

The Eggers plate had two long slots that allowed the screw heads to slide and thus compensate for resorption of the fragment ends.

Compression plating

Danis in 1949 [48]recognized the need for compression between the fracture fragments and achieved this goal using a plate he called the *coapteur*, which suppressed interfragmentary motion and increased the stability of the fixation

Figure 19: Danis' plate

Bagby and Janes described a plate with specially designed oval holes to provide interfragmentary compression during screw tightening.

Müller et al. design permitted interfragmentary compression by tightening with a tensioner.

Willenegger and members of a Swiss group of investigators, showed that a dynamic compression plate provided only one-time static compression

The Swiss group developed a new plate design intended to reduce the plate's interference with cortical perfusion and thus decrease cortical porosis called the limited contact-dynamic compression plate and claimed to reduce bone-plate contact by approximately 50%.

Limited contact dynamic compression plate [50,51]

- It is a type of dynamic compression plate
- Limited contact to the underlying bone which supposedly minimizes disruption in periosteal capillary network and thus in the fracture zone
- Has more uniform bending characters than ordinary DCP due to less inclination to bend in the area of holes in the plate
- Limited contact keeps the bone healing progression faster than other compression plate.

Problems faced in using Limited Contact Dynamic Compression plate[52,53]

The LC-DCP has groove within the undersurface which leads to an improvement in the blood supply to the underlying plate bone segment allows for a small amount of callus formation as well as even distribution of stiffness along the plate. The undercut plate holes allow extended tilting of plate screws, uniformly spaced as well as symmetrical plate holes and has a optimal screw effect. The LCDCP was claimed to reduce the bone plate contact by approximately 50%.

The newly developed Locking compression plate consists of compression plate and screw system where the screw are locked in the plate. This locking minimises the compressive forces exerted on the bone by the plate. This means that the plate does not need to touch bone surface at all.

LCP can be used in forearm fractures in the conventional plating technique for simple transverse or oblique fracture with low soft tissue compromise or in the bridging technique or in the combination technique in special situation

LCP represents the latest development in plate development, its usage in fractures with simple configuration

Clinical studies in realation to LC-DCP in both bone fracture forearm fractures

In 1990, Perren S.M and Klaue K developed the LCDCP, to realize the new concept of biological fixation. They proposed that limited contact reduces the vascular damage to the plated bone segment[54].

In 1994, Matter P, Schultz M and Perren S in a prospective multicentric study of 504 internal fixations using titanium LC-DCP with a follow up period of 14.2 months showed 95% excellent results [55].

In 1995, McKee MD et al analyzed the clinical efficacy of LC-DCP in 114 cases of upper extremity fracture and noted 97% union rates and no mechanical failure of plate and screw [53].

In 2000, Borgeaud et al evaluated the mechanical behavior of newly developed plates at the junction between plate and bone for the LC-DCP and PC-Fix under simulated physiological load. They found that slippage was more important for LC-DCP than PC-Fix. Better stability was obtained with PC-Fix[56].

In 2003, Leung et al, comparing the LC-DCP with the PC-Fix in the treatment of forearm fractures concluded that the two implants appeared to be equally effective for the treatment of diaphyseal forearm fractures[57]. They found 100% union with a mean period of 17 weeks, for closed fractures.

In 2006, Hertle et al concluded that the LC-DCP is used to treat displaced fractures of radius and ulna, and until other fixator device is proven superior, the 3.5

mm LC-DCP plate remains the gold standard for internal fixation of forearm fractures[58].

In 2009, Sharma et al conducted a prospective study in 30 adult patients of forearm fractures with a follow up at 3, 6 and 12 months. All the fractures united with a mean union time of 12.6 weeks. They concluded that LCP is a stronger construct and by preventing primary and secondary loss of reduction it does not alter the natural course of fracture healing which is not possible with the use of LC-DCP [59].

In 2011, Saikia et al, in a study comparing forearm fractures treated with locked compression plates and limited contact dynamic compression plate did not find any significant difference in the two groups. They found the grip strength of fractures treated with LC-DCP to be 60- 100% that of the contralateral side and a DASH score of 0- 44.4 [60].

In 2013, Meena et al, in a study comparing fractures of both bones of forearm treated with LC-DCP and LCP, treated 20 patients with LC-DCP and 20 patients with LCP and concluded that the functional outcomes after treatment with both plates were equal, but the LCP showed slight advantage in terms of callus formation and mean time of bone union[61].

F Leung,Sp Chow (2006), studied 45 forearm fractures treated by open reduction and internal fixation with 3.5mm stainless steel LCPs. Radiographic assessment was performed at 3,6,12 and 18 months. Two patients had delayed union but none had nonunion.33% of the fractures were reduced anatomically.56% of the fractures healed with no or minimal callus formation and 44% with moderate callus formation. Mean healing time was 16 months. The LCP is an effective bridging device used for treating comminuted fractures.[62]

Radiological Criteria

Using the criteria of Anderson et al (1975)[63], the fracture will be designated as healed radiologically when there is periosteal callus bridging at the fracture site, presence of trabeculation extending across the proximal and distal fragment and when there is obliteration of fracture.

Result	Union	Flexion-extension of wrist joint	Supination and pronation
Excellent	Present	<10° loss	<25% loss
Satisfactory	Present	<20° loss	<50% loss
Unsatisfactory	Present	<30° loss	>50% loss
Failure	Non-union	With or without loss of motion	

DASH **Criteria**[62]

The Disability of the Arm, Shoulder and Hand upper extremity outcome measure was developed by the American Academy of Orthopedic Surgeons and Institute for Work & Health . It was designed to assess the functional status and symptoms of clients with upper extremity conditions

- The DASH contains 30 items, most of which describe the amount of difficulty the patient faces while performing various physical tasks due to arm, shoulder or hand problems (21 items).
- documents the severity of each of the symptoms of pain, activity-related pain, tingling, stiffness and weakness (five items).
- the DASH describes issues that affect social activities, work, sleep and psychological impact (four items).
- The DASH also contains two four-item optional components that are scored separately from the 30-item DASH.

- These components involve the patient's ability to perform sports and/or to play a musical instrument (sport/music scale) or the ability to work (work scale).
- These optional components are meant for athletes, musicians or workers whose occupations demand increased levels of physical performance.

Each item of the DASH has five response choices that range from 1 'without difficulty or no symptom' to 5 'unable to engage in activity or very severe symptom'. At least 27 of the 30 items must be completed for a score to be obtained. The assigned values for all the completed responses are summed and averaged, and then this value is transformed to 100 by subtracting 1 and multiplying by 25, in order to compare to other measures that us 0 to 100 scales.

QuickDASH

Patient rated outcome can be assessed using the Shortened Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire[10], an 11-item questionnaire intended to assess the function and symptoms of patients with disorders of the upper limb.

Please rate your ability to do the following activities in the last week.					
1. Open a tight or new jar	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
2. Do heavy household chores (eg wash walls, wash floors)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
3. Carry a shopping bag or briefcase	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
4. Wash your back	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable

5. Use a knife to cut food	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
6. Recreational activitites in which your take some force or impact through your arm, shoulder or hand (eg: sports)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
7. During the past week. To what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups?	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
8. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
Please rate the severity of the following symptoms in the last week					

9. Arm, shoulder or hand pain	None	Mild	Moderate	Severe	Extreme
10. Tingling (pins and needles) in your arm, shoulder or hand?	None	Mild	Moderate	Severe	Extreme
11. During the past week, how much difficulty have you had sleeping because of the pain in your arm,	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	So much difficulty I can't sleep

This will be rated on a score from 1-5, 1 being 'No difficulty' and 5 being 'Extreme'. QuickDASH disability score will be calculated using [sum of response/n]-1*25.

MATERIAL AND METHODS

The study was a prospective study which was conducted at the Department of Orthopaedics in BLDEU'S Shri B.M.Patil's Medical College, Hospital and Research Centre, Vijayapur on 28 cases who presented with a diagnosis of diaphyseal fractures of both bones of the forearm between the time period October 2013 - April 2015.

Patients of either sex who presented with a diagnosis of diaphyseal fractures of both bones of the forearm who met the pre-set inclusion and exclusion criteria were asked if they were willing to take part in the study.

The patients who were willing to participate were informed about study in all respects and informed written consent was obtained. In cases where the patient was unfit to give consent the nearest legal heir's consent was taken.

INCLUSION CRITERIA:

- Patients above the age of 18.
- Patients who have been diagnosed as having diaphyseal fractures of both bones of forearm.
- Patients who are fit for surgery.

EXCLUSION CRITERIA:

- Patients below the age of 18.
- Patients who are unfit for surgery.
- Isolated fractures of radius or ulna.
- Pathological fractures.
- Compound fractures.
- Ipsilateral fractures of humerus.

SAMPLE SIZE SELECTION

Sample size was calculated using $n= [z\alpha^2 * p * q]/d^2$

At 95% confidence interval and +/- 4 margin of error the sample size is 28.

Hence 28 cases of fracture of both bones of forearm were included in the study

METHODOLOGY OF THE STUDY

- Patients were selected on the basis of history, clinical examination and radiography.
- X-Ray of affected forearm with both AP view and Lateral views was taken.
- The initial primary treatment consisted of an above elbow POP slab with a sling, so as to minimize further damage.
- As per the institutions protocol third generation cephalosporin's were started.
- Patient was given adequate pain relief using intravenous analgesics most often the opioid tramadol was used.
- The affected limb was elevated so as to prevent/reduce the odema formation .
- Patients were supervised for edema and surgery was done once the edema has subsided.
- Necessary pre-operative investigations were done which included
    - Blood – Hemoglobin, Total leukocyte count, Differential leukocyte count, Platelet count, ESR, S.Urea, S. Creatinine, Random Blood Sugar.
    - Urine-Albumin, Sugar, Microscopy.
    - Blood grouping and Rh typing.
    - BT, CT.
    - HIV, HbsAg.

Special investigations were done where ever necessary

- ECG
- Chest X-Ray - PA view
- ECHO- Cardiography

- **Radiographs**
  - Antero-posterior view and a lateral view of affected forearm were taken.
  - Any other relevant investigations if needed.
  - Physician opinion was obtained for fitness for surgery whenever indicated.

Intra operative details

The following details were noted

- Operative procedure
- Type of anesthesia
- Torniquet application time
- Approach
- Operative finding
- Plates applied: 6 holed/7 holed/8 holed
- Time taken for surgery
- Technical difficulties during surgery
- External immobilization after surgery: A/E slab
- Immediate postoperative neurovascular complications-present/ not present.

All cases were treated by open reduction and internal fixation with an appropriate length 3.5mm Limited contact dynamic compression plate.

Postoperative Management

- The limb was kept elevated for 72 hours and active finger and shoulder movements were started on the day of surgery.
- Intravenous antibiotics were given for first three days and then shifted to oral antibiotics for seven days.
- Compression bandage was released in 24-36 hours.
- All patients were given an above elbow POP slab/ cast for 2 weeks.
- Dressing was done on 2^{nd}, 5^{th} and 8^{th} post operative day.
- Sutures were removed on 12^{th} post-operative day.

Patients were evaluated at 6 weeks, 3 months and 6 months.

Follow up period was done for a minimum period of 6 months.

- Follow up and assessment of cases were performed using the
  - Anderson criteria[9] and
  - QuickDASH scoring system

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CRITERIA FOR EVALUATION AND RESULTS: RADIOLOGICAL AND CLINICAL

[USING ANDERSON et al CRITERIA[9] and Quick DASH scoring system[10]]

Radiological Criteria

Using the criteria of Anderson et al (1975), the fracture was designated as healed radiologically when there is periosteal callus bridging at the fracture site, presence of trabeculation extending across the proximal and distal fragment and when there is obliteration of fracture.

Determination of union

Using the criteria of Anderson et al (1975)[62]

1. Fractures which heal in less than 6 months will be considered unions.
2. Fractures which require more than 6 months uniting and requiring no additional operative procedure will be classified as delayed unions.
3. Fractures which fail to unite without another operative procedure will be classified as non- unions.

Clinical criteria and functional results

Using the Anderson Criteria[9], results will be graded as

Result	Union	Flexion/Extension at elbow joint	Supination and pronation
Excellent	Present	$<10^{o}$ loss	<25% loss
Good	Present	$<20^{o}$ loss	<50% loss
Fair	Present	$>20^{o}$ loss	>50% loss
Poor	Non- union	With or without loss of motion	With or without loss of motion

Patient rated outcome was assessed using the Shortened Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire[10] an 11-item questionnaire intended to assess the function and symptoms of patients with disorders of the upper limb.

SURGICAL APPROACHES

INDICATIONS FOR OPEN REDUCTION OF FRACTURES OF SHAFT OF RADIUS AND ULNA

1. All displaced fractures of radius and ulna in adults.
2. All isolated displaced fractures of the radius.
3. Isolated displaced fractures of ulna with angulation greater than 10°.
4. All Monteggia fractures.
5. All Galeazzi fractures.
6. Open fractures.
7. Fractures associated with a compartment syndrome, regardless of the degree of displacement.

APPROACHES TO THE RADIUS

1. Anterior approach (Henry)
    - Position of patient supine on operating table with the arm on an arm board.
    - Place the tourniquet on the arm, but do not exsanguinate it fully before inflating the tourniquet, venous blood left in the arm makes the vascular structures easier to identify.
    - Supinate the forearm.
    - Internervous plane Distally : Brachioradialis supplied by Radial N.
      FCR innervated by Median N.
      Proximally: Brachioradialis Pronator teres innervated by Median N.
    - Incision and Technique: Straight incision on the line from the anterior crease of elbow just lateral to the biceps tendon to the styloid process of radius. The length of incision depends on the amount of bone that needs to be exposed.

The medial border of brachioradialis is identified and a plane is developed between it and the flexor carpi radialis distally. The recurrent radial artery is ligated

and brachioradialis is retracted laterally along with superficial radial nerve underneath it. The forearm is pronated to incise the thin origin of Flexor Pollicis Longus and again supinated after striping of the periosteum.

The proximal third is covered by the supinator muscle through which the posterior interosseous nerve passes on its way to the posterior compartment. In full supination, the muscle is incised along the line of its broad insertion starting at bicipital tuberosity. Subperiosteal dissection is continued and continued and muscle is laterally retracted along with the nerve.

The anterior aspect of middle third is covered by pronator teres and flexor digitorum superficialis. The forearm is pronated so that the insertion o f pronator teres into the lateral aspect is exposed. This insertion is detached and medially retracted in subperiosteal plane. This maneuver detaches the origin of flexor digitorum superficialis as well.

The flexor pollicis longus and pronator quadratus arises from anterior aspects of distal third of radius. The forearm is partially supinated and periosteum incised on lateral aspect of radius and through subperiosteal dissection both the muscles are retracted medially.

- Dangers: Nerves- the posterior interosseous nerve is vulnerable as it winds around the neck of the radius within the substance of the supinator muscle. The key to insuring its safety is to detach correctly the insertion of the supinator muscle from the radius. The insertion of the muscle is exposed completely only when the arm is supinated fully. Once the subperiosteal dissection is begun the nerve is comparatively safe, but overzealous retraction still can lead to a neuropraxia.

The superficial radial nerve runs down the forearm under the brachioradialis muscle. It becomes vulnerable when the "mobile wad" of three muscles is mobilized and retracted laterally.

Vessels — the radial artery runs down the middle of forearm under the brachioradialis muscle. It is vulnerable twice during the anterior approach to the radius:

1. During mobilization of brachioradialis. Protection depends on recognizing the artery. Its two accompanying venae comitantes are the best surgical guide, because the artery is surprisingly small after a tourniquet has been used.
2. In the proximal end of the wound, as the artery passes to the medial side of the biceps tendon. Damage to the artery at that level can be avoided by remaining lateral to the tendon.

The recurrent radial arteries are a leash of vessels that arise from the radial artery just below elbow joint.

2. Posterior approach (Thompson)

With the forearm in pronation make a straight incision extending from a point 1.5 ems anterior to the lateral humeral epicondyle to a point just distal to the ulnar side of Lister's tubercle at the wrist. Develop the interval between extensor digitorum communis and extensor carpi radialis brevis and retract the structures of the ulnar and radial sides respectively. The abductor pollicis longus muscle is then visible retracted distally and ulnar wards to expose part of posterior surface of radius. Continue dissection proximally between the extensor digitorum communis and extensor carpi radialis brevis and longus to the lateral humeral epicondyle.

Reflect the extensor digitorum ulnar wards to expose the supinator muscle or for a wider view detach the extensor digitorum from its origin on lateral epicondyle and retract it further medially. Expose and divide the muscle fibers down to the deep

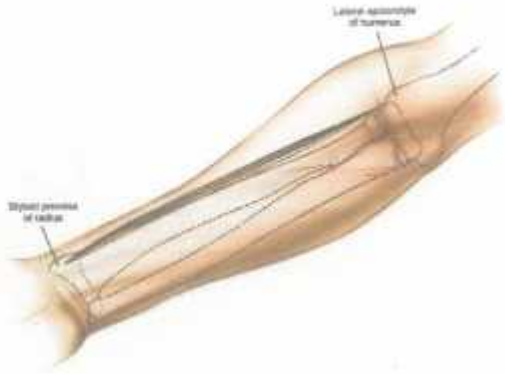
branch of radial nerve and carefully retract the nerve or free the muscle from the bone subperiosteally and reflect it either proximally or distally along medially with the nerve, the later is best method if exposure is wide enough.

APPROACH TO THE ULNA

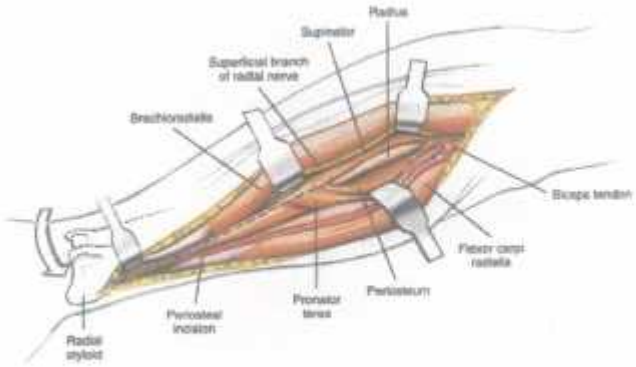
- Position of the patient: Supine on the operating table with the arm placed across the chest to expose the subcutaneous border of the ulna.
- Tourniquet applied.
- Incision: a linear, longitudinal incision is made over the subcutaneous border of ulna. The length of incision depends on the amount of bone that is to be exposed.
- Internervous plane: 1. extensor carpi ulnaris supplied by posterior interosseous nerve. 2. Flexor carpi ulnaris supplied by the ulnar nerve.
- Dangers: The ulnar nerve is safe as long as the flexor carpi ulnaris is stripped off the ulna subperiosteally.
- Vessels: the ulnar artery is also vulnerable when dissection of flexor carpi ulnaris is not carried out subperiosteally.
- Internervous plane: of Thompson.
    - Proximally ECRB supplied by radial nerve
    - EDC supplied by posterior interosseous nerve.

The common aponeurosis of these muscles is the cleavage plane.

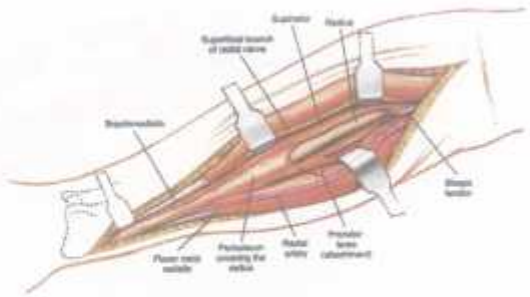
    - Distally Extensor carpi radialis longus supplied by radial nerve.
    - Extensor pollicis longus supplied by post inter nerve.
- Dangers: Identifying and preserving the posterior interosseous nerve in the supinator muscle is the only means of ensuring that it will not be trapped beneath any plate that is applied for radial fractures.



Make a straight incision on the anterior part of the forearm, from the flexor crease on the lateral side of the biceps down to the styloid process of the radius.

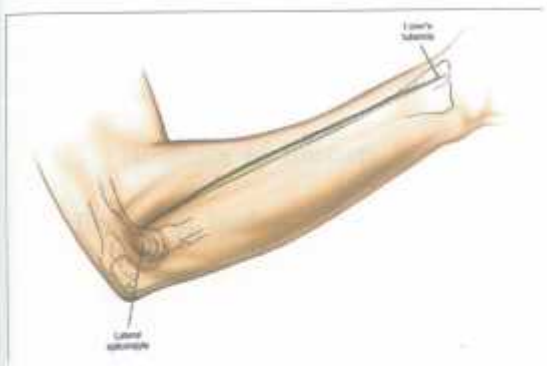


Turn the arm downward to identify the pronator teres muscle. Resect it along its insertion on the lateral aspect of the radius.



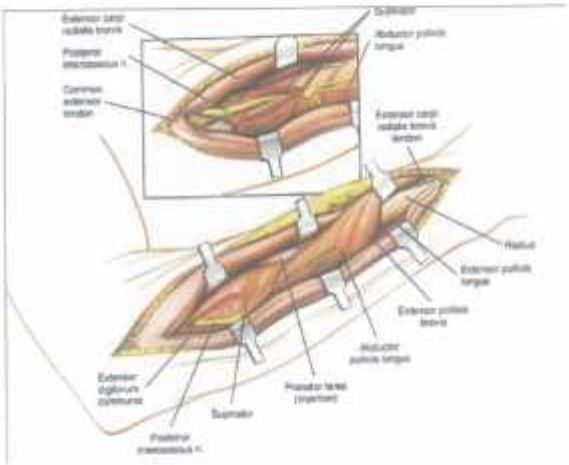
Continue dissection distally to uncover the distal of the radius. Leave the periosteum intact

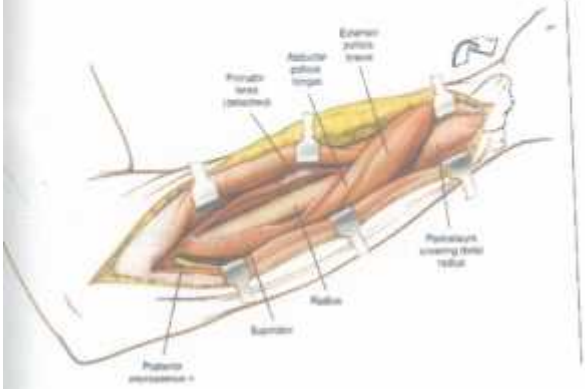
Figure 20 : Volar Henry's approach



The long incision extends from just anterior to the lateral epicondyle of the humerus to just distal to the ulnar side of Lister's tubercle at the wrist

The supinator cloaks the upper third of the radius; the posterior interosseous nerve runs through its substance. The nerve must be protected and identified as it traverses the muscle. The interosseous nerve is seen in the substance of the supinator (inset).





Detach the insertion of the supinator from the anterior aspect of the radius, with the arm in full supination to bring the origin of the supinator into view and to move the posterior interosseous nerve away from the area of incision. This uncovers the lateral border of the radius.

Figure 21 : Thomson approach to the radius.

After surgery,

- A dorsal splint for two weeks was applied and then physiotherapy was recommended for all of the patients.
- Clinical examination and radiography was performed at 3 weeks, 6 weeks and 3 months after surgery.
- The variables considered included: duration of operation, time taken for union, movements of wrist and forearm, and possible complications that were assessed and compared in the last follow-up.
- The criterion for union was observation of callus formation in 3 cortexes in AP lateral radiographs. Goniometry was used for measurement of forearm movements.

INSTRUMENTS AND IMPLANTS USED IN LIMITED CONTACT DYNAMIC COMPRESSION PLATING FOR FOREARM BONES:

1. Pneumatic tourniquet.
2. Drill.
3. Self retaining forceps.
4. Bone hooks.
5. Bone levers.
6. Fracture reduction forceps.
7. Lowman's bone holding clamp.
8. Periosteum elevator of DCP.
9. 2.5mm drill bit.
10. 3.5mm neutral and eccentric drill guide.
11. Depth gauge.
12. 3.5 Tap.
13. Narrow 3.5mm stainless steel LC-DCP plate.
14. 3.5mm hexagonal cortical screws of varying sizes.
15. Hexagonal screw driver.
16. Bending templates
17. Bending press/pliers.

The LC-DCP, 3.5mm is available in lengths 51mm to 155mm, with 4 to 12 holes.

Important dimensions:

- Thickness 4.0mm
- Width 11 mm
- Hole spacing 13mm
- Hole length 7mm

Preoperative planning:

- If evidence of compartment syndrome, surgery has to be done as soon as possible.
- Consent of the patient or relative was taken prior to the surgery.
- Appropriate length of the plate to be used was assessed with the help of radiographs.
- A dose of tetanus toxoid and antibiotic were given preoperatively.
- Preparation of the part was done before a day of surgery.
- The injured forearm was immobilized in above elbow slab during preoperative period.
- Instruments to be used were checked before hand and sterilized.

Position:

- Pneumatic tourniquet is recommended.
- Patient is supine on the operating table.
- In Henry's approach-the arm is placed on an arm-board with elbow straight and forearm in supination. In Thompson approach-the arm on the arm-board, Elbow flexion and forearm in mid pronation.

Incision:

- Ulnar shaft: Parallel and slightly volar to the subcutaneous crest of the ulna.
- Radial shaft: Dorsal Thompson approach and Volar Henry's approach.

OPERATIVE PROCEDURE:

- Pneumatic tourniquet was applied: Time noted.
- Painting and draping of the part done.

- The Radius was approached using dorsal Thompson approach for proximal radius and mid shaft fractures and for distal radius fractures Volar Henry's approach was preferred. Ulna was approached directly over the subcutaneous border.
- The bone which was less comminuted and more stable was fixed first and later the other bone was fixed.
- After identifying the fracture ends, periosteum was elevated and fracture ends were cleaned.
- With the help of reduction clamps fracture was reduced and held in position. The plate was then applied after contouring if required.
- A plate of at least 5 holes was chosen and longer plates were used in spiral, segmental and comminuted fractures.
- For upper third radial fractures, the plate was fixed dorsally. For distal two thirds, the plate was fixed dorso-laterally and for distal radial fractures the plate was fixed on the volar aspect. In ulna fractures plate was applied over the postero-medial surface of ulna.
- Using the neutral drill guide, the first screw is applied to the fragment, which forms an obtuse angle with the fracture near the plate. The resulting space between the fracture plane and plate undersurface guides the opposite fragment towards the plate. The arrow of the neutral drill guide points towards the fracture. 2.5 mm drill bit is used for drilling a hole through both cortices and with depth gauge appropriate 3.5 mm screw length is determined, 3.5 mm drill tap used before screw insertion.
- • After adaptation of the fragments, a screw hole for axial compression is drilled in the fragment which forms an acute angle near the plate. Here the

load guide is used with the arrow pointing towards the fracture line to be compressed. At this position, a lag screw will be inserted for axial compression.

- The lag screw is applied by subsequently over drilling (3.5mm) the near cortex to create a gliding hole. The lag screw and remaining screws are inserted.
- The contour between the plate and the screw head of the eccentrically placed screw moves the screw head towards the center of the plate and thus moves the fragment into the same direction.
- In case of porotic, comminuted and/or small bones, long screws and/ or a longer plate were used.
- Once stable fixation is achieved and hemostasis secured meticulously, the wound is closed in layers over a suction drain (no.8) and sterile dressing is applied.
- After treatment: Postoperatively a crepe bandage was applied over the affected forearm and arm pouch was given. The patient was instructed to keep the limb elevated and move their fingers and elbow joint. Suction drain was removed after 24-48 hours. Wound was inspected after 3-4 days postoperatively. Antibiotics and analgesics were given to the patient till the time of suture removal. Suture / staples removed on 10th postoperative day and check X-ray in anteroposterior and lateral views were obtained. Later patient were discharged after suture/ staple removal with, the forearm in arm pouch and advised to perform shoulder, elbow, and wrist and finger movements. Patients were advised not to lift heavy weight or exert the affected forearm.

Instruments and implants used for surgery

Painting

Draping

Skin incision and exposure (Ulna)

Exposure of fracture site

Reduction of fracture and placement of plate

Drilling for screws

Figure 22 : instruments and Procedure

Measuring screw length

Fixation with screws

Incision and dissection for radius

Reduction of facture and placement of plat

Drilling for Radius

Screw fixation

Good fixation with plate insitu

Skin closure

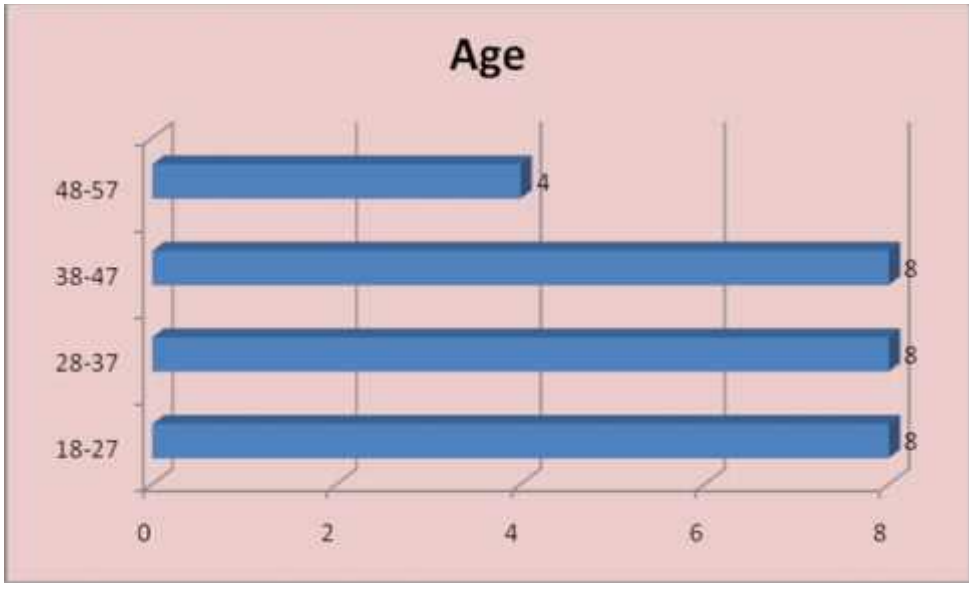
RESULTS AND OBSERVATIONS

1. DEMOGRAPHIC DATA

- **Age DISTRIBUTION**

	Frequency	Percent	Valid Percent	Cumulative Percent
18-27	8	28.6	28.6	28.6
28-37	8	28.6	28.6	57.1
38-47	8	28.6	28.6	85.7
48-57	4	14.3	14.3	100.0
Total	28	100.0	100.0	

TABLE N0 3: AGE DISTRIBUTION



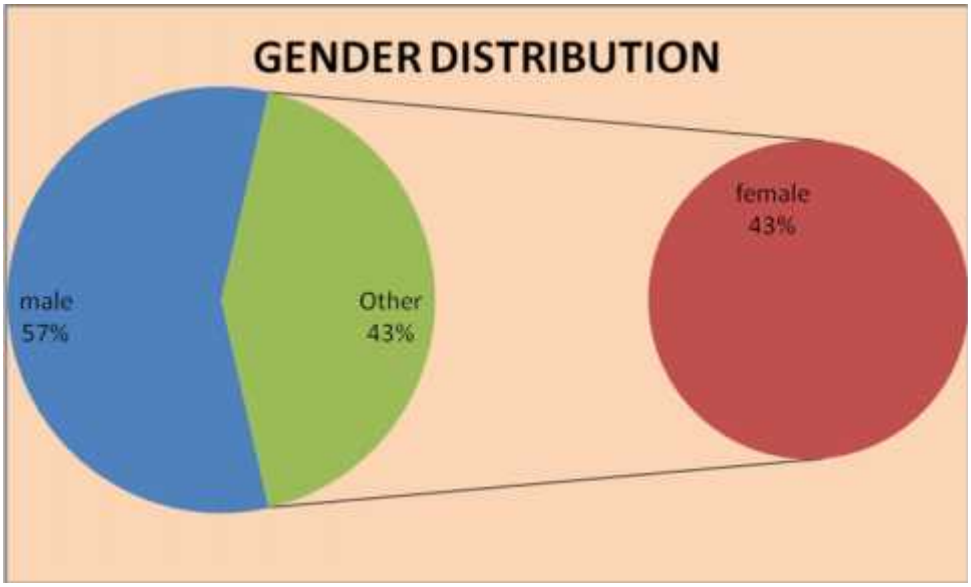
GRAPH NO 1 : AGE DISTRIBUTION

In the present study on evaluation of the age distribution we found that of the 28 cases in the study most patients were above 38 years (24 cases) , 86 %. The mean age was 34.43 years ,SD ±10.57. The youngest age was 18 years and the oldest case in our study was 55 years.

- **GENDER DISTRIBUTION**

	Frequency	Percent	Valid Percent	Cumulative Percent
FEMALE	12	42.9	42.9	42.9
MALE	16	57.1	57.1	100
Total	28	100	100	

TABLE NO 4: GENDER DISTRIBUTION



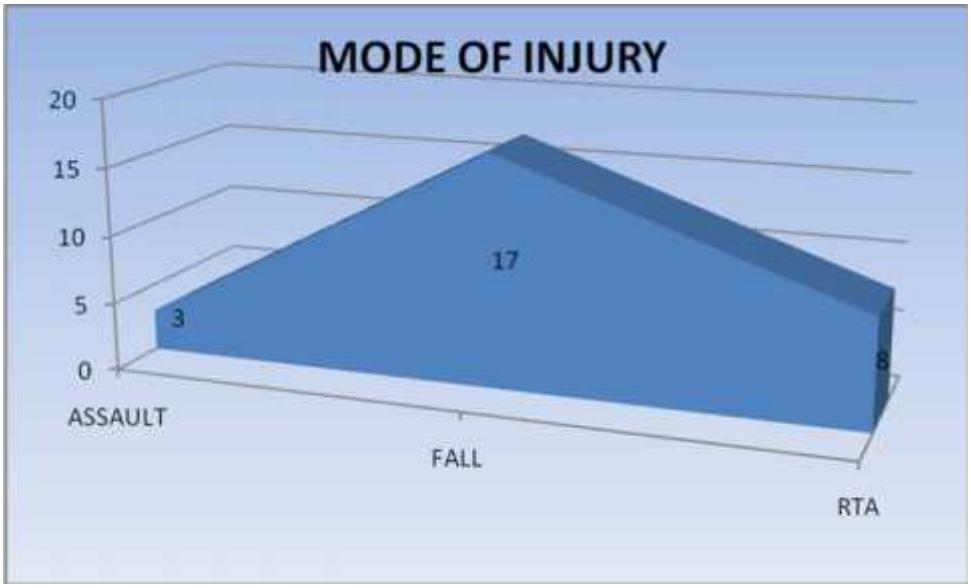
GRAPH NO 2 ; GENDER DISTRIBUTION

In the present study on evaluation of the gender distribution we found that of the 28 cases in the study most patients were males (16, patients, 57%).

- **CLINICAL PRESENTATION**
  - **MODE OF INJURY**

MODE OF INJURY	Frequency	Percent	Valid Percent	Cumulative Percent
ASSAULT	3	10.7	10.7	10.7
FALL	17	60.7	60.7	71.4
RTA	8	28.6	28.6	100
Total	28	100	100	

TABLE 5: MODE OF INJURY



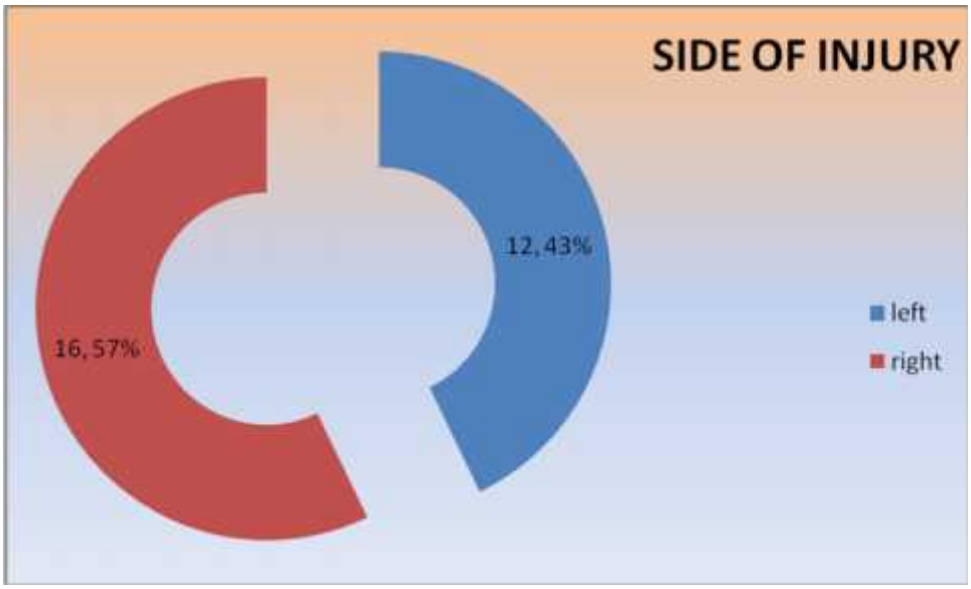
GRAPH NO 3 MODE OF INJURY

In the present study on evaluation of the mode of injury we found that of the 28 cases in the study most patients were injured by fall (17 patients,60%) followed by RTA (8 patients,28%) and (3 cases, 10%) by assault .

o **SIDE OF INJURY**

SIDE OF INJURY	Frequency	Percent	Valid Percent	Cumulative Percent
Left	12	42.9	42.9	42.9
Right	16	57.1	57.1	100
Total	28	100	100	

TABLE NO 6: SIDE OF INJURY



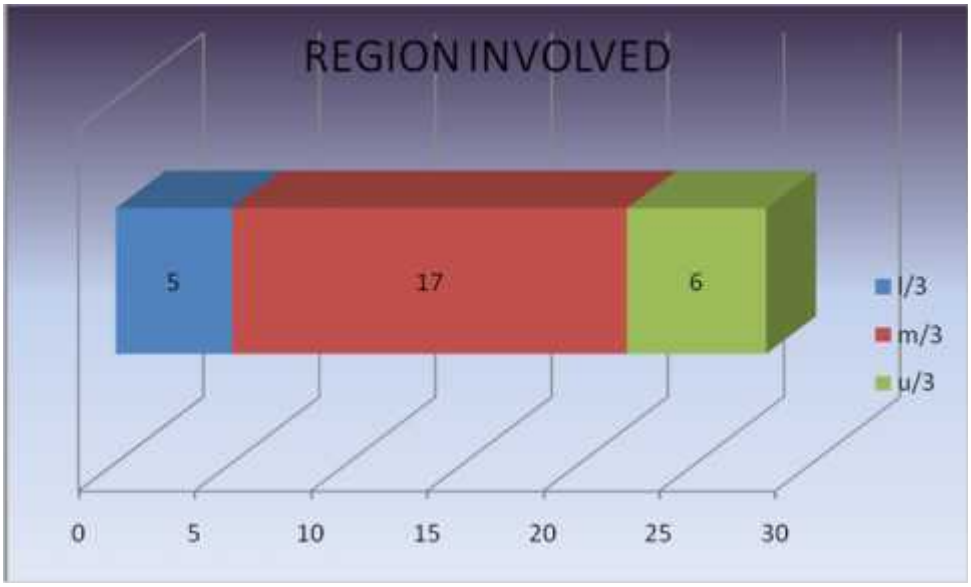
GRAPH NO 4: SIDE OF INJURY

In the present study on evaluation of the side of injury we found that of the 28 cases in the study most patients had a right sided injury (16, patients, 57%)

REGION INVOLVED

REGION INVOLVED	Frequency	Percent	Valid Percent	Cumulative Percent
l/3	5	17.9	17.9	17.9
m/3	17	60.7	60.7	78.6
u/3	6	21.4	21.4	100
Total	28	100	100	

TABLE NO 7: REGION INVOLVED



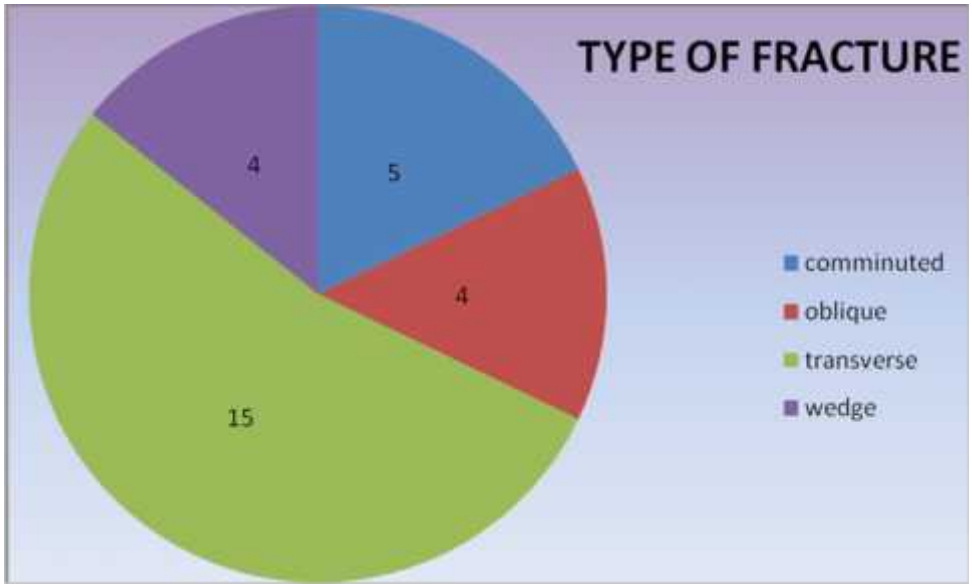
Graph 5 : REGION INVOLVED

In the present study on evaluation of the region of the bone involved in the fracture we found that, of the 28 cases in the study most patients had a middle 1/3rd injury (17, patients, 60%), followed by upper 1/3rd injury (5 patients, 17 %) and lower 1/3rd injury (6, patients, 21 %).

- **TYPE OF FRACTURE**

TYPE OF FRACTURE	Frequency	Percent	Valid Percent	Cumulative Percent
Comminuted	5	17.9	17.9	17.9
Oblique	4	14.3	14.3	32.1
Transverse	15	53.5	50	82.1
Wedge	4	14.3	14.3	100
Total	28	100	100	

TABLE NO 8: TYPE OF FRACTURE



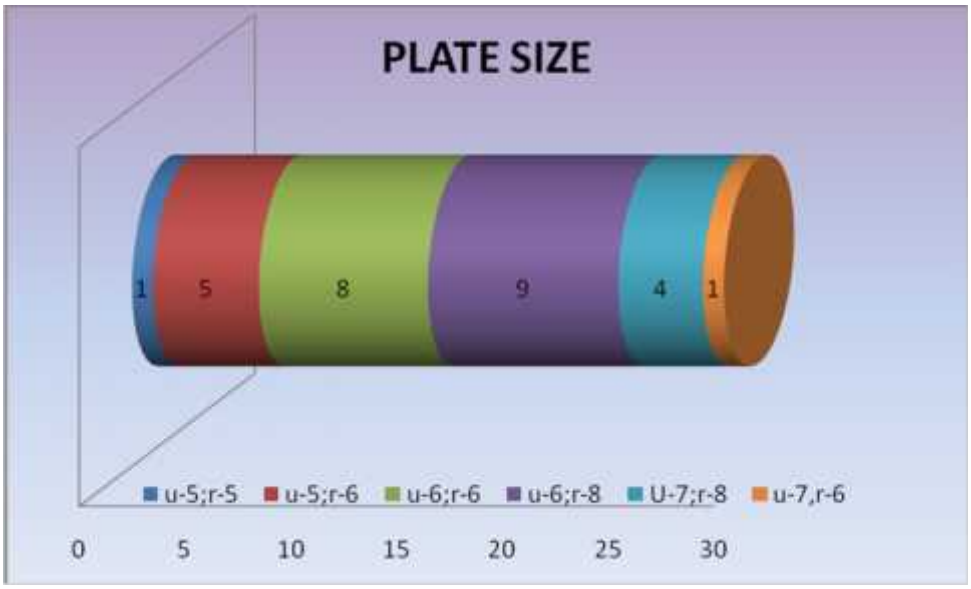
GRAPH 6 : TYPE OF FRACTURE

In our study most patients (15 cases, 53%) had transverse fracture followed by comminuted in 5 cases, oblique in 4 patients and wedge in 4 patients

- **PLATE SIZE**

PLATE SIZE	Frequency	Percent	Valid Percent	Cumulative Percent
U-5;R-5	1	5	5	5
U-5;R-6	5	5	5	10
U-6;R-6	8	35	35	45
U-6;R-8	9	40	40	85
U-7;R-8	4	10	10	95
U-7,R-6	1	5	5	100
Total	20	100	100	

TABLE NO 9: PLATE SIZE



GRAPH NO 7: PLATE SIZE

In the present study on evaluation of the plate size used in the study we found that, of the 28 cases in the study most patients had a been used size u-6;r-8 ((9, patients, 40%).

- **TYPE OF APPROACH**

	Frequency	Percent	Percent
R-Henry	22	78.5	78.5
Thompson	6	21.4	21.4

TABLE NO 10: APPROACH CHOSEN FOR SURGERY

In the present study 22 cases were operated using Henry's approach and 6 using Thompsons.

DURATION OF HOSPITAL STAY

Duration of hospital stay	Frequency	Percent	Valid Percent
4	1	3.6	3.6
6	2	7.1	7.1
7	5	17.8	17.8
8	3	10.7	10.7
9	1	3.6	3.6
10	2	7.1	7.1
11	4	14.3	14.3
12	5	17.8	17.8
14	3	10.7	10.7
15	1	2.6	3.6
Total	28	100	100

TABLE NO 9: DURATION OF HOSPITAL STAY

In our study most patients have stayed in hospital for 12 days or less. The mean was 9.67 days

DURATION OF SURGERY

	Duos	%
60-70	9	32.14286
70-80	5	17.85714
80-90	8	25
90-100	3	10.71429
100-110	2	7.142857
110-120	1	0.000357

TABLE NO 12 : Duration Of Surgery

On evaluation of the duos of the 28 cases studied 9cases each had a value 60-70 and 8 cases 80-90

- **COMPLICATIONS**

Complications	Frequency	Percent	Valid Percent	Cumulative Percent
No complications	23	82.1	82.1	82.1
Infection	1	3.6	3.6	85.7
Radial nerve palsy	2	7.1	7.1	92.9
Reduced ROM	2	7.1	7.1	100
Total	28	100	100	

TABLE NO 13: COMPLICATIONS

In the present study on evaluation of complications following surgery, most patients no complications(82%). 2 patients, (7%) had reduced range of motion, 2 had radial nerve palsy(7%) and one had infection.

DURATION TAKEN FOR THE FRACTURE UNION

Time taken	cases	percentage
6 weeks	4	14
7 weeks	1	3
8 weeks	1	4
11 weeks	1	4
12 weeks	4	14
14 weeks	9	32
15 weeks	4	14
16 weeks	3	11
24 weeks	1	4
Total	28	100

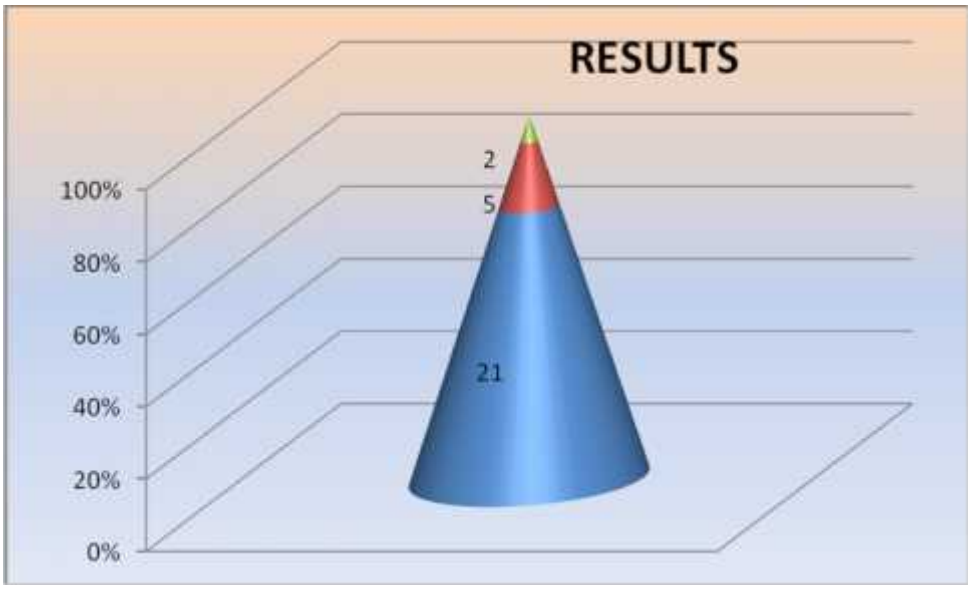
TABLE NO 14 : DURATION TAKEN FOR THE FRACTURE UNION

In the present study on evaluation of the duration taken for the fracture union most patients had fracture union in 14 weeks (9 cases with 32%%), The mean duration for fracture healing was 12.71 weeks.

o **THE FINAL OUTCOME**

RESULTS	Frequency	Percent	Valid Percent	Cumulative Percent
Excellent	21	75	75	75
Fair	5	17.9	17.9	92.9
Poor	2	7.1	7.1	100
Total	28	100	100	

TABLE NO 12: THE FINAL OUTCOME



GRAPH NO 12: THE FINAL OUTCOME

In our study on evaluation of the final outcome most patients had excellent results (21 cases, 75%)

CLINICAL PHOTOGRAPHS

CASE 1

Clinical photographs at 6 months follow up.

Pre operative **Immediate post op** **6 Month followup**

CASE 2

Supination

Pronation

Elbow flexion

Wrist dorsi flexion

Elbow extension

Wrist palmar flexion

Immediate post Op X-ray

12 weeks Post Surgery

CASE 3


Clinical photographs at 6 months follow up

AP and lateral radiographs at 6 month follow up showing plate offset of radius

STATISTICAL ANALYSIS:

- Diagrammatic presentation.
- Mean ± S.D. / Median ± S.D.
- Chi- Square Test

DISCUSSION

The main purpose of the study was to evaluate outcome of the surgery of the study group; hence all the patients that included in the study are of the operative group. We have not included any conservatively managed group. Our study shows the effectiveness of the operative treatment as the articular surface was restored anatomically and fixed with suitable implant for early mobilization.

AGE DISTRIBUTION

In the present study on evaluation of the age distribution we found that the mean age was 34.43 years, SD ±10.578. The youngest age was 18 years and the oldest case in our study was 55 years.

Study name	**Year**	**Number of cases**	**Age Distribution**	**Mean**
Saikia, K. C.[59] et al.	2011	36	16–60 years	30.5 years
Frankie Leung et al[57]	2003	92 patients with 125 forearm fractures		35 years.
Raj Kumar Meena et al [60]	2013	40 patients with 80 fractures	18 -64 years	32.55 years
Sharma S et al [58]	2009	30cases	15-60 years	34 years.
Our study	**2015**	**28**	**18-55, years**	**34.7**

TABLE16

GENDER DISTRIBUTION

In the present study on evaluation of the gender distribution we found that of the 28 cases in the study most patients were males (16, patients, 57%)

Study name	**Year**	**Number of cases**	**Gender Distribution M:F**
Raj Kumar Meena et al [60]	2013	40	24 : 16 **(**60%:40%**)**
Saikia, K. C., et al. [59]	2011	36	70%: 30%
Manjappa CN et al [63]	2011	20	75%: 3%
Sharma S et al[58]	2009	30	26:4
Our study	**2015**	**28**	**4:3(**42.9%:57.1%**)**

TABLE 17

CLINICAL PRESENTATION

MODE OF INJURY

In the present study on evaluation of the mode of injury we found that of the 28 cases in the study most patients were injured by fall (17, patients,60%) followed by RTA (8, patients,28%) and 3 cases by assault.

Study name	**Year**	**Number of cases**	**Fall:RTA:Assault:Sports**
Raj Kumar Meena et al [60]	2013	40	**17:18:5:2**
Our study	**2015**	**28**	**17:8:3**

TABLE 18

SIDE OF INJURY

In the present study on evaluation of the side of injury we found that of the 28 cases in the study most patients had a right sided injury (16, patients, 57 %)

Study name	Year	Number of cases	Side of injury RIGHT :LEFT
Raj Kumar Meena et al [60]	2013	40	16:24
Manjappa CN et al[63]	2011	20	8:12
Our study	**2015**	**28**	**16:12**

TABLE 19

REGION INVOLVED

In the present study on evaluation of the region of the bone involved in the fracture we found that, of the 28 cases in the study most patients had a middle 1/3rd injury (17, patients), followed by upper 1/3rd injury (6 patients, 20 %) and lower 1/3rd injury (5, patients, 15 %)

Study name	Year	Number of cases	Region Involved upper,middle,lower 1/3rd
Raj Kumar Meena et al[60]	2013	40	4:33:12
Our study	**2015**	**28**	**6:17:5**

TABLE 20

DURATION TAKEN FOR THE FRACTURE UNION

In the present study on evaluation of the duration taken for the fracture union most patients had fracture union in 14 weeks 10 patients (50 %), The mean duration for fracture healing was 15.47 weeks

Study name	Year	Number of cases	Region Involved upper,middle,lower 1/3rd
Raj Kumar Meena et al [60]	2013	40	16.80 weeks
Sharma S et al[58]	2999	30	12.6 weeks
Our study	**2015**	**28**	**12.71 weeks**

TABLE 21

Functional outcome

Study name	Year	Number of cases	Functional outcome
Saikia, K. C., et al. [57]	2011	36	Excellent (88%)
Sharma S et al[58]	2009	30	Excellent (16.7%) Satisfactory (73%)
Our study	**2015**	**28**	Excellent (75%)

TABLE 22

Quick Dash Score

In our study on evaluation of the average Q dash at 3 weeks it was 76.4, the average qdash at 3 months was 36.4 and the average Q dash at 6 months 1.6.

Raj Kumar Meena et al [60]in their study found that the quick dash score was 0 to 33.40 in LC-DCP group. Saikai KC et al [57]observed that the raw score ranged from 0 to 44.44 in the LC-DCP group.

CONCLUSION

These fractures have to be fixed as early as possible and it is important to achieve anatomical reduction and stable internal fixation for excellent functional outcome.

In comminuted fractures primary autogenous bone grafting along with plate fixation gives good results in term of union.

A minimum of 5 cortices have to be fixed on each fracture fragment and the nearest screw to the fracture line should be atleast 1 cm away.

Only one third of the diameter of the shaft is required for application of the plate and compression apparatus. So minimal periosteal stripping should be done.

Early radiological sign of union at 6-8 weeks indicate that the fracture was stable to leave the patient without cast support and go for active physiotherapy.

In fracture both bone of the fore arm, the surgical treatment with LC-DCP gives excellent results irrespective of the age at presentation.

SUMMARY

The study was a prospective study which was conducted at the Department of Orthopaedics in BLDEU'S Shri B.M. Patil's Medical College, Hospital and Research Centre, Vijayapur on 28 cases who presented with a diagnosis of diaphyseal fractures of both bones of the forearm between the time period October 2013 - April 2015.

Patients of either sex who presented with a diagnosis of diaphyseal fractures of both bones of the forearm who met the pre-set inclusion and exclusion criteria were asked if they were willing to take part in the study.

The patients who were willing to participate were informed about study in all respects and informed written consent was obtained

- In the present study on evaluation of the age distribution we found that the mean age was 34.7 years, SD $\pm$10.57.
- In the present study on evaluation of the gender distribution we found that of the 28 cases in the study most patients were males (16, patients, 57%)
- In the present study on evaluation of the mode of injury we found that of the 20 cases in the study most patients were injured by fall (17, patients) followed by RTA (8, patients) and 3 cases by assault.
- In the present study on evaluation of the side of injury we found that of the 28 cases in the study most patients had a right sided injury (16, patients, 57%)
- In the present study on evaluation of the region of the bone involved in the fracture we found that, of the 28 cases in the study most patients had a middle $1/3^{rd}$ injury (17 patients) followed by upper $1/3^{rd}$ injury (6 patients) and lower $1/3^{rd}$ injury (6,patients)
- In the present study on evaluation of the type of fracture line, transverse fracture was the commonest (15 patients)

- In the present study on evaluation of the plate size used in the study we found that, of the 28 cases in the study most patients had a been used size u-6;r-8 (9, patients, 40%).
- In the present study, in 22 cases approach used was Henry's and in 6 patients Thompsons approach was used.
- In our study most patients have stayed in hospital for 12 days or less .The mean was 9.67 days.
- On evaluation of the duos of the 28 cases studied 6 cases each had a value 60-70 and 80-90
- In the present study on evaluation of complications following surgery, most patients no complications(82%). 2 patients, (7%) had reduced range of motion, 2 had radial nerve palsy(7%) and one had infection
- In the present study on evaluation of the duration taken for the fracture union most patients had fracture union in 14 weeks 9 patients (32.1 %), The mean duration for fracture healing was 12.71 weeks.

LIMITATION OF THIS STUDY

The small sample size and no long term follow up was done of the patients are the major drawbacks of the study

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ANNEXURE I

ETHICAL CLEARANCE CERTIFICATE

Institutional Ethical Committee
BIJAPUR-586 103.
OUTWARD
No. 52/13
Date 14-11-13
BLDE(U)'s Shri B.M. Patil Medical College.

B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 13-11-2013 *at* 3-30pm *to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.*

Title "A prospective study of Surgical Management of diaphyseal fractures of both bones of forearm using limited contact dynamic Compression plate"

Name of P.G. student Dr. Aravind Pillai
Department of Orthopaedics

Name of Guide/Co-investigator Dr. O.B. Pattanashetty
Prof & H.O.D of orthopaedics

DR.TEJASWINI. VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

ANNEXURE II

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR — 586103.

PROFORMA

SCHEME OF CASE TAKING:

Name:	I P No:
Age/Sex:	DOA:
Occupation:	DOS:
Residence:	DOD:

Presenting complaints with duration:

History of presenting complaints:

Family History:

Personal History:

Past History:

General Physical Examination

Pallor:	present/absent
Icterus:	present/absent
Clubbing:	present/absent
Generalized Lymphadenopathy:	present/absent

Build: Poor/Moderate /Well

Nourishment: Poor / Moderate / Well

Vitals

PR: RR:

BP: TEMP:

Other Systemic Examination:

- Respiratory System
- Cardiovascular System
- Central Nervous System
- Per Abdomen

Local examination

Inspection:

- Attitude of the limb
- Deformity
- Swelling
- Shortening and Deformity
- Swelling
- Skin
- Muscle Wasting
- Wounds, if any
- Other fractures ,if any

Palpation:

- Tenderness
- Local rise of temperature – yes / no

- Swelling
- Crepitus – yes / no
- Assosiated injuries

Movements:

	Active	Passive
▪ Elbow		
▪ Wrist		

Measurements: Forearm: Lateral epicondyle to Radial styloid process

Normal limb	Injured limb

Abnormal Mobility

INVESTIGATION:

Blood:	Urine:
Hb%	Microscopy
TC	Sugar
DC	Albumin
ESR	
BT	
CT	
BLOOD UREA	
SERUM CREATININE	
RBS	

X-Ray: Chest PA view

X-ray of affected limb AP, Lateral views

Level of fracture - U/3; M/3; L/3

Type of fracture - Transverse/ Oblique/ Spiral/ Comminuted

Displacement

AO type - A1/A2/A3

B1/B2/B3

C1/C2/C3

ECG:

Final Diagnosis:

Treatment

PRE OP MANAGEMENT

Dressing

Antibiotics

A/E slab

INTRA-OP

Operative procedure

Type of anesthesia

Torniquet

Approach

Operative finding

Plates applied: 6holed/7holed/8holed

Time taken for surgery

Technical difficulties during surgery

External immobilization after surgery: A/E slab

Immediate postoperative neurovascular complications- present/ not present

POST OPERATIVE MANAGEMENT

Antibiotics/ Analgesics

Limb elevation

Suture removal

Wound healing/ gaping/ superficial or deep infections

Condition and advice on discharge

Physiotherapy

Date of Discharge:

Condition at discharge:

- Clinical:
  - Shortening if any
  - Complications if any
  - Deformity

CRITERIA FOR EVALUATION AND RESULTS: RADIOLOGICAL AND CLINICAL

[USING ANDERSON et al CRITERIA[9] and Quick DASH scoring system[10]]

Radiological Criteria

Using the criteria of Anderson et al (1975), the fracture will be designated as healed radiologically when there is periosteal callus bridging at the fracture site, presence of trabeculation extending across the proximal and distal fragment and when there is obliteration of fracture.

Determination of union

Using the criteria of Anderson et al (1975)[9]

1. Fractures which heal in less than 6 months will be considered unions.
2. Fractures which require more than 6 months uniting and requiring no additional operative procedure will be classified as delayed unions.
3. Fractures which fail to unite without another operative procedure will be classified as non- unions.

CLINICAL CRITERIA AND FUNCTIONAL RESULTS

Using the Anderson Criteria[9], results will be graded as

Result	**Union**	**Flexion/Extension at elbow joint**	**Supination and pronation**
Excellent	Present	$<10^{o}$ loss	<25% loss
Good	Present	$<20^{o}$ loss	<50% loss
Fair	Present	$>20^{o}$ loss	>50% loss
Poor	Non- union	With or without loss of motion	With or without loss of motion

Patient rated outcome will be assessed using the Shortened Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire[10], an 11-item questionnaire intended to assess the function and symptoms of patients with disorders of the upper limb.

Please rate your ability to do the following activities in the last week.					
12. Open a tight or new jar	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
13. Do heavy household chores (eg wash walls, wash floors)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
14. Carry a shopping bag or briefcase	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
15. Wash your back	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
16. Use a knife to cut food	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable

17. Recreational activitites in which your take some force or impact through your arm, shoulder or hand (eg: sports)	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
18. During the past week. To what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups?	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
19. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
Please rate the severity of the following symptoms in the last week					
20. Arm, shoulder or hand pain	None	Mild	Moderate	Severe	Extreme
21. Tingling (pins	None	Mild	Moderate	Severe	Extreme

and needles) in your arm, shoulder or hand?					
22. During the past week, how much difficulty have you had sleeping because of the pain in your arm,	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	So much difficulty I can't sleep

This was rated on a score from 1-5, 1 being 'No difficulty' and 5 being 'Extreme'.

QuickDASH disability score will be calculated using ([sum of response/n]-1*25.

Key to master chart

1. Name :
2. IP. No : Hospital number of the patients
3. Sex : Sex of the patient
4. D.O.S: Date of surgery
5. MOI : Mode of the injury
    a. Domestic fall =D
    b. Road traffic accidents =R
    c. Assault- Assl
6. Side : Side of the injury Lt = Left , Rt = Right
7. Type of # : Type of fracture

a) T- Transverse

b) Obl- Oblique

c) W- Wedge

d) Comm- comminuted

8. Ass Med problems : Associated medical problems.
    a. DM : Diabetes Mellitus.
    b. HTN : Hypertension.
9. Ass injuries : Associated injuries.
    a. D R # : Distal end radius fracture.
    b. Humerus # : Humerus fracture.
10. ANA- Anasthesia
11. B.B –Brachial block
12. G.A – General anesthesia

13. BL : Blood Loss occurred during surgery , according to number of mops used 1 mop= 50ml blood loss, 2 mops =100ml blood loss and 3 mops = 150 ml
14. Compl- Complication
    a) Inf- Infection
    b) ROM- Range of motion
15. U-Ulna
16. R- Radius
17. DUOS : Duration of the hospital stay in days.
18. Result: Result according to Anderson Criteria.
    a. Excellent : E.
    b. Good : G.
    c. Fair : F.
    d. Poor : P

MASTER CHART

sl no	ip no	name	age	sex	side	region	# line	moi	type	doa	dos	dod	ana	approach	plate size	duos	hosp stay (days)	compl	mean time of union (weeks)	results
1	5425	sangappa	50	m	left	m/3	com	fall	C3	1/3/2014	1/4/2014	1/16/2014	B.B	R-Henry	u-6;r-8	70	11		10	excellent
2	5414	sumangala	55	f	right	l/3	T	Assl	A3	1/7/2014	1/8/2014	1/17/2014	B.B	R-Henry	u-6;r-8	80	12		14	excellent
3	124	gurubai	54	f	left	m/3	com	rta	C3	1/10/2014	1/11/2014	1/23/2014	B.B	R-Henry	u-7;r-8	75	8		12	excellent
4	1867	harsha	35	f	right	m/3	t	fall	A3	1/21/2014	1/22/2014	2/3/2014	B.B	R-Henry	u-7;r-8	90	14		18	excellent
5	3120	pundlik	50	m	right	m/3	t	fall	A3	1/17/2014	1/18/2014	2/10/2014	B.B	R-Henry	u-6;r-6	50	9	inf	10	excellent
6	2468	sachin	46	m	right	u/3	obl	rta	A3	1/21/2014	1/22/2014	2/3/2014	B.B	Thom	u6;r-6	60	7		16	excellent
7	1896	suhasini	24	f	left	l/3	t	rta	A3	1/21/2014	1/23/2014	2/2/2014	B.B	R-Henry	u-6;r-8	70	12		14	poor
8	1547	gangadhar	36	m	left	m/3	t	fall	a3	1/24/2014	1/25/2014	2/6/2014	B.B	R-Henry	u-5;r-6	80	11		12	excellent
9	3244	subhas	41	m	right	l/3	t	fall	A3	2/7/2014	2/8/2014	2/21/2014	G.A	R-Henry	u-6;r-6	120	7	radial nerve palsy	14	fair
10	5353	mangala	31	f	right	u/3	obl	fall	A3	2/25/2014	2/26/2014	3/10/2014	B.B	Thom	u-6;r-8	60	14		12	excellent
11	5715	ashok	38	m	left	m/3	w	rta	B3	3/4/2014	3/5/2014	3/11/2014	B.B	R-Henry	u-6;r-6	110	8		16	poor
12	6449	chinam	43	f	right	u/3	obl	assl	A3	1/4/2014	3/8/2014	3/20/2014	B.B	Thom	u-5;r-5	90	16		10	excellent
13	8975	sangappa	32	m	left	m/3	w	fall	B3	1-Apr	4/2/2014	4/15/2014	B.B	R-Henry	u-6;r-6	70	10		16	excellent
14	10241	puneet	28	m	right	u/3	obl	rta	A3	4/10/2014	4/11/2014	4/15/2014	B.B	Thom	u-6,r-6	70	8		18	excellent
15	9461	sudhakar	18	m	right	m/3	t	fall	A3	4/4/2014	4/5/2014	4/18/2014	B.B	R-Henry	u-6;r-6	90	15		18	excellent
16	12062	rahul	34	m	left	m/3	com	fall	C3	4/14/2014	4/15/2014	4/27/2014	B.B	R-Henry	u-5,r-6	100	11		20	excellent
17	13045	satish	42	m	left	m/3	w	fall	B3	4/17/2014	4/18/2014	4/23/2014	B.B	R-Henry	u-5,r-6	90	7	radial nerve palsy	16	fair
18	14326	jayaram	38	m	right	l/3	t	fall	A3	4/19/2014	4/20/2014	5/1/2014	G.A.	R-Henry	u-7,r-8	100	12		20	excellent
19	15694	vijay	34	f	right	m/3	com	rta	C3	5/4/2014	5/5/2014	5/9/2014	B.B	R-Henry	u-5,r-6	60	4		19	excellent
20	21904	kalyan	24	m	left	u/3	t	fall	A3	5/6/2014	5/8/2014	5/12/2014	B.B	Thom	u-7,r-8	80	6		14	excellent
21	9418	jyoti	21	f	right	m/3	t	fall	A3	4/6/2014	4/9/2014	4/20/2014	B.B	R-Henry	u-6;r-8	100	11	reduced rom	17	fair
22	453	asha	20	f	left	m/3	t	fall	A3	1/6/2015	1/7/2015	1/19/2015	B.B	R-Henry	u-6;r-8	110	7		14	excellent
23	1209	shrinivas	30	m	left	m/3	t	rta	A3	1/12/2015	1/14/2015	1/27/2015	B.B	R-Henry	u-6;r-6	90	14		24	excellent
24	1981	prema	26	f	right	u/3	t	Assl	A3	1/20/2015	1/21/2015	30-2-15	B.B	Thom	u-6;r-8	90	12		14	excellent
25	2353	kaveri	24	f	right	m/3	t	fall	A3	1/23/2015	1/24/2015	2/2/2015	B.B	R-Henry	u-6;r-6	60	7	reduced rom	21	fair
26	3406	veda	20	f	right	m/3	com	rta	C3	2/1/2015	2/3/2015	2/14/2015	B.B	R-Henry	u-6;r-8	90	10		20	excellent
27	5502	karthik	30	m	left	l/3	t	fall	A3	2/4/2015	2/5/2015	2/11/2015	B.B	R-Henry	u-6,r-8	80	12		14	excellent
28	6102	basppa	40	m	right	m/3	w	fall	B3	2/9/2015	2/10/2015	2/14/2015	B.B	R-Henry	u-7,r-6	70	6		16	fair