"A PROSPECTIVE STUDY OF THE OUTCOME OF RADIAL HEAD REPLACEMENT IN RADIAL HEAD AND NECK FRACTURES"

Dissertation submitted

In partial fulfillment of the regulation for the award of

M.S. Degree in Orthopaedic Surgery

Registration Number: 221712303

Branch II

TIRUNELVELI MEDICAL COLLEGE

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MAY 2020

CERTIFICATE

This is to certify that this dissertation titled **"A PROSPECTIVE STUDY OF THE OUTCOME OF RADIAL HEAD REPLACEMENT IN RADIAL HEAD AND NECK FRACTURES"** is a bonafide work done by **Dr. CHARLES SEKAR.M,** Post graduate student in the department of Orthopaedics, Tirunelveli Medical College Hospital.

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Place: Tirunelveli.

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This is to certify that work entitled **"A PROSPECTIVE STUDY OF THE OUTCOME OF RADIAL HEAD REPLACEMENT IN RADIAL HEAD AND NECK FRACTURES"** which is being submitted for M.S. Orthopaedics, is a bonafide work by **Dr. CHARLES SEKAR.M,** Postgraduate student in the department of Orthopaedics, Tirunelveli Medical College Hospital, Tirunelveli.

He has completed the necessary period of stay in the department and has fulfilled the conditions required for submission of this thesis according to university regulations. The study was undertaken by the candidate himself and the observations recorded have been periodically checked by us. Recommended and Forwarded.

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This is to certify that the dissertation entitled **"A PROSPECTIVE STUDY OF THE OUTCOME OF RADIAL HEAD REPLACEMENT IN RADIAL HEAD AND NECK FRACTURES"** is a bonafide research work done by **Dr. CHARLES SEKAR.M,** Postgraduate M.S. student in Department of Orthopaedics, Tirunelveli Medical College Hospital, Tirunelveli, in partial fulfillment of the requirement for the Degree of **M.S. (Master of Surgery)** in **Orthopaedics.**

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DECLARATION BY THE CANDIDATE

I solemnly declare that this dissertation titled **"A PROSPECTIVE STUDY OF THE OUTCOME OF RADIAL HEAD REPLACEMENT IN RADIAL HEAD AND NECK FRACTURES"** was prepared by me, Registration Number **221712303**, Tirunelveli Medical College Hospital under the guidance of **Prof. & HOD, Dr. N. MANIKANDAN,** Tirunelveli Medical College Hospital, Tirunelveli, in partial fulfillment of Dr. M. G. R. Tamilnadu Medical University regulations for the award of M. S. Degree in Orthopaedics.

I have not submitted this dissertation to any other university for the award of any degree or diploma previously.

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PRINCIPAL INVESTIGATOR: Dr.CHARLES SEKAR.M, MBBS.,
DESIGNATION OF PRINCIPAL INVESTIGATOR: PG STUDENT
DEPARTMENT & INSTITUTION: TIRUNELVELI MEDICAL COLLEGE, TIRUNELVELI

Dear Dr.CHARLES SEKAR.M. MBBS, The Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during The IEC meeting held on 27.10.2017.

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1. TIREC Application Form ☐
2. Study Protocol ☐
3. Department Research Committee Approval ☐
4. Patient Information Document and Consent Form in English and Vernacular Language ☐
5. Investigator's Brochure ☐
6. Proposed Methods for Patient Accrual Proposed ☐
7. Curriculum Vitae of The Principal Investigator ☐
8. Insurance /Compensation Policy ☐
9. Investigator's Agreement with Sponsor ☐
10. Investigator's Undertaking ☐
11. DCGI/DGFT approval ☐
12. Clinical Trial Agreement (CTA) ☐
13. Memorandum of Understanding (MOU)/Material Transfer Agreement (MTA) ☐
14. Clinical Trials Registry-India (CTRI) Registration ☐

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1. The approval is valid for a period of 2 year/s or duration of project whichever is later
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3. A written request should be submitted 3weeks before for renewal / extension of The validity
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5. The TIREC will monitor The study
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7. The PI should report to TIREC within 7 days of the occurrence of the SAE. If the SAE is Death, the Bioethics Cell should receive the SAE reporting form within 24 hours of the occurrence.
8. In the events of any protocol amendments, TIREC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in The original project. (Page no. Clause no. etc.)
   b. The PI must comment how proposed amendment will affect the ongoing trial. Alteration in the budgetary status, staff requirement should be clearly indicated and The revised budget form should be submitted.
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CERTIFICATE –II

This is to certify that this dissertation work **title "A PROSPECTIVE STUDY OF THE OUTCOME OF RADIAL HEAD REPLACEMENT IN RADIAL HEAD AND NECK FRACTURES"** of the candidate **Dr. CHARLES SEKAR.M**, with **Registration Number 221712303** for the award of M. S. Degree in the branch of Orthopedics (II). I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion page and the result shows **17% PERCENTAGE** of plagiarism in the dissertation.

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INTRODUCTION

Fractures of the radial head and neck accounts for up to one third of the elbow fractures. Incidence is estimated to be 2.5 to 2.9 per 10,000 per year. Radial head fractures most commonly occur as the result of fall on the outstretched hand with partially flexed and pronated elbow [1].

The radial head plays a vital role in maintaining elbow stability. The ulnohumeral articulation and the medial and lateral collateral ligaments are the three primary static stabilizers of elbow. Secondary stabilizers include radial head, joint capsule and the common flexor and extensor origins. The muscles crossing the elbow function as dynamic stabilizers. If coronoid process or medial collateral ligaments (MCL) are injured, radial head becomes a critical stabilizer[2].

In communited radial head fracture excision of radial head may lead to loss of strength, valgus instability, & proximal migration of radius leads to wrist pain. Radial head replacement restores normal anatomy and functions of elbow, radioulnar & wrist joint[3].

AIM AND OBJECTIVE

AIM

To study the functional outcome of radial head & neck fractures managed by radial head replacement.

OBJECTIVE

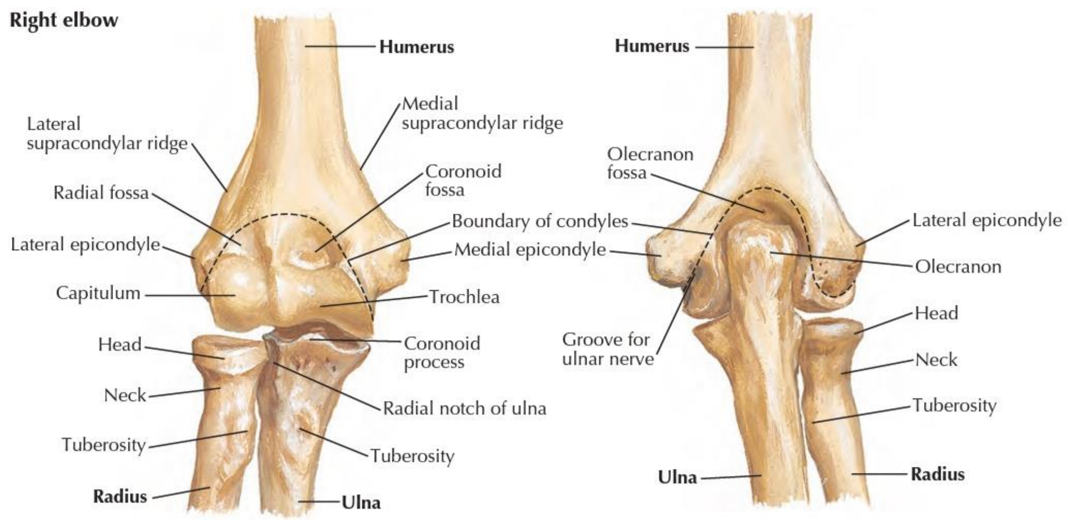
1. To analyse the clinical, radiological features, complications in patients treated with prosthetic replacement in radial head and neck fractures
2. To assess the functional outcome of the patients at 6 months follow up.

ANATOMY OF ELBOW JOINT

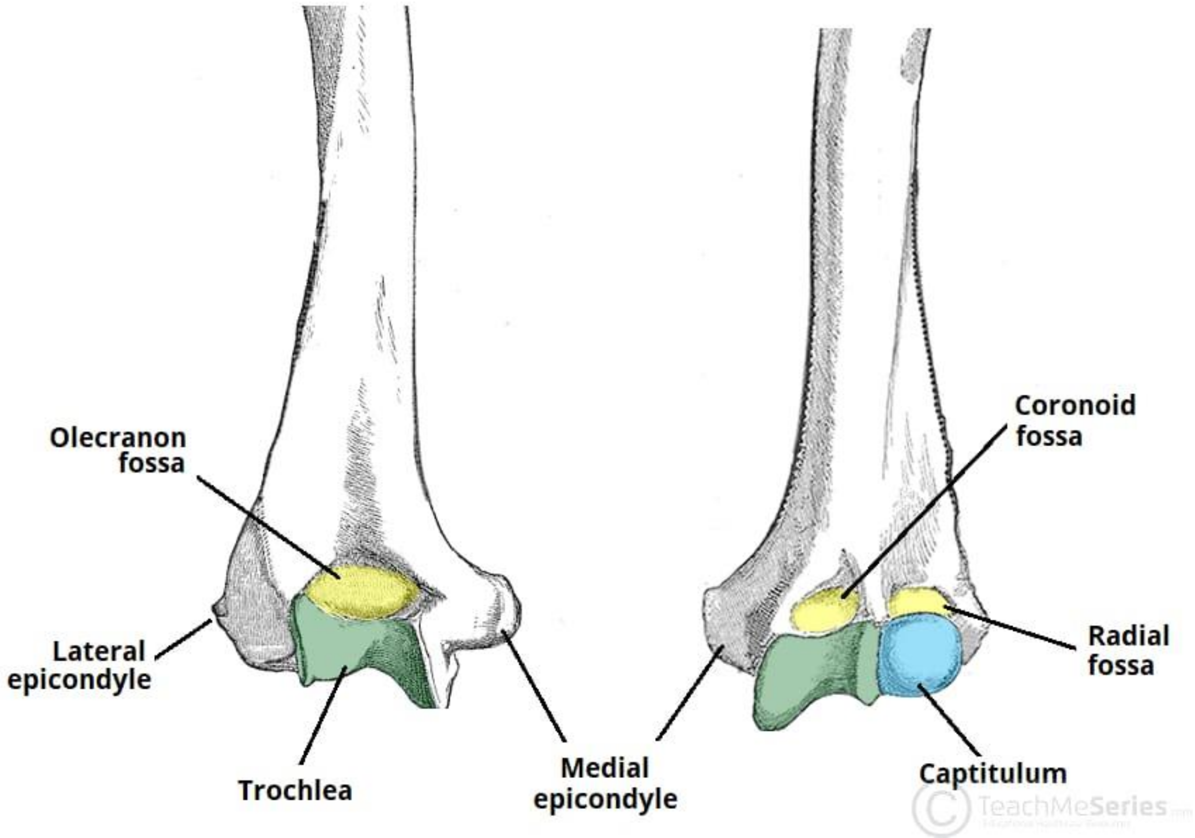
The elbow is a crucial element for a functional upper limb. The upper limb consists of a linked system between shoulder, elbow, wrist, and hand. The primary functions of elbow are to position the hand in space, act as fulcrum for the forearm, and allow for grasping and fine motions of the hand and wrist. Loss of elbow function causes significant disability & affect activities of daily living, work-related activities and recreational activities.

PASSIVE STABILIZERS

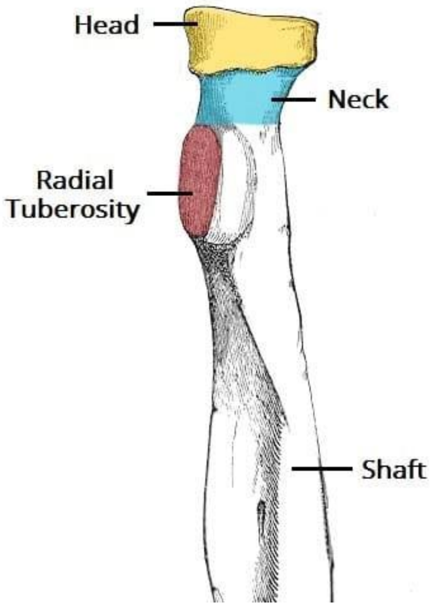
OSTEOLOGY:



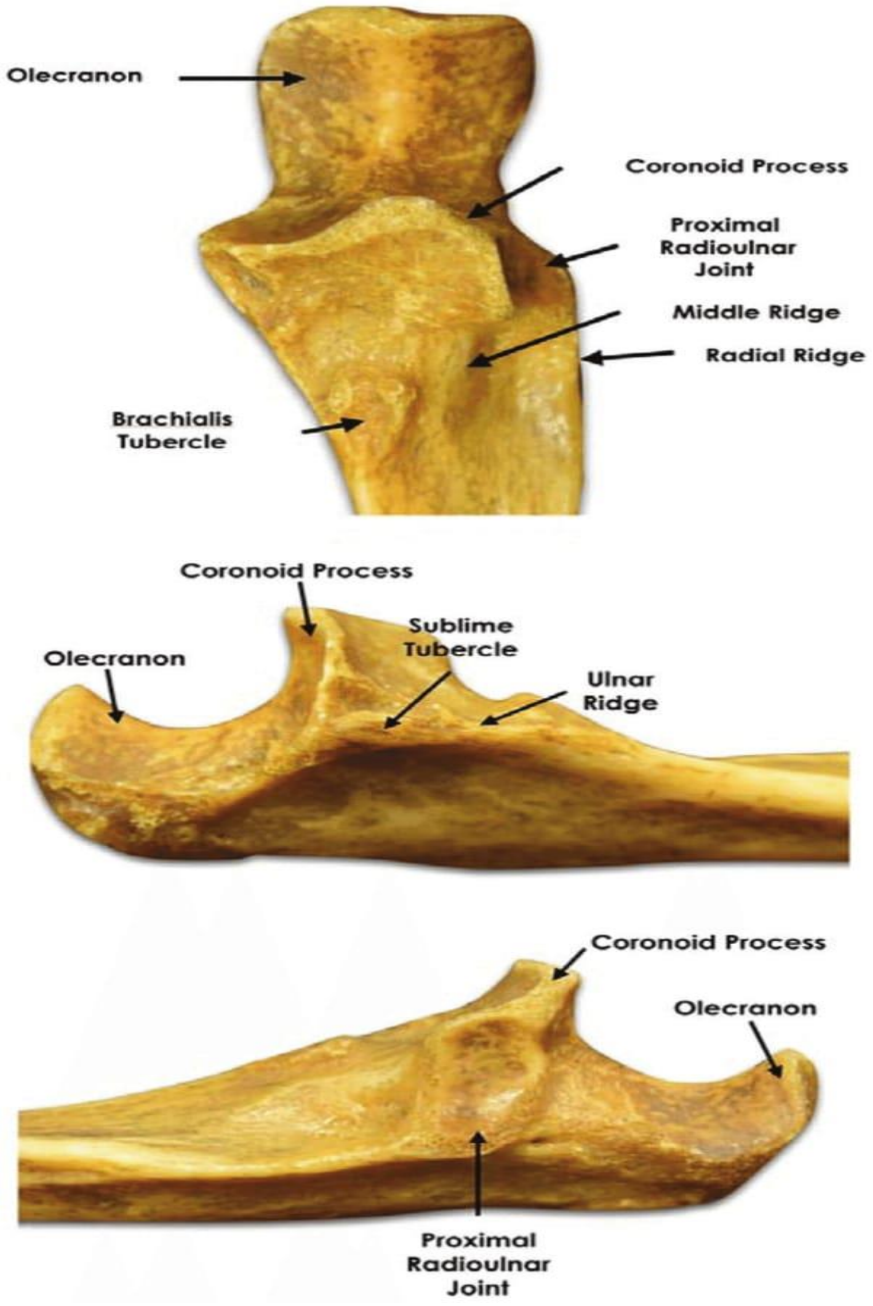
DISTAL HUMERUS comprises of two condyles forming the articular surfaces of capitellum laterally & trochlea medially. More prominent medial epicondyle is the origin point for the ulnar collateral ligament and flexor–pronator group. Less prominent lateral epicondyle is the attachment point for the lateral collateral ligament and extensor–supinator group. Anteriorly during elbow flexion, the coronoid and radial fossa accommodate coronoid process of ulna and radial head. Posteriorly during extension, olecranon fossa accommodates olecranon process of the ulna.



PROXIMAL RADIUS consists of cylindrical shaped radial head, which articulates with both radial notch of ulna & capitellum of the humerus. The radial neck at its distal aspect has the tuberosity, which is the side of insertion of biceps tendon.



PROXIMAL ULNA : Bony geometry of proximal ulna provides the elbow articulation with inherent stability, especially in full extension. The beaked greater sigmoid notch (aka the incisura semilunaris) articulates with trochlea of the humerus, and comprises olecranon (site of triceps attachment) & coronoid process (site of brachialis attachment). On the lateral coronoid process,the radial notch articulates with radial head. The crista supinatoris is on lateral aspect of proximal ulna and serves an attachment for lateral ulnar collateral ligament. On the medial aspect of proximal ulna, the anterior portion of medial collateral ligament attaches to coronoid process



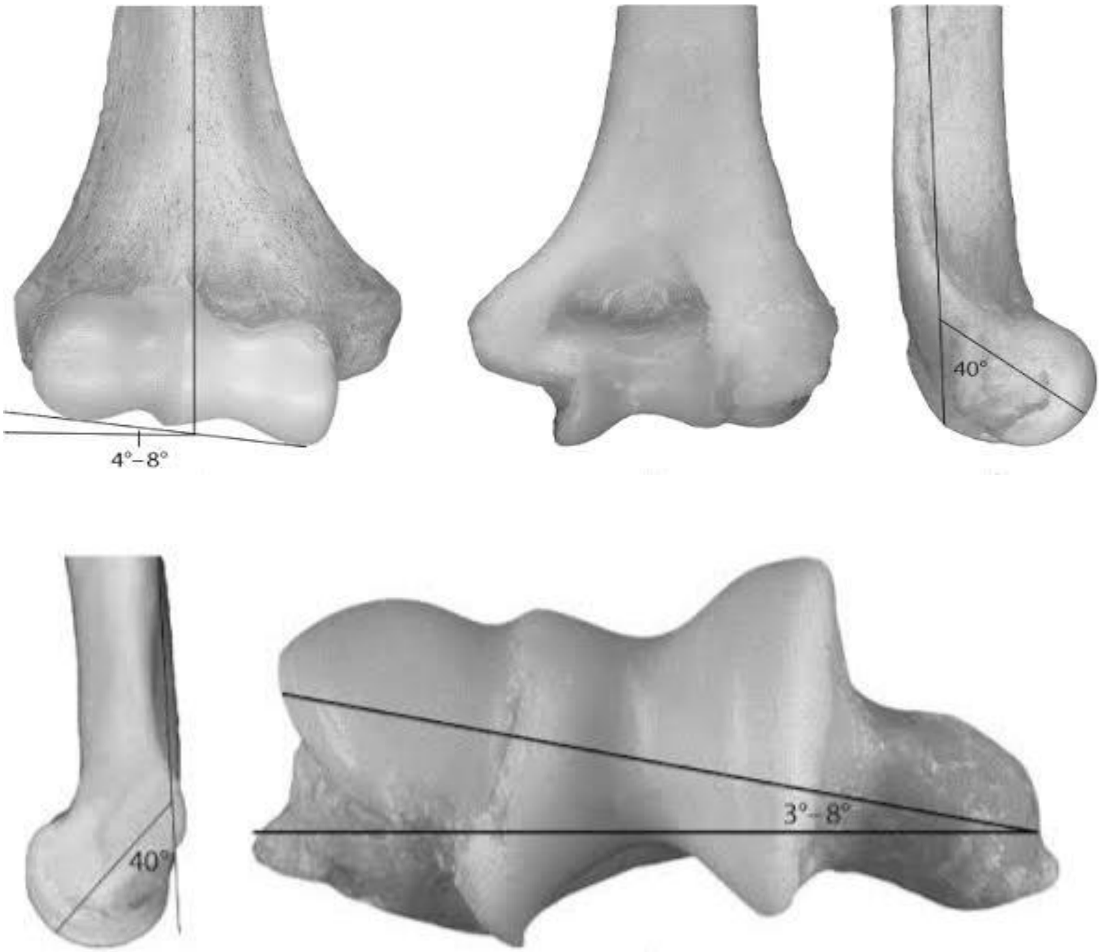
ARTICULATION:

The elbow joint is highly congruous & made up of the articulation between the radius, ulna and humerus.

The ulnohumeral joint is a hinge joint with motion of flexion and extension.

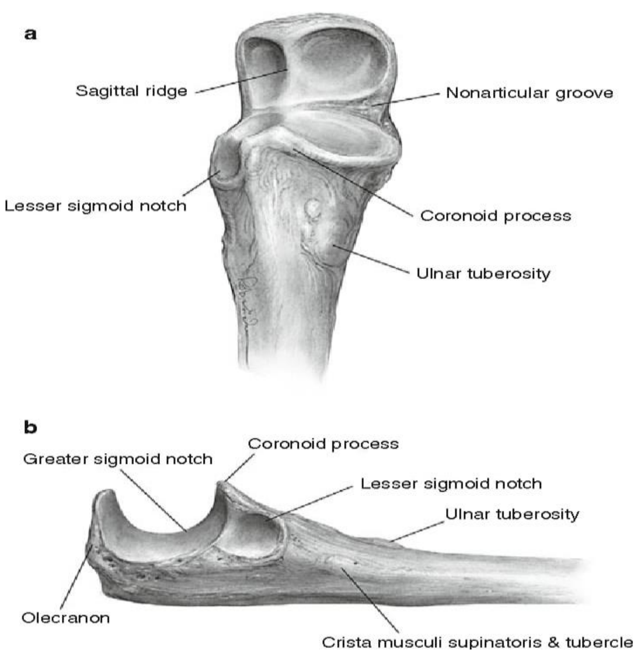
The proximal radioulnar and radiohumeral joints are pivoting joints allowing rotation.[4,5]

Trochlea is a pulley-shaped surface that is larger medially than laterally & it articulates with sigmoid notch of proximal ulna. Laterally, capitellum articulates with radial head. The trochleocapitellar groove between trochlea and capitellum is the point of articulation for the rim of radial head. Both capitellum and sigmoid notch covered with hyaline cartilage.In relation to the humeral shaft, these articular surfaces oriented 30- 40° anterior, in 5° internal rotation& in 6° of valgus angulation.[4,6]



The proximal radius has cylindrical head with hyaline cartilage covering the depression for articulation with capitellum and the outside circumference of radial head. Approximately 240° of radial head has hyaline cartilage, the anterolateral third devoid of hyaline cartilage. The head and shaft form an 15° angle to the shaft[4].

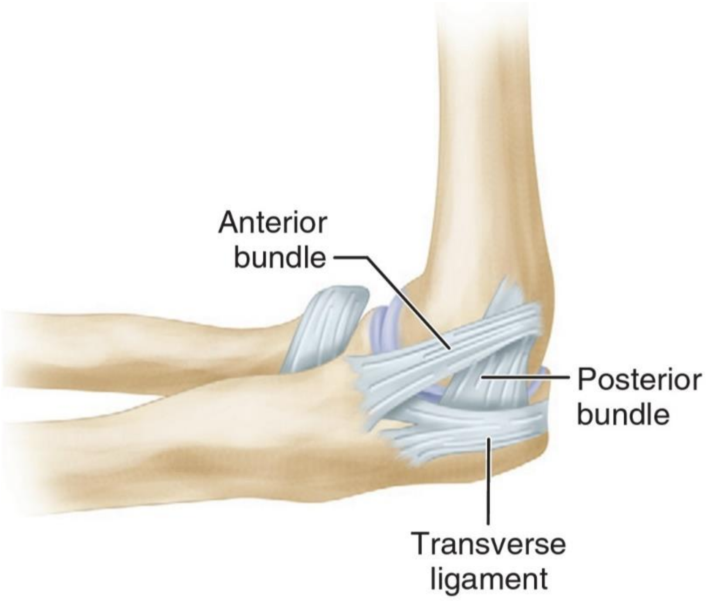
Proximal ulna consists of coronoid and olecranon process. These make up saddle-shaped, ellipsoid articular surface of sigmoid notch. The midportion of sigmoid notch devoid of articular cartilage & it is covered by fatty tissue[7]. The arc of greater sigmoid notch is approximately 190°, which opens 30° posterior to the long axis of ulna. This angle complements with the 30°anterior angle of distal humerus and articular surface. Lesser sigmoid notch has an arc of approximately 70° and articulates with radial head at lateral coronoid[5].



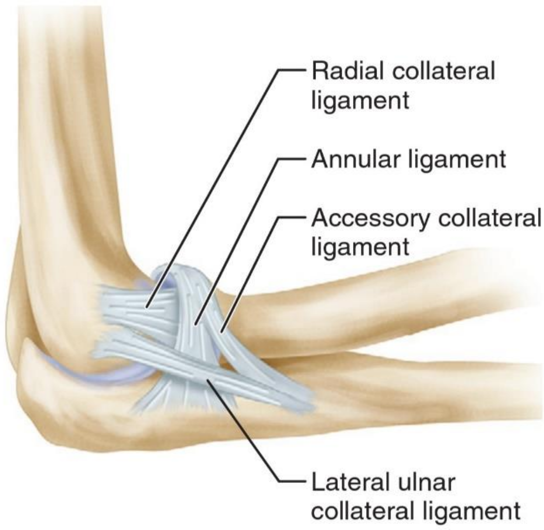
LIGAMENTS:

The ligamentous complexes stabilize the elbow joint are medial &lateral capsular thickening that form medial and lateral collateral ligaments.

Triangular medial (ulnar) collateral ligament : It has three components, the anterior bundle, posterior bundle and transverse segment . The anterior bundle is the crucial component of medial collateral ligament complex. The posterior bundle (Bardinet ligament) is best defined at 90° flexion[4,9]. transverse ligament (ligament of Cooper) contributes little to elbow stability. Medial collateral ligament originates from anteroinferior medial epicondylar surface[10]. The anterior bundle attaches to the sublime tubercle . The posterior bundle attach to the medial margin of the trochlear notch and is tight in flexion. The transverse ligament is limited to the ulna. anterior bundle width averages 4 to 5 mm, posterior bundle width averages 5 to 6 mm[11].



Lateral(radial) collateral ligament complex : It consists of the radial collateral ligament, annular ligament, lateral ulnar collateral ligament, and accessory lateral collateral ligament.



1) **The radial collateral** ligament originate from lateral epicondyle and inserts to the annular ligament. It serves as a partial origin for supinator muscle. Average dimensions of the ligament are 20 mm length and 8 mm

width. Origin of the ligament is close to axis of rotation and therefore uniformly taut throughout flexion-extension movement.

2)**Annular ligament**

Maintains contact between radial head and ulna at lesser sigmoid notch. Originates and inserts on the anterior and posterior margins of lesser sigmoid notch. The anterior insertion becomes taut in supination and posterior origin becomes taut in pronation.

3)Lateral ulnar collateral ligament:

Originates at the lateral epicondyle and inserts at the tubercle of the supinator crest of the ulna. It is the primary lateral stabilizer of the ulnohumeral joint, and it's deficiency results in posterolateral rotatory instability[12]

4) Accessory lateral collateral ligament

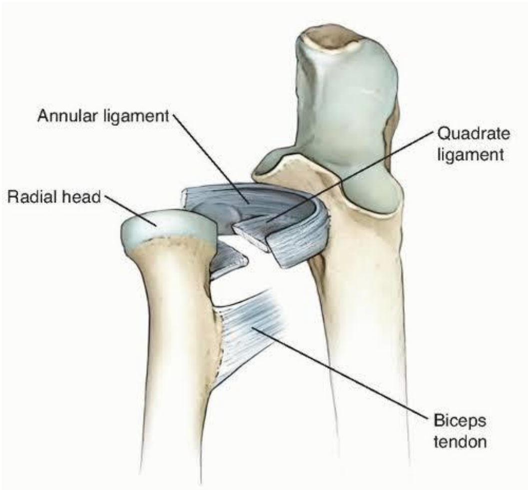
It blends with fibers of annular ligament and inserts in the tubercle of the supinator crest. It stabilizes the annular ligament during varus stress at elbow[4,9]

Oblique ligament:

It is the fascia overlying the deep head of the supinator between radius and ulna& believed to have limited functional importance[4].

Quadrate ligament :

It is a thin fibrous layer between annular ligament and ulna, it stablize the proximal radioulnar joint during pronation and supination



ACTIVE STABILIZERS → MUSCLES

Muscles crossing the elbow joint divided into four main groups

- Posteriorly, elbow extensors cross elbow joint, innervated by radial nerve.
- Laterally, wrist and finger extensors & the supinator are found and innervated by radial nerve.
- Medially, flexor–pronator group, including flexor carpi radialis, flexor carpi ulnaris, palmaris longus, and pronator teres, crosses the joint, and are innervated by the medial and ulnar nerves.
- Anteriorly, the elbow flexors cross the joint, and are innervated by the musculocutaneous nerve.
- Brachioradialis, extensor carpi radialis brevis, and longus muscles, originate at the lateral epicondyle. This three muscles together called as mobile wad of Henry[4,9].

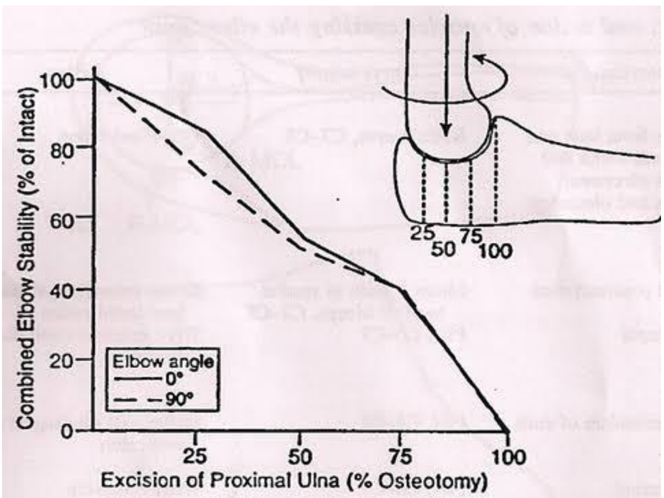
BIOMECHANICS OF ELBOW

ELBOW STABILITY AND STABILIZING STRUCTURES

Elbow joint is a highly congruous and stable joint. The passive and the active stabilizers provide stability to the elbow joint. Passive stability results from congruent articulation between the humerus and ulna and soft tissue constraints. Active stability is caused by joint compressive forces provided by the muscle.

PASSIVE BONE STABILIZERS

Ulno humeral joint is a dominant passive stabilizer. Contribution of radial head to elbow stability is evaluated with successive removal of proximal ulna. Linear decreasing relationship in stability seen with removal of olecranon in both flexion and extension.



Successive resection of the proximal ulna showed a linear decrease in elbow stability in both full extension and 90° flexion

75-85% of valgus stress resisted by proximal half of sigmoid notch. Distal half of sigmoid notch (coronoid) resisted 60% of varus stress in flexion and 67% in extension. Elbow becomes unstable if coronoid is resected. With radial head resection instability occurs earlier with less coronoid resection[13].

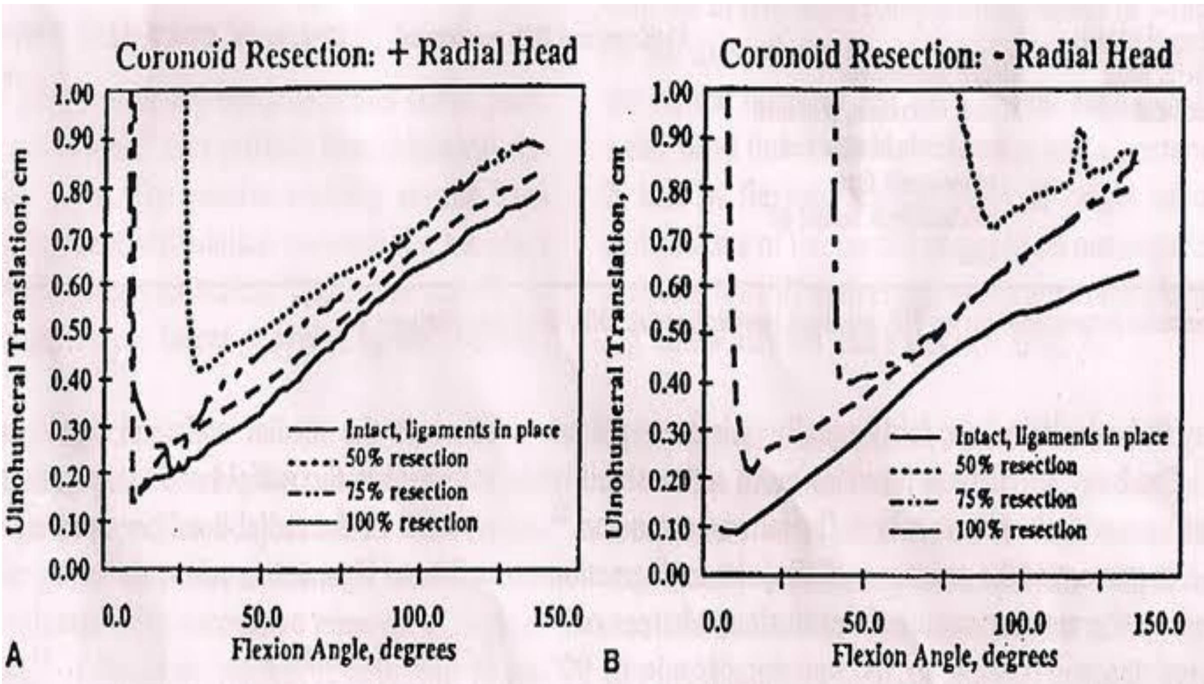
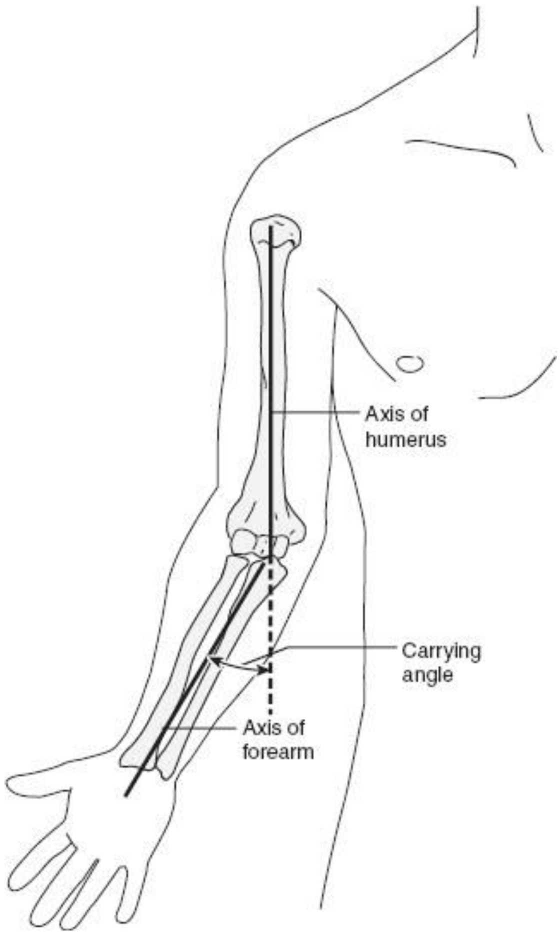


Fig A, Increasing ulnohumeral instability with successive coronoid resection and the protective role of the radial head until almost full extension. B, After radial head resection, ulnohumeral stability occurs with less coronoid resection and in less extension

Contact areas in elbow joint vary with type of applied stress. Contact areas of elbow occur at 4 facet in the sigmoid fossa , 2 in coronoid and 2 in olecranon. With varus and valgus loads contact areas changes medially and laterally.Pivot point lies just lateral to the middle of the lateral facet of trochlea[14].

- Carrying angle is formed by the longitudinal axis between the humerus and ulna in full extension. Females, the average angle is 13° to 16°, males, it is 11° to 14°. Carrying angle changes from a valgus orientation in extension to varus orientation in flexion[16].



- The axis of rotation coincides with the trochlea so the change in carrying angle with flexion is caused by anatomic variations of articulation[16].

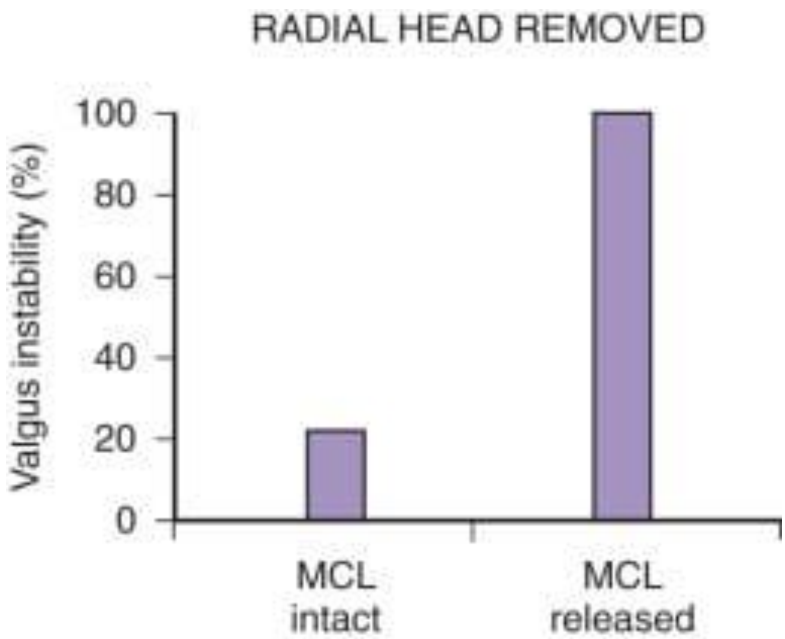
PASSIVE SOFT TISSUE STABILIZERS[4]:

It includes the medial and lateral collateral ligament complexes and the anterior capsule. Lateral collateral ligament complex includes lateral ulnar collateral ligament, which stabilize against varus stress. Other components of lateral collateral ligament complex include radial collateral ligament, annular ligament, and accessory lateral collateral ligament. Lateral and medial ligament complexes differ in their site of origin. Lateral collateral ligament originates from lateral condyle at the point where axis of rotation of elbow passes through. This ligament has uniform tension throughout range of motion, because of its origin at the axis of rotation. Medial collateral ligament consists of two main components not originating on the axis of rotation of the elbow. Anterior bundle of the medial complex has been further subdivided into anterior band, which taut in extension and a posterior band, which taut in flexion. Becasuse the point of origin do not occur at the axis of rotation.

INTERPLAY BETWEEN PASSIVE STABILIZERS

- In 90^0 elbow flexion, medial collateral ligament is the primary stabilizer to valgus stress[17].
- In extension, anterior capsule, medial collateral ligament, bony articulation are equally resistant to valgus stress.

- Radial head is the secondary stabilizer to valgus stress and it becomes significant if medial collateral ligament released/injured[19].



The stabilizing role of the radial head to valgus stress. The radial head mainly functions in this role once the medial collateral ligament is released (MCL), showing the radial head to function as a secondary stabilizer to valgus stress

- The Bony articulation provide much varus stability of elbow in both flexion and extension[18].
- 85% of resistant to joint distraction caused by anterior capsule in extension, only 8% resistant caused anterior capsule in 90^{o} flexion. In elbow flexion, 78% are resistant to traction provided by medial collateral ligament[18].

ACTIVE STABILIZERS:

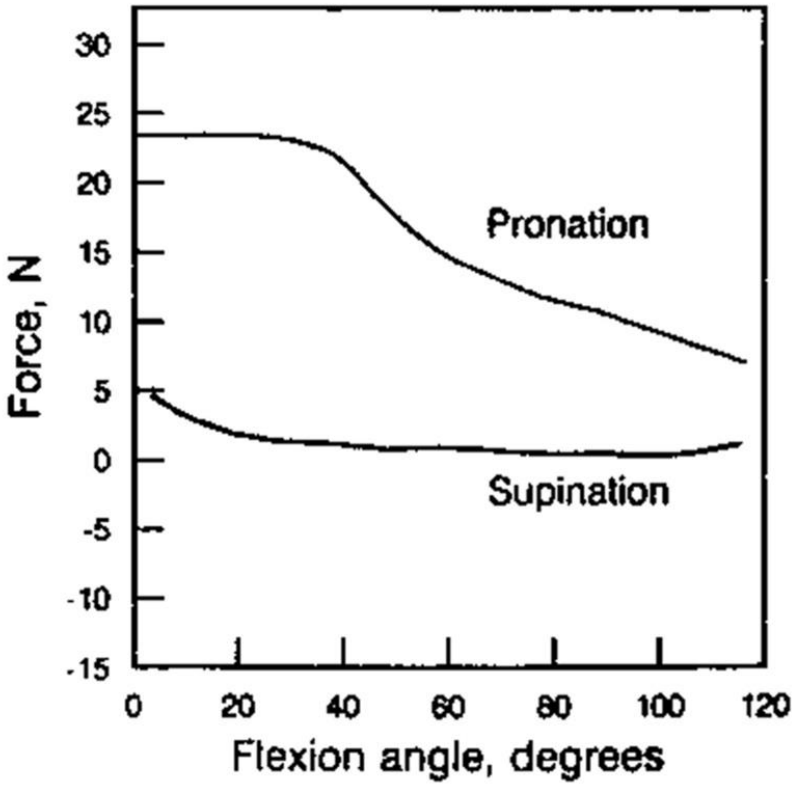
The line of pull and contraction of muscles across the joint create forces within the joint at humerus , radius and ulna. These balanced forces function as dynamic stablilizers of the elbow joint[4,9].

FORCE TRANSMISSION THROUGH THE ELBOW:

The knowledge of muscles crossing the joint, physiologic cross sectional area, moment arm, line of pull, muscle activity during motion and number of muscles involved required to know about the force transmission through the elbow. Brachialis and triceps have the largest work capacity and contractile strength.

With extension and axial loading, stress distribution is 40% across ulnohumeral joint and 60% across radiohumeral joint[4]. With valgus alignment 12% axial load is transmitted across proximal ulna[20]. In varus alignment 93% of force is transmitted through proximal ulna.

Morrey et al[21]. measured force transmission through radial head. Force transducer was placed over the radial neck and flexion force was applied through brachialis and biceps muscle. Extension forces were passive. Radial head forces were greatest from 0 –30° flexion and higher in pronation.



Greater force transmission across the radial head with pronation, suggesting proximal migration of radial head with pronation

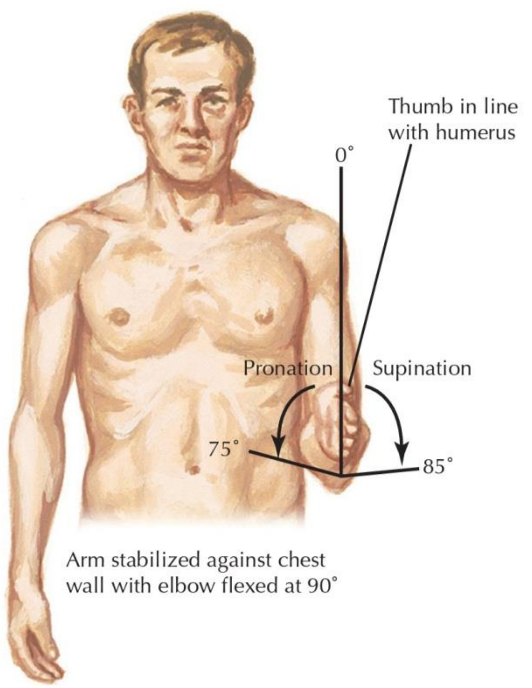
Joint forces in the ulno humeral joint range from 1-3 times from body weight with sternous lifting. The direction of the force changes with flexion angle in elbow extension the direction of the force pointing more anteriorly and posteriorly with elbow flexion.

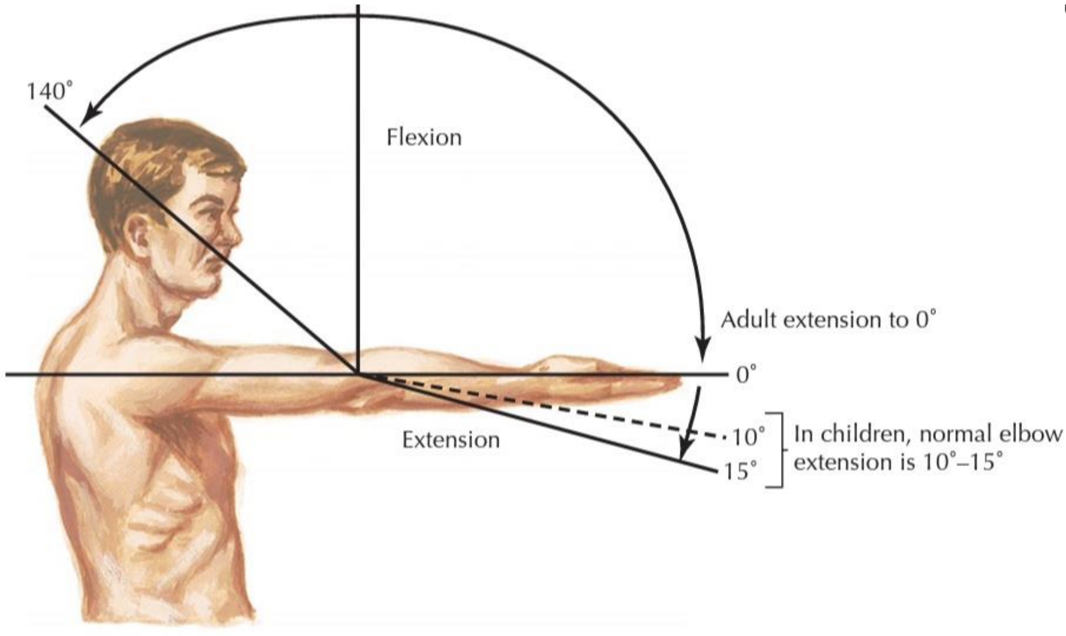
Stress on the articular cartilage of trochlear notch was evaulated by An et al.[22] The contact pressure depends on direction and magnitude of compressive force. When the force was oriented at centre of articular surface, stress was equally distributed. When the force was directed towards the margin of articulation, weight bearing surface was reduced, contact stresses were increased and stress distribution was uneven.

Askew et al[23]. measured elbow strength at 90° flexion in neutral rotation. It showed men to be twice as strong as women, dominant arm was 6% stronger than the non dominant arm.

RANGE OF MOTION:

- Flexion: 0° to 140°- 150°
- Supination: 80°-85°
- Pronation: 75°-80°
- Functional ROM: 30° - 130°





Factors limiting extension include the impact of olecrenon process on the olecrenon fossa, tension of anterior bundle of medial collateral ligament and flexor muscles. Flexion is limited by impact of coronoid against coronoid fossa, impact of radial head against radial fossa , tissue tension from capsule and triceps muscle. Pronation and supination are restricted by passive stretch of antagonistic muscles. Quadrate ligament is shown to provide static constraint to pronation and supination[4].

RADIAL HEAD FRACTURES[24,25]

INCIDENCE

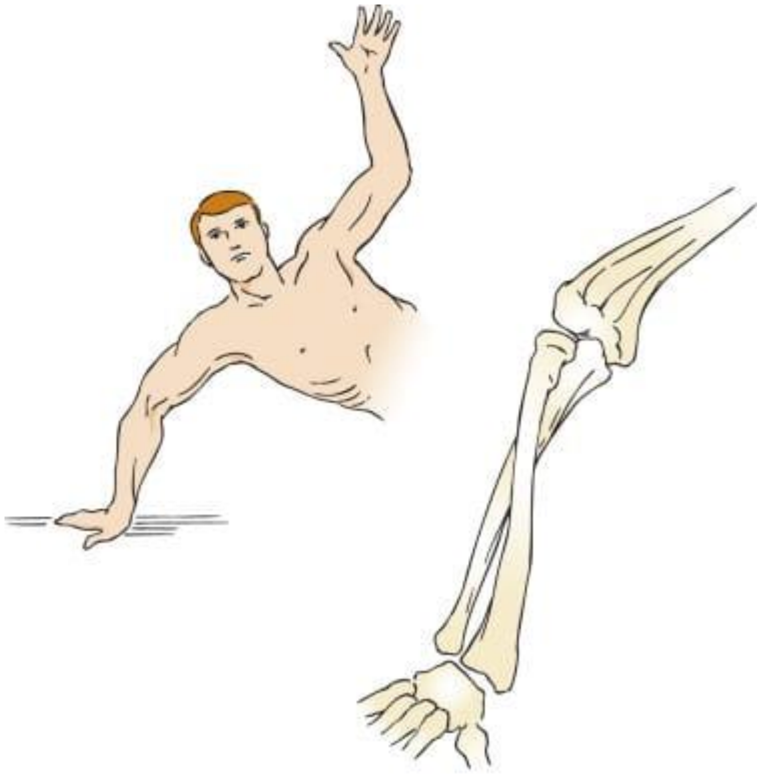
Fracture of radial head and neck reported as 1.7% -5.4% of all fractures and it accounts for 33% of elbow fractures

AGE AND SEX

- Gender ratio 1:1
- Male has severe fracture type and associated injury

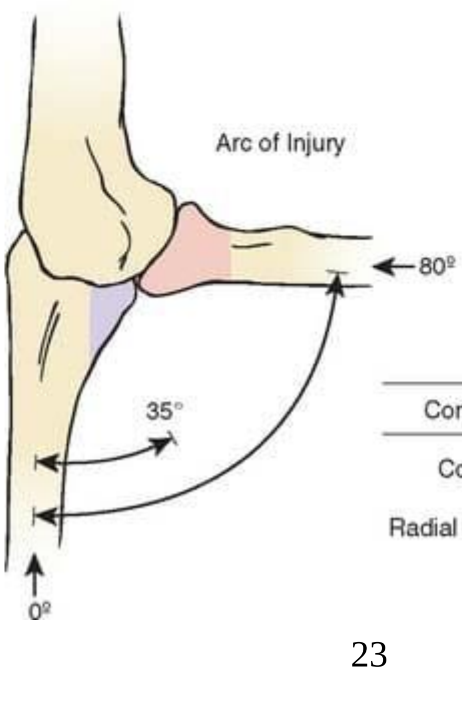
MECHANISM OF FRACTURE

INDIRECT : with axial load on the pronated forearm. Odelberg Johnson observed that fracture occurred with posterior subluxation of forearm and involved the anterior part. Because head of radius eccentric to the central axis of neck of radius and posterolateral portion of head comes into contact with the capitellum during pronation common occurrence of anterolateral fracture fragment supports this theory.



DIRECT : With direct blow in an uncommon cause.

AMIS AND MILLER correlated the fracture and angle of flexion. Coronoid and radial head fractured with elbow in full extension but radial head fractured at greater degree of flexion nearly 80^0 of flexion arc



Fracture

Component	Arc
Coronoid	0-35º
Radial Head/Neck	0-80º

ASSOCIATED INJURIES OF RADIAL HEAD FRACTURES

▪ CONCURRENT FRACTURES OF ELBOW

Incidence of associated lesion increases from 20% in undisplaced fractures to 80% in communited fractures

➢ CAPITELLAR INJURIES

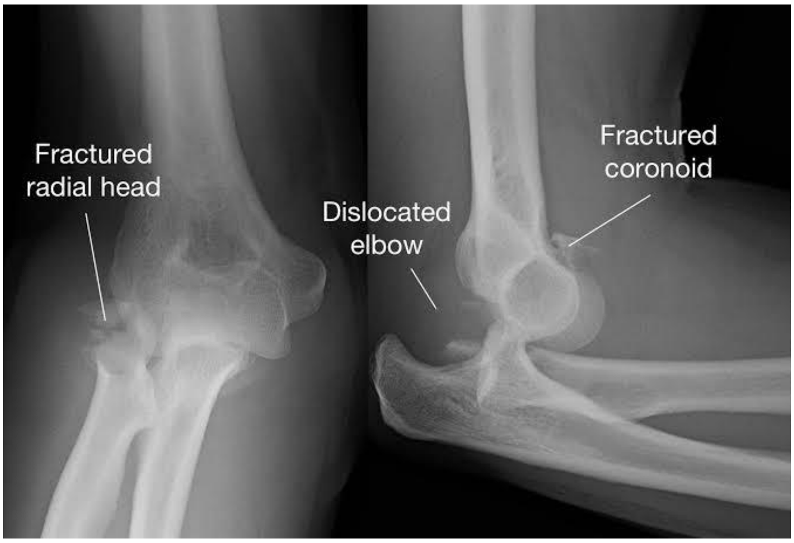
Fracture or cartilage injuries of capitellum are common but not always appreciated. Ward & Nunlen described with association between capitellum and radial head fractures. Half of capitellar fractures have associated radial head fractures but only 2% of radial head fractures are associated with capitellar fractures.

➢ OLECRANON FRACTURES

Fracture of olecranon & radial head are considered a variety of Monteggia fractures. These combination injuries are analysed in detail by Scharplatz & Allgower.

➢ CORONOID FRACTURES

15% of radial head fractures have associated coronoid fractures. Large coronoid fractures produce significant elbow instability. Combination of radial head fractures, coronoid fracture and elbow dislocation are called as Terrible triad of elbow.



- **ELBOW DISLOCATION**

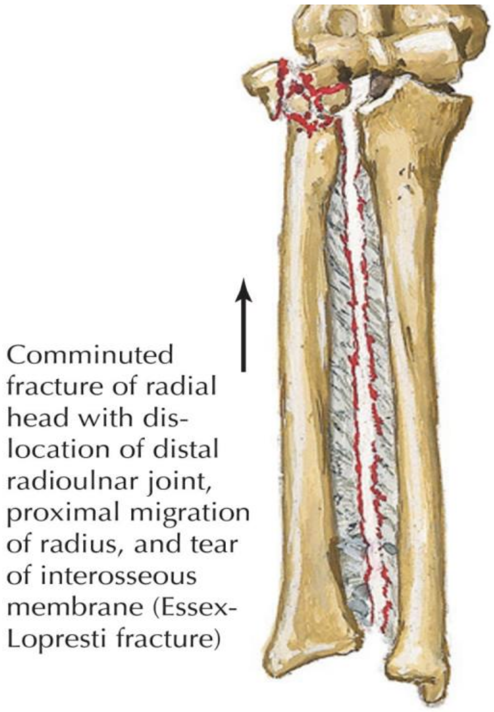
10-15% of radial head fractures are associated with elbow dislocation. Bilateral fractures are uncommon.

- **LIGAMENTOUS INJURIES AT THE ELBOW**

Some degrees of ligamentous injuries often occur with radial head fractures but not fully appreciated. Mostly ligamentous injury occur in 50% associated lesion of elbow. Most involved ligaments are medial and lateral ulnar collateral ligaments which predispose to chronic symptoms.

- **ESSEX LOPRESTI FRACTURE**

This injury comprises of communited radial head fracture, dislocation of DRUJ, interosseous membrane disruption. All these leads to proximal migration of radial head, longitudinal forearm instability.



- **NEUROVASCULAR INJURY**

Usually rare, severe anterior displacement produces posterior interosseous nerve palsy.

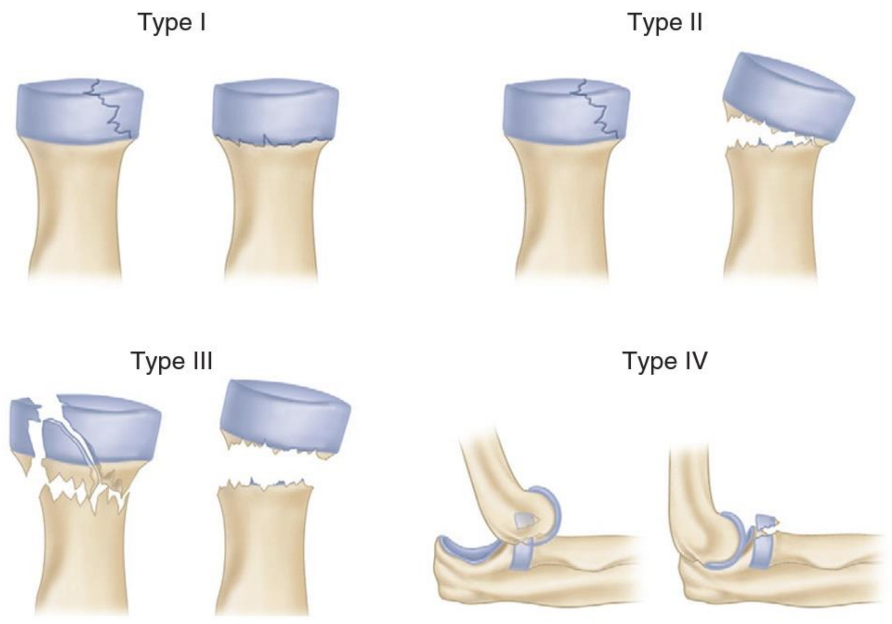
- **MUSCULAR INJURIES**

Elbow dislocation may violate the brachialis muscle and is thought to contribute to the development of myositis ossificans.

CLASSIFICATION OF RADIAL HEAD FRACTURES[24,25]

MASON CLASSIFICATION:

- **Type I** : Fissure or marginal sector fracture without displacement
- **Type II** : Marginal sector fracture with displacement
- **Type III**: Comminuted fracture involving the whole head.
- **Type IV**: Radial head fracture associated with an elbow dislocation.



BROBERG AND MORREY MODIFICATION OF THE ORIGINAL MASON CLASSIFICATION:

- **Type I:** Fracture undisplaced or displaced less than 2 mm and involves less than 30% of the articular surface.
- **Type II**: Fracture displaced greater than 2 mm and involves greater than 30% of the articular surface.

- **Type III**: Fractures which are comminuted.

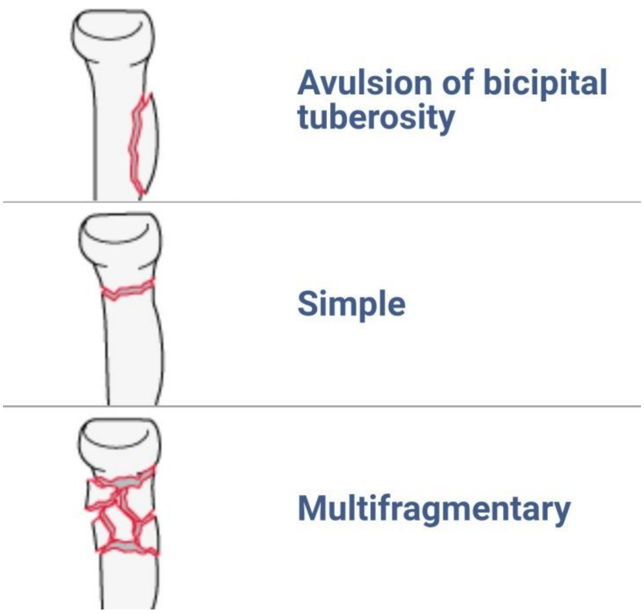
AO CLASSIFICATION:

- **Radius extra articular:**

➢ Avulsions of the bicipital tuberosity is classified as a 2R1A1 injury. Biceps tendon avulsions usually occur without fracture. Weakness of supination suggests biceps tendon avulsion.

➢ Simple fractures of the radial neck are classified as 2R1A2 fractures

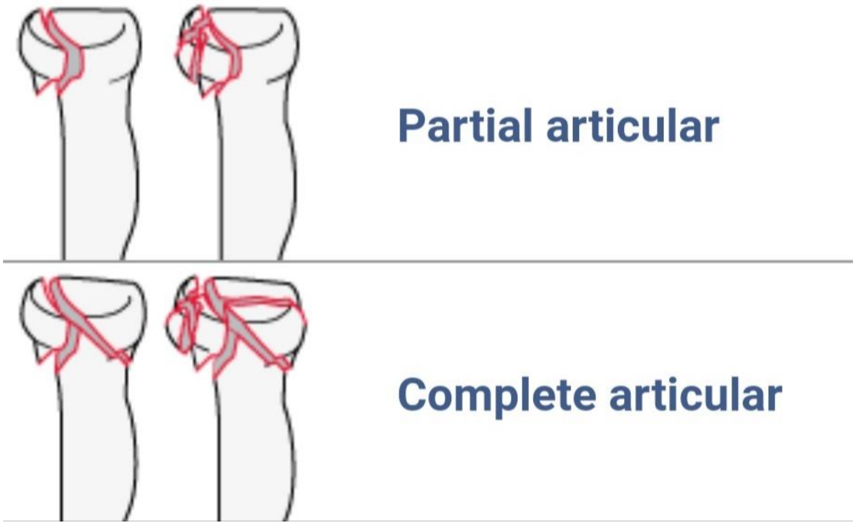
➢ Multi fragmentary fractures of the radial neck are classified as 2R1A3 fractures. Multi fragmentary radial neck fractures are uncommon and difficult to repair



If the fracture is displaced and unstable, consider injury to the medial collateral ligament (valgus injury), both the medial and lateral collateral ligaments (elbow dislocation), or the interosseous ligament of the forearm (Essex-Lopresti injury)

- **Radius articular:**
  - ➢ Partial articular fractures of the radial head are divided in two fracture classes:
    - 2R1B1 – Simple
    - 2R1B3 – Fragmentary
  - ➢ Complete articular (whole head) fractures of the radial head are divided in two fracture classes:
    - 2R1C1 – Simple
    - 2R1C3 – Fragmentary

They are either stable fractures with no associated elbow or forearm ligament injury, or unstable fractures associated with elbow dislocation, or part of an Essex-Lopresti (interosseous ligament of the forearm) injury. If there is a significant gap between fracture fragments, then there is usually an associated ligament injury or associated fracture.


Partial articular
Complete articular

MANAGEMENT OF RADIAL HEAD FRACTURES[24,25]

- **NON OPERATIVE TREATMENT**:

Indicated if functional forearm rotation can be demonstrated with or without anesthetic injection(Mason type 1 fractures)

Contraindications:

- Presence of elbow or forearm subluxation
- Infirm or dependent person
- Polytrauma

Advantages:

Allows immediate motion and stretching exercises to avoid elbow stiffness

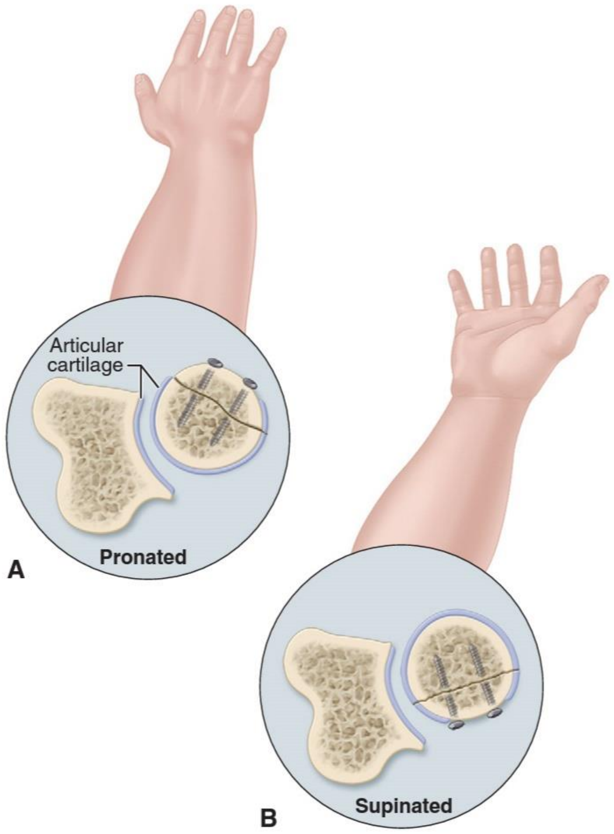
Disadvantages:

Malunion of the radial head restricting forearm rotation.

- **OPEN REDUCTION WITH INTERNAL FIXATION**:

Indicated in reconstructable Mason type 2& 3 fractures. Fracture is fixed with Herbet screws/ plates.

Implants are placed in the safe zone of radial head. Safe zone is the area of radial head that does not articulate with ulna.



To determine the location of the “safe-zone”, reference marks are made along the radial head and neck. Three such marks are made with the forearm in neutral rotation, full pronation, and full supination.

The posterior limit of the safe zone lies halfway between the reference marks made with the forearm in neutral rotation and full pronation. The anterior limit lays nearly two thirds of the distance between the neutral mark and the mark made in full supination.

The non-articulating portion of the safe zone consistently encompasses a 90 degrees angle localized by palpation of the radial styloid and Lister's tubercle.

Advantages:

- Fracture compression
- Rotational control of the radial head

Disadvantages:

- Risk of malpositioning of the plate outside the “safe zone”, beyond which the plate may block rotation of the radius, by impinging on the proximal radioulnar joint
- Risk to the posterior interosseous nerve

- **RADIAL HEAD EXCISION:**

  Indicated in isolated unreconstructable radial head fracture with stable elbow but limited forearm rotation. Intact interosseous membrane and distal radioulnar joint (DRUJ)

Contraindications:

- Simple fracture
- Associated coronoid fracture (>50%)
- DRUJ injury

Advantages:

- Fast procedure
- Good functional recovery
- Inexpensive and easy technique

Disadvantages:

- Risk of missed Essex-Lopresti injury
- Risk of unstable elbow after wrong diagnosis
- Risk of late proximal migration of the radius

- **RADIAL HEAD REPLACEMENT:**

Indications:

- Unreconstructable radial head fracture associated with an unstable fracture of the coronoid process
- After radial head excision with evidence of medial collateral ligament insufficiency or ulnohumeral instability
- Unreconstructable radial head fracture associated with interosseous membrane injury and distal radioulnar joint subluxation (Essex-Lopresti injury)

Contraindications:

- Simple fracture
- Reconstructable multifragmentary fracture
- Stable elbow

Advantages:

- Fast procedure
- Good functional recovery
- Stable elbow

Disadvantages:

- Early loosening of the prosthesis
- Risk of elbow stiffness (prosthesis too large)
- Risk of unstable elbow (prosthesis too small)

REVIEW OF LITERATURE

In the early twentieth century radial head resection was the available treatment of choice for displaced radial head fractures, before Speed introduced reconstruction of radial head with metal prosthesis. In 1924[26], Speed even stated that : "In adults, unless the lesion is only a mere crack, there is no doubt that removal of the head is primarily indicated". Regrowth of bone[27] at the proximal end of radius was seen to be one of the complications after resection . Interposition of soft tissue or bone grafting[28] was therefore suggested to prevent such regrowth. In 1941, Speed[29] described a ferrule cap which is to be placed over the radial neck to prevent heterotopic bone formation. These caps were made from casts of resected normal heads of the radius, and this was the essence which lead to the discovery of 'anatomic' radial head prostheses.

Carr et al[30]. was the first to comment that the prosthesis increased elbow stability, when compared to radial head resection. In 1951, Essex-Lopresti[31] described that the temporary use of a radial head prosthesis, until the forearm had healed and became stable in 2 cases of radial head fractures with DRUJ dislocation showed improved outcomes. In 1953, Cherry[32] described a prosthesis made of acrylic resin, to prevent proximal translation of the radius and strain on the distal radio-ulnar joint and to prevent cubitus valgus. However the use of a radial head prostheses was still rare at that time. Various studies were undertaken at that time comparing radial head prosthesis Vs resection of the radial head. Patients were more satisfied , had greater mobility, less pain, and none had wrist symptoms, compared to three patients with wrist pain in the resection group[33]. Prevention of distal radio-ulnar joint subluxation became an accepted indication for radial head replacement[34].

Gradually over a period of time, the indication for radial head prosthesis changed from the prevention of heterotopic ossification to the prevention of proximal migration of the radius leading to instability of the elbow.

Results of the long-term outcomes of the Speed prosthesis which was published in 1964 was found to be similar with those patients treated with radial head resection, with decreased pronation and supination in the prosthesis group In 1969, the Swanson Silastic ® radial head prosthesis[35,36] became available but did not prevent proximal migration of the radius and a large degree of distortion was found during movement of the elbow .

Optimal timing of the prosthetic replacement was first studied in 1974[37]. Early replacement showed better functional results, but good pain relief was found in the late group.

Structural complications[38] with the Swanson prosthesis were first reported in 1979. Among eighteen patients, the prosthesis had broken in three, subluxation in one and tilted in six, giant cell synovitis[39] from silastic particle were shown to be a problem in one patient. Results of clinical reports were mixed where some showed improved results[40,41] in silastic prosthesis over radial head resection, whereas others showing no difference or poor results[42,43].

Biomechanical studies showed that the stability of the elbow , and longitudinal stability of the forearm would be better with a stiffer implant . As the result of which, newer types of prostheses were developed and indications were again adjusted.

Morrey et al[44] limited the indications for radial head implant to instability following radial head resection and acute dissociation of the distal radio-ulnar joint.

Vitallium prosthesis (Howmedica, London, UK), was described by Knight et al [45] in 1993. Loosening of the prosthesis was described in two patients and hence the authors concluded that replacement was not clearly better than resection for simple radial head fractures .

Judet et al[46] introduced a bipolar prosthesis in 1994. The 'floating' radial head prosthesis was made of cobalt-chrome, had a collared stem with a 15° neck shaft angle. It has 2 parts which are connected by a spherical joint which allows 35° of uniplanar motion in any direction .

In 1996, Charnley et al[47,48] used the floating radial head prosthesis for heterotopic ossification . No recurrence was found at a 3.5 yr follow-up.

In 1997 allograft replacement of the radial head was studied. Three weeks after the surgery, even while the arm was still in a long arm cast one of the allografts dislocated. Another complication which was noted frequently was degeneration and collapse of the graft. Long term results were not published[49].

Beredjiklian et al[50] in 1999 reported another problem with metal radial head replacements. Anatomic data were studied in comparison with titanium radial head implants. In 39% of the cases, even the smallest prosthetic stem would not fit into the radial intramedullary canal. The radial length could not be restored in any of the cases were prosthesis were used.

Short-term results[51] of the floating radial head prosthesis were also promising with restoration of stability. However, degenerative changes[52] were noted in 50%, which resulted in removal of the prosthesis due to pain and functional impairment[53]. The long-term results of a ‘monoblock’ metal radial head prosthesis (Smith & Nephew,Inc.) were published in 2001. Following which the authors concluded the use of a metal prosthesis if the elbow was shown to be unstable following radial head resection, and concluded that radial head resection was still a valid treatment option in the otherwise stable elbow[54] .

In recent times, the accepted indication for radial head prostheses is a non reconstructable radial head fracture with associated injuries which would make the elbow unstable if the radial head were resected.

MATERIALS AND METHOD

This is a prospective interventional clinical study. This study includes 20 radial head fractures managed by radial head replacement in Department of Orthopaedics in Tirunelveli Medical College, Tirunelveli.

STUDY CHARACTERISTICS

STUDY DESIGN:
Prospective hospital based study

SAMPLE SIZE:
20 patients

STUDY PERIOD:
2 years
(August 2017 - August 2019)

STUDY PLACE:
Tirunelveli Medical College, Hospital

STUDY POPULATION:
Patients with communited radial head fractures

Inclusion criteria

- Mason type 3 # (> 3 fragments)
- Mason type 4 fractures
- Essex lapresti lesions
- Terrible triad injuries
- Elbow instability

Exclusion criteria

- Mason type 1 & 2 #
- Mason type 3 fracture with only 3 fragments
- Infection, sepsis, osteomyelitis

The following data are collected from patients :-

- History and nature of injury
- Local and systemic examination.
- Radiological examination done with Xray - elbow, AP and lateral views, CT with 3D reconstruction
- Routine pre op investigations
- Diagnosis
- Surgery – Radial Head Replacement
- Complications
- Follow up

Assessment at 6 weeks

- Clinical assessment of pain and stiffness
- Radiological assessment

Assessment at 12 weeks

- Assessment of Radiological and Functional ability of the elbow

Assessment at 6 months

- Assessment of Radiological and Functional ability of the elbow.
- Assessment of any complications.
- Assessment of function using Mayo Elbow performance score.

Preoperative planning :

- Informed written consent obtained from the patient prior to the surgery.
- Single dose antibiotic is given 1 hour prior to surgery
- Local parts prepared.
- Instruments and radial head implant were checked and sterilised.

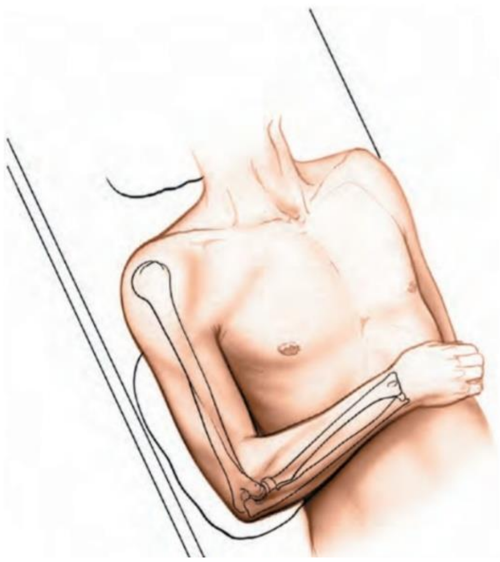
OPERATIVE PROCEDURE[24,25]

- Type of anaesthesia used : supra clavicular block
- All cases were done with Pneumatic tourniquet
- **Approach**
    - KOCHER APPROACH for isolated radial head fracture
    - BOYDS APPROACH for associated olecranon fracture

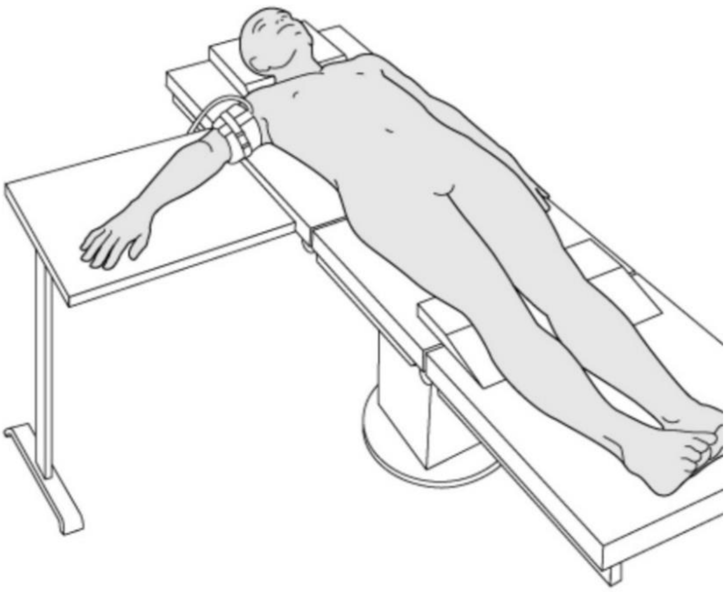
KOCHERS APPROACH:

POSITION

1. Place the patient supine on the operating table, with the affected arm positioned over the chest. Pronate the forearm. Exsanguinate the limb either by applying a soft rubber bandage or an exsanguinator or by elevating it for 3 to 5 minutes. Then, inflate a tourniquet.



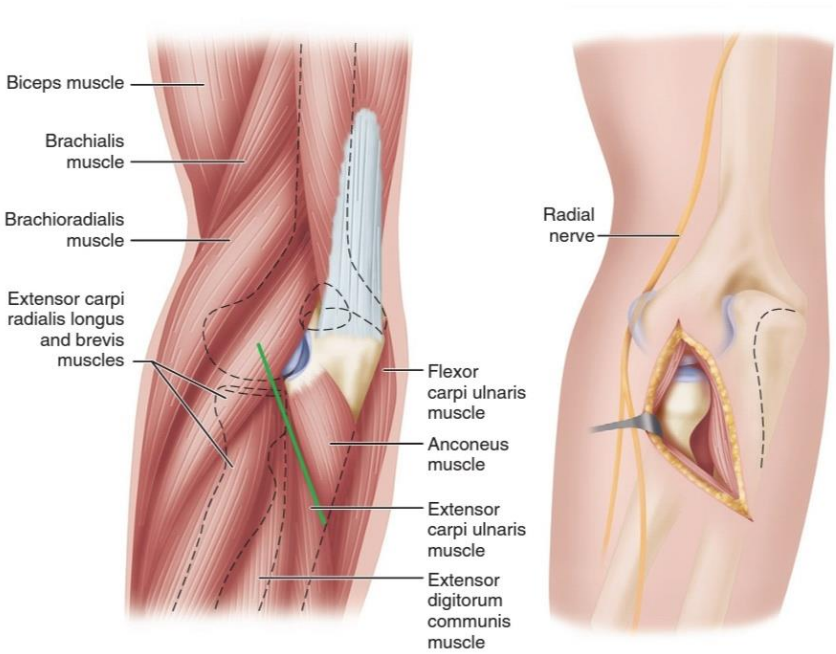
2. Place the patient supine with the shoulder abducted and the arm positioned on a radiolucent hand table. The elbow is flexed about 90°



SURGICAL APPROACH:

- Begin an oblique incision over the posterior surface of the lateral humeral condyle, and continue it obliquely distally and medially over the posterior border of the ulna 3 to 5 cm distal to the tip of the olecranon
- Divide the subcutaneous tissue and deep fascia along the line of the incision, and develop the fascial plane between the extensor carpi ulnaris and the anconeus muscles.
- Retract the anconeus toward the ulnar side and the extensor carpi ulnaris toward the radial side, exposing the joint capsule

- Supinator cross at a right angle to the wound, near its center and deep (anterior) to the extensor carpi ulnaris; retract the proximal fibers of the supinator distally.
- Incise the joint capsule and expose the head and neck of the radius
- The posterior interosseus nerve which lies between the two planes of the supinator remains undisturbed.



Avoiding damage to radial nerve:

- Fully pronating the forearm protects the posterior interosseous nerve by moving it away from the operative field.
- Beware of incising the capsule too far anteriorly as the radial nerve lies over the front of the anterolateral portion of the elbow capsule.

- Beware of dissection distal to the annular ligament or strenuous retraction, because the posterior interosseous nerve lying within the supinator muscle is at risk.
- No retractor should be placed around the radial neck.

BOYDS APPROACH:

POSITION:

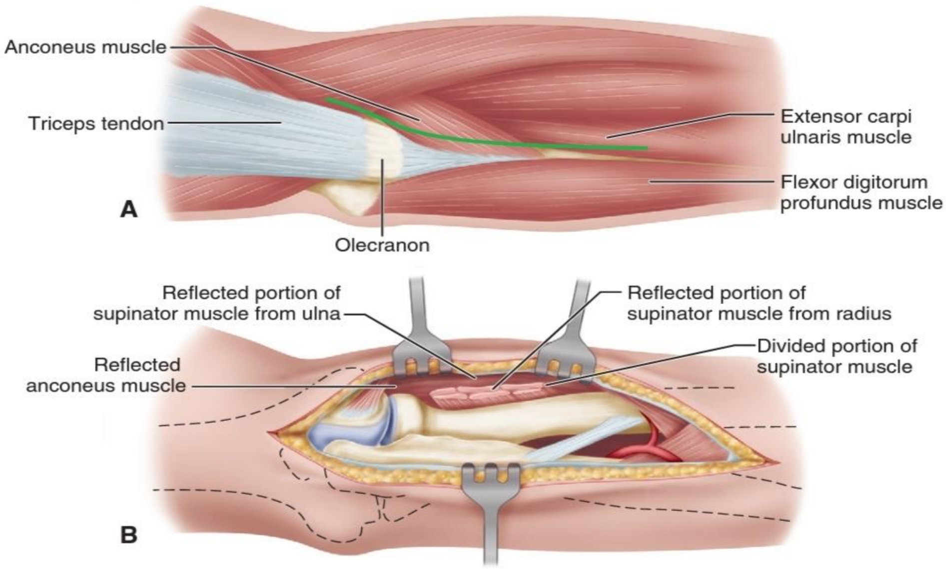
Place the patient in lateral decubitus position with the upper arm supported by a padded post.

Surgical Approach:

- Skin incision starts from 2.5 cm proximal to the elbow joint and lateral to the triceps tendon, and continued distally over the lateral side of olecranon and the subcutaneous border of the ulna, and it ends at the junction of proximal and middle thirds of ulna
- Develop the interval between the ulna on the medial side and the anconeus and extensor carpi ulnaris on the lateral side
- Strip the anconeus from the bone subperiosteally in the proximal part of the incision; to expose the radial head, reflect the anconeus radially
- Distal to the radial head, deepen the dissection to the interosseous membrane after reflecting the part of the supinator that arises from the ulna subperiosteally
- Peel the supinator from the proximal fourth of the radius, and reflect radially the entire muscle mass, including this muscle, the anconeus, and the proximal part of the exten sor carpi ulnaris. This amply exposes the lateral surface of the ulna and the proximal fourth of the radius. The substance of the reflected supinator protects the deep branch of the radial nerve.

RADIAL HEAD REPLACEMENT STEPS

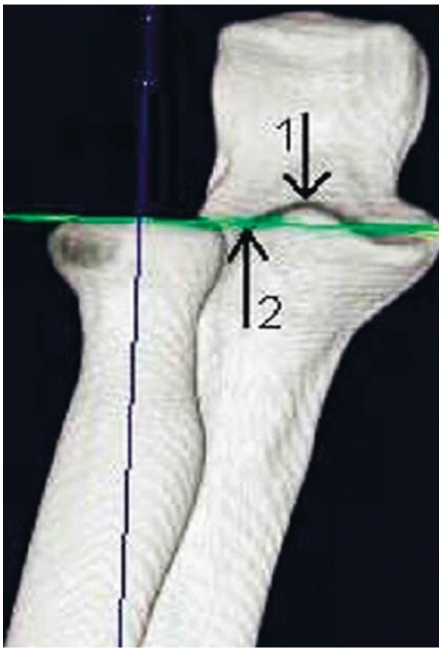
- Annular ligament is sectioned to fully expose the radial head and neck
- Fracture fragments are removed, radial head is sectioned at the junction of the radial head and neck or at the fracture site using an oscillating saw.



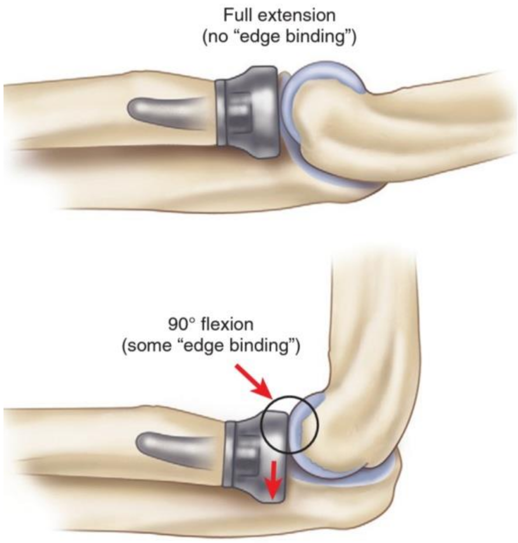
- The excised fragments are reassembled on the back table to confirm that all fragments are removed from the elbow and to measure the correct diameter and thickness of the radial head prosthesis.

- The optimal implant diameter is typically the minor diameter of the elliptical native radial head, most commonly 2 mm smaller than the maximum diameter. When it comes in between sizes, smaller prosthesis is usually chosen both in diameter as well as thickness.
- Homan retractor is placed around the posterior aspect of the radial neck and levered against ulna to translate the proximal radius laterally for the preparation of the radial canal and to insert the prosthesis.

- Rasp radial neck and select stem size 1 mm smaller than rasp.
- Trial reduction
- To avoid lengthening and overstuffing of the radiocapitellar joint, or shortening and instability, the prosthesis should fit as follows:
  - ➢ proximal edge of the prosthesis should be level with the lateral coronoid edge or 2mm below the tip of coronoid.



  - ➢ Carry the forearm through a range of flexion, extension, and rotation to observe the relationship between the capitellum and the implant in anteroposterior and lateral projections



- ➢ Check elbow stability. If the elbow is too stiff or too unstable, change the size of the prosthesis accordingly.
- ➢ Check the contralateral wrist with fluoroscopy and compare it to the wrist of the involved arm.
- ➢ Medial ulnohumeral joint space should be parallel; over-lengthened prosthesis causes the medial ulnohumeral joint to open laterally.

- After applying bone cement the radial head prosthesis is inserted.

- Annular ligament is repaired and any associated injuries are repaired
- After surgery IV antibiotics given for 5 days, orally for 5 days
- Sutures removed on 10th or 12th post operative day.

Rehabilitation Protocol for Radial Head Replacement

- Patient inmobilised in above elbow slab until suture was removed.
- After 2 weeks active and passive range of movement exercises of elbow was started.
- Forearm pronation/supination ROM with elbow at 90 degrees flexion Perform, supination ROM only with the elbow flexed to 90 degrees.
- Terminal elbow extension performed with the forearm neutral or pronated until 3 months.
- Avoid varus / Valgus forces across the elbow until 3 months postop.
- Avoid activities creating axial load to involved extremity until 3 months postop.

FOLLOW UP:

- Patients were reviewed on 6th week,12th week and thereafter every 3months. They were assessed both clinically and radiologically.
- The following parameters were assessed radiologically
  - radio-capitellar congruence
  - over stuffing
  - periprosthetic osteolysis
  - heterotopic ossification
- The clinical outcome at 6 month was determined by using the Mayo Elbow performance score (MEPS)

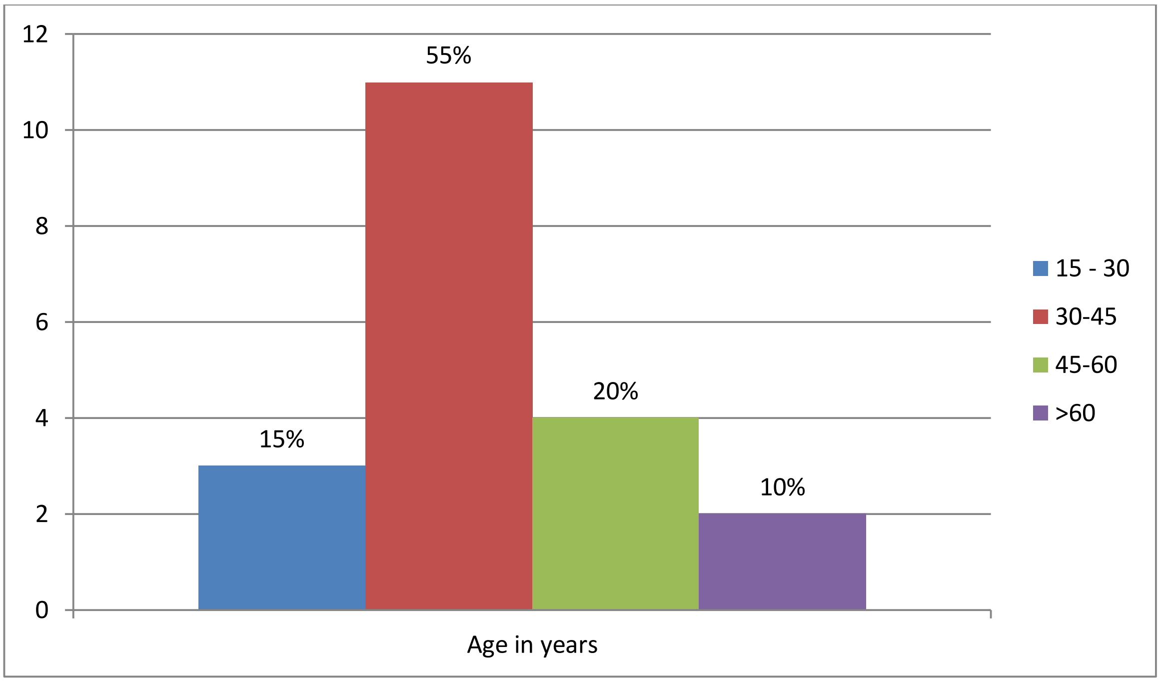
Mayo Elbow performance score (MEPS)

Criteria	Points	Definition (Score)
Pain	45	None (45) Mild (30) Moderate (15)
Motion	20	Arc>100 ° (20) Arc 50-100 ° (15) Arc <50° (5)
Stability	10	Stable (10) Moderate instability (5) Gross instability (0)
Function	25	Comb hair (5) Feed (5) Perform hygiene (5) Putting on shirt (5) Putting on shoe (5)
Total	100	

Classification: excellent - >90; good -75-90; fair - 60-74; poor - <60.

STATISTICAL ANALYSIS

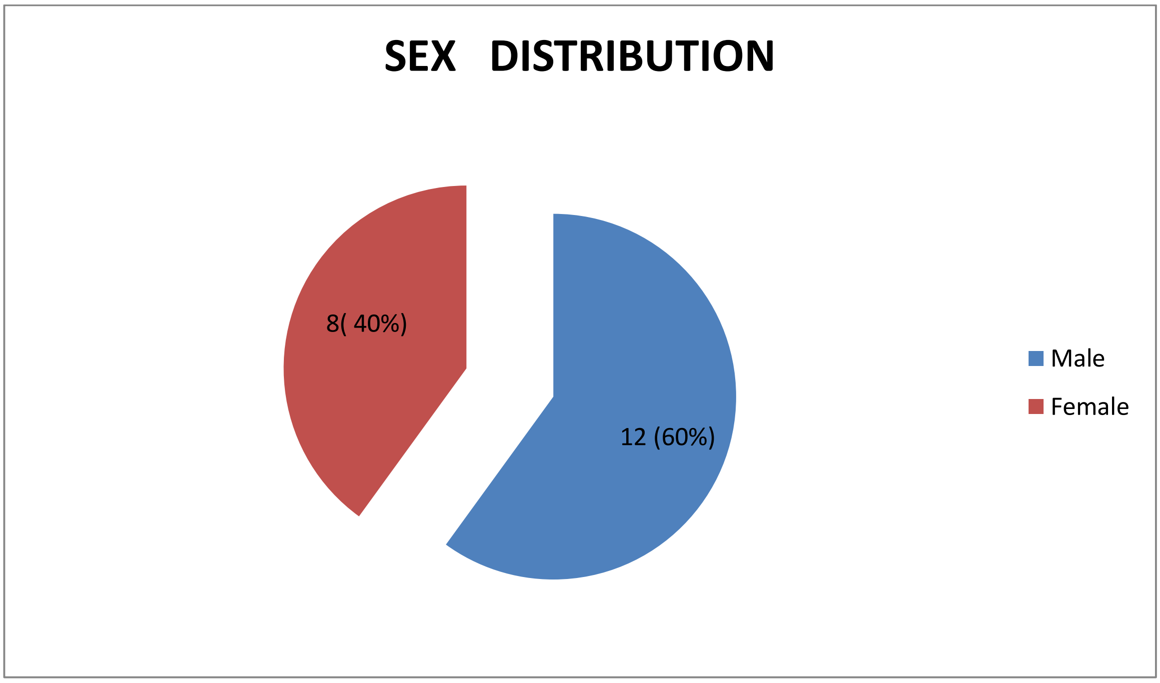
AGE INCIDENCE:



In this study majority of the patients belonged to the age group 30-45 yrs.

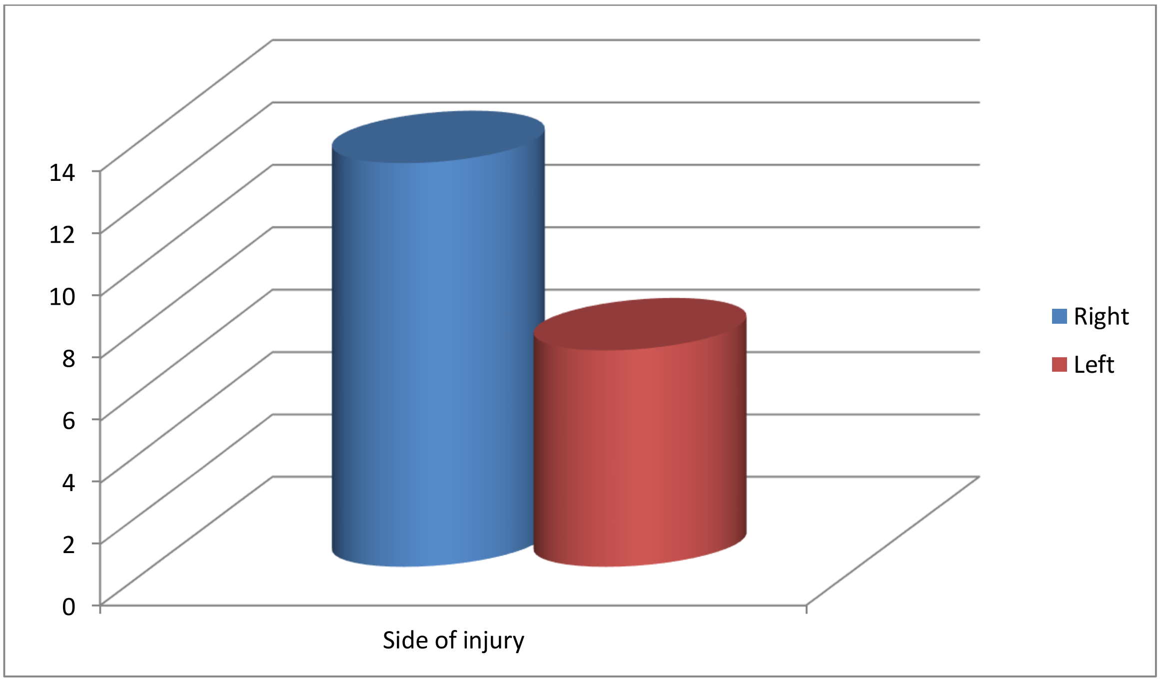
SEX INCIDENCE

This study includes 60% of males and 40% of female patients.



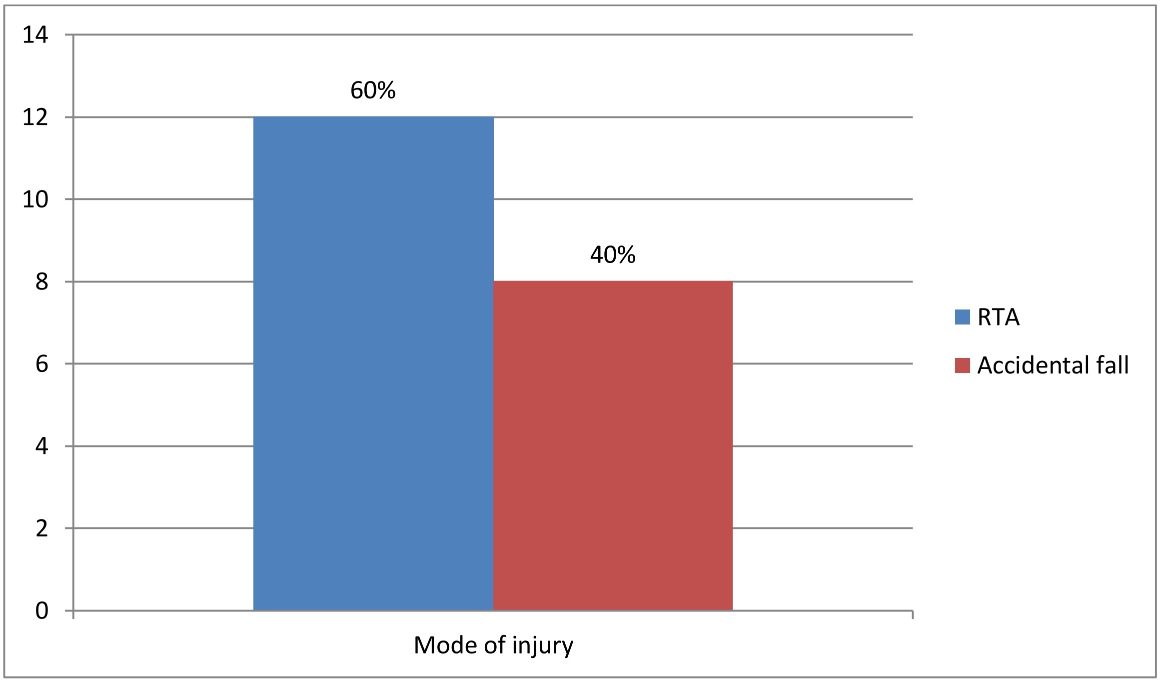
SIDE OF INJURY:

Right side was involved in 65% of patients, and left in 35% of patients.



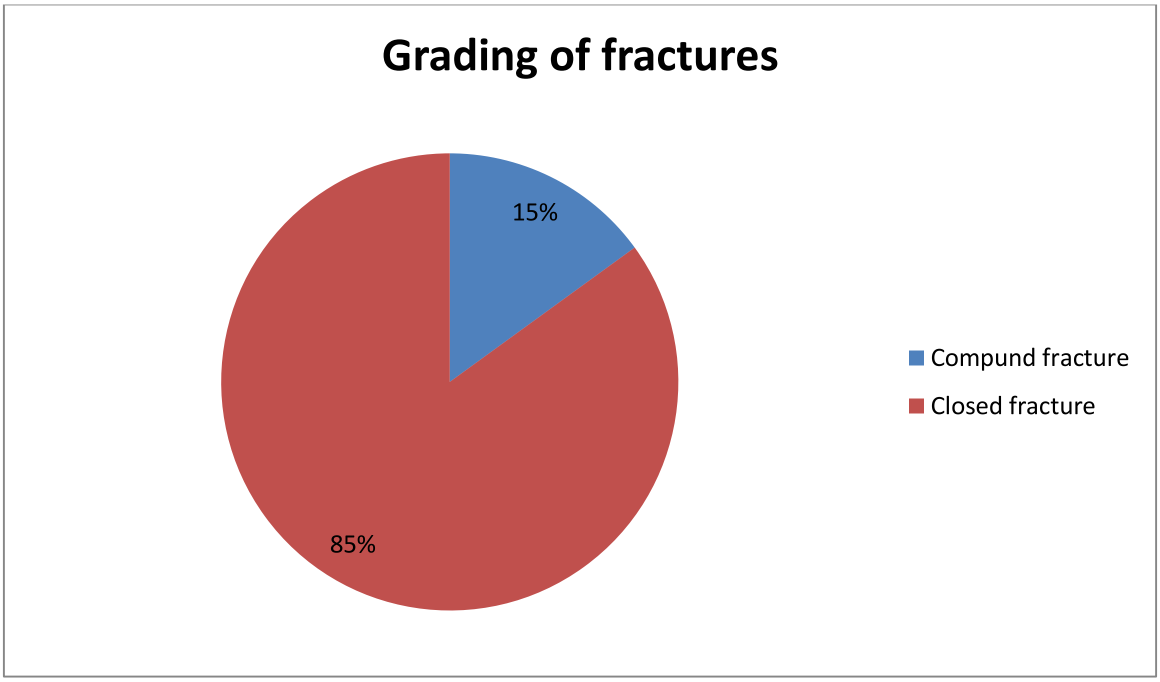
MODE OF INJURY:

Majority of patients (60%) had history of RTA.



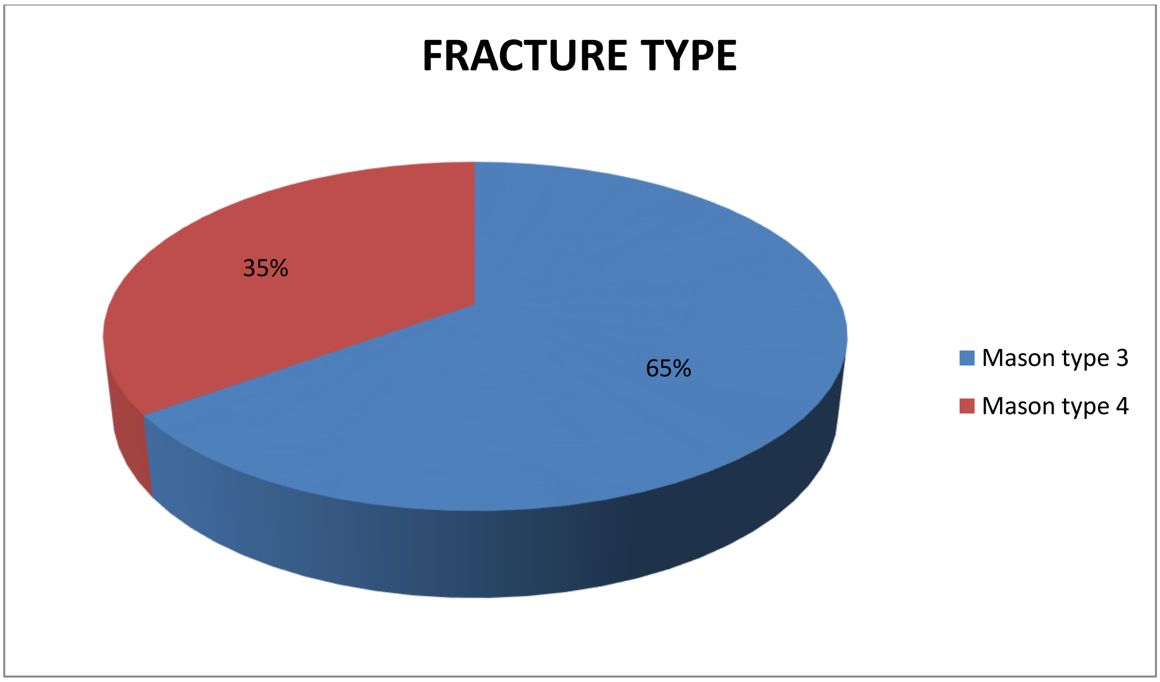
Grading of fracture

Out of 20 patients 15% of patients had compound fractures. Majority had closed fractures.



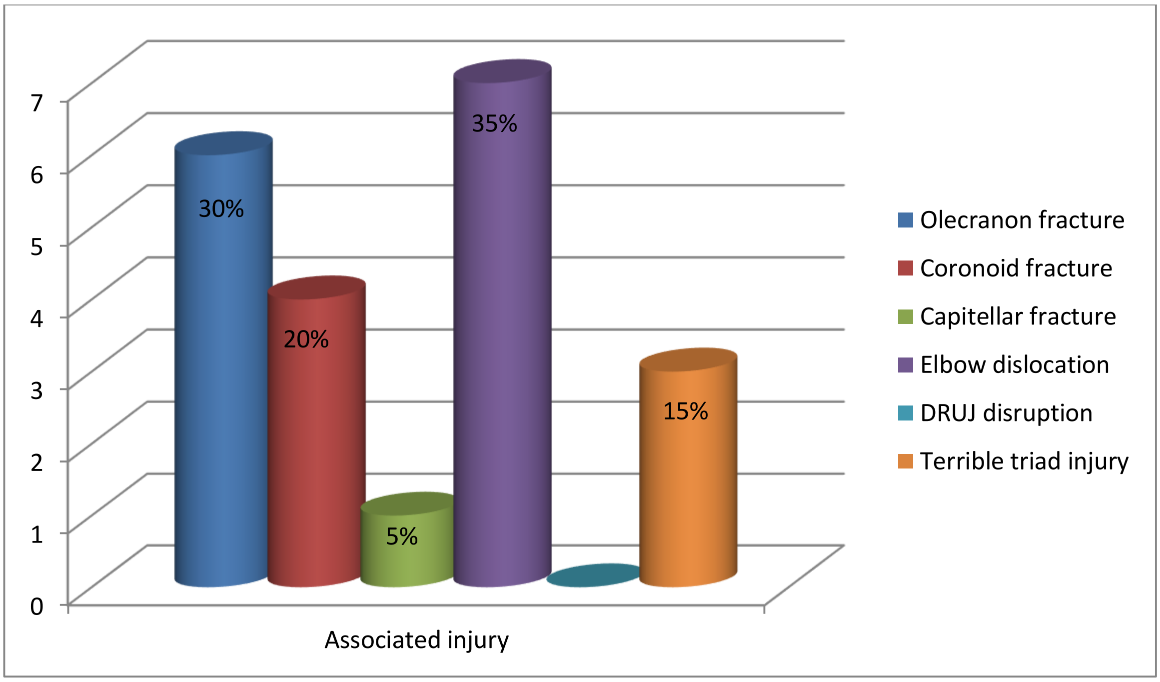
FRACTURE DISTRIBUTION TYPE:

Among the patients studied majority of them had Mason type 3 fractures (65%)



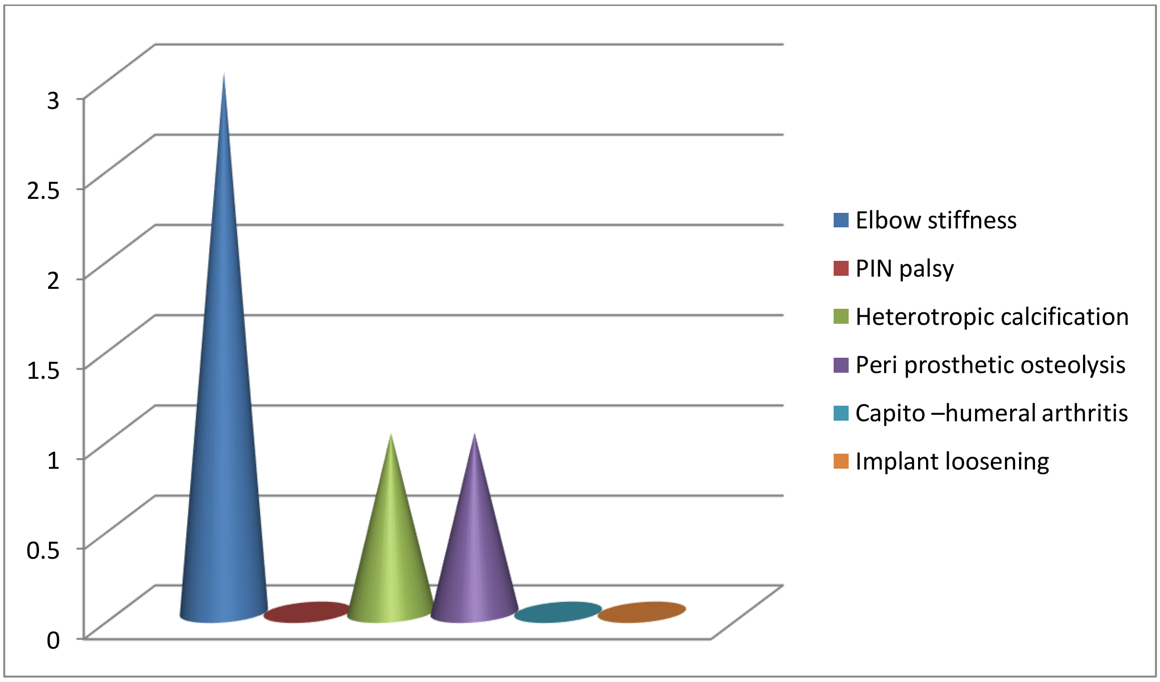
ASSOCIATED INJURIES:

Olecranon fracture is the most common associated fracture in our study, followed by coronoid fracture.



COMPLICATIONS

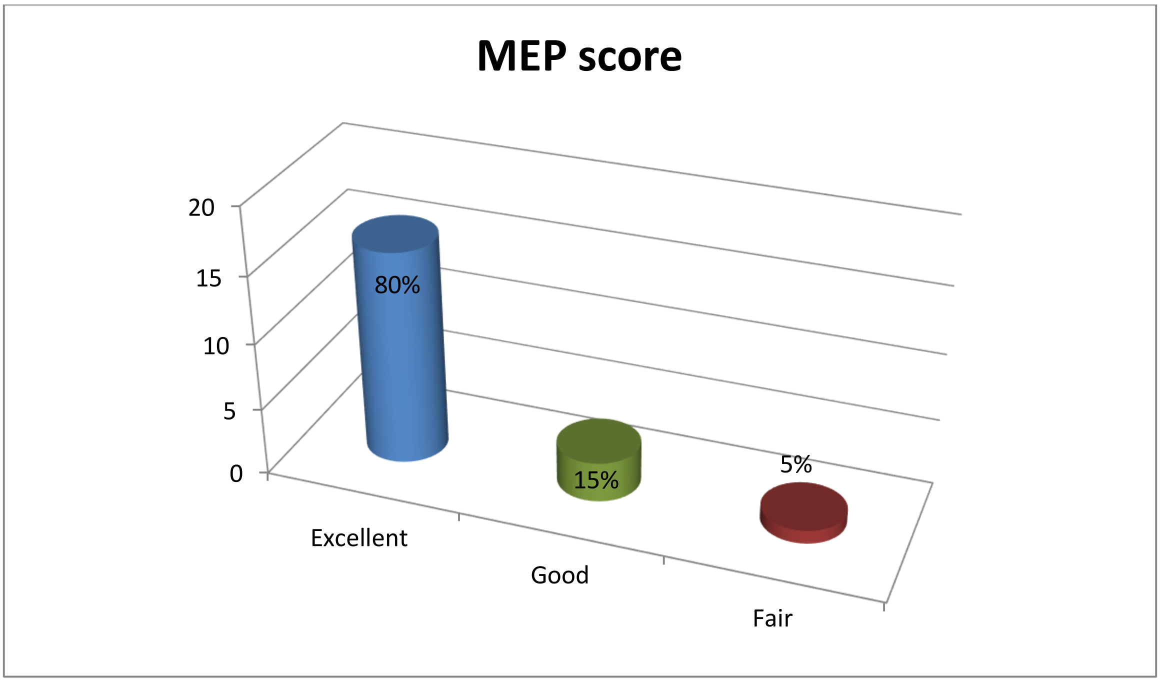
Complications	Frequency	Percentage
Elbow stiffness	3	15%
PIN palsy	0	0%
Heterotropic calcification	1	5%
Peri prosthetic osteolysis	1	5%
Capito –humeral arthritis	0	0%
Implant loosening	0	0%



- Out of 20 patients 3 developed elbow stiffness, 2 of them managed with continuous passive mobilisation exercises (CPM). For one patient elbow mobilisation under anaesthesia was done to correct the elbow stiffness.
- During the follow up period, only one patient showed features of peri prosthetic osteolysis.

FUNCTIONAL OUTCOMES

According to the Mayo elbow performance score, out of 20 patients, 16 patients showed excellent, 3 showed good and 1 showed fair performance scores at 6 month follow up.



RESULTS

This study was undertaken from August 2017 to August 2019, during which 20 patients underwent radial head replacement for radial head fractures. All of them fulfilled the inclusion criteria . There were no loss to follow up during this study period.

- Mean age of the patients in our study was 37.5 years (range 17 – 70 years). 70% of the patients were less than 45years.
- Sex distribution of fractures showed 12 males & 8 females.
- 13 patients had fractures involing the right elbow & 7 had fractures on left elbow
- RTA constituted the major (60%) cause for the fractures. 40% were due to accidental fall.
- Majority (85%) of fractures were simple (closed) fractures. 3 patients had compound fractures.
- According to MASON classification, 65 % of fractures come under mason type III, 35 % fractures belonged to mason type IV.
- 6 patients had associated olecranon fractures and 4 had coronoid fractures
- There were no pre-operative and post operative nerve injuries.
- All the 20 patients underwent cemented radial head replacement.
- No intra operative complications were noted in our study.

- The average duration of surgery was 60 minutes, ranging from 45-120 minutes. Radial head fractures with associated injuries took longer duration.
- 3 patients developed elbow stiffness of which 2 were managed by regular physiotherapy and CPM .Mobilisation under anaesthesia was done for 1 patient.
- 1 patient showed features of peri prosthetic ostelysis and 1 patient developed heterotropic ossification.
- No one showed implant loosening or arthritis of capito humeral joint during the follow up period.
- At 6 months follow up , 3 patients had GOOD MEP score 16 patients had EXCELLENT MEP score and only 1 patient had fair MEP score.
- Functional outcome was better in Isolated radial head fracture compared with radial fracture with associated fractures.

DISCUSSION

Management of comminuted radial head fractures with associated ligament disruption remains controversial. Various treatment options available for these injuries include ORIF, excision of the radial head, and radial head replacement.[55]

The proximal radial epiphysis is contained within the joint capsule. Blood supply to this region is very limited. A few small intraarticular vessels running along radial neck and a few intraosseous vessels supplies the radial head. Primary supply is via intraosseous vessels, one of which supplies the radial head directly[56] and this vessel enters through the nonarticular anterolateral surface. Fractures of radial head disrupts this vascular supply. In addition[57], open reduction and internal fixation of a comminuted radial head is technically difficult. Therefore, ORIF is not recommended and not advisable for comminuted fractures because of lot of complications including osteonecrosis, non-union of displaced fragments[58,59] which are difficult to manage.

Excision of the radial head in patients with associated interosseous membrane disruption or MCL injury results in wrist or elbow instability. In a study by Mikic et al. on radial head excision poor results were reported in 50% of patients. Josefsson et al[60]. in his study listed the outcomes following excision of the radial head which includes stiffness, weakness and pain.

Similar findings were noted by Leppilahti et al[61]. also. In a study on 42 patients with dislocated elbows with concomitant radial head fracture, who were treated with radial head excision[62] Hall et al. noticed posterolateral rotatory instability in 17% of their cases. Therefore recent reports[63] in the literature have concluded that radial head excision is contraindicated for patients with an incompetent medial collateral ligament, disrupted forearm interosseous ligament, or elbow dislocation. Radial head excision[64] results in complications such as valgus elbow instability, elbow stiffness and proximal migration of the radius[60].

Radial head arthroplasty is indicated for displaced comminuted radial head fractures which are non amendable for fixation, fracture with associated elbow dislocation[65], comminuted radial head fractures with disruption of the medial collateral, lateral collateral, or interosseous ligaments.

In patients who had non-united radial head fractures, articular injury to capitellum and radial notch of ulna leads to elbow arthrosis. Prosthesis radial head replacement restores the stability of elbow, flexion and extension of elbow, and pronation and supination of the forearm[66].

Various prosthetic materials, including silicone rubber[67], acrylic[68], cobalt-chromium[69], vitallium[70], and titanium[71], have been employed. Silicone implants may undergo fragmentation, causing synovitis, and restore axial and valgus stability of the elbow poorly. Studies have shown that metallic implants restore elbow stability to a level similar to that of the native radial head. New modular[72] prostheses have improved sizing and restore the anatomy of proximal radius, and they are technically easier to insert intraoperatively.

Historically, monoblock and bipolar metallic radial head prostheses were used. However size matching of these implants were imperfect and they had difficult insertion because of the need to subluxate the elbow. A malarticulating implant[73] leads to early failure because of high contact pressure on the opposing articular cartilage. The problems with bipolar design are polyethylene wear, tendency to become angulated under load, decreasing the stabilizing effect in the ligament-disrupted elbow[74]. The radial head implant mainly acts as a spacer. Thus it allows proper healing of soft tissue and ligaments, and improves the mobility of the elbow and restores the anatomy of elbow[75].

CONCLUSION

With our experience we concluded that Radial head replacement in mason type III & IV radial head & Neck Fractures increase the stability against valgus force at elbow, restores the axial load bearing function of the radial head & allow proper healing of the soft tissue without proximal migration of radius.

Almost all patient in our study showed better range of movement & stable elbow without pain.

CASES ILLUSTRATIONS

Sudalai, 24/M, Mason type 3 radial head fracture

Pre op

Post op

Follow up

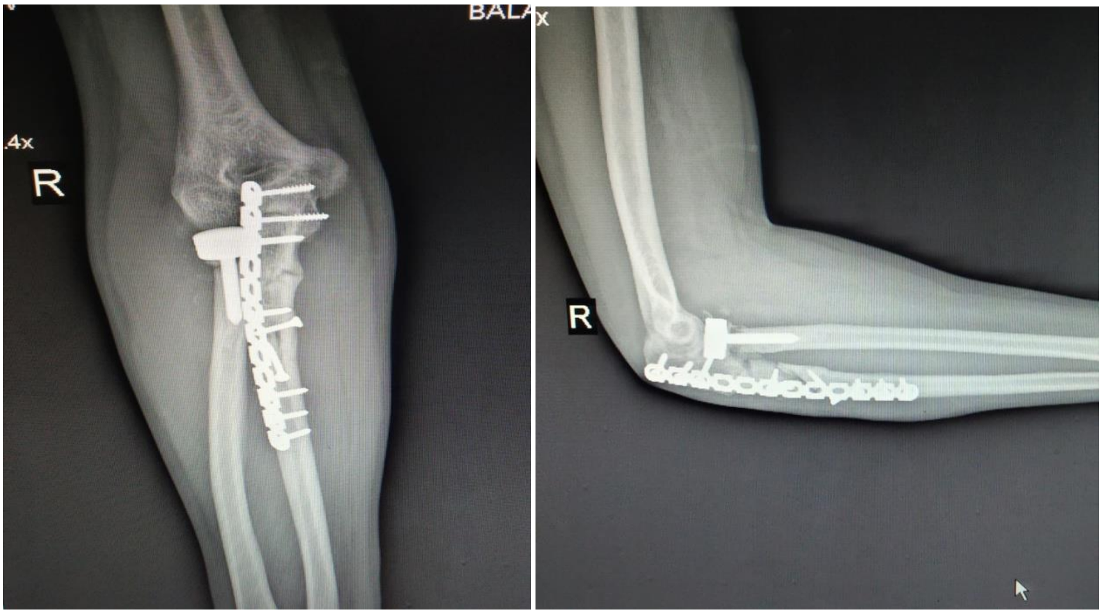
Clinical picture

Balamurugan, 35/M, Mason type 3 radial head fracture with olecrenon fracture

Pre op

Post op

Follow up



Clinical picture

Karthick, 17/M, Mason type 3 radial head fracture

Pre op

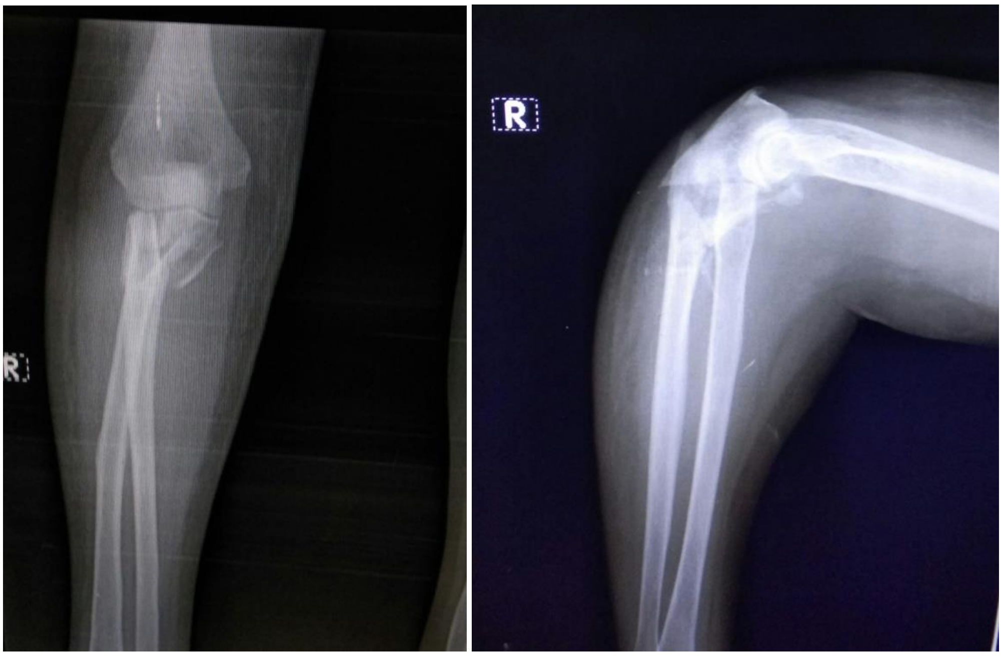
Post op

Follow up

Clinical picture

Pathirakali, 70/F, Mason type 3 radial head fracture with olecranon fracture

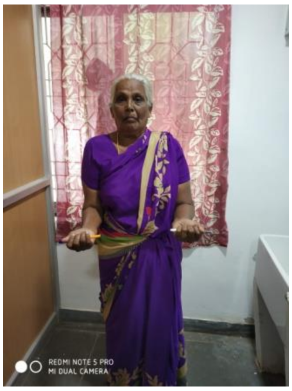
Pre op

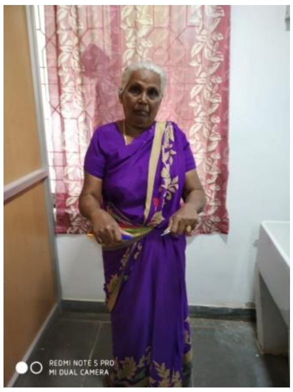


Post op

Follow up

Clinical picture

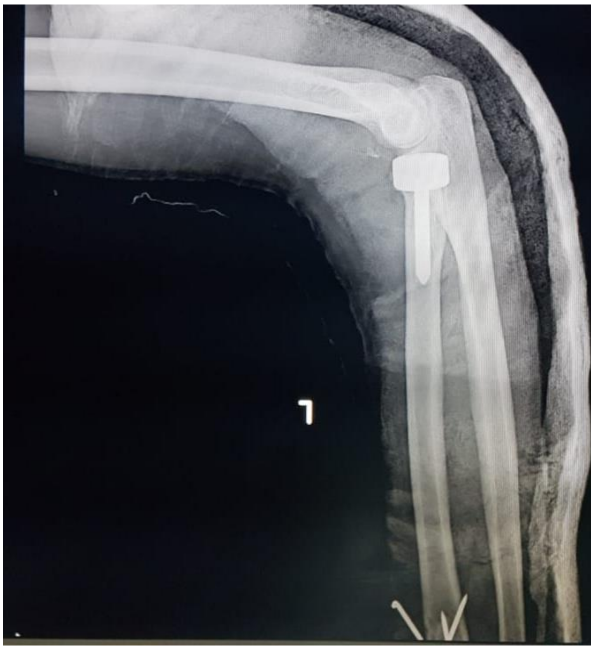




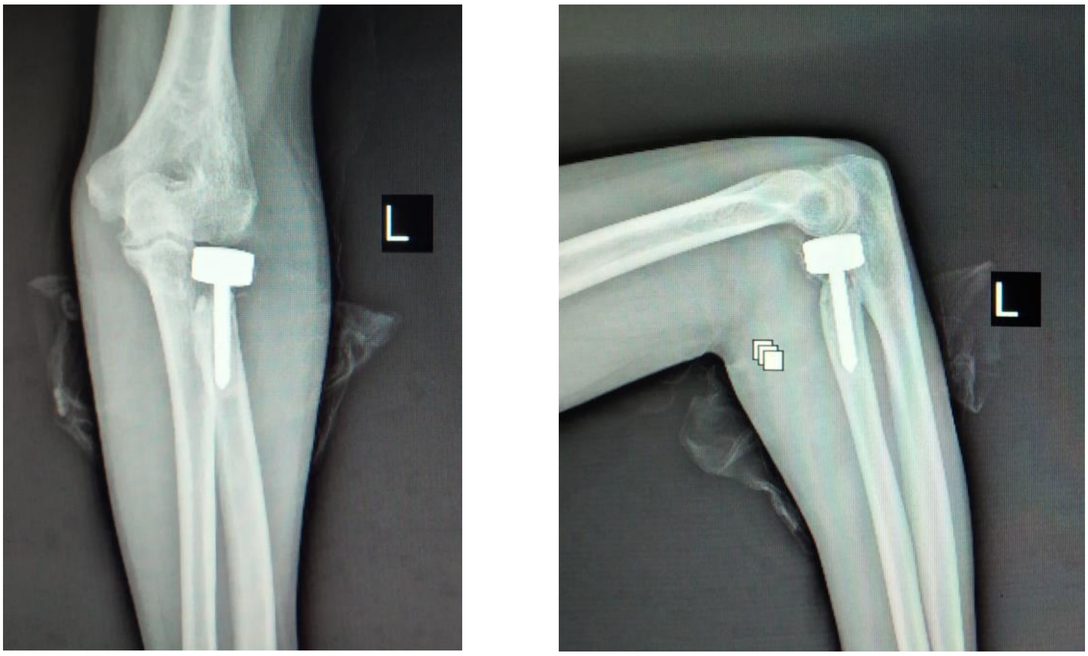
Vinu , 25/m, Mason type 3 radial head fracture

Pre op

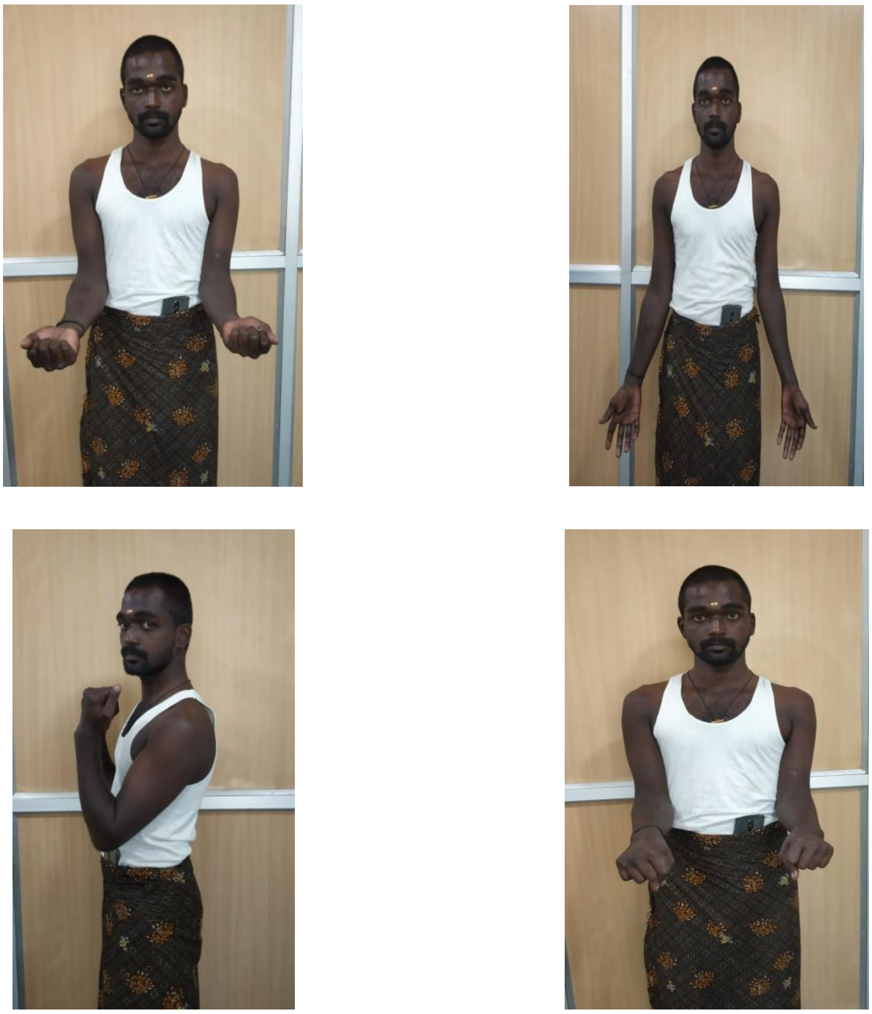
Post op



Follow up



Clinical picture



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Case Proforma

Case No:……………………… Unit:………………………

Name:…….……………………………… Age/Sex:…..…

I.P No:…………Occupation:………………………………..

Address:……………………………………………………

…………………………………………………………

Phone:……………………………………

Date of Injury : ……………………

Date of Admission: …………………….

Date of Definitive surgery:……………

Date of Discharge: ……………./……………/…………………

Mechanism of injury :

a. Road traffic accident

b. Accidental fall

c. Assault

Severity of injury: High velocity/ Moderate velocity /Trivial

Duration since injury :

Associated comorbidities :

Any Drug history :

General condition:

1) Level of Consciousness :

2) Level of Orientation :

3) Pulse : Bp : SpO2 : RR :

4) Pallor : Yes/No

5) CVS Examination :

6) RS Examination :

7) Abdominal Examination :

8) CNS Examination :

Local Examination :

Side involved: Right/Left

Grade of injury: Closed/ Open

If Open , Grade : Grade I /II/IIIa/IIIb/IIIc

Skin Condition :

Distal Neurovascular status :

X ray findings:

Type of the fracture: Mason Type I/II/III/IV

Associated injuries: Yes/No

(If Yes, Details of injury)

Associated head injury: Yes/No

CT Elbow Taken Yes/No

Routine Blood Investigations Yes/No

Chest Xray & ECG Yes/No

Diagnosis :

<u>Treatment history:</u>

Treatment elsewhere if any:

<u>Treatment in our institution:</u>

Inj. TT given Yes/No

If Open injury whether antibiotic given Yes/No

Initial management:

Time interval between injury and initial management :

Definitive Procedure done :

Anaesthesia :

Approach :

Details of implant :

Blood transfusion : Yes / No

Duration of surgery :

Intraoperative events and difficulties :

Immediate post operative events:

Physiotherapy details :

Condition at Discharge :

Follow up :

Date of Follow up :

Duration of Follow up :

Any complaints in Follow up :

Follow up Xray findings :

At 6 months follow up :

Range of Motion :

Pain :

Function :

Stability :

Mayo Elbow Performance Score : ………/100

Excellent/Good/Fair/Poor

Complications details :

நோயாளிகளுக்கு அறிவிப்பு மற்றும் ஒப்புதல் படிவம்
(மருத்துவ ஆய்வில் பங்கேற்பத்ற்கு)

ஆய்வு செய்யப்படும் தலைப்பு:
பங்கு பெறுவரின் பெயர்:
பங்கு பெறுவரின் வயது:

		பங்கு பெறுவர் இதனை ✓ குறிக்கவும்
1.	நான் மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்களை படித்து புரிந்து கொண்டேன். என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டுள்ளது என அறிந்து கொண்டேன்.	☐
2.	நான் இவ்வாய்வில் தன்னிச்சையாக தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும், எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.	☐
3.	இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்காள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.	☐
4.	இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக் கொள்ள மறுக்க மாட்டேன்.	☐
5.	இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக் கொள்கிறேன் எனக்கு கொடுக்கப்பட்டஅறிவுரைகளின் படி நடந்து கொள்வதுடன், ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ, அல்லது எதிர்பாராத, வழக்கத்திற்கு மாறான நோய்குறி தென்பட்டாலோ உடனே இதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்றேன்.	☐

பங்கேற்பவரின் கையொப்பம் / .... இடம் ....
கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் ....

ஆய்வாளரின் கையொப்பம் /.. இடம் ....

ஆய்வாளரின் பெயர் ....

மையம் ....

கல்வியறிவு இல்லாதவற்கு (கைரேகை வைத்தவர்களுக்கு) இது அவசியம் தேவை

சாட்சியின் கையொப்பம் /.. இடம் ....

பெயர் மற்றும் விலாசம் ....

S.no	Name	Age/Sex	Mode of injury	Side of injury	Mason type	Grade of injury	Associated injuries	Complication	MEP score
1	Vinu	25/M	rta	left	type 3	closed	-	-	excellent
2	Pathrakali	70/F	fall	right	type 3	closed	olecranon fracture	-	excellent
3	Sudalaimuthu	24/M	rta	right	type 3	closed	-	-	excellent
4	Balamurugan	35/M	rta	right	type 3	closed	olecranon fracture	-	excellent
5	Antony	52/M	fall	right	type 3	closed	-	periprosthetic osteolysis,elb ow stiffness	fair
6	Karthick	17/M	rta	right	type 3	closed	-	-	excellent
7	Gnapushpam	65/F	fall	left	type 4	open	olecranon & coranoid fracture	stiffness	good
8	Ganesan	39/M	rta	right	type4	closed	-	-	excellent
9	Muniyasamy	43/M	fall	right	type 3	closed	-	-	excellent
10	Mariselvam	28/M	rta	left	type4	closed	-	-	excellent
11	Shanmugaraj	55/M	fall	left	type 4	closed	olecanon & coranoid fracture	heterotropic ossification	good...
12	Jothishwari	34/F	rta	right	type 3	open	-	-	excellent
13	Selvammal	48/F	fall	right	type 3	closed	olecranon fracture	stiffness	good
14	Kamalam	42/F	rta	right	type 4	closed	-	-	excellent
15	Devagi	30/F	rta	left	type 3	closed	coranoid fracture	-	excellent
16	Usha	52/F	fall	right	type 3	closed	-	-	excellent
17	Kumaran	44/M	rta	left	type 4	closed	-	-	excellent
18	Mydeen begum	37/F	rta	right	type 3	closed	-	-	excellent
19	Ramar	29/M	rta	right	type 4	open	coranid fracture	-	excellent
20	Chellapandi	40/M	fall	left	type 3	closed	olecranon fracture	-	excellent