Radial Head
Outline

- Anatomy
- Biomechanics
- Radial Head Fractures
  - Diagnosis
  - Treatment
- Radial Head Implants
Anatomy
Anatomy

Radial fossa
- Coronoid fossa
- Lat. epicondyle, for Extensors
- Med. epicondyle, for Flexors
- Capitulum
- Trochlea
- Trochlear notch
- Radial notch
- Head
- Neck
- Tubercle on coronoid proc.
- Tuberosity for Brachialis
- Tuberity for Bursa
- Supinator fossa
- Anterior oblique line
Ligament Anatomy

![Diagram of ligament anatomy](image-url)
Ligament Anatomy

- Lateral ulnar collateral ligament is an important stabilizer against posterolateral rotational and varus instability of the elbow.
- Annular ligament stabilizes the proximal radioulnar joint and contributes to varus and posterolateral rotatory elbow instability by virtue of its attachment to the radial collateral ligament.
Biomechanics of the Radial Head

The radial head stabilizes the elbow and forearm in two ways:

1) radiocapitellar contact resists external joint forces, preventing valgus instability.
2) forearm and wrist are stabilized in grip activity as load is transferred from wrist to radiocapitellar joint.
Biomechanics of Radial Head

Valgus Stability:

- Radial head is an important valgus stabilizer of elbow, particularly in setting of an incompetent MCL, which is disrupted in most fracture-dislocations.
- A significant decrease in elbow stability occurs in association with radial head excision in elbows with LCL disruption.
Biomechanics of Radial Head

- **Longitudinal Stability**
  - The intact radial head articulating with the capitellum is the primary restraint to proximal migration of the radius.
  - The radio capitellar articulation accounts for as much as 60% of the load transfer across the elbow.
Mechanism Radial Head Fracture
Radial Head Fractures

- Nondisplaced and minimally displaced
  - >Favorable functional outcome w/non-op magmt.

- Displaced or comminuted fractures
  - >Little information showing optimal tx
Radial Head Fractures

- In 1935, Jones stated, “Fracture of the head or neck of radius with displacement is a serious injury”
- Prognosis is good for recovery of a useful elbow, rarely is it a normal elbow
Diagnosis

- Clinical evaluation:

- X-RAY:
  - AP, Lat, and oblique view:

- CT-SCAN:
  - Useful to quantify fracture size, location, displacement and comminution in cases which indications for surgery are less clear.
Clinical Evaluation

- Fall on outstretched hand; direct blow to elbow
- Ecchymosis along forearm or medial aspect of elbow, or both
- Tenderness over radial head
- Pain over lat. epicondyle may represent concomitant injury of lateral collateral ligament
Radiograph

- Radiocapitellar view can be useful because it places the radial head in profile.
- Elbow is positioned for lateral radiograph, but x-ray tube is angled 45 degrees cephalad.
Mason Classification

- **Type I:**
  Minimally displaced fracture, intra-articular displacement <2 mm.

- **Type II:**
  Fracture displaced >2 mm or angulated.

- **Type III:**
  Severely comminuted fracture, mechanical block to motion.

- **Type IV:**
  Radial fracture with associated elbow dislocation.
Treatment

- NonSurgical

- Surgical:
  1. ORIF.
  2. Radial Head Excision.
  3. Radial Head Arthroplasty.
Nonsurgical Tx.

- Nondisplaced or minimally displaced fractures of the radial head and neck and small marginal head fractures, which do not cause a block to forearm rotation, are best treated with early active motion.
Non-op tx

- Fractures involving less than one third of the diameter of the radial head that are displaced less than 2 mm can also be managed nonoperatively.
Non-op tx

- Active motion should be begun within 1 week, owing to the frequent development of elbow stiffness with longer periods of immobilization. A collar and cuff, or sling, is used for comfort between periods of active motion and is discontinued by 4 weeks.

The use of a static progressive extension splint should be considered at night if elbow extension does not progressively improve in the first 4 to 6 weeks after the injury.
Radial Head ORIF

 Preferred treatment when technically possible
ORIF indications:

- **Displaced (>2 mm), reconstructible fragments larger than one third of the diameter of the radial head or smaller extruded fragments interfering with forearm rotation**

- **Pearls** ▪ CT scan may be helpful in deciding on surgery for borderline displacement. ▪ Avoid screw penetration through opposite cortex. ▪ Fragments are typically quite anterior; avoid posterior dissection with damage to lateral ulnar collateral ligament.

- **Pitfalls** ▪ Hardware impingement with annular ligament ▪ Nonrigid fixation ▪ Fixation of comminuted fractures involving more than three fragments

- **Technical Points** ▪ Use an open approach through common extensor tendon split or Kocher's interval. ▪ Use cross-cannulated screws for noncomminuted fractures of the radial neck. ▪ Use a fixed-angle plate for selected comminuted fractures of the radial neck; ▪ Place plate on the nonarticular portion of radial head, which presents laterally with the forearm in neutral rotation. ▪ Perform careful ligament repair to avoid radiocapitellar subluxation with failure of fixation.

- **Postoperative Care** ▪ Early range of motion exercises are required to avoid annular ligament adherence to hardware or fracture lines.
ORIF

52-year-old woman who slipped and fell and sustained displaced fracture of the radial neck.
ORIF

• Comminuted fracture of the radial head and neck

• 35-year-old man who fell off a ladder, sustaining fracture of the proximal ulna and radius.
Radial Head Excision

- Complications
- pain
- joint instability.
- proximal radial translation.
- decreased strength.
- cubitus valgus.
- Osteo-arthritis.
Current literature

• Ikeda et al jbjs 2005;87:76-84.
• compared results of radial head excision to fixation in a series of 28 pts.
• At final follow-up, pts who underwent radial head fixation had greater strength, function, and joint motion than did the group with resection.
Radial Head Implants

- Choose diameter and thickness of implant on basis of reconstructed excised radial head if possible
Sizing radial head

- Articular dish dia. 2mm smaller than outer dia. of radial head

Overall thickness, same as excised radial head
Background

**Majority of radial head fractures:**

- Not assoc. with any other ligament or fracture injury
- Isolated, stable and do well with non-operative management
Radiographic evaluation

- No criteria have been consistently associated with a poor result with non-operative treatment

- **STUDY:**
  - Malmo, Sweden
    - 74% of pt w/ fracture involving 30% of the head and displaced > 2mm had good or excellent results without surgery
Indications for operation

- Replacement arthroplasty for *displaced comminuted* fractures of the radial head and neck where an *anatomic reduction and stable internal fixation is not achievable* and there are, or are less likely to be, associated soft tissue or bony injuries.
Exception

- High-level arm-specific athletes may benefit from an attempt to salvage their radial head
Cont...

- If treating fracture-dislocation of forearm or elbow w/ assoc fracture of entire radial head, ORIF is only an option if stable, reliable fixation can be achieved.
Rule of 3’s

- Nonsurgical treatment can be considered if the fracture involves less than one third of the articular surface, if there is less than 30° of angulation, and if displacement is less than 3 mm
Mason classification

The Broberg-Morrey Modification of The Mason Classification

TYPE I

TYPE II

TYPE III

TYPE IV
Radial head design

- Based on 4 aspects:
  - 1) Material
  - 2) stem design
  - 3) neck design
  - 4) head design
Material

- acrylic
- silicone rubber
- cobalt chromium
- titanium
- ceramic
Silicone

Swanson

- Introduced in 1970’s, most popular at that time
- Initial results good
- Poor 3-6 year follow-up
- More recent clinical and biomechanical studies have shown that these silastic prostheses were unable to restore valgus stability and prevent proximal migration of the radius
In addition, many complications were reported including implant breakage, dislocation, and capitellar osteopenia.

- silicone will shed particulate debris which leads to giant cell synovitis which may persist even after the implant is removed;
- chronic inflammatory changes may occur in the intramedullary bone of the radius
Silicone

- fracture of the silicone spacer stem
Metal

- Most commonly used today
- found to provide the necessary resistance to axial and valgus loads
- In 1993, Knight et al. found that clinically and biomechanically, vitallium prostheses provided an excellent resistance to axial loads and valgus stability
Stem Type

- implanted into the medullary canal of the radius and supports the remainder of the implant.

**Classification:**
- loose-fitting (smooth)
- fixed (press-fit or cemented)
Stem type cont...

- Rationale behind the smooth stems is that some degree of play is available which will help accommodate any differences between the prosthetic and native head during elbow motion.
Fixed stems

- fixed stems do not allow for play within the radius intramedullary canal. Thus, the articular congruency with both the capitellum and lesser sigmoid notch depend on the prosthesis.
- exception to this is the bipolar prosthesis, which allows for play by virtue of an articulation at the head-neck junction
Bipolar stems

- Bipolar prostheses are designed to maintain centered contact on the capitellum and reduce stresses at the implant-bone interface.

- Several studies have shown that bipolar prostheses provide satisfactory outcomes, comparable to that of nonbipolar radial head replacements.
Bipolar implant
Radial head shape

- Smooth-stemmed prostheses such as the Wright Evolve are designed to function as a spacer, allowing for kinematic centering due to their loose stems, and thus do not rely on accurate reproduction of the native anatomy.
Smooth-stemmed implant
Anatomic head implant

- Acumed
- feasible to design an anatomic radial head prosthesis that will match a patients' variable anatomy.
- theoretically radiocapitellar and proximal radioulnar kinematics should be restored, thus decreasing the likelihood of long-term problems. Clinical results with this implant are yet to be demonstrated.
Available Implants

- **Acumed anatomic radial head system:**
  - A modular implant made of highly polished cobalt chrome and a neck angle of 4 degrees which is intended to prevent implant loosening and to maintain the proper angled relationship between the radial neck and the plane of the head. An oblong head design has 20 stem options in 5 diameters and 4 collar height options. The grit blasted stem surface promotes bony in-growth.
Acumed

- Height is restored by collar height, not the head height.
- Studies show that the length of the radial neck affects the valgus-varus position of the ulna throughout the flexion arc in each of the forearm rotations. Restoration of proper axial length of the radius is critical to avoid a number of complications such as residual instability.
Ascension Modular Radial Head

- An oblong cobalt chrome head, which is available in 6 sizes, long and standard heads in 3 sizes (20, 22, and 24 mm).
- The modular design has 4 grit-blasted stem options used for press fit without cement.
ExploR Modular Radial Head

- A monoblock implant with 3 available head diameters, 5 head heights ranging from 10 to 18 mm, and 5 stem sizes, all combining for 75 different combinations. No assembly necessary before implantation which allows for in situ replacement. Partial titanium plasma spray coating of the stem allows for ingrowth.
Evolve Radial Head Implant System

- A modular polished cobalt chromium alloy implant allows for 150 combinations of head and stems (10 stem sizes and 15 head sizes). This implant has a smooth stem which is designed to be inserted loosely and intended to allow centering of the head on the capitellum.
Evolve implant

- Comminuted fracture of the radial head and neck.
- Posterolateral elbow dislocation and comminuted fracture of the radial head.
- CT scans after closed reduction show injury to the radial head and associated comminuted fracture of tip of the coronoid.

Excellent range of motion was achieved, and the patient was asymptomatic at 2 years.
Judet Prosthesis

- A bipolar prosthesis made of cobalt chromium.
- The stem comes in 2 sizes and is designed for cemented fixation.
- The heads come in 19-mm and 22-mm diameters and articulate with the stem through a polyethylene insert allowing for 35 degrees of motion. This is intended to help the head center on the capitellum.
Swanson Titanium Radial Head Implant

- A monoblock design that is press fit into the radial shaft until there is no free rotation within the canal.
- The geometry is similar to that of the Swanson silicone radial head implant.
Excision Radial Head

- Assemble excised fragments to ensure all are removed; intraoperative fluoroscopy is helpful.

**Pitfalls:**
- Avoid excision with unrecognized ligamentous injuries.
- Excessive excision of the radial neck may cause radioulnar impingement.
Operative Approach

● **Kocher exposure**
  - Exposes fractures by going btw anconeus and ECU
  - Protects PIN
  - Must protect lateral collateral ligament complex
  - Should not elevate anconeus posteriorly
  - Incise elbow capsule and annular ligament diagonally, in line with posterior margin of ECU
Approach: alternative

- More anterior interval protects lateral collateral ligament, but may place PIN at greater risk
- A useful technique for protecting lat. Collateral lig. Is to start at supracondylar ridge of distal humerus
- Then, incise origin of ECR, and elbow capsule and can then see capitellum and radial head
Summary

- **Indications for arthroplasty:**
  - Displaced nonreconstructible fracture larger than one third of the diameter of the radial head with known associated or probable medial or lateral collateral ligament or interosseous membrane injury
  - Nonunion, malunion, and post-traumatic arthritis of the radial head
Summary

- Choose the diameter and thickness of radial head implant on the basis of the reconstructed excised radial head if available.

- The diameter of the radial head arthroplasty is determined from the articular dish diameter of the reconstructed excised radial head; this is typically 2 mm smaller than the outer diameter of the native radial head.
Cont...

- The radial head prosthesis should articulate at the level of the proximal radioulnar joint, 2 mm distal to the coronoid.
- If the radial head does not articulate well with the capitellum, downsize the stem.
- Translate the radial neck laterally to facilitate implant placement.
Radial Head Implants

- Choose diameter and thickness of implant on basis of reconstructed excised radial head if possible