Evaluation & Treatment of the Elbow Joint Complex

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I have no financial relationships to disclose within the past 12 months relevant to my presentations during this symposium.
The “Normal” Elbow

• Extension/ flexion: 0-140 degrees
  – 7-10 degrees varus/ valgus displacement
• Pronation/ supination: 0-85 degrees
  – posterior lateral /anterior medial displacement

Functional:
• Extension/ flexion: 30-130 degrees
• Pronation/ supination: 0-50 degrees
Evaluation and Flow of Procedure

**Inspection:**
- Disrobe to allow
- Scan the entire body first
- Spinal & head alignment,
- Discoloration in the arm
- Atrophy / hypertrophy
- Skin integrity
- Willingness to move
- Asymmetries
- Carrying angle
- Extension deficits
- Focal or diffuse swelling
- ‘Triangle Sign’
Carrying Angle

5 degrees
Cubitus varus

18 Degrees
Normal

30 degrees
Cubitus valgus
Carrying Angle

- Normal valgus 18 degrees
Posture:

- Resting posture.
- Rounded shoulders?
- Atrophy or hypertrophy along the thoracic spine, shoulder or cervical spine.
- Forward head.
- Scapular winging (medial boarder, inferior angle prominence).
- Thoracic kyphosis.
Soft Tissue assessment

• Quality/extensibility
• Mobility
• Color
• Temperature
• Hair growth
**Neurological Testing:**
Clonus, Babinski and Hoffman testing can be completed if the patient demonstrates sign of upper motor neuron dysfunctions (changes in gait, coordination, speech, vision etc.)

**Myotomes (5 sec.), Dermatomes and DTR:**

<table>
<thead>
<tr>
<th>Level</th>
<th>Myotome</th>
<th>Dermatome</th>
<th>DTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Occiput flexion</td>
<td>Top of head</td>
<td>N/A</td>
</tr>
<tr>
<td>C2</td>
<td>Occiput extension</td>
<td>Occiput</td>
<td>N/A</td>
</tr>
<tr>
<td>C3</td>
<td>Cervical side bending</td>
<td>Behind ear</td>
<td>N/A</td>
</tr>
<tr>
<td>C4</td>
<td>Shoulder shrug</td>
<td>Supraclavicular</td>
<td>N/A</td>
</tr>
<tr>
<td>C5</td>
<td>Shoulder abduction</td>
<td>Deltoid insertion</td>
<td>Biceps</td>
</tr>
<tr>
<td>C6</td>
<td>Elbow flexion</td>
<td>First web space</td>
<td>Brachioradialis</td>
</tr>
<tr>
<td>C7</td>
<td>Elbow extension</td>
<td>Dorsum of long finger</td>
<td>Triceps</td>
</tr>
<tr>
<td>C8</td>
<td>Thumb extension</td>
<td>Medial hand</td>
<td>Digit flexors</td>
</tr>
</tbody>
</table>
Cutaneous Innervations
Joints above and below:

**Cervical Screening:**
Perform the CPR for cervical radiculopathy (Wainner 2003).
- Spurling’s test
- ULTT test
- Cervical distraction
- Cervical rotation <60 degrees to the affected side

**Shoulder and wrist screening:** Assess the shoulder/wrist ROM in all directions. Note any limitations or asymmetries.
Functional Testing:

Assess for functional movement patterns, note limitations or asymmetry with elbow flexion coupled with forearm supination to reach hand to mouth and elbow extension coupled with forearm pronation for reaching to interact with the environment.
Push off Test

• Tests weight bearing capacity
• Set handle in the second with handle facing outward
• Place on a 74-76 cm table with buttocks leaning against the table
• Shoulder in 10-40 degrees of extension
• Proceed with maximal load

Vincent et al. JHT27(2014)
Functional Complaints

• Personal hygiene
• Earrings
• Eating
• Drying hair
• Putting hair up
• Pushing up from a chair
• The gym
• Scratching
• Getting things out of the oven
Active Range of Motion:

- 4 prime motions of the elbow: flexion, extension, supination and pronation.
- Wrists ability to flex, extend and deviate.
- *Quantity* of motion, *quality* of motion, and the *effect on symptoms*.
- Perform the most provocative movement last.

Passive Range of Motion:

At this point we will assess all of the preceding movements, but now evaluate a 4th component, namely end-feel. This provides us with vital information, not only on potential pathology, but also on treatment approach and prognosis.

Types of end feel:
- Firm: Capsular (knee extension)
- Empty: Unable to reach end feel due to pain
- Hard: Boney (most often elbow extension)
- Soft: Soft tissue approximation (elbow flexion)
Resisted Isometric Testing:

- Helps assess: contractile or non-contractile.
- All structures that cross the elbow should be assessed for gross strength and effect upon symptoms.
- Shoulder and wrist motions be assessed as well.
- Gross movements of elbow
- The examiner may also choose to test specific muscles including biceps, brachioradialis, ECRL/ECRB, ECU, FCU.
Anatomy and Biomechanics
Lock and Key Joint
Humerus

Lateral epicondyle
Capitulum
Head
Neck
Tuberosity

Radius

Ulna

Radial notch
Coronoid process
Trochlear notch
Olecranon

{ of ulna}
Surface Anatomy
The **Cubital Fossa**, bound by the pronator teres, brachioradialis and a line connecting the epicondyles.

It contains the following:

- **Biceps Tendon** located centrally
- **Brachial artery** is medial to the biceps tendon
- Distally and medial to the artery the **Median Nerve** may be palpated in some individuals where it enters the pronator
- The **Lacertus Fibrosis** is an extension of biceps tendon that travels medially over the brachial artery and blends with the deep fascia of the forearm
- **Radial head**
- **Coronoid process**.
Lateral Epicondyle

- Palpated at the lateral aspect of the elbow where the RCL complex and the common extensor origin originate.

- **Lateral Supracondylar Ridge** can be palpated superior to the lateral epicondyle, which gives rise to the brachioradialis and ECRL.

- **Radiohumeral joint** line is distal to the lateral epicondyle where it articulates with the annular ligament and the radial head.

- The **radial head** can be readily detected on forearm rotation.

- The ‘**Mobile Wad of Three**’: Lateral to the radius lies the brachioradialis, ECRL, and ECRB.

- Just anterior and distal to the lateral epicondyle, the **radial nerve** splits into its two branches.
Medial Epicondyle

- May be palpated at the medial aspect of the elbow where the flexor-pronator group originates
- Gives rise to the main stabilizer of the MCL complex, the **anterior oblique bundle** where its two bands inserts anteriorly into the Coronoid Process, and posteriorly into the Olecranon
- Just superior to the medial epicondyle is the **medial supracondylar ridge**, and if present, the **Ligament of Struthers** may also be palpated
- Posterior to the medial epicondyle is the **ulnar nerve** can be palpated in the cubital tunnel.
Posterior

- The hook-like **olecranon process** of the ulna
- The posterior skin can be rolled to assess the **Olecranon bursa** for signs of thickening
- With the elbow slightly flexed, the **olecranon fossa** can be assessed in the depression superior to the olecranon
- The **triceps tendon** can be palpated superior to the olecranon
Biceps Brachii

Location

Origin:
Long head: supra-glenoid tubercle of the scapula.
Short head: coracoid process of the scapula.

Insertion:
a. Radial tuberosity.
b. Bicipital aponeurosis to the fascia on the medial side of the forearm. **Palpate in supination, muscle belly and distal tendon in antecubital fossa.**

Significance
Elbow flexion and supination. Prone to both proximal and distal rupture. MMT supinated
Brachialis

**Location**

**Origin:**
Anterior distal half of the humerus

**Insertion:**
Coronoid process and tuberosity of ulna.

**Palpate distally with resisted pronated elbow flexion.**

**Significance**
Flexes forearm at elbow. MMT pronated. Muscle belly lies over anterior joint capsule ***bleeding, scaring and adherence with trauma***
Brachioradialis

Location
Origin:
Lateral Supracondylar ridge of humerus
Insertion:
Styloid process of radius. **To palpate resist elbow flexion in neutral, palpate radial forearm**

Significance
Flexes forearm at elbow. Is both a pronator and supinator depending on forearm position. Most effective at midrange for quick movements.
Anconeus

Location
Origin:
Lateral epicondyle of humerus
Insertion:
Posterior olecranon process of ulna.


Significance
Extends forearm at elbow. Distracts posterior capsule for terminal extension. Some pronation assist. Important varus and posterolateral rotary force stabilizer.
Median Nerve

Location
The median nerve arises from the cubital fossa.

Points of Entrapment
• Lacertus Fibrosis- Biceps aponeurosis
• Between the two heads of pronator teres.
• FDS arch
• Carpal tunnel

Can be palpated in the brachial fold and the anticubital fossa

Significance
Prone to compression at multiple sites around the elbow and traumatic injury
Radial Nerve

Points of entrapment

- The triangular interval – teres major, long head of the triceps
- Posterior compartment between long head of triceps and humerus
- The spiral groove between lateral and medial heads of triceps.
- Lateral intermuscular septa never less than 7.5 cm above the distal articular surface. **You can palpate it at this point just proximal of the lateral epicondyle****.
- It then goes through the intermuscular septum surfacing anterior of the lateral epicondyle just lateral of the brachialis and medial to brachioradialis.
- Leash of Henry
- Supinator through the arcade of froshe

Significance
Pathology is a key differential dx for LET, wrist and digital extension, painful entrapment potential. PIN compression, radial tunnel syndrome, posterior cutaneous nerve can be prone to irritation
Suprascapular Nerve

1. Entrapment: suprascapular notch
2. Ganglion
3. Ossification
4. Trauma
5. Repetitive overhead load
PIN Entrapment

- Fibrous tissue radial capitellar joint
- Arcade of Froshe-proximal part of supinator also called supinator arch
- Leash of Henry-recurrent radial a. vessels
- Distal edge of the supinator
- Medioproximal edge of ECRB
Radial Tunnel

• Pain-dull
• Fatigue
• May radiate
• No weakness

PIN-Supinator syndrome

• Purely motor
• Weak wrist extension into radial deviation-ECRL intact
• Absent/weak digital extension
Rule of Nine

- Red indicates radial nerve
- Yellow median nerve
- Blue control

Left Forearm just distal of crease

Arch Bone Jt Surg. 2015 Jul;3(3):156-162
Ulnar Nerve

Points of Entrapment

• The arcade of Struthers* Arcade of Struthers occurs in 70-80% of population, aponeurosis from medial triceps to intermuscular septum*

• The cubital tunnel posterior to the medial epicondyle.

• Palpate anterior of medial head of the triceps. Palpate medial epicondyle and slide posterior into cubital tunnel.

• FCU

• Guyon’s canal
Location

Origin:
Common extensor tendon from lateral epicondyle of humerus, and deep antebrachial fascia

Insertion:
By four tendons, each penetrating a membranous expansion of the dorsum of the second to fifth digits and dividing over the proximal phalanx into a medial and two lateral bands. The medial band inserts into the base of the middle phalanx while the lateral bands reunite over the middle phalanx and insert into the base of the distal phalanx

Palpate common extensor origin and confirm with mcp isolated extension.

Significance

Extends the MCP joints and, in conjunction with the lumbricals and interossei, extends the IP joints of the second through fifth digits. Assists in abduction of the index, ring, and little fingers; and assists in extension and abduction of the wrist
Location
Origin:
Lateral epicondyle of humerus
Insertion:
Base of the 5th metacarpal

Palpate common extensor origin and confirm with ulnar biased extension.

Significance
Extends and ulnar deviates hand at wrist. Subsheath is a component of the TFCC. Prone to subluxation at distal ulna. In supination is primary ulnar deviator. In pronation secondary wrist extensor.
ECRL

Location

Origin:
Distal lateral supracondylar ridge

Insertion:
Base of 2\textsuperscript{nd} metacarpal

Significance
Extends and radial deviates hand at wrist
ECRB

**Location**

**Origin:**
Lateral epicondyle of humerus

**Insertion:**
Base of 3rd metacarpal

**Significance**
Extends and radial deviates hand at wrist
Supinator

Location

Origin:
Deep part (horizontal): supinator crest and fossa of ulna.
Superficial part (downwards): lateral epicondyle and lateral ligament of elbow and annular ligament

Insertion:
Neck and shaft of radius, between anterior and posterior oblique lines

Significance
Supinates forearm. Only acts alone when elbow extended
Muscles of the Volar Forearm

(A) Anterior view of supinated forearm
Pronator Teres

Location
Origin:
Humoral Head: Medial epicondyle of humerus and distal supracondylar ridge
Ulnar Head: Medial side of coronoid process of Ulna
Insertion:
Middle of lateral surface of radius.

Palpate the medial border of the mobile wad. At its midpoint palpate deeply to insertion on radius. THIS DOES NOT FEEL GREAT Pronate to confirm location

Significance
Pronates and flexes forearm at elbow. Median nerve entrapment. Prone to trigger points
FCR

**Location**

**Origin:**
Medial epicondyle of humerus

**Insertion:**
Bases of 2\textsuperscript{nd} and 3\textsuperscript{rd} metacarpal

**Palpate medial epicondyle. Muscle travels obliquely medial of PT**

**Significance**
Flexes and radially deviates hand at the wrist. Manifests tendinopathy
FCU

Location
Origin:
Medial epicondyle of humerus and medial margin of the olecranon.
Insertion:
Pisiform, hook of hamate, and base of 5th metacarpal

*Palpate medial epicondyle, muscle lies at ulnar border of flexor mass, ulnar deviation and flexion to confirm palpation.*

Significance
Flexes and ulnar deviates hand at wrist. Ulnar nerve may become entrapped at the aponeurosis
Kinetic Chain

- Stable
- Load bearing
- Puts the hand where it needs to be
- Balance of stability and mobility
- Open and closed chain tasks
Load at Wrist
- 80% radius
- 20% ulna

Load at Elbow
- 57% radius
- 43% ulna
• Ulno-humoral flexion and extension mostly fixed throughout arc with a little slush 7-10 degrees
• Rotary motion and stability maintained by the annular ligament and IOL
Radial Head

• Posterior pronation
• Anterior supination
• 30% valgus stability
• Most vital at 0-30 degrees of pronation/flexion
• Provides additional stability during gripping tasks
• Most closely approximated in pronation
Articular Pathologies
Osteochondritis Disseicans

- Injury and separation of the cartilage over the capitellum
- Typically adolescent males dominant arm.
- Overhead and UE weight bearing activities.
- Gymnastics, throwers, bowlers
Panners Disease

- < 10 years old
- Benign
- Same MOI OCD
- nonsurgical
• Insidious activity related lateral elbow pain
• Loss of extension
• Catching, locking, grinding.
Management

- Nonoperative: type I lesion-intact cartilage, stable fragments
- 3-6 weeks immobilization
- Slow return to activity 6-12 weeks
- Good prognosis
Operative

• Protected ROM
• Strengthening at 2 months
• Throwing 4-6 months
• Arthroscopic reduction, capitellar drilling or fixation

• Debridement, excision of loose bodies
• Early motion in hinged brace
• Strengthening when ROM pain free—especially end range
• No throwing or weight bearing 3x months
ASSESSMENT and TREATMENT of FRACTURES of the HUMERUS, RADIUS, and ULNA
General Guidelines and Special Considerations

- Edema
- Neurologic function
- Pain
- Inflammation
Radial Head

- Most common fx of the elbow
- More common in women
- Type I: sling
- Type II: immobilize supinated/neutral? 90 degrees flexion
- Type III and IV: surgical
- Surgical: AROM if stable, PROM at 2 weeks
- Night extension at 6 weeks if extension deficit
Radial Head Replacement

- Begin AROM to end range ASAP
- 4-6 weeks PROM
- STR 8 weeks
- MOVE IT! MOVE IT! MOVE IT!
Olecranon
• Majority will need ORIF
• Up to 50% will have extension loss
• Good function
• Good alignment is vital, even a small step off will result in arthritis
Displaced
- 3 weeks LAC
- No active flexion beyond 90 degrees
- Orthosis at 45 degrees until 6 weeks between exercise
- Confirm healing before PROM at 8 weeks

Non displaced
- Triceps avulsion, repair?
- May result in bony defect
- 2 weeks: elbow AROM 0-90 degrees
- PROM at 6 weeks but healing should be confirmed by x-ray
Special Considerations

• Triceps injury, mechanical involvement and repair
• HO, Ectopic bone
• Pain in hardware-removal
• Ulnar Nerve injuries
• May involve dislocation
Humerus Fx
Types

A: Supracondylar
B: Single column
C: Bicolumn

- Low energy falls in the elderly
- High energy in younger populations
- Most adults will have some motion loss
- Up to 30% activity related pain
Medial Epicondyle

- Extra articular
- Often avulsion “Little Leaguer's Elbow”
- May result from direct blow
- Fixated if valgus instability
- Fragment can be lodged between trochlea and coronoid
Lateral Epicondyle

- Very rare
- Usually an avulsion
- Good prognosis
Lateral Condyle

- 2\textsuperscript{nd} most common pediatric
- Blow or varus stress
- Medial condyle fx very rare
• Best outcomes if movement begins in first could post op days
• Fixation with compression screws is usually stable
• K-wires may be used as well
• Protected ROM 4-6 weeks
• Avoid PROM due to HO
Supracondylar

- Usually direct force to olecranon on elderly low speed impact
- Usually do well
Pediatric Supracondylar

- Children tend to fracture supracondylar whereas adults intercondylar fractures usually occur
- Median, radial or AIN neuropathy risk
- May result in gunstock deformity later in life
Gunstock Deformity

Cubitus Varus
Intra-articular Bicolumn

• High risk for neurovascular injury
• Non operative LAC 2-3 weeks
• ORIF LAC 3 weeks
• If combined with olecranon fx traction is required
• May need Total ER
Volkmann's Ischemia

- Rare but possible
- Permanent muscle shortening from un-dx compartment syndrome

- Rare but possible
- Pronator teres - Median innervation
- Flexor carpi radialis - Median innervation
- Flexor carpi ulnaris - Ulnar innervation
- Flexor digitorum superficialis - Median innervation
- Palmaris longus - Median innervation
- Flexor pollicis longus - Median (anterior interosseous) innervation
- Pronator quadratus - Median (anterior interosseous) innervation
- Flexor digitorum profundus - Median (anterior interosseous) and ulnar innervation
Other Fractures

- Trochlea and capitellar fractures are rare alone
- Usually part of a more complex trauma
- Small coracoid fx’s may be maintained in a hinged elbow support
Rehabilitation Considerations

- If no AROM within 2 weeks significant risk of stiffness
- Hinged reduction to prevent medial/lateral instability
- Work on flexion in supine
- Extension seated
Other Complications

- Hardware prominence
- Hardware failure
- Stiffness
- Infection
- Ulnar neuropathy
Ligamentous Function and Pathology
Stability

- Primary stabilizing factors
  - Anterior band of MCL esp. anterior oblique fibers, both valgus and distraction
  - LCL
  - Coronoid
- Secondary stabilizers
  - Radial head: 30% valgus stability, 0-30 degrees flexion and pronation
  - Capsule: distraction in extension
  - Anconeus and lateral capsule: secondary varus stability

***50% of articular stability is ligamentous***

Capsule primary stabilizer in full extension
Radial Collateral Ligaments

LUCL
• Primary Varus stabilizer
RCL
• Varus stability
• *Posterolateral rotatory instability
Annular
• Maintains radial head in lesser sigmoid notch
Ulnar Collateral Ligaments

Anterior Band
- Most Important valgus stabilizer
- Throwers

Posterior band
- Co-stabilizer during flexion

Oblique band
- Weak
- Floor of the cubital tunnel
Dynamic Stability

• Tension on the biceps and Brachialis = posterior force

• Coronoid and radial head counteract creating joint reaction force.

Maintains compression = dynamic stability
Varus Load

• Not common in normal function
• Shoulder abduction creates varus load
• Distraction injury can lead to LUCL laxity and posterolateral instability
• Overhead athletes, industrial, acrobats, gymnasts
Posterior Dislocation

- Common
- Usually athletic in isolation
- Prolonged dislocation is a neurovascular danger
Anterior Dislocation

- Pediatrics-radial head subluxes
- Posterior hit with a partially flexed elbow
Radial Head Dislocation

- “Nursemaid’s elbow”
- Pediatric dislocation when epiphyseal plate has not yet fused-traction injury
Medical Management

• Simple dislocations-nonsurgical

• Complex dislocations
  – Ligament repair
  – Radial head replacement, ORIF, excision
  – Coronoid ORIF
  – Proximal ulna ORIF

• Unstable elbows
  – Traditionally immobilized 4-5 weeks 90 flexion and pronation
Therapeutic Management

Inflammation/protection 0-3 weeks

- 90-20 degrees of flexion pronation
- Position of stability, limits varus stress
- Radial head is stabilized against coronoid-keeps it from subluxing
- Pronation unloads lateral ligaments
Therapeutic goals

- Maintain stability
- Protected ROM
- NO combined extension and supination
- NO shoulder Abduction-varus load
- Supine with elbow flexed at 90
- Minimizes ulnohumeral distraction
- Flex/ext in pronation
- Rotate in flexion
Factors that Influence Timeline Overall

- Pre-op status
- Quality of the bone
- Cognitive status
- Compliance
- Specific surgical intervention
  - Method of reduction
  - Strength of fixation
  - Stability of fractures
  - Integrity of ligaments
- Integrity of the soft tissue
- Surgeons skill-your skill
Combination Injuries
Essex-Lopresti

- IOM tear
- Comminuted radial head fx
- Proximal migration of radius-DRUJ disruption
- FOOSH in elbow extension an pronation
1. FOOSH
2. Radial head FX
3. IOM tears
4. Radius migrates proximally
5. DRUJ disruption

Mechanism
• Supinated immobilization = pronation stiffness
• DRUJ disruption may lead to pain
• AIN
• Generally immobilized 4 weeks to ensure DRUJ stability
• Rotational strength deficits are a concern
Monteggia Fx

- Dislocation of PRUJ
- Ulna fx
- DRUJ lesion
- FOOSH with Rotation
Mechanism

IMPACT FROM GROUND

FORCE TRANSMITTED THROUGH ULNA AFTER DISTAL END RADIUS FRACTURE
Terrible triad
Coronoid Fracture

- Type I tip fracture: Stable
- Type II 50% or less of height: ORIF
- Type III Greater than 50%: May need hinged external fixator
Complications

- Malunion
- Stiffness
- Ectopic ossification
- OA
- Nerve injury
Medical Management

- Restore articular congruity
- Stable anatomic reduction
- Stable rigid fixation
- All conditions must be met for early motion
Types of Fixation

- Rigid: early motion, full pain-free
- Stable: Protected early AROM
- Tenuous: Delayed protected AROM
Rehab Guidelines

- Non-operative vs. Operative
- LAC/ Orthosis 10 days to 8 weeks
- Immobilization vs Early motion
- Fixation?
- Stability?
Orthosis

• Rigid
• Hinged
• Extension/ rotation block
<table>
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<tr>
<th>Ligament disruption</th>
<th>Position rotation</th>
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<td>LCL</td>
<td>Pronation</td>
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<tr>
<td>MCL</td>
<td>Supination</td>
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<tr>
<td>MCL and UCL</td>
<td>Neutral</td>
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</table>
Phase I: Inflammatory

• 0-2 weeks
• Pain control
• Edema management
• AROM
• ROM uninvolved joints
• Monitor for complications
Early protected AROM

• In supine allow permitted movement
Considerations for Forearm Complex Fractures

- Rotation limitation- sugar tong, Munster, hinge
- Limited flexion and extension
- IOM repair will delay rotation
- Immobilization 4-8 weeks
Phase II: Fibroplasia

- 2-8 weeks
- Maximize A/PROM
- Respect the tissue
- If stable PROM at 3 weeks
- Proprioceptive tasks as appropriate
Phase III: Remodeling

- 8+ weeks
- Maximize Function
- Complex and resistive exercise
- Stability static/dynamic
- Weight bearing
Exercise/ HEP

- Towel stretch
- Hammer
- Walk outs
- Isometrics with magazine
- Isometrics with Theraband bar
- Prone activities
- Theraband *short arc*
- Focus on coupled motions
- Weight bearing
Capsulo-Ligamentous Special Tests

- Medial Stress Test
- The Moving valgus Stress Test
- UCL 'Milking Maneuver'
- Lateral Stress Test
- Postero-Lateral Instability Test
Medial Stress Test

1. Examiner stands lateral to the patient’s arm
2. With neutral forearm rotation, then bring the patient’s shoulder into full external rotation
3. Then passively move the elbow to end range extension and back off into flexion of the elbow approximately 15-25 degrees
4. A valgus force is applied to elbow in order to stress the MCL complex

Positive test: Reproduction of patient’s symptoms and/or hypermobility compared to the unaffected side.
The Moving Valgus Stress Test

1. Place the patient elbow in full flexion
2. A valgus stress is applied and maintained as the arm is quickly, passively straightened

**Positive test:** Reproduction of medial elbow pain is elicited at 90 degrees of flexion, however moving through the ROM tests different aspects of the MCL complex.

*O’Driscoll has shown this test to have 100% sensitivity and 75% specificity*
The milking maneuver tests the posterior band of the anterior oblique bundle of the MCL complex.

Position patient in elbow flexion just greater than 90 degrees. Neutral rotation.

Palpate the medial joint line.

Apply a downward and valgus stress by pulling on the patient’s thumb.

**Positive test:** Medial joint line gapping and/or reproduction of pain at the medial elbow.
Lateral Stress Test

1. With neutral forearm rotation, then bring the patient’s shoulder into full external rotation
2. Then passively move the elbow to end range extension and back off into flexion of the elbow approximately 15-25 degrees
3. A Varus force is applied to elbow in order to stress the LCL complex

Positive test: reproduction of the patient’s symptoms and/or hypermobility compared to the unaffected side.
Postero-Lateral Instability Test

1. The patient lies in supine with the arm elevated overhead
2. Place the shoulder in full external rotation, elbow in extension and the forearm in supination
3. Apply an axial load and valgus stress to the elbow as it is brought into flexion

Positive test: The examiner will notice a clunk, which is the reduction of the radial head.
Tendon Injuries
Distal Biceps Rupture

- May be partial or complete
- Steroids, 7x more likely with tobacco, hypovascularity, intrinsic degeneration, mechanical impingement
- Eccentric contraction
- Tendon midpoint has reduced vascularity

Reverse POPEYE

Medial ecchymosis
Management

• Conservative/nonsurgical - Strength loss: -50% sustained supination, -40% supination, 30% flexion, 15% grip.
• Surgical-young healthy patients
• Immobilize 110 with moderate supination
• Strength- Button 400N > Suture 380N> Bone tunnel 310N > interface screw 230N
• 1kg static load at 90 degrees 50N
• Combinations stronger yet
• Reality?
Complications

- HO
- Median nerve compression
- PIN or radial nerve injury
- Synostosis—results in loss of pronation and supination
- Proximal radius fx
Lateral Antebrachial Neuropathy

Most common but not
A huge functional issue.
Usually resolves.
Triceps Rupture

- Competitive weight lifters, body builders, football players
- Steroid use, renal osteodystrophy, local steroid injection, fluoroquinolone use, olecranon bursitis, previous triceps surgery
- Eccentric contraction
- Rupture usually at insertion
Complications

• Stiffness “tethering”
• Ulnar nerve injury
• The patient typically presents after trauma such as a fall on an outstretched hand with posterior elbow swelling and ecchymosis.
• A palpable defect proximal to olecranon may be palpable.
• Surgical repair for complete or greater than 50% tears
The Hook Test (for Distal Bicep Rupture):
1. Place the shoulder in ~90 degrees of shoulder abduction
2. Flex the elbow to 90 degrees
3. Supinate the forearm
4. Place a finger at the lateral edge of the biceps tendon

Positive test: Inability to hook the finger due to an absence of the tendon
Ruland Biceps Squeeze Test

1. Elbow held at 60-80 degrees
2. One hand stabilizes elbow while other hand squeezes across distal biceps muscle belly.

**Positive test:** failure to observe supination across forearm and wrist.

*Sensitivity 96%*
Triceps Tendon Test

1. Place the patient prone
2. Support the humerus on the table
3. Place the elbow hanging at 90 degrees

Positive test: An inability to extend the elbow against gravity

Modified Thompson Test:
1. Same position as above
2. Squeeze the triceps muscle

Positive test: Lack of elbow movement
Management of complex/complicated injuries
TEA

- MEM
- Avoid torsion
- Ulnar nerve
- Education- proper lifting/ restrictions
The Stiff Elbow

• Who’s to blame and what do we do about it?

• Extrinsic Contracture
  – Skin, soft tissue, capsule, neurovascular bundle, capsule, ligaments, muscle/tendon, ectopic bone

• Intrinsic contractures
  – Intraarticular adhesions, cartilage loss, articular deformity, malunion, hardware

• Mixed contractures-common
Extrinsic Contractures

- Duration of immobilization
- Is it blocked or tethered?
- Flexion is more common and more easily managed
- Extension is usually adhesions/scar rather than capsule
- Pronation more common than supination
- Anterior capsule and brachialis tend to tear setting up conditions for anterior fibrosis and contracture
Intrinsic Contractures

• Almost always have extrinsic factors
• Heterotrophic Ossification
• Surgical
Additional Assessment Considerations for Extrinsic Tightness

• Assess muscle length
  – Biceps
  – Triceps
• Joint play assessment
• Mobility vs stability
Who Needs an Orthosis?

- Modified Weeks Test - gains after 15 min heat and exercise

<table>
<thead>
<tr>
<th>Increased PROM in Degrees</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>None</td>
</tr>
<tr>
<td>15</td>
<td>Static</td>
</tr>
<tr>
<td>10</td>
<td>Dynamic</td>
</tr>
<tr>
<td>0-5</td>
<td>Static progressive or serial static</td>
</tr>
</tbody>
</table>
Considerations

• End feel
• Degree of contracture
• Therapists experience
• Patient compliance
Harmful

- ROM improves
- Adjustment variables increase i.e. time

Effective

- Pain
- Loss of motion additional inflammation
- Edema
- Numbness
Heterotrophic Ossification and Ectopic Bone Growth
• Heterotrophic ossification/Myositis ossificans traumatica
• Chronic posterior instability, pain and clicking
• Common in traumatic elbow injuries with: fractures/dislocations, severe soft tissue trauma, overly aggressive ROM
• Signs

• Heat
  • Worsening ROM
  • Becomes a mechanical block
• Pre-op

• Must wait for significantly decreased triphasic bone scan activity to indicate maturity of osseous overgrowth

• Normalization of ALP (alkaline phosphatase) – elevated with skeletal trauma

• CT common for surgical planning

• Often 1 year post-injury
• Procedure

- Resection of HO
- Wide exposure as neurovascular structures are commonly involved
- Ulnar nerve often transposed
- Removal of non-essential hardware
• Complications
  • Hematoma
  • AVN
  • Recurrence
  • Fracture – Often osteopenia, careful with ROM
  • Chronic instability
  • Pain
• Special Post-op Considerations

• Is there a drain?
• Radiation therapy 1X (4 hours to 6 weeks post-op)
• Medication (NSAIDS, Indomethacin)
• Surgical report: OR ROM?, ligamentous integrity?, transposition?
• Early ROM
• Custom orthosis
• Off the shelf orthosis
• Edema management
• Pain management
• Gentle
Joint Play Assessment

**Radial Head Quick Test:**

1. Hold both forearms of the patient
2. Palpating the Radio-Humeral joint line with the index fingers
3. Passively flex and extend the elbows
4. Assess opening of the joint space is assessed side to side
# Coupled Motions

<table>
<thead>
<tr>
<th>Coupled Motion</th>
<th>Corresponding Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supination</td>
<td>Elbow Flexion</td>
</tr>
<tr>
<td>Pronation</td>
<td>Elbow Extension</td>
</tr>
<tr>
<td>Wrist extension</td>
<td>Digital flexion</td>
</tr>
<tr>
<td>Wrist flexion</td>
<td>Digital Extension</td>
</tr>
</tbody>
</table>
**Radio-Humeral Compression:**

1. Place the patient's elbow in slight elbow flexion and pronation.
2. Stabilize the distal humerus with your palm while palpating radio-humeral line with the thumb.
3. Grasp the patient's distal forearm, biasing the radius.
4. Apply a long axis compression.
Humero-radial Joint Distraction:

1. Stand lateral to the patient’s elbow
2. Place the patient’s elbow in slight elbow flexion and pronation
3. Stabilize the distal humerus with your palm while palpating radio-humeral joint line with the thumb
4. Grasp the patient’s distal forearm, biasing the radius

Mobilization: Apply a long axis distraction force

Improves: Elbow flexion, extension, pronation and supination
Lateral-Gapping of The Elbow:

1. Examiner stands medial to the patient’s arm
2. With neutral forearm rotation, then bring the patient’s shoulder into full external rotation
3. Then passively move the elbow to end range extension and back off into flexion of the elbow approximately 15-25 degrees (this will unlock the olecranon process from the fossa)
4. Place the lateral hand’s index finger along the radio-humeral joint
5. Place the medial hand just below medial epicondyle

Mobilization: Apply a superior lateral force with the medial hand while the lateral index finger is palpating for gapping of the radio-humeral joint.

Improves: Elbow flexion
Medial Glide of The Elbow (component of lateral gapping):
With the same set up as a lateral gap, a medial glide can be performed.

1. The examiner is medial to the patient’s arm with the same elbow position during the lateral gap
2. The examiner will keep the lateral hand distal to the joint line and move the medial hand just proximal to the joint line
3. The examiner will bring their forearms parallel to the joint line

Mobilization: The examiner’s medial hand is stabilizing while the lateral hand is applying a medial glide through the action of body weight shifting medially.

Improves: Elbow flexion
**Medial-Gapping of the Elbow:**

1. Examiner stands lateral to the patient’s arm
2. With neutral forearm rotation, then bring the patient’s shoulder into full external rotation
3. Then passively move the elbow to end range extension and back off into flexion of the elbow approximately 15-25 degrees
4. Place the lateral hand just distal to the lateral epicondyle
5. Place the medial hand slightly more distal to the medial epicondyle with the index finger palpating the joint line

**Mobilization:** Apply a superior, medial and anterior force, with the lateral hand to gap the medial joint line.

**Improves:** Elbow extension
Lateral Glide of The Elbow (component of medial gapping):
With the same set up as the medial gap, lateral glide can be performed.

1. The examiner is lateral to the patient’s arm with the same elbow position during the medial gap
2. The examiner will keep the medial hand distal to the joint line and move the lateral hand just proximal to the joint line
3. The examiner will bring their forearms parallel to the joint line

Mobilization: The examiner’s lateral hand is stabilizing while the medial hand is applying a lateral glide through the action of body weight shifting laterally.

Improves: Elbow extension
Distraction of the Humero-Ulnar Joint:

1. The patient can be positioned in sitting or supine  
2. Elbow is flexed to between 70-90 degrees  
3. Supinate the forearm  
4. Stabilize the distal humerus with your non-mobilizing hand  
5. Rest the patients forearm on your shoulder  

Mobilization: The mobilizing hand will provide a distraction force through the proximal ulna that is on an axis 30-45 degrees as related to the forearm  

Improves: Elbow flexion, extension, supination and pronation
Anterior Glide of the Superior Radio-Ulna Joint:

1. The patient is sitting with the elbow ~90 degrees of flexion
2. Place the forearm in the neutral position
3. Place both thumbs over the shaft of the radius, just distal to the radial head

Mobilization: Apply and anterior force (towards the patient) to the shaft of the radius

Improves: Forearm supination and assists with coupling motion of elbow flexion
Posterior Glide of the Superior Radio-Ulna Joint:

1. The patient is sitting with the elbow ~90 degrees of flexion
2. Place the forearm in the neutral position
3. Grasp the radial head with the thumb and index finger

**Mobilization:** Apply blocking force to the radial head while passively pronating the forearm

**Improves:** Forearm pronation and assists with coupling motion of elbow extension
Anterior Glide of the Distal Radio-Ulnar Joint:

1. Stand lateral to the forearm
2. Place the patient in the sitting position with the elbow at 90 degrees forearm in neutral
3. Grasp the distal radius and distal ulna with a staggard thumb grasp just proximal to the wrist joint on the posterior surface of the forearm, the staggard thumb on the radius should be slightly more distal
4. Fix the ulna against the table with one hand

Mobilization: An anterior force (toward the patient) is applied through the thenar eminence to the radius.

Improves: Elbow pronation which couples with elbow extension
**Posterior Glide of the Distal Radio-Ulnar Joint:**

1. Stand medial to the patient’s forearm
2. Place the patient in the sitting position with the elbow at 90 degrees forearm in neutral
3. Grasp the distal radius and distal ulna with a staggered thumb grasp just proximal to the wrist joint on the anterior side of the forearm
4. Fix the ulna against the table with one hand

**Mobilization:** A posterior force (away from the patient) is applied through the thenar eminence to the radius.

**Improves:** Elbow supination which couples with elbow flexion
Mobilization Techniques for the Elbow.

**Techniques to improve flexion:** It is important to remember that flexion couples with supination at the elbow, so techniques designed to directly influence one will tend to improve the other. This therefore increases the number of potential techniques to gain range into flexion. It is also important to bear in mind that, if plastic tissue deformation is the goal of the mobilization, it should be performed towards the end of the available range of motion.

1. Humero-Ulnar Distraction, distraction tends to improve overall joint play and therefore potentially increases all motions at a joint.
3. Lateral Gapping, as extension tends to decompress the medial side of the elbow, flexion does the same at the lateral aspect. Gapping can therefore be a useful adjunct to treatment. Likewise, its component motion...
4. Medial Glide can also be employed.
5. Anterior Glide of the Radial Head at the superior Radio-Ulnar joint. As flexion couples with supination, this technique, designed predominantly to gain supination, can assist in gaining flexion. Following the concave-convex rule, if the convexity glides in the opposite direction to the osteokinematic motion, an anterior glide of the Radial Head will increase supination.
6. Likewise, gliding the Radius posteriorly on the Ulna at the inferior or distal Radio-Ulnar Joint (the radius is concave on a convex ulna here), will also tend to increase supination, and therefore, flexion.
Techniques to improve extension.

4. Lateral Glide.
5. Posterior Glide of the Radius at the PRUJ.
6. Anterior Glide of the Radius at the DRUJ.
DONE!