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Management of the Elbow Complex:

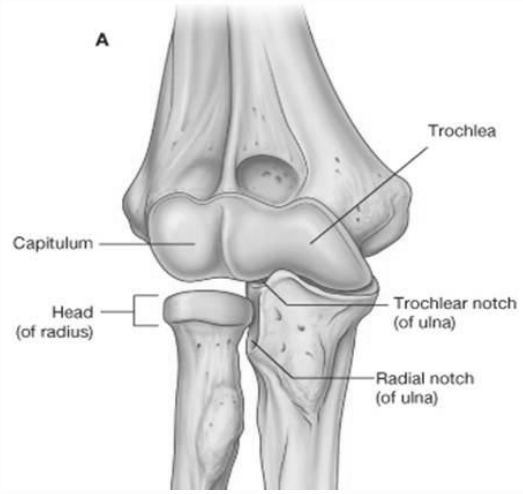
David Nolan, PT, DPT, MS, OCS, SCS, CSCS

Learning Objectives

- Understand the anatomic & biomechanical relationships of the elbow as it relates to normal function
- Describe pathomechanics of selected elbow injuries
- Discuss evidence-based examination & intervention techniques for selected elbow conditions

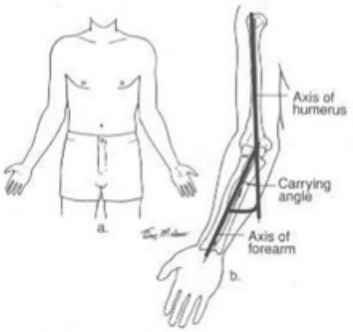
Anatomy

- Articulations
  - Humeroulnar
  - Humeroradial
  - Proximal radioulnar

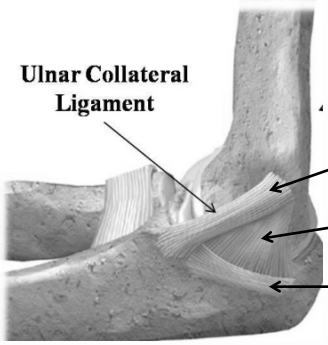


Anatomy

- Carrying Angle
  - Valgus angulation
    - Males: 11° - 14°
    - Females: 13° - 16°
      - Wider pelvis?



Anatomy



- Medial Ligament Complex
  - Ulnar Collateral Ligament (UCL)
    - Anterior bundle
      - Taught in extension
    - Posterior bundle
      - Taught in flexion
    - Transverse bundle

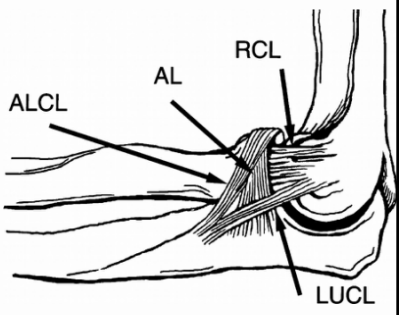
Anatomy

- Restraint to Valgus Stress

Restraint	Elbow Extension	Elbow Flexion
Joint Articulation	30%	35%
Medial Ligaments	30%	55%
Joint Capsule	40%	10%

Anatomy

- Lateral Ligament Complex
  - **Radial collateral ligament**
    - Taught throughout ROM
  - **Lateral UCL**
    - 1° restraint to varus stress
  - **Accessory collateral ligament**
    - Blends with annular ligament
  - **Annular ligament**
    - Stabilizes proximal radioulnar joint
    - Anterior taught with supination
    - Posterior taught with pronation



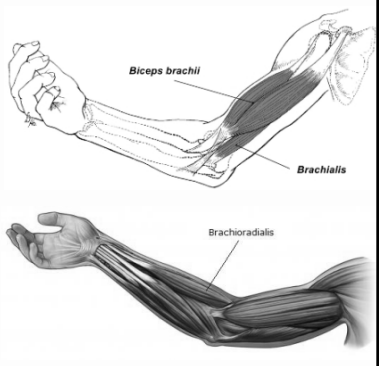
Anatomy

- Restraint to Varus Stress

Restraint	Elbow Extension	Elbow Flexion
Joint Articulation	55%	75%
Lateral Ligaments & Joint Capsule	45%	10%
Other Soft Tissues	0%	15%

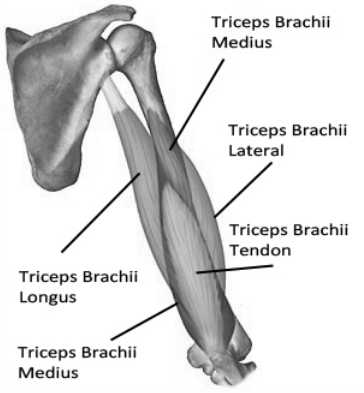
Anatomy

- Elbow Flexors
  - Biceps
    - Strong supinator
  - Brachialis
    - Poor mechanical advantage
  - Brachioradialis
    - Strongest elbow flexor



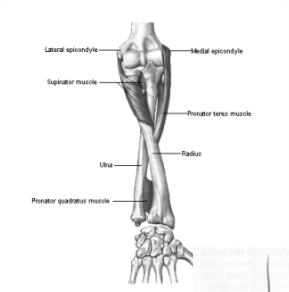
Anatomy

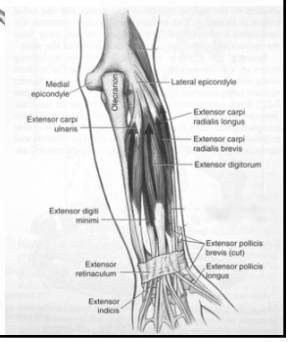
- Elbow Extensors
  - Triceps
    - Long Head
      - infraglenoid tubercle
    - Medial / Lateral Heads
      - posterior aspect of humerus



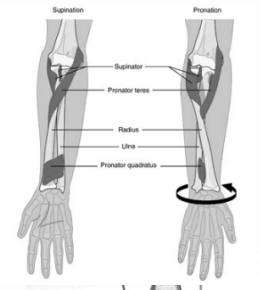
Anatomy

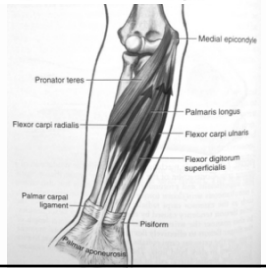
- **Extensor-Supinator Group**
  - Supinator
  - Extensor Carpi Radialis Longus
  - Extensor Carpi Radialis Brevis
  - Extensor Digitorum Communis
  - Extensor Digiti Minimi
  - Extensor Carpi Ulnaris





Anatomy

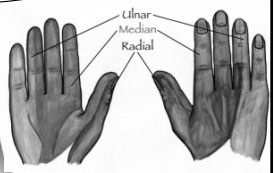


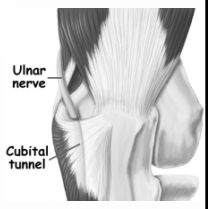


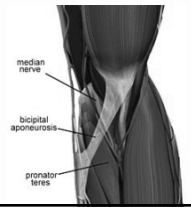
- **Flexor-Pronator Group**
  - Pronator Teres
  - Flexor Carpi Radialis
  - Palmaris Longus
  - Flexor Carpi Ulnaris
  - Flexor Digitorum Superficialis

Anatomy

- Nerves
  - Radial
    - Anterior to lateral epicondyle
    - Innervate extensor-supinator group
  - Ulnar
    - Posterior to medial epicondyle
    - Innervates Flexor Carpi Ulnaris
  - Median
    - Innervates flexor-pronator group







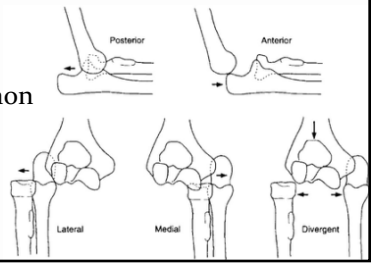
Selected Elbow Pathology

Evidence-Based Examination
& Treatment Recommendations

Elbow Instability

Instability

- Mechanism
  - Fall on outstretched hand
- Considerations
  - Timing
    - Acute, Chronic, Recurrent
  - Articulations involved
  - Direction of displacement
    - Anterior, Posterior, Lateral, Divergent
      - Posterior & posterolateral most common
  - Degree of displacement
    - Subluxation or dislocation
  - Presence / Absence of fracture



Instability

- Patient Presentation
  - s/p traumatic event
  - Ulnar, median, radial nerve complaints
- Simple Dislocation
  - Acute soft tissue injury
  - No fracture

- Complex Dislocation
  - Multiple articulations
  - Fractures

Simple Dislocation

- **Management** (de Haan J et al. *Arch Orthop Trauma Surg*. 2010)
  - Closed reduction
    - Stable joint post reduction
      - Immediate AROM in pain-free ROM
      - Compression garment for edema
      - Gripping
    - Unstable joint post reduction
      - Immobilization (cast/brace)
      - >14 days ↑ risk of stiffness
      - Pronation/Supination strength for stability

Complex Dislocation

- **Management**
  - Reduction of dislocation
  - Fixation of fractures
    - Common fractures
      - Radial head & coronoid process
      - "Terrible Triad"
  - Rehabilitation
    - Dependent on bony healing & associated injury

Complex Dislocation

- Postoperative Management of "Terrible Triad"
  - Zeiders GJ & Patel MK. *JBJS*, 2010

Intervention	Mobility	Time Frame	Comments
Immobilization	Immobilized at 90°	0-10 days post-op	Pronation: Lateral ligaments repaired: Neutral: None/both ligaments repaired
AROM	Protected motion out of brace	10-15 days post-op	30° - 60° by week 6 post-op
Strengthening	No Guidelines provided		

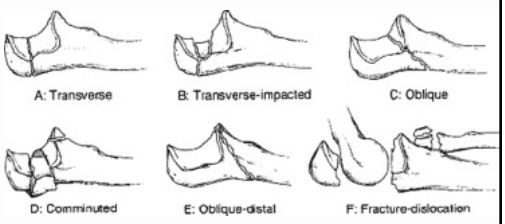
Elbow Fractures

Supracondylar Fracture

- >50% of elbow fractures in children
- Mechanism: Fall on outstretched arm
- Fixation- ORIF vs Closed reduction
  - Dependant on displacement

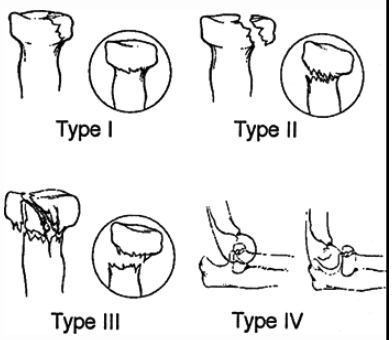
Olecranon Fracture

- Common in elderly
- Presentation
  - Disruption to triceps function
  - Displaced intra-articular joint fracture
- Surgery to restore humeroulnar congruence
  - Complications
    - Loss of extension
    - Ulnar neuropathy
    - Posttraumatic arthritis
    - instability



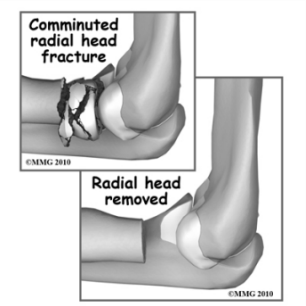
Radial Head Fracture

- **Common in females** (20-60 yo)
- **Mechanism of injury**
  - Axial load on pronated forearm
  - Direct blow to elbow
  - Hyperflexion injury
- **Management**
  - Type I: Early motion
  - Type II-IV
    - Immobilization in full extension
    - Surgical
      - ORIF
      - Radial head excision
      - Radial head replacement



Radial Head Fracture

- **Management**
  - Radial head excision
    - Intact UCL required
    - Flexor-pronator mass compensates
    - ↓ strength post-op compared to ORIF
  - Radial head replacement
    - Indications
      - Type IV fracture
      - UCL or RCL dysfunction & instability
      - Coronoid fractures >50%
    - Rehabilitation
      - Immediate ROM



Osteoarthritis

Elbow Osteoarthritis

Primary: Degenerative

- **Presentation**
  - Age: 40-60 yo
  - Gender: Male
  - History: Repetitive use or UE weight bearing occupation
  - Onset: Insidious
  - Symptoms: End range pain. Loss of extension, painful locking
  - Radiographs: Normal joint space with osteophyte formation

Secondary: Prior Trauma

- **Presentation**
  - Age: Any
  - Gender: Male or Female
  - History: Prior trauma or surgery
  - Onset: s/p trauma
  - Symptoms: End range pain. Loss of extension, painful locking
  - Radiographs: Joint space destruction with inflammatory arthritis

Elbow Osteoarthritis

- **Nonoperative Management**
  - Maximize flexibility
  - Mobilizations at elbow
    - Initiate at grade I-II
  - Shoulder strength
  - Modalities PRN

Elbow Osteoarthritis

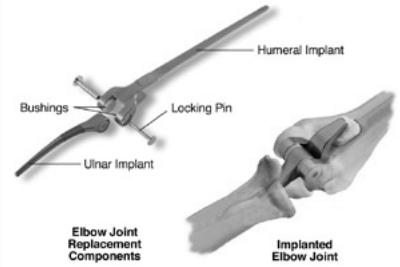
- **Operative Management**
  - Debridement
  - Osteophyte excision
  - Contracture release

  - Total Elbow Arthroplasty is rare for OA
    - Limited longevity

Total Elbow Arthroplasty

Total Elbow Arthroplasty (TEA)

- Indications (Moro JK & King GJ, *Clin Orthop*. 2000)
  - Advanced age
  - Low physical demand
  - Chronic instability
  - Advanced RA
  - Posttraumatic OA
  - Ankylosis of elbow
  - Elbow stiffness
  - Functional ROM loss
  - Pain



Total Elbow Arthroplasty (TEA)

- Complications
  - Loosening
  - Hardware failure
  - Proximal ulna fracture
  - Radial head impingement
  - Instability
  - Ulnar nerve sensory damage
  - Infection
  - Posterior elbow dislocation

Total Elbow Arthroplasty (TEA)

- **Unconstrained**
  - Resurfacing or unlinked
  - Stability from soft tissue integrity & humeroulnar contact
  - Requires good bone stock & strong capsuloligamentous support
  - Rarely used in traumatic cases
- **Semiconstrained**
  - Loose hinged or linked
  - Prosthesis alone provides stability
  - Preferred s/p trauma

Total Elbow Arthroplasty (TEA)

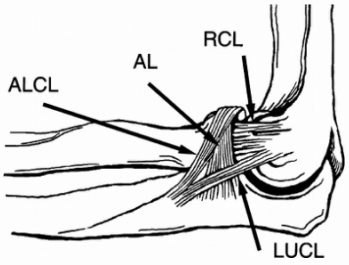
- **Postoperative Management**
  - Moro JK & King GJ. *Clin Orthop*. 2000
  - Mansat P & Morrey BF. *JBJS*. 2000

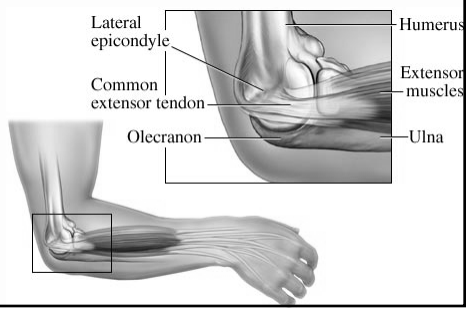
	Acute (0-7 days)	Post Acute (7 days +)
Unconstrained	No extension > 30° ROM with forearm pronated Passive assist with extension Resting splint at 90° elbow flexion & pronation	No extension > 30° until week 4 Forearm pronated position with ROM until week 6
Semiconstrained	Extension splint (X 3 days) Passive assist with extension Active assist flexion	AAROM begins Day splint at 90° elbow flexion until week 6 Extension splint at night until week 12

Varus Instability

Varus Instability

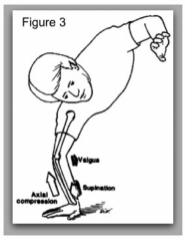
- Varus restraint
  - RCL
  - Common extensor origin
  - Posterolateral capsule





Varus Instability

- Radial (Lateral) Collateral Ligament Insufficiency
  - **Elbow dislocation**
  - **Varus elbow stress**
    - UE weight bearing (crutch use)
      - O'Driscoll SW. *Clin Orthop*. 2000
  - **Iatrogenic causes**
    - Over-aggressive lateral tendinopathy surgery
      - Savoi FH et al. *Hand Clin*. 2009
    - ? Corticosteroid injection
      - Kalainov DM & Cohen MS. *JBJS*. 2005



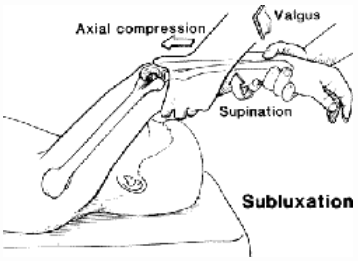
Varus Instability

- Patient Presentation
  - Vague elbow discomfort
  - Lateral elbow pain
  - Mechanical symptoms with supination
    - Clicking, snapping, clunking

Varus Instability

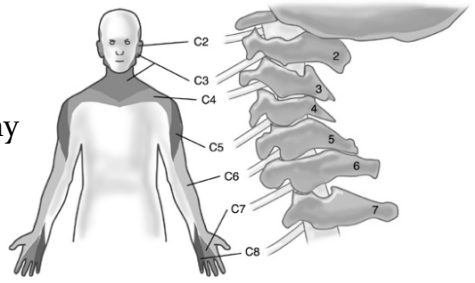
- Physical Exam
  - RCL Insufficiency
    - Varus Stress
      - 0°
      - Between 5° - 30°
        - olecranon out of fossa

  - PLRI
    - PLRI test of elbow/Pivot Shift of elbow
      - "Clunk"



Varus Instability

- Differential Diagnosis
  - PLRI vs. RCL insufficiency
  - Lateral epicondylalgia
  - Wrist extensor tendinopathy
  - Radial Tunnel Syndrome
  - Cervical Spine referral

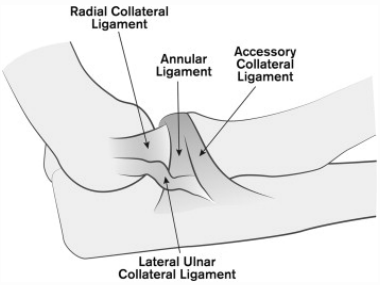


Varus Instability

- Nonoperative Management
  - Protect healing structures
    - Hinged brace with forearm in pronation (4-6 weeks)
    - Avoid any varus load at elbow
  - Potential benefit of strengthening
    - Wrist extensors

Varus Instability

- Operative Management
  - Radial (Lateral) Collateral Ligament Reconstruction
    - Indicated with chronic instability
    - Arthroscopic & open procedures have similar outcomes



Varus Instability

- Radial (Lateral) Collateral Ligament Reconstruction
  - **Acute Phase (weeks 0-4)**
    - Immobilization at 90° flexion with slight pronation & wrist extension for up to 2 weeks
    - Neutral shoulder rotation to limit lateral joint gapping
    - Modalities for pain control/edema
    - Hand/finger AROM
    - Isometrics: triceps, biceps & shoulder musculature in brace
    - Manual scapular exercises

Varus Instability

- Radial (Lateral) Collateral Ligament Reconstruction
  - **Postoperative Phase (weeks 4-6)**
    - Elbow AROM in pronation (in brace) multiple x/day
    - Avoid supination due to varus stress
    - Grade I-II elbow mobilizations
    - Hand/finger AROM
    - Gripping exercises in pronation
    - Isometrics: triceps, biceps & shoulder musculature in brace
    - Manual scapular exercises

Varus Instability

- Radial (Lateral) Collateral Ligament Reconstruction
  - **Intermediate Phase (weeks 6-12)**
    - AROM of elbow
      - Avoid PROM elbow extension & supination
    - Active supination with full flexion only
    - Grade III-IV mobilizations at elbow
    - Shoulder & core exercises
      - Maintain precautions at elbow

Varus Instability

- Radial (Lateral) Collateral Ligament Reconstruction
  - **Advanced Phase(weeks 12-16)**
    - Wean from brace
      - Strengthening in brace should be pain-free
    - Should have normal ROM
    - Progress functional activity
      - Avoid extension, supination & varus
    - Elbow strengthening begins
      - Low reactivity
      - Begin with elbow flexors while in pronation

Varus Instability

- Radial (Lateral) Collateral Ligament Reconstruction
  - **Return to Sport Phase(weeks 16+)**
    - Upper quarter flexibility should be normal
    - Progress strengthening
    - Incorporate balance
    - Incorporate core stabilization

Varus Instability

- Posterolateral Rotary Insufficiency
  - **Postoperative Phase (weeks 0-2)**
    - Immobilization at 45° - 90° flexion with slight pronation
    - Gripping activities
    - Shoulder isometrics
    - Manual scapular exercises

Varus Instability

- Posterolateral Rotary Insufficiency
  - **Intermediate Phase (weeks 2-6)**
    - Progression of brace with extension block
      - Week 2: 60°
      - Week 4: 45°
      - Week 6: 30°
    - Extension performed with pronation
    - Active supination allowed with elbow flexion >90°
    - Avoid PROM of extension & supination

Varus Instability

- Posterolateral Rotary Insufficiency
  - **Advanced Phase (weeks 6-16)**
    - Wean from brace
      - Strengthening in brace should be pain-free
    - Should have normal ROM
    - Progress functional activity
      - Avoid extension, supination & varus
    - Elbow strengthening begins at week 10
      - Low reactivity required

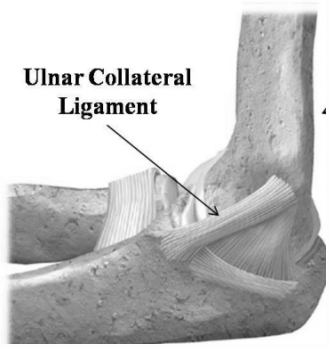
Varus Instability

- Posterolateral Rotary Insufficiency
  - **Return to Sport Phase (weeks 16+)**
    - Normalize flexibility
    - Initiate full strengthening of elbow

Valgus Instability

Valgus Instability

- Ulnar (Medial) Collateral Ligament Insufficiency
  - Acute
    - Fall on outstretched hand
  - Insidious
    - Chronic overuse (throwers)

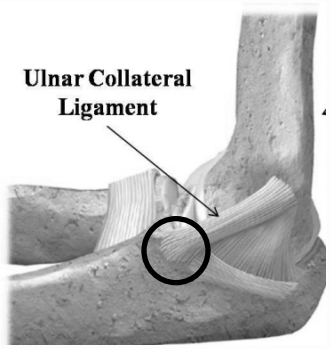


Valgus Instability

- Patient Presentation
  - Overhead Athlete
    - Repetition of throwing
    - High forces associated with
      - Elbow extension
      - Valgus stress
        - ↑ with shoulder ER
      - Pronation of supinated forearm
    - Force during acceleration phase of throwing exceeds failure rate of UCL of cadaver specimens

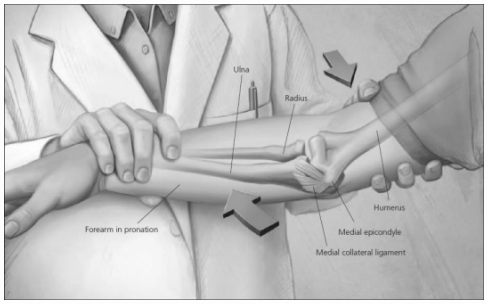
Valgus Instability

- Patient Presentation
  - C/O medial elbow pain
  - Tender at ulnar insertion of UCL
    - 2cm distal to medial epicondyle
  - Traumatic
    - Associated injury
      - Pronator flexor group
      - Radial head fracture
  - Subjective
    - Heard or felt "pop"
    - Info related to throwing



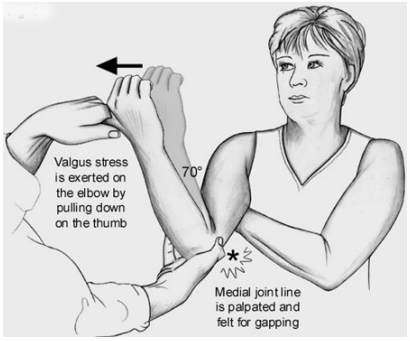
Valgus Instability

- Physical Exam
  - ROM Examination
    - "Instability" when forearm pronated vs. supinated
  - Valgus Stress Test
    - Forearm pronated
      - Full Extension
      - Flexed 5° - 30°
    - (+) Greater laxity



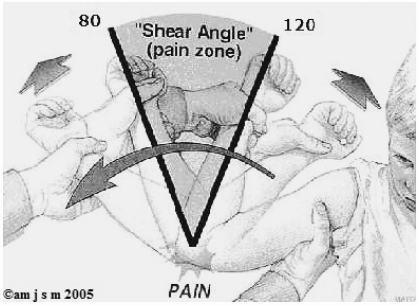
Valgus Instability

- Physical Exam
  - Milking Maneuver
    - Shoulder adducted & ER
    - Elbow flexed to 70°
      - Greatest UCL laxity
    - Valgus force at elbow
    - (+) if medial elbow pain



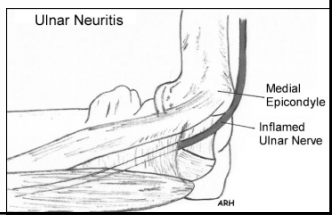
Valgus Instability

- Physical Exam
  - Moving Valgus Stress Test (O'Driscoll SW et al. *AJSM*. 2005)
    - Shoulder abducted to 90°
    - Elbow taken from full flexion & quickly extended to 30° flexion with valgus force
    - (+) Medial elbow pain between 120° & 70°
      - Sensitivity = 100%
      - Specificity = 75%



Valgus Instability

- Differential Diagnosis
  - Medial tendinopathy
  - Valgus extension overload syndrome
    - Postero-medial impingement
    - Ulno-humeral compression
  - Radio-capitellar overload syndrome
  - Elbow OA
  - Ulnar neuritis



Valgus Instability

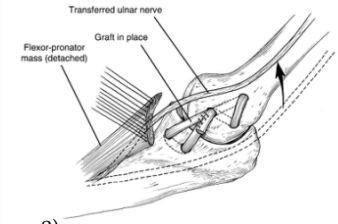
- Little Leaguer's Elbow
  - Apophysitis & fragmentation
    - Children
  - Avulsion of medial epicondyle
    - Adolescent
  - Fleisig GS et al. *Curr Sports Med Rep.* 2009
    - <25 pitches
      - ↑ Risk of elbow injury 21%
    - 75-99 pitches
      - ↑ Risk of elbow injury 35%

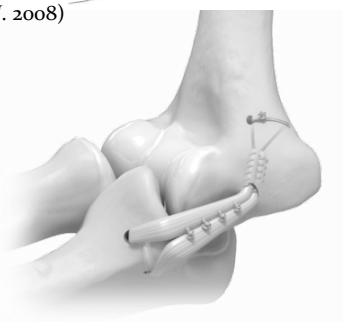
Valgus Instability

- Nonoperative Management
  - Successful in non-throwing athletes
  - Initial phase
    - Immobilization
    - Control inflammation
    - Avoid overhead activity
  - Strengthening phase
    - Flexor-pronator group
    - Kinetic chain approach
      - Core & shoulder strength
      - Address GIRD

Valgus Instability

- Operative Management
  - Primary repair
    - Suture ligament to bone
  - Reconstruction
    - ↑ Success rate (Vitale MA & Ahmad CS. *AJSM*. 2008)
    - Palmaris longus graft
    - "Tommy John" procedure
    - Docking technique
  - Rehabilitation
    - Protection for 2 weeks
    - Strength after 4-6 weeks
    - Interval throwing at 4 months
    - Competition after 9-12 months

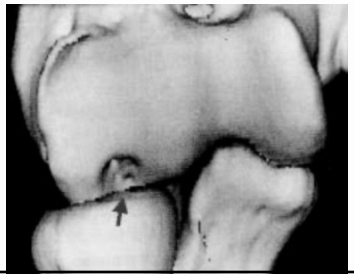




Osteochondritis Dissecans

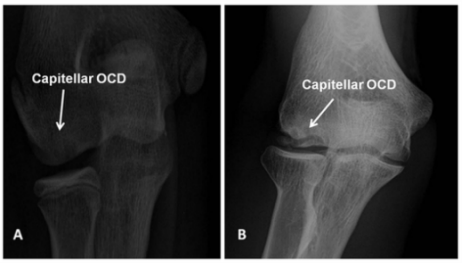
Osteochondritis Dissecans

- Lateral compression in adolescent population
  - Radiocapitellar joint
  - High Risk: overhead activity & weight bearing
    - Male baseball pitchers
    - Female gymnasts



Osteochondritis Dissecans

- **Patient Presentation**
  - 90% active male population
  - Ages 12-17
  - Loss of extension
  - Vague lateral elbow pain
  - Tender to palpation radiocapitellar joint
  - Clicking, popping or locking



Osteochondritis Dissecans

Nonoperative

- Intact cartilage over detached fragment
  - Bracing
  - Avoid throwing & weight bearing activity
  - Address ROM & strength impairments
  - Shoulder & scapular strength
  - ADLs by 3 months
  - Full activity in 6 months

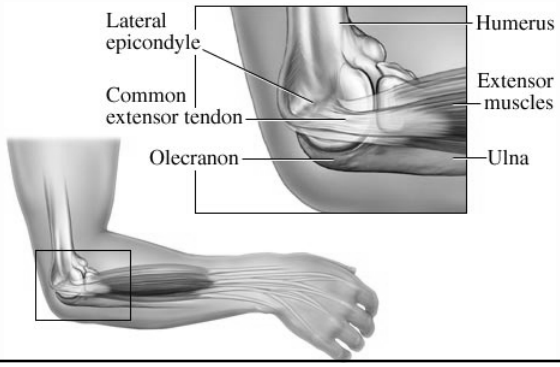
Operative

- Indications
  - Worsening of symptoms
  - Fracture of articular cartilage
  - Symptomatic loose bodies
  - Displaced radiocapitellar lesion

Elbow Tendon Disorders

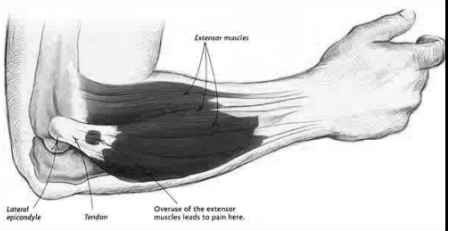
Lateral Tendinosis

- AKA "Tennis Elbow", "Epicondylitis", "Epicondylalgia"
- Lacking inflammation response



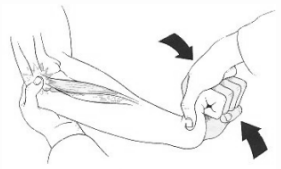
Lateral Tendinosis

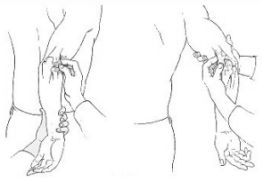
- **Patient Presentation**
  - Lateral elbow pain 1cm distal to epicondyle
  - Difficulty with
    - Gripping
    - Passive wrist flexion
    - Active wrist/finger extension
  - Demographics
    - Females 35-50 yo
    - Physical work



Lateral Tendinosis

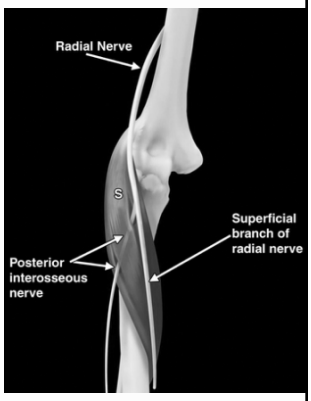
- **Physical Exam**
  - Cozen test
    - Resist wrist extension & radial deviation
  - Mill test
    - Wrist & finger flexion
    - Elbow & shoulder extension
  - Maudsley test
    - 3rd finger resistance (EDC)
  - Grip strength
    - Deficit compared to uninvolved





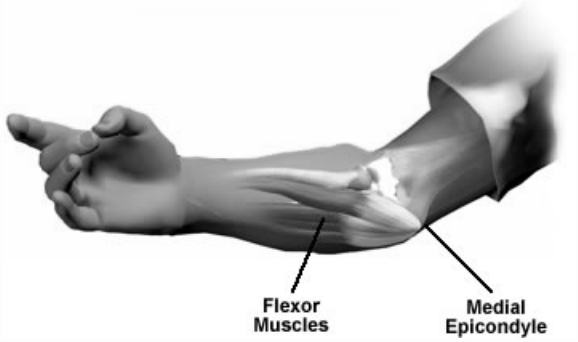
Lateral Tendinosis

- **Differential Diagnosis** (Faro F & Wolf JM. *J Hand Surg Am*. 2007)
  - Tendinitis vs. Tendinosis
  - C6-7 nerve root
  - Radial Tunnel Syndrome
  - Posterolateral Rotary Insufficiency (PLRI)
  - Posterior Interosseous Nerve compression
  - Intra-articular pathology



Medial Tendinosis

- AKA "Golfer's Elbow", "Epicondylitis", "Epicondylalgia"
- Lacking inflammation response



Medial Tendinosis

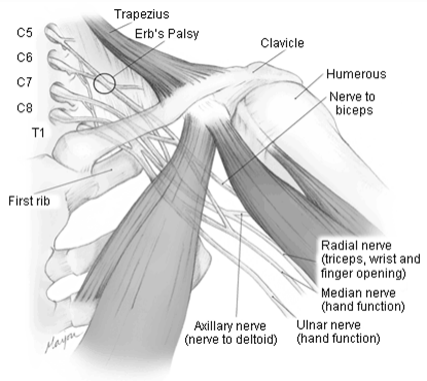
- **Patient Presentation**
  - Medial elbow pain
  - Not gender specific
  - 75% report pain in dominant arm
  - Mechanisms
    - Flexor-pronator fatigue
    - UCL fails to stabilize valgus forces

Medial Tendinosis

- **Physical Exam**
  - Palpation of medial epicondyle
    - Pain within 5cm of medial epicondyle
  - Grip strength
    - Deficit compared to uninvolved
    - (+) Pain
    - Caution in presence of ulnar neuritis
  - Passive position testing
    - Wrist & finger extension
    - Supination

Medial Tendinosis

- **Differential Diagnosis**
  - C7, C8, T1 nerve compression
  - Thoracic Outlet Syndrome
  - Ulnar nerve injury
  - Medial elbow instability

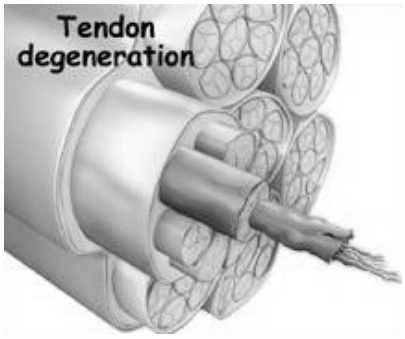


Nonoperative Management of Tendinosis

- **General Guidelines**
  - Evidence is limited and often conflicting
  - Relative rest
  - Avoid aggravating activities

Evaluation and Management of Elbow Tendinopathy

Samuel A. Taylor, MD,*† and Jo A. Hannafin, MD, PhD†



Nonoperative Management of Tendinosis

- **Bracing**
  - Bisset LM et al. *Br J Sports Med*. 2005
    - Systematic Review with Meta-Analysis
    - 2/9 studies met inclusion criteria
    - Effective for short-term relief of pain-free grip

  - Bisset LM et al. *J Orthop Sports Phys Ther*. 2014
    - Pain improved with bracing
    - No difference between braces
    - Patient preference, comfort & cost

Nonoperative Management of Tendinosis

- **Shock Wave Therapy**
  - Buchbinder R et al. *Cochrane Database Syst Rev*. 2005
    - Cochrane Review
    - 9 placebo controlled trials met criteria
    - Little or no benefit in terms of pain or function

Nonoperative Management of Tendinosis

- **Manual Therapy**
  - Herd CR & Meserve BB. *J Man Manip Ther*. 2008
    - Systematic Review
    - Mulligan MWM at elbow
    - Cervical Spine manual therapy

Nonoperative Management of Tendinosis

- **Exercise**
  - Woodley BL et al. *Br J Sports Med*. 2007
    - Systematic Review
    - Limited evidence suggests eccentric exercise has (+) effect on pain and function when compared to other interventions

  - Ellenbecker TS et al. *Sports Health*. 2013
    - Eccentric exercise coupled with a complete UE strengthening program

Nonoperative Management of Tendinosis

Eccentric Strengthening for Chronic Lateral Epicondylosis: A Prospective Randomized Study

Dennis Y. Wen, MD,*† Brian J. Schultz, MD,‡ Bob Schaal, PT,§‖ Scott T. Graham, PT,‖ and Byung Sung Kim, MD, PhD*

- **Exercise**
  - Wen DY. Et al. *Sports Health*. 2011
    - Prospective randomized controlled trial
    - 28 adults with lateral epicondylosis > 4 weeks randomized
      - Wrist extensor eccentric strengthening
      - Stretching group
    - Visual Analog Scale (0-100) @ baseline, 4, 8, 12, 16, 20 weeks
    - Results
      - Both groups improved baseline to 4 weeks
      - No significant difference between groups

Nonoperative Management of Tendinosis

- **Corticosteroid Injections**
  - Barr S et al. *Physiotherapy*. 2009
    - Systematic Review
    - 4/5 RCT reviewed used pain-free grip strength as outcome
    - Injection offered short term benefit over physical therapy
    - Physical Therapy interventions were more favorable for intermediate & long-term outcomes
- **Modalities**
  - Bisset L et al. *Br J Sports Med*. 2005
    - Systematic Review with Meta-Analysis
    - Ultrasound, iontophoresis, phonophoresis
    - Some evidence during first 3 months
    - Lack of evidence compared to placebo beyond 3 months

Nonoperative Management of Tendinosis

- **Soft Tissue Mobilization**
  - Bisset L et al. *Br J Sports Med*. 2005
    - Systematic Review with Meta-Analysis
    - Deep Friction used in combination of PT interventions
    - "Marginal evidence" for combined approach
- **Low Level Laser**
  - Tumilty S et al. *Photomed Laser Surg*. 2010
    - Systematic Review with Meta-Analysis
    - 25 controlled trials met criteria (included all tendinopathy)
    - 12studies demonstrated (+) effects
    - 13 studies were inconclusive or shoed no effect

Operative Management of Tendinosis

- **Surgical Criteria**
  - Failure of conservative management >1 year
  - Constant pain
  - Intra-articular pathology
- **Surgical procedures** (lateral most common)
  - Release of common extensor origin
  - Debridement &/or repair of extensors
  - Decortication or drilling of lateral epicondyle
- **Surgical Outcomes**
  - Lateral success 88% - 97%
    - Nirschl RP. *Clin Sports Med*. 1992
    - Kraushaar BS & Nirschl RP. *J Bone Joint Surg Am*. 1999
  - Medial Success: 87%
    - Gabel GT & Morrey BF. *J Bone Joint Surg AM*. 1995

Operative Management of Tendinosis

- **Post-Op Rehabilitation**
  - Significant variability depending on procedure & surgeon preference
  - General Guidelines
    - Protect tissues initially
    - Begin mobility/strength after adequate healing
    - Limit heavy and/or repetitive activity
    - Criteria for return to sports
      - Full ROM
      - Full strength
      - No pain

Distal Biceps Tendon Rupture

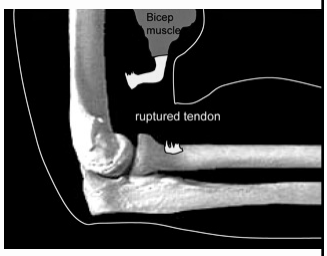
- **Patient Presentation**
  - Greater incidence in males 4th – 6th decade of life
    - Safran MR & Graham SM. *Clin Orthop*. 2002
  - Weightlifters & bodybuilders
    - Kokkalis ZT & Sotereanos DG. *Hand Clin*. 2009
  - Mechanism: Rapid eccentric contraction while in supination
    - Aldridge JW et al. *Hand Clin*. 2000
  - ↑ Risk with anabolic steroids & smoking
    - Mazzocca AD et al. *Orthop Clin North Am*. 2008

Distal Biceps Tendon Rupture

- **Physical Exam**
  - History: "pop" & acute onset of weakness
  - Tender over biceps tendon & tuberosity
  - (+) Ecchymosis in antecubital fossa
  - Deformity of biceps insertion
  - Weakness/pain with elbow flexion & supination

Distal Biceps Tendon Rupture

- **Nonoperative Management**
  - 30% loss of elbow flexion strength
  - 40% loss of supination strength
- **Operative Management**
  - Reattachment to radial tuberosity
  - < 10 days ideal
  - Delay: semitendinosus or palmaris longus graft



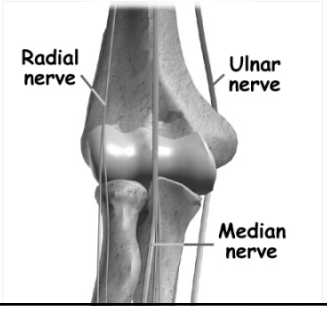
Distal Biceps Tendon Rupture

- **Postoperative Rehabilitation**
  - Hinge brace at prevents extension beyond 60° flexion
  - Full ROM by 4 weeks post-op
  - Strengthening begins post-op week 6-8
    - ROM is initial priority
  - Unrestricted activity between weeks 8-16

Nerve Disorders & Syndromes

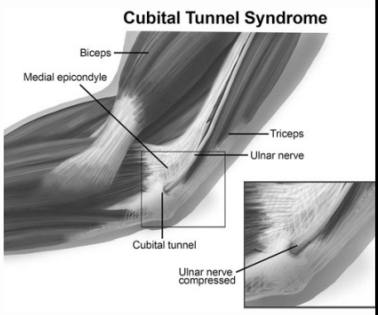
Nerve Injury

- **Risk Factors**
  - Superficial location of nerve
  - Pathway through narrow bony canal
  - Nerve location high risk area for trauma
- **Injury Mechanisms**
  - Direct or indirect trauma
  - Traction
  - Friction
  - Compression



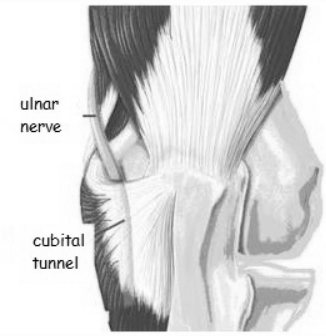
Cubital Tunnel Syndrome

- **Ulnar nerve**
  - Walls
    - Medial epicondyle & olecranon
  - Roof
    - Aponeurosis
  - Floor
    - UCL, Joint capsule, & Olecranon
- **Mechanism of Injury**
  - Traction (valgus force in throwers)
  - Postures of valgus deformity or flexion contracture
- **Differential Diagnosis**
  - Cervical Radiculopathy
  - Thoracic Outlet Syndrome



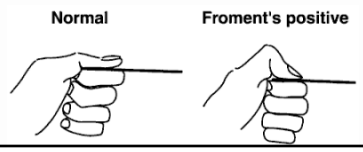
Cubital Tunnel Syndrome

- **Patient Presentation**
  - Paresthesias
  - "Clumsiness" of hand or "loss of coordination" of fingers
  - C/O painless "snapping" or "popping" during A/P flexion/extension



Cubital Tunnel Syndrome

- **Physical Exam**
  - Neurologic exam
  - Tinel @ cubital tunnel
    - (+) numbness/tingling into 4th & 5th digits
    - Sensitivity = 54%-70%, Specificity = 98%
  - Froment sign
    - Patient holds piece of paper between tip of thumb & tip of forefinger
    - (+) inability to maintain due to weakness of adductor pollicis, ulnar portion of flexor pollicis brevis & 1st dorsal interosseous



Cubital Tunnel Syndrome

- **Physical Exam**
  - Elbow flexion test
    - Shoulder ER, max elbow flexion & wrist extension
    - (+) numbness/tingling in ulnar distribution
    - Sensitivity = 75%, Specificity = 99%
  - Pressure provocative test
    - Shoulder ER, max elbow flexion & wrist extension
    - 30" of pressure to ulnar nerve at cubital tunnel
    - (+) numbness/tingling in ulnar distribution
    - Sensitivity = 46%-91%, Specificity = 99%

Cubital Tunnel Syndrome

- **Nonoperative Management**
  - Keys to success
    - Prevent excessive flexion postures
    - Prevent external pressure on nerve
  - Interventions
    - Night splint in 30° – 45° of flexion & full supination
      - Typical duration = 4-6 weeks
    - Patient education
      - Avoid elbow flexion >90°
      - Avoid valgus stress
      - Avoid excessive wrist/finger flexion
    - PROM multiple times per day

Cubital Tunnel Syndrome

- **Operative Management**
  - Indications
    - Failure of conservative management
    - Evidence of muscle atrophy
    - (+) nerve conduction findings
  - Techniques
    - Decompression
    - Submuscular transposition
  - Rehabilitation
    - Immediate motion & protect flexor-pronator group
    - Avoid wrist extension & forearm supination
    - Gripping activity in wrist flexion & pronation
    - Functional activity at week 12

Thank You