Elbow Disorders
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Agenda
• Anatomy & Biomechanics
• Elbow pathology
• Examination techniques
• Elbow Pathology
  I. Ligamentous Injury
    a. Lateral Collateral Ligament Complex
    b. Medial Collateral Ligament Complex
  II. Dislocations
  III. Fractures
    a. Elbow trauma
    b. Total elbow replacement
  IV. Tendinous

Elbow Anatomy

- 3 bones:
  • Distal humerus
  • Proximal ulna
  • Radial head

- 3 joints:
  - Radiohumeral
  - Ulnohumeral
  - Proximal radial ulnar

Palpate Radial Head & Olecranon

Motions of the Elbow

- Flexion/Extension
- Supination/Pronation

Elbow Angles

- Lateral and medial angles
  - Valgus/Varus

Women valgus varies from 13 to 16 degrees
Men valgus varies from 11 to 14 degrees

Elbow function

- The elbow has 2 degrees of freedom
- Extension / flexion – functional motion is defined as -30/130"
  - Flexion trumps extension in functional value
- Supination / pronation - functional motion defined at 50/50°
### Joint Congruency

- **Humeroulnar**
  - Closed Pack = End Range
  - Extension/Supination
  - Open = 70° flex/10° sup

- **Humeroradial**
  - Closed Pack = 90° flex/5° sup
  - Open = ext/sup

- **Proximal Radioulnar Joint**
  - Closed = 5° sup/ext
  - Open = 70° flex/35° sup

### ELBOW STABILIZERS

- **STATIC**
  - Boney Congruency
  - Medial Collateral Ligament
  - Ulnar Lateral Collateral Ligament Complex
  - Annular Ligament
  - Capsule

### Elbow anatomy

3 ligamentous complexes:

- **Medial** collateral ligament (largest)
  - Most important ligamentous contributor to elbow stability against a valgus stress

- **Lateral** collateral ligament –
  - If damaged can lead to Posterolateral Rotatory Instability (PLRI)

- **Annular** ligament - binds radial head to ulna
  - Allows radial head to spin during rotation

### Medial collateral ligament stabilizes against valgus stress

- **AB**=Anterior bundle
- **PB**=Posterior bundle
- **TB**=Transverse bundle
- **MCL** is most important ligamentous stabilizer

### Valgus Constraints

- MCL provides 1/3 valgus stability in extension; ½ stability in 90° flexion
- Anterior bundle is the primary valgus stabilizer
- Posterior bundle is the primary stabilizer for posteromedial rotatory forces
- Radial head secondary when MCL not present
- Flexor carpi ulnaris, flexor carpi radialis, flexor digitorum superficialis and pronator teres resist valgus

### Elbow Videos

- **Valgus stress test AVI**

### Stabilize humerus in ER

- **Palpate MCL**

- Valgus stress with the elbow positioned at 30 to 60 degrees flexion to extension testing anterior MCL
- Valgus at mid range to 140 degrees flexion testing posterior MCL.

*Photo retrieved on 2/20/15 from: http://www.radiologyassistant.nl/data/bin/w440/a5210f8073ab45_20-hinge.jpg*

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*Humeroradial closed pack = 90° flex/5° sup, open = ext/sup.*

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- Humeroulnar closed pack = end range extension/supination, open = 70° flex/10° sup.
- Humeroradial closed pack = 90° flex/5° sup, open = ext/sup.
- Proximal radioulnar joint closed = 5° sup/ext, open = 70° flex/35° sup.*

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Lateral Collateral Ligaments

- Annular ligament
- Radial collateral ligament
- Lateral ulnar collateral ligament (LUCL)
  - Provides stability to posterolateral rotation

*Majority of varus stability is provided by the osseous stability of the ulnohumeral anatomy*

- Accessory lateral collateral ligament

Varus stress test

- Axial compression to the elbow with medial force applied distal to elbow.
- Positive: Pain and/or increased joint play compared to uninvolved side.

Other Stabilizers: Elbow Capsule

- Small contributor as a passive soft tissue stabilizer (questionable)
- Ant. Capsule secondary stabilizer to a varus stress
- Most lax at 80 degrees of flexion
- Position of comfort after injury
- Risk of flexion contracture

Interosseous Membrane (IOM)

- Fibers run medially and distally from radius.
- IOM transfers part of the load at the distal radius to the proximal ulna.

Dynamic Stabilizers

Joint compression forces: biceps, brachialis and triceps.

FCU, FCR & FDS produce a varus moment that could contribute to valgus stability in MCL deficient elbow.

EDC, ECRB/L, ECU & anconeus can contribute to varus stability by producing a valgus moment

In Conclusion: Elbow stability

- Most dependent on bony structures: coronoid and radial head
- Collateral ligaments
- Studies have shown that coronoid fx with radial head fx can lead to chronic elbow instability, even if collateral ligaments were repaired
Valgus Constraints

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Varus Constraints

- Ulnohumeral anatomy (coronoid process)
- Lateral collateral ligament complex resists 10%
- Extensor carpi ulnaris, digitorum communis, extensor carpi radialis longus & brevis, anconeus
- Posterior Lateral Rotatory Forces
- Lateral collateral ligament is the primary stabilizer
- Varus Posterior Medial Constraints
- Lateral collateral ligament
- Anteromedial facet of the coronoid

Elbow pathologies - Exam

- History
- Visually inspect the front, side and back of both elbows to compare symmetry
- Look for edema, ecchymosis, bony misalignment
- Normal carrying angle is slight valgus
- Ask patient to extend/flex and sup/pro bilaterally
- Feel for warmth, a sign of infection
- Palpate for tenderness

Elbow pathology - ligamentous

- Described as simple or complex
  - Simple = no associated fracture
  - Complex = concurrent fracture

ELBOW PATHOLOGIES

- Exam
- Elbow Pathology
  I. Ligamentous Injury
    a. Lateral Collateral Ligament Complex
    b. Medial Collateral Ligament Complex
  II. Dislocations
  III. Fractures
  IV. Tendinous

I. Elbow Pathology Ligamentous Lateral Collateral Ligament Complex (LCL)

- Ligamentous
  - Lateral collateral ligament complex sprain or tear is also associated with trauma and often occurs with a fracture
  - Mechanism of injury
    - Fall on outstretched hand (FOOSH)
    - Forced twisting of the arm with varus (lateral) forces

www.medical-dictionary.thefreedictionary.com
I. Elbow Pathology Ligamentous Lateral Collateral Ligament Complex (LCL)

Clinical Presentation
– Spectrum of complaints: pain, locking, clicking, snapping.
– Symptoms increase with activities of supination and elbow extension

Elbow pathology – ligamentous (LCL)
• Movement without stability is usually painful
• Elbow typically becomes more unstable as it moves into extension because the elbow in 20° to 30° of extension unlocks the olecranon from the humerus and open-pack.
  - ROM and strengthening in pronation and overhead b/c the elbow is more stable from varus forces in pronation.
  - Avoid shoulder internal rotation with flexion and abduction

Elbow pathology – ligamentous (LCL)
• Not all tears are repaired; sometimes they are left to heal on their own
• This can lead to chronic instability
• Ligament repair can occur if surgery is performed within 2-3 weeks of injury
• Ligament reconstruction is chosen if injury is more than 3 weeks old
• Palmaris longus is usually used for reconstruction
  - If not repaired or trauma...

Posterior Lateral Rotatory Instability (PLRI) pattern of instability

Posterolateral Rotatory Instability (PLRI)
Can result from a FOOSH with forearm supinated

Lateral collateral ligament complex stabilizes against a posterolateral rotatory instability

Leads to ulna (moving with radius due to annular ligament) externally rotating away from trochlea

(Picture sourced from Radiosource: http://www.radiosource.us/dxre/0001)
Special Tests: Lateral Elbow Posterolateral Rotary Instability

Push-up and Stand-up tests
Sensitivity: 87.5%
Specificity: 100%  (Regan et al. 2006)

Posteromedial Rotatory Instability (PLRI)
Can result from a FOOSH with forearm pronated

Lateral collateral ligament complex stabilizes against a posterolateral rotatory instability

Leads to ulna (moving with radius due to annular ligament) externally rotating away from trochlea

(Picture resource: http://www.radsource.us/clinic/0901)

Table-top Relocation Tests (PLRI)

Elbow pathology – ligamentous (LCL)

• Differential: Posterolateral Plica Syndrome
• TTP posterior to lateral epicondyle at radiocapitellar joint
• Painful snap with elbow extension and supination
• Elbow not grossly unstable
• Caused by repetitive microtrauma which causes thickening/fibrosis of plica
• Usually treated with arthroscopic debridement

(Ruch 2006)

Surgical Procedures Vary

• Reconstruction with tendon grafts (palmaris longus)
• Reconstruction with fascia graft (triceps)

Sanchez, Morrey, O’Driscoll

Rehab PLRI (LCL complex)

Elbow pathology - ligamentous

• General Post-op LCL Reconstruction Guidelines
  – Splint 90° flexion, pronated
  – AROM extension/flexion; extension limited to 60° initially and gradually increased
  – Forearm rotation from pronation to neutral only for 6 weeks (no supination)
  – Immobilization period varies from 2 to 12 wks;
  – Gradually resume supination
  – Return to sport at 6 to 9 mo post-op
Rehab PLRI (LCL complex)

- Flexion and pronation increase the contact between the radial head and capitellum.
- Studies have shown that the LCL deficient elbow is more stable in pronation.
- Shoulder AB and IR increase varus stress to the elbow—so avoid this position with exercises.
- Unstable elbows should not exceed 30° extension.

Key Points for Rehabilitation of Lateral Ligament Complex

- Any injury to the LCL complex and secondary supporting structures can cause PRLI.
- Early rehabilitation immobilization period varies (2 to 12 wks); early aarom in stable arc and supine.
- Orthosis and early elbow ROM exercises need to be in pronated position to avoid varus stress.
- Supination forces are avoided during healing.
- Limit elbow extension to 30°.
- Avoid shoulder abduction and weight-bearing during healing.
- Dynamic stabilization to lateral elbow are provided by extensor wrist muscle group.

I. Elbow Pathology Ligamentous Medial Collateral Ligament (MCL)

- Ligamentous
  - Medial collateral ligament injury is usually not associated with trauma but with overuse.
  - Most often occurring in athletes who participate in overhead sports such as throwing, tennis and volleyball.
  - Also known as “Baseball Elbow” or “Little League Elbow”

Elbow pathology - MCL

Medial collateral ligament injury

- May have spontaneous failure characterized by a "pop".
- Onset may be vague, characterized by failure to perform at less than normal ability:
  - Decreased accuracy
  - Decreased velocity
  - Decreased endurance

Elbow pathology - MCL

MCL Injury

- If no specific “pop” or rupture is noted, conservative management consisting of strengthening the muscles surrounding the joint, is pursued.
- If surgery is required, ligament repair may be possible in nonprofessional athletes.
- Most professional athletes require ligament reconstruction, aka “Tommy John Procedure”.

Elbow pathology - MCL

Palpate MCL

- Valgus stress with the elbow positioned at 30 to 60 degrees flexion to extension testing anterior MCL.
- Valgus at mid range to 140 degrees flexion testing posterior MCL.

Stabilize humerus in ER

- Do not hallucinate.
Moving Valgus Stress Test

- ER humerus
- Examiner places a constant valgus stress on the elbow as it is moved rapidly through the arc of flexion and extension

- Sensitivity 100%
- Specificity 75%

Special Tests: Medial Elbow
Medial Collateral Ligament Instability

- Valgus Stress Test:
  - Sensitivity: 66%
  - Specificity: 60%

- Moving Valgus:
  - Sensitivity: 100%
  - Specificity: 75%

Elbow pathology - ligamentous

Conservative Management MCL Injury
- Protect – no overhead activity
- AROM - sagittal plane
- Strengthening - core, shoulder, elbow, and wrist
- Thrower’s Ten Program for shoulder, elbow, forearm, and wrist
- Evaluation of throwing technique
- Advanced Thrower’s Ten Program

Elbow pathology - ligamentous

- Post-operative management of MCL injury
  - Splint in neutral rotation, 90° flexion
  - Active elbow extension and flexion, with full extension limited initially
  - AROM digits and wrist, ok to grip
  - Isometric strengthening of shoulder. **No external rotation of shoulder as it creates valgus stress at elbow**
  - Splint D/C’d at 6 weeks
  - Progress through full ROM and into Thrower’s Ten

MCL Strengthening Considerations

**Dynamic Stabilizers Against Valgus**
- Strengthen flexor carpi ulnaris, and flexor digitorum superficialis to increase stability
- Radial head contributes to stability
- Start exercises in supination and progress to pronated position.

Intermediate Phase
Sub-Maximal Isometrics
Medial Collateral Ligament Rehab.

- Strengthen with forearm in supination. FCU & FDS and isometric pronation
Key Points for MCL Rehabilitation

- Immobilization orthosis in neutral or supination
- Protected elbow motion exercises limiting end range extension
- Avoid shoulder activities requiring external rotation to limit valgus stress
- Initially exercise with forearm in supination
- FCU and FDS are dynamic stabilizers
- Avoid 30° extension in the unstable elbow

Dislocation Classification

- **Simple**
  - Small osseous fractures not affecting joint stability
  - Described as posterior, anterior, medial, lateral
- **Complex**
  - Described as posterior, anterior, medial, lateral, or divergent affect joint stability

- **Acute** (less than 2 weeks)
- **Subacute** (2 to 4 weeks)
- **Chronic** (6 weeks or more)

II. Elbow Dislocations

Conservative Management

*Overhead Motion Protocol*

1-3 wks
Supine AAROM supination/pronation and flexion/extension to patient’s tolerance

3-4 wks
Sitting or standing AAROM in stable arc of motion (avoiding shoulder abd/IR)

6 wks
ROM without limitations, strength/endurance and resume functional activities
Passive motion and orthosis for motion

II. ELBOW DISLOCATIONS

Dislocations
Evidence for Early Motion in Simple Posterior Dislocations

- Loss of extension is the most frequent complication.

- Ross et al protocol: Immediate active motion combined with modalities to reduce pain and swelling and UE strengthening. Results of nearly full ROM within safe ROM ext.

**General Consideration for Therapy Post Dislocation**

- Early motion within safe arc (check with MD)
- Is there a ligament involved that requires protection?
- Elbow orthosis to limit end range motions with forearm in neutral if unaware of ligament involvement
- Orthosis or hinge brace discharged from 4 to 6 weeks

**III. Elbow Pathology – Fractures/Trauma**

- Fractures - Most often associated with trauma
  - Probable edema, acute pain, tender to palpation, x-ray confirms diagnosis

  **Lateral Column**
  - Radial Head
  - Capitellum

  **Medially**
  - Olecranon
  - Coronoid

**Elbow pathology – Fractures Conservative Management**

- Post-reduction considerations
  - Elbow may be stable in a limited range of motion
  - Elbows get stiff quickly when not moving through full range of motion
  - Dynamic stability is provided through compressive forces of muscles crossing elbow allows early AROM

- Sheps et al 2004

  Picture retrieved on 2/23/11 from: http://orthoinfo.aaos.org/figures/A00029F01a.jpg

**Simple Posterior Dislocation Orthosis Considerations**

- Posterior elbow splint or hinged brace, wrist neutral
  - Forearm neutral if MCL and LCL involved
  - Forearm pronated when protecting LCL
  - Forearm supinated when protecting MCL

- Shapo el al 2004


**Radial Head Fractures Most Common Elbow Fx**

Fall on axial loaded elbow & pronated forearm.
Radial Head Modified Mason Classification

- **Type I**: Non-displaced or minimally displaced with < 2mm intra-articular displacement.
- **Type II**: Displaced > 2mm and/or angulated.
- **Type III**: Comminuted fractures.
- **Type IV**: Radial head fracture with associated elbow dislocation.

Early Mobilization for Minimally Displaced Radial Head Fractures (Liow et al 2002)

- Immediate Active Mobilization vs 5 day delay with Mobilization
- Results after one week:
  - Decreased pain in early motion group
  - Increased AROM in early motion group (flexion and supination)
  - Increased function (Morey Score)
    - Similar at 4 weeks
    - Conclusion: Early motion did not adversely affect outcomes

Comparing Mobilization Protocols in Type 1 Fractures (Paschos et al 2013; Level I/RCT)

Group 1: immediate mobilization
Group 2: sling for 2 days followed by active ROM
Group 3: cast immobilization for 7 days followed by ROM

Results: ROM, strength and functional outcomes was best in group 2.

Long-term Results for Non-Displaced Radial Head Fractures with Conservative Management

Functional Limitations at 46 month f/u

- Immobilization between 1 day to 2 weeks in a pressure bandage or upper arm cast. Mobilization exercises initiated as pain decreased
  - No difference with casting types
  - Shorter immobilization period resulting in improved DASH scores, but not significant
    - 42% 0 DASH score
    - 38% 0.1 – 10.1 DASH score
    - 20% over 10 DASH scores

Key Points: Elbow Fractures

General Guidelines for Conservative Management

- Stiffness is a major concern after elbow fractures. Early motion is important.
- A/AAROM until healed, usually 6 weeks
  - Nondisplaced fractures start motion best to start early ROM after one week immobilization
  - Elbow should be positioned towards extension
  - Consider ligament involvement during AAROM
  - Surgical reduction: initiation of ROM depends on stability of the fixation
  - Progress to PROM and static progressive splinting if needed once fracture is healed

Flexion, extension or sling? Mason Type I and II

Interventions (n=81)
- Group 1: Immobilization in extension
- Group 2: Immobilization in flexion
- Group 3: Sling immobilization

Results: 17 loss of extension; 1 limited flexion (extension WNL); flexion casting resulting in significant ROM deficits

Outcomes: Improve with immobilization towards extension. Extension ROM loses are most common.
ELBOW TRAUMA

Therapy Goals

- Gradually incorporate the involved upper limb into functional activities by:
  - Protect surgical repair
  - Restoring functional arc of motion
  - Restoring functional muscle power

- Considerations
  - Edema and pain control
  - Prevent elbow contracture

- Challenge
  - Balance mobility & stability

Terrible Triad

- Posterolateral dislocation
- Radial head fx
- Coronoid fx

  Occurs with fall onto outstretched arm
  Requires surgery to reduce and stabilize, followed by early AROM

Radial Head Fractures in Elbow Trauma

- Terrible Triad
  - Posterior or posterolateral dislocation of ulnohumeral joint with fractures of the radial head and coronoid process. Avulsion of medial collateral ligament (MCL) and lateral collateral ligament (LCL)
  - Coronoid process provides stability
    - Buttress against posterior displacement of the ulna and contributes to varus stability (Budoff, 2012)
- Essex Lopresti: radial head fracture, rupture of the interosseous membrane (IOM) resulting in forearm instability and proximal migration of the radius

APPENDIX: Guidelines for rehabilitation progressions

STABILITY
- Know the safe arc of motion
- Closed pack positions
- Humeroulnar: ext/sup, Humeroradial: 90° flex/5°sup

MOBILITY
- Maximize ROM, scar management, prevent contracture
- Exercise positioning and working dynamic stabilizers

FUNCTION
- Maintain ROM and strength to uninvolved structures

WARNING
- Monitor ulnar nerve involvement
- Recognize symptoms of heterotrophic ossification
- Implement mobility orthosis when appropriate/avoid contracture
**Customizing Therapy to Patient**

**What are the signs of heterotopic ossification?**
- **Risk Factors:** >1 reduction (Shukla et al 2015), head injuries (Garland & O'Hollaren, 1982), burns, operative care > 48 hours after injury (McLauglin 1955), floating fractures (Bauer et al 2012)
- **Signs & Symptoms:**
  - Decreased ROM
  - Increased pain
  - Localized edema
  - Increase in temperature (Hinck, 1994)

**Customizing Therapy to Patient**

**What are the symptoms of ulnar nerve involvement?**
- **Clinical Presentation**
  - Paraesthesia at ring and small fingers
  - Elbow pain
  - Weakness in grip
- **Clinical Management**
  - Nerve gliding, elbow orthosis nocturnally, protect cubital tunnel

**Elbow Static Progressive vs. Dynamic Orthosis**


**Key Points Rehabilitation for Elbow Trauma**
- Early motion within a safe arc
- Forearm position to stabilize elbow when ligament involvement
- Maintain ROM of uninvolved structures
- Know signs of complication (HO, ulnar nerve, etc)
- Dynamic and static progressive orthosis are effective to gain ROM
**Total Elbow Replacement**
Epidemiology & Pathogenesis

- Rheumatoid arthritis (RA)
  - 50% of RA patients have elbow involvement
  - Pain with elbow motion, pain laterally, limitations with forearm motion in late stages
  - Can have synovitis, annular ligament rupture, collateral ligament rupture, ulnar nerve neuropathy and/or cartilage and bone destruction
- Osteoarthritis
  - History of heavy arm use
  - End range pain at early stages progressing to pain through entire arc of motion
- Post-traumatic arthritis
  - Related to traumatic insult of elbow

**Rehabilitation after total elbow arthroplasty (TEA)**

**Week 1-6**
- Maintain shoulder and wrist ROM
- Posterior elbow orthosis to wear between exercises
- Passive elbow extension and active elbow flexion
- Respect the integrity of the triceps
- Instructions with activities of daily living (ADLs)
- Avoid lifting > 1 lb

**Proliferation Phase of Rehabilitation after TEA**

**Week 6-8**
- Lifting restrictions 5 lbs, no strengthening exercises
- Submaximal isometrics for function avoiding end range isometrics
- Proprioception training

**Customize Therapy to Patient**

**Linked/Semi-constrained Design**
- Laxity in valgus and varus stresses
- ROM initiated depending on the wound and quality of the triceps
- May need ext orthosis nocturnally

**Unlinked design**
- Requires intact ligaments and capsule
- Immobilization to protect ligaments

**Rehabilitation after total elbow arthroplasty (TEA)**

**Week 1-6**
- Encourage functional ROM (elbow -30/130, sup/pro 60/60)
- Exercises performed with humerus adducted to side
- Wean from posterior elbow orthosis at 2 weeks
- Patient education to avoid active contraction of triceps for 3 months (sparing, reflecting or splitting)

**Proliferation Phase of Rehabilitation TEA**

**Week 8**
- Light hand and forearm exercises may be initiated
- Consider static progressive orthosis if patient has not reached functional elbow flexion
- 5 - 10 lb lifetime lifting restrictions
- No repetitive elbow uses such as racquet or throwing activities for lifetime
Complications

- Implant loosening
- Periprosthetic fracture
- Implant failure
- Infection
- Triceps insufficiency
- Nerve palsy

(Kim, Mudgal, Konopka & Jupiter, 2011)

Rehabilitation for elbow trauma/arthrosis

- Open debridement
  - Younger patient
  - Immediate active rehabilitation with slow return to sports activity
- Interposition arthroplasty
  - Younger patient
  - Immediate aaron/cpm, rehab emphasis on returend motion with static progressive orthosis (Shestov & Motley, 2008)
- Radiocapitellar semi-arthroplasty (Segrest et al. 2012)
  - Elbow orthosis with elbow flexed 90°, AAROM
  - PROM avoided until 6 weeks
  - Light strengthening at 6 weeks

Elbow Tendon Injuries

- Elbow Angles
- Ecchymosis
- Palpation
- Edema
- Resisted muscles

Varus  Valgus

Women valgus varies from 13° to 16°
Men valgus varies from 11° to 14°

Elbow pathology – Distal Biceps

- Patient points to:
- Antecubital fossa – suspect ...what?
- Palpate at elbow crease and just distal
- Resist supination
- Resist elbow flexion with forearm supinated
- Hook Test – Supinate forearm, examiner “hooks” her finger under the biceps tendon on the lateral side. Positive if tendon is not felt
- Most often there is an event involving a sudden eccentric load to biceps

Elbow pathology- Biceps

- Complete distal biceps rupture
  - Men aged 40-60
  - Smokers (7.5 times more likely)
  - ~30% loss of flexion strength
  - ~40% loss of supination strength
- Diagnosis usually confirmed by MRI or US

Hook Test
Distal Biceps

Popeye Sign
Proximal Biceps

Conclusion: Therapist Responsibilities

- Monitor
  - Know warning signs of infection
  - Increased pain could be a sign of implant failure
  - Recognize ulnar nerve symptoms
- Protect Surgery
  - Know soft tissue involvement (triceps, ligaments, ulnar nerve)
- Stability
  - Return to function (functional arc of elbow motion 30° to 130° and functional arc of forearm motion is 50° pronation and 50° supination) (Worrey, Aske & Chao, 1981)
Elbow pathology – Distal Biceps Rehab

- Nonoperative Management
- Patients should expect to recover more of their flexion strength than supination strength (expect 30% to 50% loss of supination strength)
  - Surgery is recommended for complete ruptures within 6 wks from injury.
- Pain management
- AROM as able without significant pain
- Strengthening when pain has resolved

Elbow pathology – Distal Biceps

Post-op distal biceps repair
- LAS or hinged orthosis blocking full extension
- ROM in first 6 weeks is surgeon dependent:
  - Passive elbow flexion, active extension
  - Early AROM E/F, Sup/Pro (first p.o. visit) to -30° ext
  - Progress weekly per comfort level
  - Pain free strengthening at 8-12 weeks.
  - Return to full activity 4-5 months
- Spencer et al (2008) report patients who had no therapy and no restrictions on motion after 2 weeks did better than those who had supervised therapy.

Immobilization/Protected Mobilization

Adverse Effects Following Distal Bicep Repair

- Single incision approach and obesity related to adverse effects.
- 1 in 5 patients expected to have minor complication
- 1 in 20 expected to have a major complication
- Lateral antebrachial cutaneous neurapraxia is the most common adverse event
Elbow pathology – Lateral Epicondylosis

Patient points to:
Lateral elbow – suspect lateral epicondylopathy/epicondylitis/epicondylalgia, lateral elbow teninopathy (LET)

The Tennis Elbow

• **Is not a tendonitis**
• Histology studies reveal a lack of inflammatory cells
• LET is a de-conditioned status of the ECRB origin

IV. Elbow Pathology – Tendinous

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• Tendinitis? Tendinous?
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Elbow pathology – Lateral Epicondylosis

Clinical Exam

• TTP at lateral epicondyle? Radial tunnel? Posterior elbow?
• Numbness or tingling?
• Pain with full elbow extension?
• Pain with resisted wrist extension? (Cozen’s Test)
• Pain with elbow extension wrist flexion? (Mills Test)
• Pain with resisted EDC to long finger? (often negative)

Special Tests for Lateral Elbow

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Cozen’s Test
Mills Test
Grip stronger with elbow flexed
Pain with palpation
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Palpate Radial Tunnel

Supination painful

Elbow pathology - tendinous

Lateral Epicondylitis -

• **Caused** by activity demand exceeding muscle supply in a degenerating muscle-tendon unit.
• **Goal:** return patients to prior level of activity without lateral elbow pain
  • First goal: get patient pain free at rest and with light activity
  • Progression of HEP is geared at strengthening the extensor complex, especially the ECRB, so that it is able to meet activity demand without overload.
Elbow pathology – Lateral Epicondylosis

**Clinical Pearls:**
- Muscle tendon length
- Measure wrist flexion and compare to composite wrist/digit flexion. If >10° different then muscle tendon unit needs to be lengthened
- c/o pain with wrist extension?
  - need to put ECRB on rest
- c/o pain with resisted EDC?
  - will need to strengthen EDC

Elbow pathology – Lateral Epicondylosis

- Once patient is pain free at rest and with light activity (two weeks after initial) begin eccentric exercise program
- Progression of exercises:
  - Eccentric extension
  - Strengthen sup/pro
  - Strengthen grip (because it strengthens ECRB)
  - Strengthen EDC if initial evaluation demonstrated involvement
  - Exercises should be low load high reps

**CURRENT EVIDENCE for LATERAL EPICONDYLOSIS**

**Physical Modalities**
- Strong evidence to support low level laser for improved grip and decreased pain
- Moderate evidence for extra-corporeal shockwave therapy
- Weak evidence for iontophoresis (short term evidence)

**Orthosis**
- Moderate evidence for forearm orthosis to improve grip
- Strong evidence short & long term to support resistive exercises improve function & decrease pain

**Exercise**
- Elbow in extension held on flat surface and forearm pronated while the wrist extends with the hand fisted and hanging over the surface
- Patient performs an isometric contraction for 45 seconds
- Patient flexes wrist slowly counting to 30
  (3 sets of 15 repetitions/5x weekly for 4 wks)
CURRENT EVIDENCE for LATERAL EPICONDYLOSIS

<table>
<thead>
<tr>
<th>Manual Techniques</th>
<th>Multimodal Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strong evidence to support: soft tissue technique, movement with mobilization and muscle energy techniques</td>
<td>• Moderate evidence for cortisone injection for short term effect, but therapy interventions demonstrated medium to large effect at later follow-up times (exercises, manual techniques and modalities)</td>
</tr>
<tr>
<td>• Moderate evidence for extra-corporeal shockwave therapy</td>
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</tbody>
</table>

Elbow pathology – Medial Elbow Pain

Golfer’s Elbow

a.k.a. Medial Epicondylitis, etc

• Involves the origin of the flexor pronator mass
• Aggravated by activities involving wrist flexion and grip

Elbow pathology – Medial Elbow Pain

• Exam should include:
  – TTP at medial epicondyle
  – Check for TTP and Tinel’s at cubital tunnel – may have concurrent condition, or not be MET at all
  – c/o pain with resisted grip, wrist flexion or pronation?

Elbow pathology – Medial Elbow Pain

• Medial Epicondyle Tendinopathy management:
  – Treated the same as tennis elbow, in reverse, with stretches and exercises applied to the flexors instead of the extensors

Elbow pathology - Snapping

Patient presents with painful “snapping” during elbow motion. Possible sources include:

• Intra-articular loose bodies
  - Can be bony or cartilaginous
  - Elbow may “get stuck” when attempting motion
  - Painful
  - X-rays helpful if bony
  - Arthroscopic removal
• Elbow instability / ligament laxity

VALGUS OVERLOAD

• Medial elbow opening
• Lateral elbow compression
• Posterior elbow olecranon impingement
Elbow pathology - Snapping

• Ulnar nerve
  – Subluxes over medial epicondyle
  – Usually at 90° elbow flexion
• Medial head of triceps
  – Subluxes over medial epicondyle
  – Occurs during elbow extension and flexion – usually at ~110° flexion

Special Tests: Medial Elbow Cubital Tunnel Syndrome

Tinel's Sensitivity: 54% to 70%
Modified Shoulder Internal Rotation Test Sensitivity: 87% (5 second) Specificity: 97%
Elbow Flexion Test Sensitivity: 46% to 75% (1 to 3 min.)

SCRATCH COLLAPSE TEST

1) Resist external rotation bilaterally with the humerus adducted and the elbow flexed at 90 degrees.
2) Scratch cubital tunnel lightly.
3) Resist external rotation a second time immediately after the scratch.

Positive Test: Momentary loss of shoulder external rotation strength on the affected side.

Sensitivity: 69%  
Cheng et al 2008, J Hand Surg

APPENDIX/GUIDELINES FOR ELBOW TRAUMA REHABILITATION

Internal Fixation

• Phase I
  – Early mobilization 3 to 5 days post-op/PROM gentle
  – Posterior elbow orthosis 90° flexion with forearm neutral
  – Regain motion 1 to 3 wks post-op AAROM (flex/ext, pro/sup)
  – CPM
• Phase II (4 to 6 wks post-op)
  – Regain full motion and gradual strengthening
• Phase III (6 to 12 wks)
  – Advance strengthening and closed chain exercises
  – Joint mobilizations
  – End range strengthening

Radial Head Replacement

• Phase I (Week 1 to 3 post-op)
  – Early mobilization (orthosis CPM forearm pronated or neutral), AROM wrist and hand during 1st week
  – Hinged elbow orthosis worn at all times
  – Advance elbow and forearm motion exercises. Elbow AAROM with gravity assisted extension. Position elbow at 90° flexion during forearm exercises
  – Consider edema glove for hand
• Phase II (Week 3-6 post-op)
  – Begin AAROM pro/sup, PROM elbow stretching to tolerance, initiate orthosis to increase flex/ext if needed, advance to AROM forearm rotation and elbow motion
• Phase III (Week 6-9 post-op)
  – Discharge hinged orthosis, begin isometrics, continue mobilization orthosis
• Phase IV (Week 8-12 post-op)
  – Light resistance gradually upgrade strengthening
Distal Humerus Intra-articular Fractures

Fixation Plating (post-op 1 week):
- Edema control
- Long arm orthosis alternating between elbow flexion daily and elbow extension nightly
- Elbow, shoulder, forearm, wrist, hand AROM every 1 to 2 hours

Post-op 2 weeks:
- Initiate scar management
- Progress ROM each week
- Non-weight-bearing until fracture healed
- Strengthening when fractured healed

References

ELBOW TRAUMA INVOLVING THE FOREARM

Galeazzi Fracture
- Radial shaft fracture with dislocation of distal radial ulna joint

Monteggia Fracture
- Fracture of the proximal 1/3 of the ulna and dislocation of the radial head

References

The forearm:

References
2016


2018 Added References


Medial Collateral Ligaments

- Elbow extension stability to valgus stress
  - MCL contributes 30%
  - Anterior capsule 30%
  - Bony Articulation 40%

- Elbow at 90 degree flexion stability to valgus stress
  - MCL contributes 55%
  - Anterior capsule 10%
  - Bony articular 35%

Lateral Collateral Ligaments

- Elbow extension stability to varus stress
  - LCL contributes 15%
  - Anterior capsule 30%
  - Bony Articulation 55%

- Elbow at 90 degree flexion stability to varus stress
  - LCL contributes 10%
  - Anterior capsule 15%
  - Bony articulation 75%
Radial Head Fractures
Internal Fixation or Radial Head Replacement

- Fragmentation of less than 3 fragments have improved results with fixation (Ring & Jupiter, 2001)
- Lateral collateral ligament protection may be required if ligament re-attached or involved, reattached after surgery (pronation) at 2 days post-op allow pro/sup with elbow flexed at 90