ELBOW TRAUMA: MANAGING CHALLENGING CLINICAL SEQUELLAE

Jane Fedorczyk, PT, PhD, CHT
Certified Hand Therapist
Professor - University of South Florida

Matthew Lazinski, PT, DPT, OCS
Board Certified Clinical Specialist in Orthopedics
Assistant Professor - University of South Florida

Disclosure

Matt Lazinski, PT, DPT, OCS
Nothing to Disclose

Jane Fedorczyk, PT, PhD, CHT
Royalties, Elsevier
Consultant, MedRisk
Objectives

- Describe anatomy and biomechanics of the elbow complex including the course of the peripheral nerves.
- Employ clinical examination techniques to identify peripheral nerve injuries and other causes of movement dysfunction.
- Formulate a plan of care with targeted interventions to reduce movement dysfunction and optimize functional outcomes.
- Develop concepts for future clinical research investigation.

ANATOMY AND BIOMECHANICS

Elbow Complex: 3 Articulations

- Ulnohumeral
- Radiohumeral
- Superior or Proximal Radioulnar Joint
Elbow Complex: Osteology
“Lock and Key” Configuration Primary to Stability

Articular Configuration
Adds to Stability

Elbow Most Stable in Flexion
One Capsule Surrounds All Joints

Brachialis Adherent to Anterior Capsule

Elbow: Lateral Ligaments
Elbow Complex: Medial Ligaments

Performing Elbow Motion in Sagittal Plane
- Elbow Injury
- Fracture/Dislocation
- Ligament Disruption With or Without Repair

- LCL Instability?
- MCL Instability?
- MCL & LCL?

- Forearm Pronated
- Forearm Supinated
- Forearm Neutral

Early Controlled Protected Ext/Flex
- Forearm Neutral
- Forearm Pronated
Radial Nerve – Deep Branch

Median Nerve

Median Nerve
Types of Elbow Trauma

- FOOSH
- Simple Dislocations
- Elbow Fractures
- Forearm Fractures
- Overuse

Coronoid and Radial Head Act as a Buttress to Posterior Deforming Forces Imposed by Biceps, Brachialis, and Triceps

Triceps Tendon

Post R/C
Complex Dislocations
Include Fracture(s)
Terrible Triad

Elbow Instability: 3 Stages
Normal Stage 1 LUCL failed Stage 2 LCLC failed Stage 3A – MCL (post) Stage 3B – MCL (ant)

Elbow Fractures
Represent 6% of all fractures
Radial Head Most Common Elbow Fracture
Elbow Fractures
- Distal Humerus
- Extraarticular
  - Extracapsular vs. Intracapsular
- Intraarticular
- Radial Head – Types I, II, III
- Ulna
  - Olecranon – Types I, II, III
- Coronoid – Types I, II

FOREARM FRACTURES
- Essex – Lopresti
- Galeazzi
- Monteggia

MUGR
- Monteggia fracture-dislocation: Ulna
- Galeazzi fracture-dislocation: Radius

Essex-Lopresti Injury
- Tear of the IOM (central band)
- Comminuted fracture of the radial head.
- Disruption of the DRUJ – radius migrates proximally
- The cause typically is a FOOSH with the elbow extended and forearm pronated.
- Degree of radial head comminution is related to the energy of the fall.
Acute:
Radial head replacement is recommended.
Reconstruction of the IOM?
+ TFCC repair

Chronic:
Ulnar-shortening osteotomy ("leveling" of DRUJ)
TFCC repair to restore DRUJ stability
Radial head replacement?
Reconstruct the IOM?

Galeazzi Fracture
Consists of:
• fracture of the radius
  (typically mid - distal 1/3rd shaft – most typically fx is just above the proximal border of the pronator quadratus)
• dislocation of DRUJ
Monteggia Fracture

“Monteggia” denotes a group of injury types that include:
- Dislocation of the PRUJ
- Ulnar fracture
- DRUJ lesion

“Unfortunately, in many of the cases in which there is concern about the potential for developing recurrent instability, the propensity for stiffness is also high. This balance between motion and stability remains a challenge.”


Rehabilitation Guidelines for Simple Dislocations

- Therapy initiated within 1 wk post closed reduction; ligament reconstruction rare
- Sling, Long Arm Orthosis, Hinge Brace for immobilization between exercise sessions
- A/AAROM for flexion/extension in neutral rotation
- Pronation/supination in elbow flexion
- Residual laxity, limit extension to 30° in hinge brace for 3-8 wks
- Greater the period of immobilization the greater the likelihood of stiff elbow
- Progress strengthening and functional use over 3 – 9 months; similar to ligament reconstruction
Medical Management of Fractures

- Restore articular congruity
- Stable anatomic reduction
- Stable rigid fixation
  - Necessary for Early Active Mobilization

Rehabilitation Depends on Medical Management of Fracture and Surgeon/Therapist Experience

- Non-operative vs. Operative Management
- Long Arm Cast or Orthosis 10 days – 8 wks
  - Acute elbow flexion
  - Forearm and wrist neutral
- Immobilization vs. Early Motion
  - Depends on fixation and stability

Type of Fixation

Determines When Therapy Initiated

- Rigid: Full, early, pain-free AROM
- Stable: Protected early AROM (limited range)
- Tenuous: Delayed protected AROM
Protective Orthoses: Fractures and/or Dislocations

Phase I: Inflammatory (0-2wks)

- Protective Orthosis or Cast
- Pain Modulation
- Edema Management
- AROM/fracture/fixation
- Maintain ROM to Noninvolved Joints
- Monitor for Complications

Performing Elbow Motion in Sagittal Plane
- Fracture/Dislocation
- Ligament Instability or without
  - UCL Instability?
  - MCL Instability?
  - MCL & UCL?
Early Controlled Protected Ext/Flex

Foresarm Neutral  Foresarm Pronated

Early Controlled Protected

Pronation/Supination to Neutral

Immobilization 4-8 weeks
- IOM repair longer
- Allow limited elbow ext/ext
- Derotation/Long Arm Orthosis
- Edema management
- AROM of uninvolved joints.
- After 4-6 weeks, begin gentle progressive ROM exercises, then strengthening.

Treatment: Forearm Fractures
Phase II: Fibroplasia (2-6/8wks)
• Continue interventions used in Phase I as indicated
• Promote tissue extensibility
• Progress/Maximize A/PROM w/o inflammation
  • Orthotic Intervention and Exercise
  • PROM after 3 wks
• Progress Strength and Function
• Monitor for Complications

Phase III: Remodeling (8wks - ?)
• Continue with Phase II interventions as indicated
• Maximize ROM, strength, and endurance w/o complications
• Management of a Stiff Elbow

Elbow Fracture/Instability

Health Condition
  (Injury or Disease)

Body Functions & Structures
  Impairment

Activity

Participation

Contextual factors

Environmental factors
  Workplace
Sports Regulations

Personal factors
  Co-morbidities
  Co-pays
  Family Obligations

Occupations:

LOM
Pain
Edema

Work
Play

ADLs
Physical Exam
Findings
Elbow Fracture/Instability

Self Report Measure, Observation, Patient Interview

Body Functions & Structures
(Activities of Daily Living (ADL), Instrumental ADL (IADL), Participation (Recreational, Work, Social))

Hazard Associated with Falls

Low Bone Mass
Fall Risk Education

Self Report Measure, Observation, Patient Interview

Elbow Fracture/Instability

Functional Range of Motion
Normal
Extension – Flexion = 0-140
Pronation – Supination = 0-80/85 each

Functional
Extension – Flexion = 30-130
Pronation – Supination = 0-50 each

Elbow Function
• Mobile link for activities
  • Eating and reaching
• Stability for WB activities
  • Pushing up from a chair
• Combined Elbow and Forearm movements
  • Elbow flexion with supination
  • Eating and grooming
  • Elbow extension with pronation
  • Reaching, throwing or pushing

Morrey, Askew, An, 1981
The Ugly or Unforgiving Elbow

Clinical Exam of the Elbow: Early Identification of Clinical Sequellae
- Motor Function Testing
- Sensation Testing
- ROM Assessment
  - Intrinsic Sources of Limited Motion
  - Extrinsic Sources of Limited Motion
  - Muscle Length Testing
  - Accessory Motion Testing
  - Soft Tissue Mobility
  - Neurological Sensitivity
- Instability Testing

Testing of Peripheral Nerve Function Post Fracture
- Survey of 315 PT/OT Practitioners on Evaluation/Treatment post Elbow Fracture (MacDermid 2012)
  - Evaluation of Motor/Sensory Function
    - Acute Phase
      - Sensory Evaluation 67.3%
      - Motor/Strength Testing not in top 8
    - Rehabilitative Phase
      - Sensory Evaluation 86.1%
      - Motor/Strength Testing 67.7%
Elbow Region Peripheral Nerve Key Motor Signs

- Median Nerve – Anterior Interosseous Nerve
- OK Sign
- Radial Nerve
- Wrist Drop
- Ulnar Nerve
- Froment’s Sign

Motor Function

- Purpose is to rule out any undiagnosed and subtle motor function loss that will confound rehabilitation.
  - However, must be succinct and time effective!

- High/ Low concept
  - Testing of each nerve at the proximal and distal end of the nerve root innervation

<table>
<thead>
<tr>
<th>Nerve</th>
<th>&quot;High&quot; Muscle</th>
<th>&quot;Low&quot; Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial</td>
<td>Wrist Extensor 5-8 (ECRB, ECRL)</td>
<td>Finger Extensor 7-8 (ED, EPL)</td>
</tr>
<tr>
<td>Median</td>
<td>FCR or FDS</td>
<td>Thesnar Muscles (OP, FPB)</td>
</tr>
<tr>
<td>Ulnar</td>
<td>FCU or FDP</td>
<td>Interossei (ADP or ADD)</td>
</tr>
</tbody>
</table>

Peripheral Nerve Sensory Screen
ROM Testing

• Just taking a look at A/PROM with a goniometer is not enough!
  • End Feel
  • Tone/Stiffness throughout range
  • Alterations/Movement Deviations
  • Muscle Length as ROM

Intrinsic Sources of Contracture

• Incongruity of Articular Surfaces
  • Bony Block or Hardware Block

Intrinsic Sources of Contracture

• Ectopic Bone or Heterotopic Bone
  • Joint Effusion
Extrinsic Sources of Contracture

- Joint Capsule Shortening/Fibrosis
- Adherent Brachialis
- Collateral Ligament Shortening/Fibrosis

Examination of Extrinsic Sources

- Assess Muscle Length of Biceps
- Tightness limits elbow extension

Look at Contract Relax as Differentiation of Capsule and Muscle for These!!!

Examination of Extrinsic Sources - Muscle Length

Assess Muscle Length of Triceps
Tightness limits elbow flexion
Movement Patterns of the Elbow

Osteokinematic Motions
- Elbow Flexion/Extension
  - Thru Capitulum and Trochlea
  - Increased PROM over AROM
- Elbow Pronation/Supination
  - Thru both Proximal and Distal Radioulnar joints - spin thru Radial Head
  - Limitation in PROM due to muscle, connective tissues

Coupled/Combined Motions
- Flexion- Humeral Adduction
- Extension- Humeral Abduction
- Supination- Adduction, external rotation of Ulna
- Pronation- Abduction, internal rotation of Ulna, positive ulnar variance

Force Couples During Elbow ROM

Flexion/Extension
- Biceps and Triceps are antagonists
- Increased flexion force over extension
- ECIL can be flexor with forearm pronated

Pronation/Supination
- Supinators stronger than pronators
- Pronation more easily compensated
- Shoulder abduction, medial rotation
- Overuse of pronator teres w/ wrist extension
- Possible rotation of ulna
- Supinator more active with increased elbow flexion
- Otherwise primary supinator is biceps tendon

Joint Play Accessory Motion
- What is the role at the elbow?
- Usage Patterns for assessment and treatment
- Osteokinematics vs. Arthrokinematics vs. Combined
Cases focused on clinical examination

Elbow Stiffness s/p Radial Head Fracture

• 20 y/o male with history of FOOSH injury playing soccer
• MD visit one week later w/ X-ray and CT scan
  • Findings of 1.8-2mm displacement of radial head
  • Mild Displaced Communioned Coronoid Fracture
• Conservative care: 90 degree splint for one week, then wean off/ MD visit 4 weeks

Elbow Stiffness s/p Radial Head Fracture

• 4 weeks Follow Up
  • patient in splint for all 4 weeks, no movement in sling
  • Limited ROM 10 degrees supination, 95 flexion per MD
  • Immediate referral to PT
Radial Fracture Case

- Subjective Complaints
  - Stiffness in elbow, concerned about moving elbow
  - No Prior History of Etiology of Elbow
  - Moderate sleeping dysfunction
- Observation: Moderate guarding of right elbow, no swing in gait pattern
  - No focal edema noted
- Outcome Measure: Patient Rated Elbow Evaluation
  - Pain 21 points, Activity 39 points, Usual Activity 24 points: Total 42%
  - Pain level - 6/10 with flexion, extension, supination movement
  - Functional deficits- eating, dressing, combing hair

Patient Rated Elbow Evaluation

- 3 subscales
  - Pain - 50%
  - Function - 50%
  - Specific Activities
  - Usual Activities

Elbow Stiffness s/p Radial Head Fracture

<table>
<thead>
<tr>
<th>ROM</th>
<th>PROM</th>
<th>Endfeel</th>
<th>Pain Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow Flexion</td>
<td>108</td>
<td>113</td>
<td>Capsular</td>
</tr>
<tr>
<td>Elbow Extension</td>
<td>36</td>
<td>36</td>
<td>Guarded - anterior pain</td>
</tr>
<tr>
<td>Pronation</td>
<td>32</td>
<td>N/T</td>
<td>Guarded</td>
</tr>
<tr>
<td>Supination</td>
<td>52</td>
<td>N/T</td>
<td>Guarded</td>
</tr>
<tr>
<td>Wrist Flexion</td>
<td>67</td>
<td>70</td>
<td>Capsular</td>
</tr>
<tr>
<td>Wrist Extension</td>
<td>54</td>
<td>61</td>
<td>Capsular</td>
</tr>
</tbody>
</table>
Elbow Stiffness s/p Radial Head Fracture - Findings

- Muscle length
  - Lacking 10 degrees for biceps, 5 degrees for triceps over available range
- Strength Testing:
  - Elbow flexion, pronation, supination N/T
  - Elbow extension 3+/5 in available
  - Wrist flexion, extension 4/5 without pain
  - Grip 43 lbs
  - Median, Radial, Ulnar High/Low 5/5
- Structure Specific Testing
  - Negative OK, Negative Froments, + Ulnar nerve compression for parathesia
  - Sensation - Normal 2.83 all peripheral nerves

Case 2 - ORIF Radius Ulna with Nerve Involvement

- High energy fracture FOOSH from skateboard accident
  - States that he also grabbed at bar as he fell
- ORIF radius/ulna 10 days later
  - Operation report with no abnormal finding, good fixation
- Functional Preferences:
  - Drumming
  - Skateboarding
  - Works as Server at Restaurant
Evaluation - 3 weeks Post Surgery

- Evaluation performed 11/10/17
- Quickdash 84%
- ROM (degrees)
  - Flexion/Extension 29-132
  - 38 extension
  - 30 full extension
  - 60 flexion
- Full finger flexion
  - Full finger flexion
- MCP ROM:
  - Digit 1 0-60
  - Digit 2 0-50
  - Digit 3 0-50
  - Digit 4 0-70
  - Digit 5 0-30
- Modified Kapandji 9/10
ORIF Examination Continued

- Sensation:
  - Monofilament Testing (Semmes Weinstein)
    - Right Hand:
      - 3.61 over thenar eminence
      - Third Finger Palmar Sensation:
        - Sensation present at middle distal phalange
      - Sensation present at middle distal phalange
    - Dorsal Aspect:
      - All 3.61 over digit 1-5 distal phalange
- Left Hand WNL

  - Moving 2-point discrimination (m2pd):
    - 2 mm across all distal R finger tips

  - Functional MMT Testing:
    - RUE LUE
    - Grip Dynamometer: 10lbs R & L
    - Key Pinch: 5 lbs R, 19 L.

- Reflexes:
  - Biceps: 1+ Bilateral
  - Brachioradialis: 1+ L, R N/T
  - Triceps: 2/5 L, N/T R

Targeted Interventions to Manage Clinical Sequellae and Maximize Patient Outcomes

Elbow Fracture Survey – Interventions Performed

- Acute Phase
  - HEP 99%
  - Education 93%
  - Active ROM 86%
  - AAROM ROM 75%
- Rehabilitative Phase:
  - AROM / PROM 95%
  - Mobilization with Movement 67%
  - Manual Therapy not surveyed
Instrumented Soft Tissue Mobilization

- Systematic Review Performed in 2016 by Cheatham, etc al.
  - 5 total studies with varied methodology
  - 2 studies that examined short term (up to 24 hour) ROM change
  - Small increase in ROM

Manual Therapy- Accessory Motion Mobilization

- Cochrane Review on Early Mobilization for Elbow Fractures discovered one study with poor methodology
- Issues to Performance
  - Bone Healing
  - Heterotopic Ossification
  - Practitioner Preference
  - Patient Preference??

Manual Therapy- Accessory Motion Mobilization

- Humeroulnar
  - Distraction
  - Cephalic Glide
  - Caudal Glide
  - Varus/Varus Tilt
- Humeroradial
  - Distraction
  - Dorsal glide
  - Volar Glide
- Proximal Radioulnar
  - Dorsal Glide
  - Volar Glide
  - Cephalic Glide
  - Caudal Glide/Distraction
  - Proximal Radial Glide
Neural Mobilization
Systematic Review and Meta-Analysis- JOSPT 2017 Basson et. Al

Lateral Epicondylalgia- 3 studies total
• 1 study with lateral cervical glides found to be effective
• 2 other studies unclear, high bias

Cubital Tunnel Syndrome
• 1 study- no significant difference compared to control group and elbow brace

Orthotic Intervention for ROM Deficits
Low Load Prolonged Stress

Which patients require orthoses to improve ROM?

<table>
<thead>
<tr>
<th>PROM (°)</th>
<th>Type of Orthosis</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>
Which patients require orthotic intervention to improve ROM?

- Compare PROM gains after 15 minutes of preconditioning (heat and exercise)

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<th>Orthotic Intervention</th>
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<td>Keep going with therapy; manual techniques; maybe static orthosis to maintain motion</td>
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<tr>
<td>0 - 10°</td>
<td>Mobilizing Orthosis: Serial static; static progressive; dynamic</td>
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Jane's Modification

Considerations for Orthoses Selection

- End Feel
- Degree of Contracture
- Therapists' Experience
- Patient Compliance
- Refer to stiffness presentations

(5-30°) Terminal extension deficits with firm (springy) end feel

Anterior Serial Static Extension Orthosis

Belly Gutter Extension Orthosis
20-90° extension deficits with **Firm** (aka cement) end feel

Turnbuckle applied in closed position and turned to extend elbow

Anterior turnbuckle until 20 degrees extension

Green and McCoy (1979)

---

Terminal Flexion from 100-125° **Firm** (springy) end feel

---

Semi-Custom Over the Counter Options
Flexion 100° or less
Two Turnbuckles applied in open position and turned to flex elbow

Two turnbuckles evenly shortened by patient to increase elbow flexion

Forearm Rotation
Proximal and Distal Radioulnar Joints
- Longitudinal axis for forearm rotation
- Radius moves about the ulna

Rotation deficits: Firm end feel
- Colello-Abramson Rotation Orthosis
- Use either dynamic or static progressive 4 lines of pull
- Addresses both deficits with one orthosis
Rotation Deficits - Semi Custom/ Over the Counter

How much should the patient use the orthosis?

- Manipulate variables of duration, frequency, intensity to apply effective "dosage" of splinting
- Maximize TERT = Total End Range Time to ↑ ROM
- Intensity least important variable, but the one that could do the most harm

Typical Orthosis Wearing Schedule

- TERT = 2 – 8 hours
- Extension orthosis at night
- Flexion orthosis during the day
- Prefer one 60 minute session vs. two 30 minute sessions due to time needed to reach new end range position following preconditioning
How do you know if the orthosis is effective or harmful?

**Effective**
- ROM improves
- Measurements taken after preconditioning
- Adjust variables to progress
  ROM increases especially duration and frequency

**Harmful**
- Tissues Reactive
- Pain
- Loss of motion
- Sign of inflammation
- Edema
- Some joints more susceptible than others
- Rest tissues for a few days

When do you discontinue using the orthosis?

**Good news:** ROM goals achieved

**Bad news:**
- ROM plateau
- Splint not tolerated
- Joint inflammation present

Cases focused on interventions
Elbow Stiffness Case

- Patient preference to not have any more braces/splints on Day #1
- Young, active patient but with considerable apprehension in movement patterns.
  - Low/Moderate Irritability levels
  - Patient leaving for Winter Break in 5 weeks
  - Fair Psychosocial Status Visit #1, increased quickly

Which patients require orthotic intervention to improve ROM?

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Jane’s Modification

Elbow Stiffness s/p Radial Head Fracture

- Plan of Care 2x week for 5 weeks
- Leaving for Winter Break for 4 weeks
- First 5 visits treatment plan
  - AROM within pain free range
  - Low Load long duration stretching 15 min w/ Heat into Extension
  - Muscle Length Stretching/Mobilization
  - IASTM to biceps and triceps, NO IASTM over radial head
  - Pain science/ cognitive training
Results after 5 visits

- AROM 20-138 degrees extension/flexion, 59 Supination, 71 pronation
  - Pain in lateral elbow end range pronation/supination
  - Pain complaints in anterior cubital fossa region, olecranon at end range motion
  - Muscle length impairment abolished- biceps and triceps
  - Grip MMT 64lbs

Elbow Stiffness s/p Radial Head Fracture

- Visits 6-10
  - Restriction noted in lateral elbow (radial head) with anterior/posterior glide
  - 2/6 mobility
  - Pain in radial head region 4/10 end range
  - Joint mobilizations to radial head began
  - Grade 2/9 first visit, up to grade 4 at end
  - No pain during treatment or afterwards
  - Functional Training/bodyblade for stabilization of elbow musculature
  - Weight bearing progression initiated.

Elbow Stiffness s/p Radial Head Fracture- 10th Visit

- Quikdash 11% with recreational activities most limited
  - 90% Perceived Recovery
  - Patient Rated Elbow Evaluation:
    - Pain 7 points
    - Activity 11 points
    - Usual Activity 12 points
    - Total 144 (41% at IE)
  - Strength:
    - Elbow Flexion, Extension 4+5
    - Elbow Supination, Pronation 5/5
    - Wrist Flexion, Extension 5/5
    - Grip strength 79lbs, 101lbs unaffected

<table>
<thead>
<tr>
<th>Range</th>
<th>PROM</th>
<th>Full</th>
<th>Endfeel</th>
<th>Pain Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow Flexion</td>
<td>161</td>
<td>161</td>
<td>Soft Tissue</td>
<td>1/10</td>
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<tr>
<td>Elbow Extension</td>
<td>8</td>
<td>6</td>
<td>Firin</td>
<td>2/10</td>
</tr>
<tr>
<td>Pronation</td>
<td>90</td>
<td>70</td>
<td>Guarded</td>
<td>2/10</td>
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<tr>
<td>Supination</td>
<td>70</td>
<td>61</td>
<td>Calculated</td>
<td>2/10</td>
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<tr>
<td>Wrist Flexion</td>
<td>WNL</td>
<td>WNL</td>
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<td>WNL</td>
<td>WNL</td>
<td>WNL</td>
<td>0/10</td>
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### Case 2 - ORIF Radius / Ulna Interventions

- **Plan Of Care:**
  - 1x week for 8-12 weeks
  - First 4 weeks
    - Tendon Gliding
    - AROM of Wrist, Elbow
    - Patient Education:
      - Skin Protection
  - ROM Elbow 12-138 Flexion/Extension
  - Full Finger Composite ROM

- **Weeks 4-12**
  - Began light PRE’s for Wrist Extension, Gripping
  - Nerve Flossing to Median, Ulnar Nerves with Elbow Bias
  - Partial Weight Bearing Progression Initiated
  - Standing—Quadruped
  - Drumming Initiated at 10 weeks

### ORIF Case - Outcomes - 13 Visits Over 16 Weeks

#### Functional Outcomes
- QuickDASH: 15.90%
- GROC: +6
- PSFS: Total Score: 8.2 / 10
  - Forearm Flex: 5/5
  - Sensory: 3/5
- Arm/Knee/Wellness: 5/5
- Activities: 2/5

#### Objective Measures

**ROM:**
- All Planes WNL and Painless

**MMT:**
- Elbow Flexion, Extension 4/5
- All Peripheral Nerves 5/5 at Wrist/Hand

**Grip dynamometer (lbs):**
- R: 80
- L: 115

**Pinch Grip - key pinch:**
- R: 20
- L: 20

**Sensation:**
- All Light Touch 2.83
- Slight Complaints of Continued Intermittent Paresthesia to third digit
Case 3

- 18 y/o male; LHD college freshman; plays club basketball
- Posterior dislocation of left elbow; referred 2 weeks after injury
  - Positive x-ray, closed reduction
  - Braced for 5 weeks locked in acute flexion (90°), short arc motion (SAM)
  - Medial elbow pain and stiffness limited SAM

Examination

<table>
<thead>
<tr>
<th>Passive ROM</th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td>Flexion</td>
<td>150</td>
<td>106</td>
</tr>
<tr>
<td>Extension</td>
<td>4 hyper</td>
<td>94 hypo</td>
</tr>
<tr>
<td>Supination</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>Pronation</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

Circum. Meas. | Right | Left |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>5 cm proximal to lat epicondyle</td>
<td>25 cm</td>
<td>27 cm</td>
</tr>
<tr>
<td>5 cm distal</td>
<td>26 cm</td>
<td>28 cm</td>
</tr>
</tbody>
</table>

- Passive ROM
  - Extension hard EF
  - Flexion/supination soft/empty

Pain Limited Willingness to Move

- 7/10 verbal rating scale (VRS) pain score and brace limiting factors to performing SAM
- Medial elbow pain and tingling in small and ring fingers
  - + ULNT (ulnar); limited PROM with hard end feels suggest capsular tightness
  - Modified Weeks test suggests patient requires (low load prolonged stretch) LLPS with orthoses
Health Condition
Elbow dislocation

Body Function & Structure
- Decreased ROM, Pain
- Decreased strength

Activity
- Lifting
- Pain with elbow flexion

Participation
- Basketball

Contextual Factors
- Environmental Factors
- Mom
- Personal Factors
- Motivation: Good support
- Time

Re-evaluation - the 3 week mark
- Flexion not changing with stretching 3 x 30 sec 2x a day
  - Recently modified to 4x every hour
- Extension improving but slowly
  - Recently modified to 5 x 5 min a day

Re-evaluation - 3 weeks

<table>
<thead>
<tr>
<th>Circumferential measurements</th>
<th>IE</th>
<th>RE</th>
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</thead>
<tbody>
<tr>
<td>5 cm proximal to lat epi</td>
<td>27 cm</td>
<td>26 cm</td>
</tr>
<tr>
<td>5 cm distal</td>
<td>28 cm</td>
<td>24.8 cm</td>
</tr>
</tbody>
</table>

Passive ROM
- Flexion 106 114
- Extension 94 hyper 24 hypo
- Supination 10 66
- Pronation 90 90
Change of POC

- Orthotic intervention
- Ulnar nerve management secondary to poor nerve dynamics
  - Nerve glides

Neural dynamics

- Nerve glides/mobilizations
  - Ulnar nerve – C/S side bending ipsilaterally with elbow flexion
Which patients require orthotic intervention to improve ROM?

- Compare PROM gains after 15 minutes of preconditioning (heat and exercise)

<table>
<thead>
<tr>
<th>PROM ↑</th>
<th>Orthotic Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 - 20°</td>
<td>Keep going with therapy; manual techniques; maybe static orthosis to maintain motion</td>
</tr>
<tr>
<td>0 - 10°</td>
<td>Mobilizing Orthosis: Serial static; static progressive; dynamic</td>
</tr>
</tbody>
</table>

**Jane’s Modification**

**Priority #1: ROM – Orthosis: Flexion**

**Priority #2: ROM – Orthosis Extension**
Other impairments

- Edema
- KT tape (used for pain too)
- Strengthening
  - functional activity; no more than 3-5#
  - 2 months – total arm strengthening w/ wts

Results - impairments

- GROF 87.5%
- Pain at worst 1/10
- Current pain 0/10
- PREE 1.7%
- DASH 2%

<table>
<thead>
<tr>
<th>Passive ROM</th>
<th>IE</th>
<th>Week 3</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>108</td>
<td>114</td>
<td>142</td>
</tr>
<tr>
<td>Extension</td>
<td>94</td>
<td>24</td>
<td>2 hypo</td>
</tr>
<tr>
<td>Supination</td>
<td>10</td>
<td>96</td>
<td>82</td>
</tr>
<tr>
<td>Pronation</td>
<td>90</td>
<td>90</td>
<td>84</td>
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</table>

IE 0/10 7/10
DC 0/10 1/10

Patient-rated Outcomes

<table>
<thead>
<tr>
<th>DASH and PREE</th>
<th>100</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>50</th>
<th>40</th>
<th>30</th>
<th>20</th>
<th>10</th>
<th>0</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>48.7</td>
<td>31</td>
<td>15.7</td>
<td>6.6</td>
<td>1.7</td>
<td>2</td>
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<table>
<thead>
<tr>
<th>DASH</th>
<th>PREE</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
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<td>8</td>
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</table>
Summary Comments

- Experience matters for managing elbow trauma and identifying clinical sequellae.
- Access to imaging and communication with surgeon essential.
- Elbow stiffness does not discriminate with patient’s age.
- Nerve injuries may need to be treated coincidentally.
- Future investigations need to validate our clinical observations.
- Items within the tests and measures field need to be included within the outcomes registry.

Questions?
References


