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Conservative Contract Remediaiton for the Upper Extremity Series

Part 3 – Wrist and Hand

Ellie Pong DPT, MOTR/L

- This course series will explore conservative treatment combinations including modalities, Botulinum toxin injections, dynamic and static splinting, and hands-on soft tissue and joint mobilization for patients with soft tissue and joint contractures of the upper extremity. Neurological and orthopedic-caused contractures will be addressed separately.
- The series consists of three courses: The Shoulder Complex; The Elbow; and The Wrist and Hand.
Learner Outcomes

As a result of this course, participants will be able to:

1) ...identify the joint and soft tissue structures of the wrist and hand that are commonly problematic in neurological and orthopedic contractures

2) ...recognize in post-course testing, best combined use of conservative treatments including modalities, splinting, hands-on manual treatments, and Botulinum toxin injection guidance to treat patients with contractures of the wrist and hand.

3) ... discuss and later incorporate into the participant's daily practice, evidence-based conservative treatments as well as those pending clinical trials which have demonstrated successful use in the clinic for these impairments.

The Stiff Wrist and Hand

- When considering treatments for a patient who has wrist and hand stiffness, a consideration of the tissue status is very important.
  - Normal tissue, non-fibrous or scarring, tightened from simple non-use.
  - Fibrous tissue from scar formed in normal healing process.
  - Fibrous tissue from burn scarring with superficial and deep tissue contracture.
  - Bony tissue from unknown reactive tissue pathology.
  - Hypertonic contractile tissue with contracture of both muscle and tendon.
  - Hypotonic tissue with contracture due to gravity, muscle unable to maintain normal anatomical positioning.
The Stiff Wrist and Hand

• Wrist and hand stiffness can be caused by pathologies requiring highly specialized treatments outside of the scope of this course, such as burn scarring, CRPS, upper limb lymphedema, or pediatric upper limb dysfunction after brachial plexus birth injury.

• We will address more generalized causes today, yet provide specific treatment examples.

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The Stiff Wrist and Hand

• Normal tissue, non-fibrous or scarring, tightened from simple non-use.
  – I see this more in the hand, after a fracture of the distal radius in which the cast or splint blocks the distal palmar crease for 6 weeks or longer.
  – With blocking of the distal palmar crease, the fingers are unable to make a full fist.
  – The actual structures of the fingers are not in a healing mode (given that the long finger tendons were not injured with the radius).
  – Stretching is not painful to the fingers, although some discomfort may be present.
  – Joint mobilizations needed will be minimal; the tendons are the tightest structures here.
The Stiff Wrist and Hand

• Fibrous tissue from scar formed in normal healing process.
  – After wrist or hand surgery such as a tendon repair, patient is restricted in active use of the wrist and hand.
  – Passive range is limited at first, gradually increasing.
  – Meanwhile, in the natural healing process, scar develops in the healing tissues.
  – Our stretching and mobilizations must not disrupt the repair, and they must avoid engendering an excessive scar healing response by their aggression. Specific techniques will address specific tissues.

The Stiff Wrist and Hand

• Stiff tissue from unknown reactive tissue pathology.
  – In the wrist and hand, this may occur with complex regional pain syndrome.
  – Complex regional pain syndrome often occurs after preceding trauma
    • 40% of the cases are after fracture or surgery
    • 30% are after decompression of the median nerve (Maihöfner, Seifert & Markovic, 2010).
  – We must avoid increasing the body’s reactivity and engendering a prolonged or exacerbated response to pain or tissue trauma.
The Stiff Wrist and Hand

- Hypertonic contractile tissue with contracture of both muscle and tendon.
- Hypotonic tissue with contracture due to gravity, muscle unable to maintain normal anatomical positioning.
  - Now the situation is extremely complex. A myriad of relationships between hypertonic and hypotonic restrictions must be considered.
  - No matter what we do to the tissue, the tone will not permanently change to normal; therefore, there will always be likelihood of redevelopment of contracture.

Anatomical Considerations

FCR
Palmaris Longus
FCU
Supinator
Pronator Teres
Pronator
Quadratus
ECU
ECRB
ECL
Anatomical Considerations

- FDS
- FPL
- FDP

Anatomical Considerations

- Opponens Pollicis
- Abd Pollicis Brevis
- Flexor Pollicis Brevis
- FPL
- Adductor Pollicis
- Lumbricales
- Palmaris Brevis
- Flexor Digiti Minimi Brevis
- Abductor Digiti Minimi
Biomechanical Considerations

- Why did I show that last image?
- Have you ever been urged by a physician to “crank” someone’s wrist into flexion after a distal radius fracture or carpal fracture?
- Did you feel the carpals in a traffic jam?
- A bony block can be present dynamically
- Restriction may not be the soft tissues
- Look at the complexity of the carpals to produce wrist flexion and extension.
Biomechanical Considerations

• In any contracture, there will be (at the very least) an imbalance of short, tight structures and lengthened, often weakened, structures.
• Pathological structures may be contractile and/or non-contractile.
• The very basics of the biomechanical alterations then lead us to a two part harmony of lengthening and strengthening to restore “normal” joint movement.

Biomechanical Considerations

• Wrist and hand musculature considerations:
  – Intrinsic hand muscles that move only the digits
  – Extrinsic hand muscles that move mostly the digits but also influence the wrist
  – Wrist muscles that move the wrist
Biomechanical Considerations

- As we explore treatments for the stiff wrist and hand then, we must consider both the passive limitations (tightened tissue) and the dynamic limitations (muscle weakness, altered kinematics producing blocks to movement).
- Let us begin with a review of general wrist and hand contracture treatments.

General Wrist and Hand Contracture Treatments

- A general order of treatment:
  - Physically warm the tissue
    - Exercise or moist heat
  - Long positional stretching
    - Relax tissues to full length potential
  - Soft tissue work, manual stretching
  - Joint mobilization
  - Functional activity, strengthening
  - Splinting at home, at rest
General Wrist and Hand Contracture Treatments

• Physically warm the tissue
  – Exercise and/or modalities
    • You want to avoid beginning the session with pain
    • If the patient is unable to perform a warming exercise without pain, then moist heat is a better choice.
    • Paraffin with moist hot pack
    • Moist hot pack with wrist/hand position in stretch
    • Fluidotherapy with active exercise

Myrer and associates (2011) found that adding a topical analgesic to the paraffin bath enhanced movement and function over a 12 treatment period in patients with osteoarthritis.

Sibtain and associates (2013) found that using the paraffin bath with manual therapy produced superior movement in the post-traumatic stiff hand than did manual therapy alone.
General Wrist and Hand Contracture Treatments

Physically warm the tissue

• Fluidotherapy
  – Has been shown to increase intramuscular temperature by 5.66 degrees C (42F) compared to baseline temperature (Vardiman, Jefferies, Touchberry & Gallagher, 2013).
  – A study specific to the hand corroborated this temperature increase (Öksüz, Akel, Aran & Kayihan, 2011).

• Long positional stretching
  – Relax tissues to full length potential
  – These will of course depend upon the area of restriction and the patient’s position tolerance.
General Wrist and Hand Contracture Treatments

• **Stretching**
  – Must relax tissues to full length potential
  – Example: wrist flexion stretch over a bolster

General Wrist and Hand Contracture Treatments

• **Soft tissue work, manual stretching**
  – Many techniques are available, some can be very painful
  – Consider carefully the role that increased pain may play in increasing muscle tension, patient guarding, inability to reach true end range
  – A deep comfortable massage of the muscles that is not painful appears to engender both tissue and subjective relaxation.
General Wrist and Hand Contracture Treatments

• Soft tissue work - Myofascial release, cross-friction, massage
  – Examples: interesting release of the forearm and hand using the therapist’s elbow and other techniques
    • Advanced Myofascial Release Massage for Forearm & Hand: https://youtu.be/iEJQfRhIEaY
    • Myofascial Massage Therapy for Forearms & Hands, & Mild Wrist Mobilization https://youtu.be/xm1twT7u-7c

General Hand Contracture Treatments

• Passive range of motion and manual stretch techniques.
  – Example: Volar Sweep Stretch of Syndesmosis at the Metacarpal Heads (Patla & Paris, 2000, p. 81)
  – Patient sits with elbow flexed and supported on table.
  – Therapist’s thumbs are placed horizontally across metacarpal shafts; her bilateral index and middle fingers are placed horizontally on the volar surface of the metacarpal shafts.
General Hand Contracture Treatments

• **Volar Sweep Stretch of Syndesmosis at the Metacarpal Heads** (Patla & Paris, 2000, p. 81)

  – To increase the arch: therapist’s index and middle fingers push dorsally as thumbs apply a force away from the midline of the hand.
General Hand Contracture Treatments

- **Volar Sweep Stretch of Syndesmosis at the Metacarpal Heads** (Patla & Paris, 2000, p. 81)
  
  – To flatten the arch: therapist’s thumbs push volarly as her index and the middle fingers apply a force away from the midline of the hand.
General Hand Contracture Treatments

- **Volar Sweep Stretch of Syndesmosis at the Metacarpal Heads** (Patla & Paris, 2000, p. 81)

General Wrist and Hand Contracture Treatments

- Specific manual muscle stretching
  - Example: **Stretch of the hand intrinsics**
General Wrist and Hand Contracture Treatments

• Specific manual muscle stretching
  – Example: Stretch of the hand intrinsics
  – IMAGE

General Wrist Contracture Treatments

• Joint Mobilizations (Patla & Paris, 2000, p. 88)

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<th>Mobilization to Increase Supination</th>
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<td>Ulno-Menisco-Triquetral joint:</td>
<td>Ulna volar glide</td>
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<td>Distal Radio-Ulnar joint:</td>
<td>Radius dorsal glide</td>
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General Wrist Contracture Treatments

- Joint Mobilizations (Patla & Paris, 2000, p. 88)

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General Wrist Contracture Treatments

- Joint Mobilizations (Patla & Paris, 2000, p. 88)

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General Wrist Contracture Treatments

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General Wrist Contracture Treatments

• Joint Mobilizations (Patla & Paris, 2000, p. 88)

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<td>Ulnar glide (proximal row)</td>
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General Wrist Contracture Treatments

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General Wrist Contracture Treatments

• Joint Mobilizations: **Volar Glide of the Ulna** (Patla & Paris, 2000, p. 98)
• Patient is sitting with forearm in neutral, elbow flexed and supported on table.
• Therapist’s right hand grasps radial side of hand, wrist and distal radius.
• Therapist’s left thumb is placed horizontally on the dorsal/distal ulna.
• Therapist’s left 2nd digit is curled, with the flexed PIP stabilizing the patient’s pisiform.
General Wrist Contracture Treatments

- Joint Mobilizations: **Volar Glide of the Ulna**
  (Patla & Paris, 2000, p. 98)

  Mobilization: The therapist’s thumb on the distal dorsal ulna exerts a volar glide while the therapist’s second digit PIP stabilizes the patient’s pisiform and the therapist’s other hand stabilizes the radial side of the patient’s hand and forearm.
General Wrist Contracture Treatments

• Joint Mobilizations: **Volar Glide of the Ulna**
  (Patla & Paris, 2000, p. 98)

  - Second digit curls PIP joint around patient’s pisiform

General Wrist Contracture Treatments

• Joint Mobilizations: **Cephalic Movement of Radius** (Patla & Paris, 2000, p. 113)

  - Therapist stabilizes by grasp of the posterior distal humerus and posterior proximal ulna, cupping the posterior-medial joint aspect.
  - Therapist’s other hand provides manipulation with her thenar eminence to the patient’s thenar eminence contact, Sawmiller’s grip. Maintains patient’s wrist in extension.
  - Force is directed from therapist’s forearm in cephalic direction through thenar eminence contact, compress and rotate.
General Wrist Contracture Treatments

• Joint Mobilizations: **Cephalic Movement of Radius** (Patla & Paris, 2000, p. 113)

• Therapist stabilizes with a grasp of the patient’s anterior-distal humerus.
• Manipulation is given by therapist’s other hand contacting the patient’s distal radius in a golfer’s grip.
• Therapist’s forearm and hand provides a downward (caudal) force on the radius.
• Oscillation may be added, and movement of joint to end range extension may be combined.
General Elbow Contracture Treatments

• Joint Mobilizations: **Caudal Movement of Radius** (Patla & Paris, 2000, p. 114)

General Wrist Contracture Treatments

• Joint Mobilizations: **Dorsal Glide of the Radius on the Ulna** (Patla & Paris, 2000, p. 99)
  • Patient is sitting with forearm in neutral, supported on table.
  • Therapist stabilizes with an underhand grasp of the patient’s distal ulna and lateral side of the carpals.
  • Therapist contacts the volar-distal surface of the radius with her proximal palm, while her finger pads contact the dorsal-distal aspect of the radius.
    KEEP OFF THE ULNA!
  • Mobilization is given through the palm contact on the volar radius in the dorsal direction.
General Wrist Contracture Treatments


General Wrist Contracture Treatments

  - SAME procedure as for the dorsal glide just described, except for mobilization.
  - Mobilization is given through the finger pads on the dorsal radius in the volar direction.
General Wrist Contracture Treatments

• Joint Mobilizations: **Volar Glide of the Radius on the Ulna** (Patla & Paris, 2000, p. 99)


  • Patient sits with forearm pronated and supported on table or wedge, the distal radius and ulna just at the edge of the support.
  • Therapist’s left hand grasps dorsal/distal surface and sides of patient’s distal radius and ulna.
  • Therapist’s right hand web space contacts the dorsal surface of the patient’s carpal bones.
General Wrist Contracture Treatments

• Joint Mobilizations: **Radiocarpal Distraction** *(Distraction of the Proximal Carpal Row)*
  (Patla & Paris, 2000, p. 101)

• Mobilization: The therapist’s right forearm exerts a force through her web space and finger contact on the patient’s proximal carpal row, in the long axis motion, distracting the proximal carpal row from the distal radius.
General Wrist Contracture Treatments

- Joint Mobilizations: **Radiocarpal Distraction** *(Distraction of the Proximal Carpal Row)*
  (Patla & Paris, 2000, p. 101)

- Patient is sitting with forearm supported in pronation on wedge or table, distal radius and ulna are clear of support underneath.
- Therapist’s right hand grasps distal/dorsal surface and sides of the radius and ulna for stabilization.
- Therapist’s left web space contacts the patient’s dorsal/proximal carpal bones.

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General Wrist Contracture Treatments

- Joint Mobilizations: **Volar Radiocarpal Glide**
  (Patla & Paris, 2000, p. 102)

- Patient is sitting with forearm supported in pronation on wedge or table, distal radius and ulna are clear of support underneath.
- Therapist’s right hand grasps distal/dorsal surface and sides of the radius and ulna for stabilization.
- Therapist’s left web space contacts the patient’s dorsal/proximal carpal bones.
General Wrist Contracture Treatments

• Joint Mobilizations: **Volar Radiocarpal Glide**
  (Patla & Paris, 2000, p. 102)

• Mobilization: The therapist’s left forearm produces a force in the volar direction through the patient’s proximal carpal row.
General Wrist Contracture Treatments

• Joint Mobilizations: **Volar Radiocarpal Glide**
  (Patla & Paris, 2000, p. 102)

• The Dorsal Glide is similar to the Volar Glide except that the patient’s forearm is supinated, and the therapist’s hand placements are reversed, contacting the patient’s volar proximal carpal row.
General Wrist Contracture Treatments

- Joint Mobilizations: **Dorsal Radiocarpal Glide** (Patla & Paris, 2000, p. 102)

- Patient sits with forearm in neutral, supported by wedge or table, with distal radius and ulna just over edge.
- Therapist uses her right hand to stabilize with grasp over the top of the patient’s distal radius, and down to the ulna on each side.
- Therapist’s left hand web space contact’s patient’s scaphoid while her left index finger contacts the patient’s volar proximal carpal row.

General Wrist Contracture Treatments


- Patient sits with forearm in neutral, supported by wedge or table, with distal radius and ulna just over edge.
- Therapist uses her right hand to stabilize with grasp over the top of the patient’s distal radius, and down to the ulna on each side.
- Therapist’s left hand web space contact’s patient’s scaphoid while her left index finger contacts the patient’s volar proximal carpal row.
General Wrist Contracture Treatments


Mobilization: Therapist’s left forearm produces an ulnar or medial glide of the proximal carpal row through the web space and index finger contacts.
General Wrist Contracture Treatments

• Joint Mobilizations: **Radiocarpal Ulnar Glide** (Patla & Paris, 2000, p. 103)

- The radial glide is similar to the ulnar glide except that the patient’s forearm is positioned so that the thumb is inferior and the pinky finger is superior (opposite direction from the “thumb up” ulnar glide).
General Wrist Contracture Treatments

• Joint Mobilizations: **Radiocarpal Radial Glide** (Patla & Paris, 2000, p. 103)

![Diagram of wrist with arrow indicating movement]

Patient’s hand is pinky up and thumb down

• Joint Mobilizations: **CarpoMetacarpo and MidCarpo Movements** (Patla & Paris, 2000, p. 92-95)

• These techniques are so repetitive and numerous that I have not pictured them.

• For example, the capitate:
  – Right hand grasps capitate with finger and thumb
  – Left hand contacts 3rd metacarpal and distracts it from capitate
  – Left hand contacts 3rd metacarpal and glides it on capitate
  – Repeat for second metacarpal on capitate
  – Then scaphoid and trapezoid are glided on capitate

**Continued**
General Hand Contracture Treatments

• Joint Mobilizations (Patla & Paris, 2000, p. 71)

<table>
<thead>
<tr>
<th>Mobilization to Increase MCP Flexion</th>
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<td>Distraction</td>
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<tr>
<td>Volar glide</td>
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<tr>
<td>Radial glide</td>
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<td>Ulnar glide</td>
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continued
General Hand Contracture Treatments

- **Joint Mobilizations** (Patla & Paris, 2000, p. 77)

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<th>Mobilization to Increase PIP and DIP Flexion</th>
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<td>Distraction</td>
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<td>Volar glide</td>
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<td>Four unicondylar glides</td>
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<th>Mobilization to Increase PIP and DIP Extension</th>
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<tr>
<td>Four unicondylar glides</td>
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General Hand Contracture Treatments

- Joint Mobilizations: **Glides of the First Metacarpal Base** (Patla & Paris, 2000, p. 96-97)
- MEDIAL or LATERAL GLIDE
- Patient sits with forearm in neutral and supported on table
- To stabilize, the therapist grasps dorsal and volar surface of patient’s trapezium with her thumb and index finger, respectively.
- Therapist’s other thumb and forefinger will grasp the 1st MCP and glide it medially OR laterally across the palm or away from the palm.
General Hand Contracture Treatments

• Joint Mobilizations: **Glides of the First Metacarpal Base** (Patla & Paris, 2000, p. 96-97)

• DORSAL or VOLAR GLIDE (at right angles to palm)

• Patient sits with forearm in partial supination and supported on table

• To stabilize, the therapist grasps dorsal and volar surface of patient’s trapezium with her thumb and index finger, respectively.

• Therapist’s other thumb and forefinger will grasp the 1st MCP _on its dorsal and volar surfaces_ and glide it dorsally OR volarly at right angles either away from or into the palm.
General Hand Contracture Treatments

• Joint Mobilizations: **MCP Joint Distraction**
  (Patla & Paris, 2000, p. 72)
  - Therapist uses thumb and index fingers of each hand to grasp the patient’s distal metacarpal and proximal phalanx on each side and close to the MCP joint.
  - The MCP joint is held in 20 degrees of flexion for the mobilization.
  - Mobilization: The therapist distracts the MCP joint with a long axis pull of the proximal phalanx in alignment with the slightly flexed joint position.
General Hand Contracture Treatments

- Joint Mobilizations: **MCP Dorsal and Volar Glides** (Patla & Paris, 2000, p. 73)
- Therapist uses thumb and index fingers of each hand to grasp the patient’s distal metacarpal and proximal phalanx on each side and close to the MCP joint.
- The MCP joint is held in 20 degrees of flexion for the mobilization.
- Mobilization: The therapist produces a volar OR a dorsal glide of the proximal phalanx
- NOTE: patient’s forearm is pronated for volar glide and supinated for dorsal glide

**CONTINUED**
General Hand Contracture Treatments

• Joint Mobilizations: **MCP Dorsal and Volar Glides** (Patla & Paris, 2000, p. 73)

![MCP Dorsal and Volar Glides](image)

• Joint Mobilizations: **MCP Radial and Ulnar Glides** (Patla & Paris, 2000, p. 74)

• Therapist uses thumb and index fingers of each hand to grasp the patient’s distal metacarpal (dorsal and volar) and proximal phalanx (radial and ulnar) on each side and close to the MCP joint.
• The MCP joint is held in 20 degrees of flexion for the mobilization.
• Mobilization: The therapist produces a radial glide of the proximal phalanx via her thumb contact on the ulnar side proximal phalanx
• NOTE: patient’s forearm is pronated

![MCP Radial and Ulnar Glides](image)
General Hand Contracture Treatments


  - Therapist uses thumb and index fingers of each hand to grasp the patient’s distal metacarpal (dorsal and volar) and proximal phalanx (radial and ulnar) on each side and close to the MCP joint.
  - The MCP joint is held in 20 degrees of flexion for the mobilization.
  - Mobilization: The therapist produces an ulnar glide of the proximal phalanx via her thumb contact on the radial side proximal phalanx
  - NOTE: patient’s forearm is pronated
General Hand Contracture Treatments

- Joint Mobilizations: **MCP Long Axis Rotation** (Patla & Paris, 2000, p. 75)
  - Therapist uses thumb and index fingers of each hand to grasp the patient’s distal metacarpal (dorsal and volar) and proximal phalanx (radial and ulnar) on each side and close to the MCP joint.
  - The MCP joint is held in 20 degrees of flexion for the mobilization.
  - Mobilization: The therapist produces a Grade II distraction held while performing a rotary force in the radial OR ulnar direction.
General Hand Contracture Treatments

• Joint Mobilizations: *Unicondylar Glides of the PIP and DIP joints* (Patla & Paris, 2000, p. 78)
  • Therapist uses thumb and index fingers of each hand to grasp the patient’s phalanx on each side of the PIP or DIP joint. The mobilizing hand will be distal to the joint, and only one side of the distal phalanx will be grasped, either medial or lateral.
  • The PIP/DIP joint is held in 20 degrees of flexion for the mobilization.
  • Mobilization: The therapist produces a dorsal or volar glide of a single condyle (medial or lateral) at a time.
General Wrist and Hand Contracture Treatments

• Strengthening of weak antagonists
  – May enhance with Functional Electric Stimulation
  – Think about how we use our hand and arm functionally; we do not make just one movement at a time
  • Use small round pads for the intrinsics, such as opponens, adductor pollicis
  • Use larger pads for extrinsic muscle bellies

General Wrist and Hand Contracture Treatments

• At all times, remember that transfer of training is often poor.
• Remember human task motivation for functional activity versus lifting a free weight.
• Use functional activities and movements when possible.
General Wrist and Hand Contracture Treatments

• Splinting Considerations
  – Botulinum toxin focal injections to force relaxation, improving tolerance to splinting and stretching
  – Dynamic and static splinting
    • Pros and cons, specific applications

General Wrist and Hand Contracture Treatments

• Reminder of tissue mechanics we hope to achieve with splinting:
  – “Connective tissue is capable of being stretched after it shortens because of its viscoelastic nature. Under tension, it can respond by reaching either an elastic or plastic deformation state. In elastic deformation, tissue reverts to its original length after a force is removed; however, when tissue is plastically deformed, it will maintain a newly elongated length after removal of the force” (Ulrich et al., 2010, p. 196-197).
Splinting Tools

• Treatment – Dynamic Splinting

• Let us discuss some common errors in utilization of dynamic splinting.
  – Contracture must be not due to bony block.
  – Relaxation of the tissue in a lengthened position must be present for “creep” to occur.
  – This cannot be achieved if the splint pressure is too great as to produce pain.
    • Tissue will simply become painful and reactive, so the patient will carry it in shortened position defensively.

Splinting Tools

• Treatment – Splints providing creep-based loading to obtain plastic deformation of soft tissue

• Force is constant and applied over time.
  – Hours

• Displacement varies

• Low load with prolonged stretch

• (Ulrich et al, 2010)
Splinting Tools

- Treatment – Splints providing stress-relaxation loading to obtain plastic deformation of soft tissue
- Force varies over time
- Displacement is constant
- “Stress relaxation principles can be further applied in the therapeutic technique of static progressive stretch. Static progressive stretch is defined as incremental, periodic application of stress relaxation where the force applied changes over time as the tissue accommodates” (Ulrich et al., 2010, p. 197).

Neurological Wrist and Hand Contractures

**Common Presentations:** (Horn & Zasler, 1996)

- Bent wrist
  - Wrist flexion contracture is more common than wrist extension.
- Clenched fist
  - The fingers are clenched tightly into the palm, separately, in part, or in their entirety of the flexor digitorum superficialis and the flexor digitorum profundus, and, possibly, weakness in the extrinsic finger extensors
  - Contracture of the palmer skin and joint capsule, collateral ligament tightness at various finger joints, and fixed contracture of the intrinsic muscles
Neurological Wrist and Hand Contractures

**Common Presentations:** (Horn & Zasler, 1996)

- Thumb-in-palm deformity
  - The thumb is pulled into the palm and unable to function due to spasticity in many different muscles
    - flexor pollicus longus
    - flexor pollicus brevis
    - abductor pollicis brevis
    - opponens pollicus
    - adductor pollicis
    - first dorsal and palmer interossei muscles

Neurological Wrist and Hand Contractures

- Remember...
  - Hypertonic muscles prevent effective stretching in a relaxed, fully lengthened position of the muscle fibers.
  - Interventions, whether surgical lengthening or sessions of botox, stretching of the hypertonic agonist and strengthening of the weak antagonists, yield temporary results.
  - The cause of the problem, in the brain, remains...and will continue to re-shorten the tissue.
Neurological Wrist and Hand Contractures

• Does this mean that we should not try to intervene, because we know it will be only temporary?
  – No. But we do need to make it clear to the patient and/or caregivers that what we provide will most often be temporary improvement, and may be repeated.
  – Quality of life is the benefit here, whether for active use of the arm, or for ease to the caregiver and patient in dressing and other assisted or dependent activities of daily living (Lam et al., 2012).

Neurological Wrist and Hand Contractures

• Distinguish between the function of the extremity and the function of the individual.
  – We think of active function and passive function of the extremity. These terms refer to the expected outcomes for a limb but do not indicate the outcome for the person as a whole. Surgical releases of an arm contracted in a flexed and internally rotated position in a hemiplegic patient often allows the person to become independent in dressing even though the arm itself remains nonfunctional” (Keenan & Mehta, 2004, p. 144).
Neurological Wrist and Hand Contractures

• Treatment of patients with contractures of the wrist and hand due to neurological causes may include stretching and strengthening enhanced by dynamic splinting and botulinum toxin injection.
• CARE must be taken to identify the major players and decide which muscles to inject.

Neurological Wrist and Hand Contractures

• Currently, large double-blind, randomised, placebo-controlled studies are focused on proving that the use of botox in the upper extremity for the neurologically impaired patient population is safe (Gracies et al., 2015).
Neurological Wrist and Hand Contractures

- We already discussed the general mechanics of botox injection, length of relaxation etc.
- Let’s look at an example of a hasty decision and the results.
- Patient’s hands are positioned in wrist flexion, MCP extension, PIP flexion, and DIP flexion. Her forearms are pronated.
- Patient’s goal was to open her hand.

Neurological Wrist and Hand Contractures

- Which muscle would you inject?
Neurological Wrist and Hand Contractures

• Which muscle would you inject?
• The FDS was injected, along with the patient’s pronators and FCU.
• What do you think happened to her hand?

Neurological Wrist and Hand Contractures

• What happened to her hand?
  – Swan neck deformity
Neurological Wrist and Hand Contractures

• Why did this happen?
  – Do you think that the FDS had greater spasticity than the EDC?
  – Is it possible that the FDS contracture was due as much or more to gravity with positioning versus spasticity?
  – She has an open hand now...but is it functional?
  – CONSIDER which are the major players and what their tightness is caused by BEFORE you recommend injection.

Neurological Wrist and Hand Contractures

• Considerations for FES with neurological muscle weakness:
  – Time needed for full contraction of muscle is longer
  – Time needed for full muscle relaxation is longer
  – Fatigue is earlier
  – Therefore, longer ramp times are needed with longer rest times in between and fewer repetitions before lengthy rest period.
Neurological Wrist and Hand Contractures

– Is there supportive evidence for use of FES on the elbow to treat neurological wrist and hand contractures?

– Remember that Meadmore and associates (2014) have demonstrated positive results in the application of FES to three muscle groups in the upper limb to complete goal-oriented movements to facilitate functional motor recovery post-stroke.

– “During each session FES was applied to the anterior deltoid, triceps, and wrist/finger extensors to assist performance of functional tasks with real-objects, including closing a drawer and pressing a light switch” (Meadmore et al., 2014, p. 105).

Neurological Wrist and Hand Contractures

– What about the new robotic UE devices?

– Why not just use as assistive device rather than trainer?

• “However, FES may cause strong involuntary muscle contractions and can be painful for patient” (Maciejasz et al., 2014p. 17 of 29 in pdf).
Neurological Wrist and Hand Contractures

- Robotic devices to date are not cost effective for home use, yet best results for this patient population come with extended use, extended therapy.
  - Please see Maciejasz and associates’ 2014 article: “A survey on robotic devices for upper limb rehabilitation” for an outstanding summary of the current devices on the market.
  (Available as open access: https://jneuroengrehab.biomedcentral.com/articles/10.1186/1743-0003-11-3 )

Neurological Wrist and Hand Contractures

- What about dynamic and other splinting?
  - I strongly recommend using only with concurrent botox injection.
  - They must be practical so that the caregiver can apply them correctly.
  - I find the use of dynamic splints more reasonable for neurological contractures of the wrist and hand, as less of the total arm is restrained by the device as for an elbow or shoulder splint.
Summary

• We have more tools now than ever before to treat contractures of the wrist and hand, regardless of the cause or type.
• This course has explored in detail general wrist and hand contracture treatment, with emphasis on specific joint mobilization techniques.
• We have also discussed unique considerations for treatment of contractures due to neurological pathology.
• In each case, important considerations are the state of the tissue, limitations imposed by the causative pathology, and each patient’s personal goals for functional use of his/her arm and hand.

Learner Outcomes

As a result of this course, participants will be able to:

1) ...identify the joint and soft tissue structures of the wrist and hand that are commonly problematic in neurological and orthopedic contractures

2) ...recognize in post-course testing, best combined use of conservative treatments including modalities, splinting, hands-on manual treatments, and Botulinum toxin injection guidance to treat patients with contractures of the wrist and hand.

3) ... discuss and later incorporate into the participant's daily practice, evidence-based conservative treatments as well as those pending clinical trials which have demonstrated successful use in the clinic for these impairments.
References


Questions and Answers:

Point of Contact:
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