SESSION 1 OBJECTIVES

At the conclusion of the lecture portion of this session, participants will be able to:

1. Utilize the best available evidence to identify conditions that would benefit from the use of neurodynamics.
2. Differentiate neural tension techniques from neural mobilization techniques.
3. Understand the phenomenon of double-crush injury to the nervous system and formulate appropriate treatment strategies for this condition.
4. Develop an appropriate treatment plan to address a variety of peripheral nerve pathologies.

NEURODYNAMICS

Elizabet h A. Ballard, LAT, ATC*  
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*Murphy Deming College of Health Sciences, Mary Baldwin University
*Moravian College Department of Rehabilitation Sciences

Special Thanks to the NATA Research and Education Foundation for sponsoring this talk.

SOFT-TISSUE ASSESSMENT

- This commonly includes muscle, tendon but not nervous tissue
  - Nervous tissue travels through muscle
- Muscle Flexibility Assessment ➔ Nerve Mobility Assessment
  - Assess muscle length tension relationship
  - Assess nerve length tension relationship

Is ROM limited
Is Joint Play limited
Are flexibility tests positive

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Is Joint Play limited
Are flexibility tests positive

Neurodynamics are NOT indicated
Neurodynamics ARE indicated

Are neural tension tests positive


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- Nervous tissue travels through muscle
- Muscle Flexibility Assessment ➔ Nerve Mobility Assessment
  - Assess muscle length tension relationship
  - Assess nerve length tension relationship
SOFT-TISSUE ASSESSMENT

Key differences including subjective report from patient, onset of symptoms, and range in which symptoms present.

HILTON’S LAW

- The nerve supplying the muscles that act on the joint also innervates the joint
- Thus, when assessing limited mobility of a joint, a clinician should assess:
  - The joint
  - The soft tissue that crosses the joint
  - The nerve that crosses the joint

ANATOMY CONSIDERATIONS

- Low elasticity but high mobility
  - Nerves “glide” or “mobilize” but do not “stretch”
  - Although non-elastic, a nerve will elongate or move
    - As nerves elongate, blood flow increases, pressure increases
  - One continuous tissue from brain to spinal cord (CNS) to peripheral nervous system (PNS)
  - Restriction in one location results in symptoms in another location

- Nerve anatomy similar to muscle
  - Epineurium → Epimysium
  - Perineurium → Peri mysinium
  - Endoneurium → Endomysium
  - Fascicle → Fascicle
  - Nerve mobility can be affected by scarring inside or outside the nerve

PERIPHERAL NERVE PATHOLOGY

- Damage to peripheral nerves usually occurs through:
  - Orthopedic means:
    - Entrapment or Occlusion (Pinching)
    - Traction or Stretching (Tension)
  - Other:
    - Vitamin or Nutritional Deficiency
    - Diabetes
    - Neurological Diagnosis: Guillain-Barré Syndrome (GBS)

COMMON INJURY SITES

- **Upper extremity**
  - Brachial plexus
  - Axillary nerve
  - Musculocutaneous nerve
  - Median nerve
  - Ulnar nerve
  - Radial nerve

- **Lower extremity**
  - Femoral nerve
  - Obturator nerve
  - Sciatic nerve
  - Tibial / Posterior Tibial nerve
  - Common / Fibular nerve
NERVE MOBILITY TERMINOLOGY

- Nerve Mobility:
- Movement of nerve
- Neural Tension:
  - Tight nerve
- Neurodynamics:
  - Anything that affects the mobility or dynamics of the neural system

TESTING/TREATMENT TERMINOLOGY

- Neural Tension Testing:
  - Testing of anything that could impede nerve mobility
  - Including: compression, tension, adhesion
- Neural flossing/gliding:
  - Treatment method to improve neural mobility

PERIPHERAL NERVE PATHOLOGY

- Signs and symptoms of impaired nerve mobility
  - Paresthesia
  - Limited ROM
  - (+) Provocation tests
  - Causes of symptoms
  - Entrapment (between muscle or fascia)
  - Nerve root compression
  - Scarring / Adhesions

COMMON SITES OF ENTRAPMENT- MEDIAN NERVE

- Cervical/Shoulder:
  - Thoracic outlet
- Elbow:
  - Cubital fossa
- Forearm:
  - Pronator teres
- Wrist:
  - Carpal tunnel

ADSON'S TEST

- Palpate distal radial pulse
- Extend & ER the shoulder
- Patient takes a deep breath
- Extends and Rotates Cervical Spine to test side
- Positive test is diminished radial pulse or reproduction of symptoms

ADSON'S TEST REFERENCES


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ADSON'S TEST REFERENCE

**ELBOW FLEXION TEST**

- Actively flex elbow to end-range
- Forearm supinated or pronated
- Hold this position 3-5 minutes
- Positive test is reproduction of symptoms into the median nerve distribution

<table>
<thead>
<tr>
<th>Reliability</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
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<tr>
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<td>0.76</td>
<td>0.97</td>
<td>1.24</td>
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**PHALEN'S TEST**

- Dorsum of hands placed together
- Wrists in full flexion
- Compression applied through hands
- Position held for 1 minute
- Positive test is reproduction of symptoms

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**PINCH GRIP TEST**

- Patient is instructed to touch the tip of the thumb to the tip of the index finger, forming a circle
- Touching pad to pad as opposed to tip to tip is a positive test

**PHALEN'S TEST REFERENCES**


**ULTT 1: MEDIAN NERVE BIAS**

- Depress shoulder
- Abduct shoulder to 110°
- Supinate forearm
- Extend wrist
- Extends fingers
- Extends elbow

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**ULTT 2: MEDIAN NERVE BIAS WITH MODIFIED ELBOW**

- Depress shoulder
- Abduct shoulder to 10°
- Supinate forearm
- Extend wrist
- Extends fingers
- ER shoulder
- Extends elbow

<table>
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<td>1.24</td>
<td>0.14</td>
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</tbody>
</table>
**COMMON SITES OF ENTRAPMENT - RADIAL NERVE**

- Shoulder:
  - Saturday Night Paley
  - Honeymoon Paley
  - Forearm:
    - Radial Tunnel Syndrome

**ULTT 3: RADIAL NERVE BIAS**

- Depress shoulder
- Abduct shoulder to 90°
- Pronate forearm
- Flex & UD wrist
- Flex fingers
- ER shoulder
- Extend elbow

**COMMON SITES OF ENTRAPMENT - ULNAR NERVE**

- Elbow:
  - Cubital Tunnel Syndrome
  - Wrist/Hand:
    - Guyon's Canal Syndrome
    - Hand/Elbow Paley

**Tinel's Test at Elbow**

- Clinician taps over cubital tunnel / ulnar nerve
- Positive test is reproduction of symptoms in the ulnar nerve distribution

**ULTT 4: ULNAR NERVE BIAS**

- Depress shoulder
- Abduct shoulder to 90°
- Supinate forearm
- Extend & RD wrist
- Extend fingers
- ER shoulder
- Flex elbow

**COMMON SITES OF ENTRAPMENT - AXILLARY NERVE**

- Shoulder:
  - Axillary
  - Crutches
**Common Sites of Entrapment - Sciatic Nerve**

- Sacroiliac Joint / Hip
- Periformis syndrome

**Piriformis Test**

- Hip flexed to ~40 degrees with knee flexed
- Clinician stabilizes hip and applies downward pressure at the knee
- Positive test is buttock pain or peripheral symptoms

**Straight Leg Raise Test**

- Referenced in 20 different studies
- Overall good sensitivity
- Pain below 70 degrees hip flexion usually indicates HNP or sciatic nerve involvement
- 0-30 Mechanical LBP or Hip
- 30-50 Sciatic Nerve
- 70-90 SI

**Reliability**

<table>
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<tr>
<th>Study</th>
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<th>S.R.</th>
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<tr>
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<td>0.20</td>
<td>2.00</td>
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</table>

**Neurodynamics Evaluation: Lower Extremity**

- Standard SLR assessment
- Assess sciatic nerve, hamstring issues
- Bias for common fibular and tibial nerves

**SLR References**

**SLR REFERENCES**


**COMMON SITES OF ENTRAPMENT - FEMORAL NERVE**

- **Hip:**
  - Inguinal ligament
  - Hip flexor

**COMMON SITES OF ENTRAPMENT - TIBIAL NERVE**

- **Knee:**
  - Popliteal space
- **Lower leg:**
  - Gastrocnemius
  - Achilles:
    - Tarsal tunnel

**TINELE'S TEST AT TARSAL TUNNEL**

- **Clinician taps over tarsal tunnel**
- **Positive test is reproduction of symptoms in the tibial nerve distribution.**

<table>
<thead>
<tr>
<th>Muscle Group</th>
<th>Test Action</th>
<th>Hip Adduction</th>
<th>LR</th>
<th>SLR</th>
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</thead>
<tbody>
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<td>Hip</td>
<td></td>
<td>S/A</td>
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**NEURODYNAMICS TESTING**

- Neurodynamics is often tested through the application of neural tension tests
- Assesses whether the nervous system is involved
- Neural tension testing is used to examine nerve:
  - **Length:**
    - Adaptive shortening
  - **Mobility:**
    - Entrapment
  - **Inflammation:**
    - Damage

**NEURODYNAMICS DYSFUNCTION**

- Potential mechanisms:
  - Loss of ROM
  - Increased dural tension can be felt throughout the neural system, which can potentially affect the available ROM at the trunk and/or distal extremities
  - Find the "cause of the cause"
  - Inflammation:
    - Neural injury responds the same as injury to the rest of the body through an inflammatory response, which results in pain

**DIFFERENTIATING NERVE, MUSCLE, JOINT**

- Subjectively:
  - Listen to your patient
  - Describing: "burning", "throbbing", or "stabbing" symptoms
  - Reducing pain present
- Objectively:
  - ROM/MOBILITY:
    - Compare bilaterally
    - Special testing:
      - Does (+) neural tension test reproduce patient's symptoms
      - Does a "sensitizer" affect the response
      - Moving a distal component such as hand or foot

**EVALUATION**

- Peripheral neuropathies rarely occur in isolation
  - Something is usually cause of
  - Need to determine the cause
    - Muscle tightness
    - Posture
    - Compression
    - Trauma
    - Scar tissue

**COMMON CAUSES: MUSCLES**

- Scalenes & Pectoralis minor
- Brachial plexus
- Piriformis & Hamstring
- Sciatic Nerve
- Gastrocnemius
- Tibial Nerve

**COMMON CAUSES: POSTURE**

- Lack of mobility in spine → tight muscle

**COMMON CAUSE: COMPRESSION**

- Stenosis, disc herniation, muscle tension, swelling

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https://www.pinterest.com/pin/356839970452299454

Lack of mobility in spine → tight muscle

Stenosis, disc herniation, muscle tension, swelling
COMMON CAUSE: TRAUMA

- Stinger, burner, brachial plexopathy

OTHER COMMON CAUSES

- Facet joint restriction
- Retinaculum
- Scar tissue

DOUBLE CRUSH THEORY

- If axoplasmic flow is partially reduced at a proximal site of injury, further reduction can occur at a distal compression site
- Example:
  - Proximal issue:
    - Example or herniated disc
    - Leading to distal involvement:
    - Tight peroneus

DOUBLE CRUSH ASSESSMENT/TREATMENT

- Evaluation:
  - Entire length of nerve
  - Every joint involved
- Treatment:
  - Should progress to entire length of nerve

TREATMENT METHODS

- Multiple methods exist
  - Find what works for you
- Tensioners- sustained stretch
  - NOT recommended

TREATMENT- NEURAL GLIDING/FLOSSING

- Option 1
  - Provide slack at one end
  - Take up slack at the other
  - Alternate rhythmically
  - Begin with small range
  - DO NOT PRODUCE / INCREASE SYMPTOMS
  - Need to know available range of motion, to the point of symptoms
TREATMENT- NEURAL GLIDING/FLOSSING

- Option 2
- One end remains fixed
- Clinician manipulates slack/tension on the distal end
- Controlled, Consistent, Rhythmic motion
- Begin with small range
- DO NOT REPRODUCE / INCREASE SYMPTOMS
- Need to know available range of motion, to the point of symptoms

TREATMENT TAKE HOME POINTS

- Treatment should not reproduce symptoms
- If symptoms begin at end treatment session
- Symptoms should resolve immediately
- Need to be confident in patients ability to perform before given as HEP

LAB REMINDER

- Lab sessions will occur at 4:30 and 5:30 p.m
- Each session is limited to 50 attendees
- Please come dressed for hands-on learning (shorts and t-shirts)
- Evaluation & Treatment Techniques

SPECIAL THANKS

- MAATA Planning & Selection Committee
- Lori Bristow
- NATA Research and Education Foundation
- Dr. Marty Fontenot, PT, DPT, SCS, OCS
- Faculty Advisor Mary Baldwin University

QUESTIONS?

SESSION II OBJECTIVES

- At the conclusion of lab portion of this session, participants will be able to:
  1. Perform selected neural tensioning techniques to assess patients suffering from peripheral nervous system pathology.
  2. Appropriately apply neurodynamic treatment techniques to address upper and lower extremity pathologies.
  3. Incorporate neural mobilization into the overall treatment plan of a patient with a musculoskeletal pathology.
**STRAIGHT LEG RAISE TEST**

- Referenced in 20 different studies
- Overall good sensitivity
- Pain below 70 degrees hip flexion usually indicates HNP or sciatic nerve involvement
- 0-30 Mechanical LBP or Hip
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Normal HB flexibility is 70 degrees or more

**TREATMENT - NEURAL GLIDING/FLOSSING**

- **Option 2**
  - Clinician manipulates slack/tension on the distal end
  - Controlled, Consistent, Rhythmic motion
  - Begin with small range
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<tr>
<td>Option 2</td>
<td>0.83</td>
<td>0.72</td>
<td>0.33</td>
<td>1.07</td>
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Treating TAKE HOME POINTS

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