

NEURODYNAMICS

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Athletic Training



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



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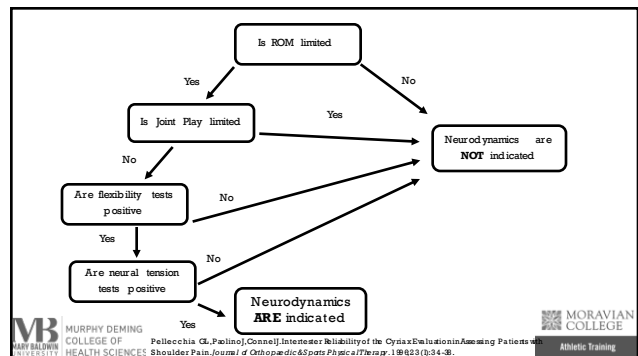
SESSION I OBJECTIVES

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.



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SOFT-TISSUE ASSESSMENT

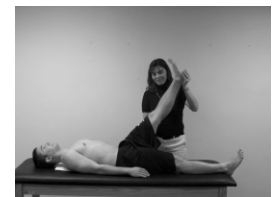
- This commonly includes muscle, tendon but not nervous tissue
- Nervous tissue travels through muscle
- **Muscle Flexibility Assessment → Nerve Mobility Assessment**
 - Assess muscle length tension relationship
 - Assess nerve length tension relationship



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SOFT-TISSUE ASSESSMENT

- **Muscle Flexibility Assessment → Nerve Mobility Assessment**
 - Assess muscle length tension relationship
 - Assess nerve length tension relationship



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SOFT-TISSUE ASSESSMENT



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



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HILTON'S LAW

- The nerve supplying the muscles that act on the joint also innervate 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



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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

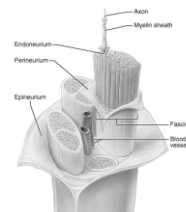


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ANATOMY CONSIDERATIONS

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



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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-Barre Syndrome (GBS)



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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



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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

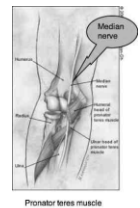
PERIPHERAL NERVE PATHOLOGY

- 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

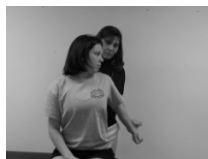
- **Cervical/Shoulder:**
 - Thoracic outlet
- **Elbow:**
 - Cubital fossa
- **Forearm:**
 - Pronator teres
- **Wrist:**
 - Carpal tunnel



Pronator teres muscle

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



Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	0.50-0.79	0.16-1.00 3/4 studies above 0.70	3.3	0.27

ADSON'S TEST REFERENCES

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- Piers MG, Delinger M. The false-positive rate of thoracic outlet syndrome shoulder maneuver in healthy subjects. *Acad Emerg Med*. 1998;5:633-637.
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Novak CB, Lee GW, Mackinnon SE, Lay L. Provocative testing for cubital tunnel syndrome. *J Hand Surg [Am]*. 1994;19(5):817-820.
 Rayan CM, Jensen C, Duke J. Elbow flexion test in the normal population. *J Hand Surg*. 1992;17:86-89.

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



Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	0.75	0.99	0.75	0.25

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PINCH GRIP TEST

- Patient is instructed 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



MacDermid JC, Kame H, Woodbury MG. Interrater reliability of pinch and grip strength measurements in patients with cumulative trauma disorders. *J Hand Ther*. 1994;7:10-14.

Reliability	Sensitivity	Specificity	+ LR	- LR
0.76	N/A	N/A	N/A	N/A

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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



Reliability	Sensitivity	Specificity	+ LR	- LR
0.58-0.79	0.47-0.87 4/7 studies above 0.70	0.17-0.95 4/7 studies above 0.80	0.57-15.0 3/7 studies above 9.0	0.13-12 4/7 studies below 0.4

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PHALEN'S TEST REFERENCES

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- Gellman H. Carpal tunnel syndrome: an evaluation of the provocative diagnostic tests. *J Bone Joint Surg*. 1986;68:734-737.
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- Miedany VE, Samia A, Yousef S, et al. Clinical diagnosis of carpal tunnel syndrome: Old tests, new concepts. *Joint Bone Spine*. 2008;34:451-457.
- Mondelli M, Pavesio S, Gannini F. Provocative tests in different stages of carpal tunnel syndrome. *Clin Neurol Neurosurg*. 2001;103:178-183.
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ULTT 1: MEDIAN NERVE BIAS

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



Wainner R, Fitz J, Impong J, Basinger M, Delitto A, Allison S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. *Spine*. 2003;28(3):3073-19.

Reliability	Sensitivity	Specificity	+ LR	- LR
0.76	0.97	0.22	1.24	0.14

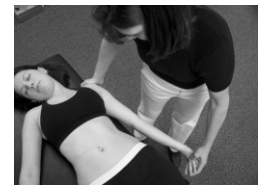
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ULTT 2: MEDIAN NERVE BIAS

(WITH MUSCULOCUTANEOUS & AXILLARY NERVE)

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



Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	N/A	N/A	N/A	N/A

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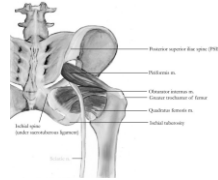
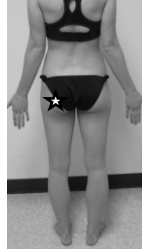
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COMMON SITES OF ENTRAPMENT- SCIATIC NERVE

- Sacroiliac Joint / Hip:
- Piriformis syndrome



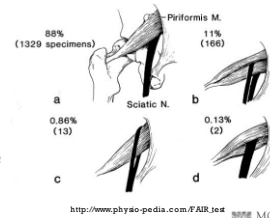
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COMMON SITES OF ENTRAPMENT- SCIATIC NERVE

- Examined 1510 limbs (755 cadavers) to examine relationship between sciatic nerve and piriformis muscle
- In 89% of cases (a & c) the sciatic nerve ran under the piriformis muscle
- In 11% of cases (b & d) the sciatic nerve ran through the piriformis muscle



http://www.physio-pedia.com/Piriformis_test

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Beaton LE, Anson BJ. The relation of the sciatic nerve to its subdivisions to the piriformis muscle. *Anat Rec* 70:1-4, 1938.

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PIRIFORMIS TEST

- Hip flexed to ~60 degrees with knee flexion
- Clinician stabilizes hip and applies downward pressure at the knee
- Positive test is buttock pain or peripheral symptoms



Fukunaga L, Dombi G, Michalson C, et al. Piriformis syndrome: diagnosis, treatment and outcome a 10-year study. *Arch Phys Med Rehabil*. 2002;83(10):295-301.

Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	0.83	0.88	5.2	1.4

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NEURODYNAMICS EVALUATION: LOWER EXTREMITY

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

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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 SIJ
- Normal HS flexibility is 70 degrees or more



Reliability	Sensitivity	Specificity	+ LR	- LR
0.32-0.92	0.16-0.97	0.10-0.89	1.03-4.72	0.05-0.90
Mixed	Above 0.8	Below 0.5	Below 2.0	~ 0.40

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SLR REFERENCES

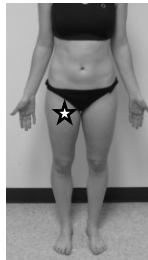
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SLR REFERENCES

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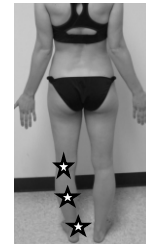
COMMON SITES OF ENTRAPMENT— FEMORAL NERVE

- Hip:
 - Inguinal ligament
 - Hip flexor



COMMON SITES OF ENTRAPMENT- TIBIAL NERVE

- Knee:
 - Popliteal space
- Lower leg:
 - Gastrocnemius
- Ankle:
 - Tarsal tunnel



TINEL'S TEST AT TARSAI TUNNEL

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



Koff LM & Schulhofer SD. Flexor hallucis longus dysfunction. *J Foot Ankle Surg*. 1998; 37(2):101-09.

Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	0.58	N/A	N/A	N/A

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

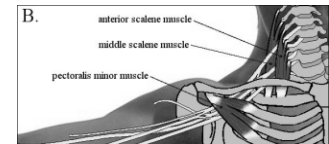
- Subjectively:
 - Listen to your patient
 - Describing: "burning", "throbbing", or "stabbing" symptoms
 - Radiating pain present
- Objectively:
 - ROM/MOBILITY:
 - Compare bilaterally
 - Special testing:
 - Does (+) neural tension test reproduce patient's symptoms
 - Does a "sensitizer" affect the response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

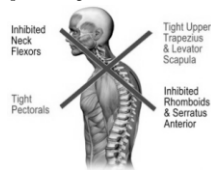
COMMON CAUSES: MUSCLES

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



COMMON CAUSES: POSTURE

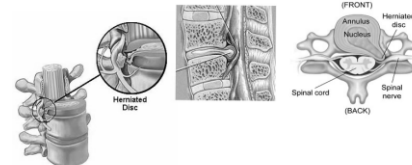
- Lack of mobility in spine → tight muscle



Upper Crossed Syndrome

COMMON CAUSE: COMPRESSION

- Stenosis, disc herniation, muscle tension, swelling



COMMON CAUSE: TRAUMA

- Stinger, burner, brachial plexopathy

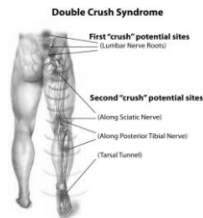


OTHER COMMON CAUSES

- Fascial 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:
 - Stenosis or herniated disc
 - Leading to distal involvement:
 - Tight piriformis



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 REPRODUCE / 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 → 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 pm
- 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
 - 30-50 Sciatic Nerve
 - 70-90 SIJ
- Normal HS flexibility is 70 degrees or more



Reliability	Sensitivity	Specificity	+ LR	- LR
0.32-0.92	0.16-0.97	0.10-0.89	1.03-4.72	0.05-0.90
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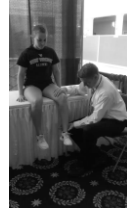


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TREATMENT- NEURAL GLIDING/FLOSSING

- 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

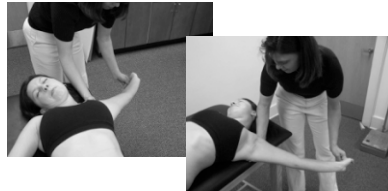


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ULTT 1: MEDIAN NERVE BIAS

- Depress shoulder
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- Supinate forearm
- Extend wrist
- Extends fingers
- Extends elbow



Wainner R, Fritz J, Ingram J, Boeringe M, Delino A, Allon S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. Spine. 2003;28(3):3073-19.

Reliability	Sensitivity	Specificity	+ LR	- LR
0.76	0.97	0.22	1.24	0.14



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ULTT 3: RADIAL NERVE BIAS

- Depress shoulder
- Abduct shoulder to 10°
- Pronate forearm
- Flex & UD wrist
- Flex fingers
- IR shoulder
- Extend elbow



Wainner R, Fritz J, Ingram J, Boeringe M, Delino A, Allon S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. Spine. 2003;28(3):3073-19.

Reliability	Sensitivity	Specificity	+ LR	- LR
0.83	0.72	0.33	1.07	0.84



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ULTT 4: ULNAR NERVE BIAS

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



Wainner R, Fritz J, Ingram J, Boeringe M, Delino A, Allon S. Reliability and diagnostic accuracy of the clinical examination and patient self-report measures for cervical radiculopathy. Spine. 2003;28(3):3073-19.

Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	N/A	N/A	N/A	N/A

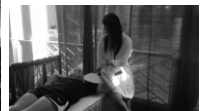


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TREATMENT- NEURAL GLIDING/FLOSSING

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



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ULTT 2: MEDIAN NERVE BIAS

(WITH MUSCULOCUTANEOUS & AXILLARY NERVE)

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



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Reliability	Sensitivity	Specificity	+ LR	- LR
N/A	N/A	N/A	N/A	N/A



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TREATMENT TAKE HOME POINTS

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



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QUESTIONS?



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