Spasticity

Goals and Objectives

Course Description
“Spasticity” is an online recorded video of a previously presented live CE webinar for occupational therapists and occupational therapy assistants. This course includes a review of current literature relating to pathophysiology, measurement, pharmacological management, and rehabilitation techniques for spasticity.

Course Rationale
The purpose of this course is to provide a comparative analysis of traditional and contemporary techniques to assess and manage spasticity based on current research to aid the clinician in employing these techniques effectively to facilitate recovery of motor control.

Course Goals and Objectives
Upon completion of this course, participants will be able to:
1. Identify the pathophysiology of spasticity.
2. Identify the causes of hemiplegic shoulder pain.
3. Compare scales utilized to assess muscle tone.
4. Define the role of casting and splinting aid in contracture management.
5. Identify the stages of recovery of motor control.
6. Differentiate current treatment concepts specific to managing spasticity.
7. Select therapeutic interventions to manage increased muscle tone and facilitate motor control.
8. Identify the effectiveness of electrical stimulation for spasticity reduction.
10. Classify various methods pharmacological management of spasticity.

Course Provider – Innovative Educational Services
Course Instructor - Jodi Gootkin, PT, MEd, CEAS
Target Audience – Occupational Therapists, Occupational Therapy Assistants
Course Educational Level – This course is applicable for introductory/intermediate learners.
Course Prerequisites – None
Method of Instruction/Availability – Recorded video available on demand at cheapceus.com.
Criteria for Issuance of CE Credits – Completion of viewing of 3 hour recorded video, and a score of 70% correct or greater on the course post-test
Continuing Education Credits – Three (3) hours of continuing education credit.
Course Fee - $34.95
Conflict of Interest – No conflict of interest exists for the presenter or provider of this course.
Refund Policy - Unrestricted 100% refund upon request. The request for a refund by the learner shall be honored in full without penalty or other consideration of any kind. The request for a refund may be made by the learner at any time without limitations before, during, or after course participation.

Innovative Educational Services
SPASTICITY

Live Interactive Webinar Presented By:
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Course Overview

“Spasticity” examines traditional and contemporary interventions used to normalize muscle tone. This course includes a review of current literature relating to pathophysiology, measurement, pharmacological management, and rehabilitation techniques for spasticity.

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Course Rationale

The purpose of this course is to provide a comparative analysis of traditional and contemporary techniques to assess and manage spasticity based on current research to aid the clinician in employing these techniques effectively to facilitate recovery of motor control.

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Goals and Objectives

1. Understand the pathophysiology of spasticity.
2. Compare scales utilized to assess muscle tone.
3. Identify how the developmental sequence is utilized to facilitate return to function.
4. Differentiate current treatment concepts specific to managing spasticity.
5. Select therapeutic interventions to manage increased muscle tone and facilitate motor control.
6. Determine the effectiveness of electrical stimulation for spasticity reduction.
7. Summarize how mirror therapy and vibration impact muscle tone.
8. Define the role of contracture management in reducing spasticity.
9. Classify various methods pharmacological management of spasticity.
10. Identify surgical management techniques for spasticity.

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• After the live interactive webinar and prior to 11:59 pm TONIGHT go to www.cheapceus.com
• Complete the post test with score of at least 70%
• May be retaken multiple times
• Submit online payment for course
• Print certificate
• Course review and summary for post test at the end of the webinar.

Normal Muscle Tone
• At rest there is a minimal amount of tension maintained in a muscle that resists passive stretch.
• Resting tone is low enough to allow movement but high enough to support activity.

Muscle Spasm
• In an intact neuromuscular system, involuntary contraction of a muscle due to overuse, electrolyte imbalance, or dehydration.
• Often presents in therapy as the body’s protective mechanism to avoid further injury or in response to muscular compensations for movement.

Muscle Spasm ≠ Spasticity

Tone Alterations
• Resting tone in the muscle changes in response to injury of the nervous system.

Spasticity

Nervous System
• The nervous system is subdivided into two primary components:
  • Central Nervous System (CNS)– brain and spinal cord
  • Peripheral Nervous System (PNS)– sensory and motor nerves outside of CNS
Healthy Stretch Reflex

• Normally when muscle is elongated, the muscle spindle recognizes the altered length and speed at which it occurred.
• When stretched quickly, it transmits a signal to the spinal cord triggering the stretch reflex.
• Signal sent back down motor neuron to muscle which develops tension to resist the change in length.

Lower Motor Neuron Lesion

• The healthy stretch reflex response is absent with a lower motor neuron lesion of the peripheral nerve resulting in flaccidity and hyporeflexia.

Upper Motor Neuron Syndrome

• Injury or disease process of the brain or spinal cord presents with specific signs/symptoms.
  • Spasticity
  • Hyperreflexia
  • Associated Reactions
  • Motor Weakness

Diagnoses

• Conditions presenting with spasticity involve upper motor neuron lesions.
  • Cerebral Palsy CP
  • Multiple Sclerosis MS
  • Traumatic Brain Injury TBI
  • Spinal Cord Injury SCI
  • Cerebrovascular Accident CVA
  • Amyotrophic Lateral Sclerosis ALS
  • Parkinson’s Disease PD

Pathophysiology of Spasticity

• Several mechanical and neuronal mechanisms have been theorized as result in prolonged disinhibition of the spinal reflexes that result in spasticity.
  • Disrupted descending regulation
  • Denervation supersensitivity
  • Hyperexcitable stretch reflex

Disrupted Descending Regulation

• Upper motor neuron lesions result in an imbalance of excitatory and inhibitory spinal tracts between the brain and muscles.
• This leads to reduced inhibitory control over the stretch reflex that allows exaggerated muscle firing at rest.
Denervation Supersensitivity

- Without inhibition from higher cortical centers over activity occurs due to:
  - Alpha motor neurons form new postsynaptic membrane receptors
  - Adjacent interneurons induce local sprouting creating abnormal synapses

Connective Tissue Adaptations

- Over time connective tissue mechanical changes alter the length tension relationship of the muscle and contribute to increased muscle spindle stimulation of the stretch reflex.

Hyperexcitable Stretch Reflex

- Spasticity
  - Augmented Stretch Reflex
  - Viscoselastic Muscle Changes Due to Shortened Position
  - Lower Muscle Spindle Stretch Threshold
  - Decreased Muscle Extensibility

Classifications of Spasticity

- Generalized: Spasticity affecting more than two regions of the body
- Regional: Spasticity affecting one or two regions of the body
- Focal: Spasticity around one joint or isolated muscle(s)

Patterns of Spasticity

- Often spasticity tends to present more in specific muscle groups.
  - Upper Extremity Flexor Tone
    - Scapular retraction and depression
    - Shoulder ADDuction and Internal Rotation
    - Elbow Flexion
    - Forearm Pronation
    - Wrist and Finger Flexion
  - Lower Extremity
    - Knee flexors or extensors
    - Ankle Plantarflexors
Lower Extremity Extensor Tone

- Pelvic Retraction and Elevation
- Hip Extension, ADDuction, and Internal Rotation
- Knee Extension
- Ankle Inversion and Plantarflexion

Lower Extremity Flexor Tone

- Hip ADDuction
- Knee Flexion

Clasp Knife Spasticity

- Passive stretch produces initial high resistance to motion followed by sudden letting go allowing passive motion.

Clonus

Cyclical spasmodic hyperactivity of both agonist and antagonist muscles.

- Sudden Stretch
- Muscle Spindle Activation
- Stretch Reflex Triggers Muscle Contraction
- Stretch Persists
- Golgi Tendon Organ Activated

Rigidity

Spasticity of both the agonist and antagonist muscles resulting in significant resistance to movement in both directions.

- Cogwheel rigidity: Ratchet-like response to passive motion with alternating letting go and increased resistance
- Lead pipe rigidity: Constant resistance from both agonist and antagonist

Decorticate and Decerebrate Rigidity

- Decorticate: Bilateral Upper Extremity Flexion + Bilateral Lower Extremity Extension
- Decerebrate: Bilateral Upper Extremity Extension + Bilateral Lower Extremity Extension
Assessing Muscle Tone

- Manual muscle testing is not valid as voluntary muscle contraction cannot be measured when increased tone is present.
- When spasticity is present, manual muscle testing is not applicable.

Modified Ashworth Scale (MAS)

- Most widely utilized tool for measuring spasticity.
- Clinician passively moves limb through range of motion to assess resistance to stretch.
- The modification to the original scale differentiates between mild and moderate spasticity.

Modified Ashworth Scale Grading

Grade | Description
--- | ---
0 | No increase in muscle tone
1 | Slight increase in muscle tone; catch and release OR minimum resistance at end of ROM when moved in flexion or extension
1+ | Slight increase in muscle tone; catch followed by minimum resistance throughout the remainder ROM (less than half)
2 | Moderate increase in muscle tone throughout most of the ROM, but body part(s) easily moved
3 | Marked increase in muscle tone; passive movement difficult
4 | Affect part(s) rigid in flexion or extension

Modified Ashworth Reliability and Validity

- Generally suggested for use with CVA, SCI, and TBI but not recommended for MS
- Criticized for assessing global resistance to passive movement as opposed to stretch reflex hyperexcitability.

Modified Tardieu Scale

- Considers multiple factors when assessing spasticity.

Modified Tardieu Reliability

- Appears to be more accurate than Modified Ashworth Scale across multiple populations, but is less frequently utilized in the clinical setting.
  - CVA, TBI, SCI
Patient Reported Impact of Spasticity Measure (PRISM)

- Patient self-report questionnaire on the impact of spasticity on quality of life.
- Subscales provide perspective on social avoidance/anxiety, psychological agitation, daily activities, need for assistance/positioning, need for intervention, and social embarrassment.

Penn Spasm Frequency Scale

- Self-report questionnaire of patient's perception of the frequency and severity of their spasticity.

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Spasm Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No spasm</td>
</tr>
<tr>
<td>1</td>
<td>Mild spasms induced by stimulation</td>
</tr>
<tr>
<td>2</td>
<td>Infrequent full spasms occurring less than once per hour</td>
</tr>
<tr>
<td>3</td>
<td>Spasms occurring more than once per hour</td>
</tr>
<tr>
<td>4</td>
<td>Spasms occurring more than 10 times per hour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 2</th>
<th>Spasm Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mild</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>Severe</td>
</tr>
</tbody>
</table>

Influential Factors

- With pediatric patients increased tone may be indicative of illness, pain, anxiety, fatigue or other heightened emotional states.

Exacerbating Factors

- Monitor the patient for and educate them or caregivers about nociceptive, visceral, or somatic stimuli that may aggravate spasticity.
  - Ingrown nails
  - Pressure sores
  - Bladder retention
  - Constipation
  - Generalized or local infection
  - Skin irritation
  - Exertion

Complications from Spasticity

- Normalizing tone is necessary to manage complications of muscle shortening, loading on bony prominences, pain, altered body image, and loss of function.

Joint Subluxation

- Forces generated by spastic muscles alter forces on femoral head in acetabulum leading to joint subluxation.
  - Can be “silent” or painful
  - Progression can contribute to pelvic obliquity and scoliosis.
Considerations

- Comprehensive rehabilitation incorporates strategies to address both the neurogenic and biomechanical component of spasticity.

Neurogenic
- Hyperactive muscle contraction

Biomechanical
- Stiffness and short tissue shortening

Rehabilitation Goals

- Prevent complications
- Prevent contractures
- Improve positioning and seating
- Decrease dependence with ADLs
- Increase functional mobility
- Reduce fall risk

Spasticity Management

- Facilitate Antagonists
- Inhibit Spastic Muscles
- Prevent Contracture
- Promote Normal Movement

Positioning

- Positioning devices such as towel rolls and wedges provide stability and alignment minimizing the need for compensatory muscle contraction that could lead to a global increase in tone.
- Altering body position can break spastic patterns and assist in minimizing joint contracture.

Positioning Strategies

- Avoid positions that favor abnormal tone and contribute to soft tissue shortening.

Intervention Selection

- “Lack of consensus on the basis of spasticity and the associated absence of guidelines for treatment, use of drugs and rehabilitation programmes.”
- Multiple techniques are recognized to reduce tone and facilitate return to function.
  - Brunstrom
  - Bobath
  - Proprioceptive Neuromuscular Facilitation
  - Complementary Techniques
- Work in various developmental sequence postures to encourage antigravity control.
Spasticity

<page content>
Spasticity

Tapping

• Brisk tapping over the muscle belly opposite the spastic muscle facilitates it to contract.
• Through reciprocal inhibition the spastic muscle will relax.

Skill Progression

• Mobility – Obtain Posture

Skill Progression

• Stability – Hold Posture accepting challenges at head/neck, pelvis and shoulder

Skill Progression

• Controlled Mobility – Weight Shift, lifting and reaching with extremities, trunk rotation

Skill Progression

• Skill – Locomotion within posture

Modified Plantigrade

• Allows weight bearing through upper and lower extremity with wide base of support.

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Pressure Splints
• Transparent inflatable pressure splints support the extremity while stimulating proprioceptive and cutaneous receptors in weight bearing postures.
• Johnstone air splints are distributed by Urias in pediatric through bariatric sizes for the upper and lower extremity.

Sensory Stimulation
• Auditory
  • Quiet environment, soft tone of voice with calm emotional overtones and regular rhythm of speech
• Olfactory
  • Avoid strong odors and utilize pleasant scents
• Visual
  • Cool colors, low lighting, and avoid busy patterns
• Vestibular
  • Slow linear acceleration and avoid spinning

Brunnstrom Stages of Recovery
• Brunnstrom describes specific stereotypical stages of motor recovery beginning with flaccidity progressing to full motor function return following a stroke.
  - Flaccidity
  - Spasticity Begins
  - Spasticity Increases
  - Spasticity Decreases, some movement out of synergy
  - Spasticity Continues to Decrease, synergy patterns no longer dominate
  - Disappearance of Spasticity
  - Normal Function

Brunnstrom Theory
• As reflexive activity emerges, utilize it to create background tone and superimpose volitional control to progress toward functional recovery.
• Interventions can be applied directly to the spastic muscle to reduce its high tone or to the antagonistic muscle to reduce tone through reciprocal inhibition.

Associated Reactions
• Movements that occur reflexively as a result of active or resisted movement of another body segment.
• Can be utilized to inhibit spastic muscle directly or through reciprocal inhibition.

Raimiste’s Phenomenon
• Description: Resisted ABDuction of the lower or upper extremity on one side facilitates ABDuction on opposite side through overflow.
• Indication: Applied to uninvolved limb to inhibit spastic ADDuctors and allow active motion.
Marie Foix

• Description: Strong passive flexion of toes initiates flexor withdrawal pattern of the lower extremity with hip and knee flexion.
• Indication: Can break up extensor tone in the lower extremity to facilitate active motion and positioning.

Gentle Rocking

• Description: Gentle repetitive rocking of the head/neck, scapular and pelvic regions inhibits tone.
• Indications: General inhibition of tone prior to or during task performance when spasticity increases due to volitional effort.

Slow Stroking

• Description: Slow overlapping strokes with hand performed skin on skin starting at occiput with continuous contact to coccyx.
• Indication: General inhibition of tone prior to or during task performance when spasticity increases due to volitional effort.

Cryotherapy

• Prolonged application of cold to the spastic muscle to inhibit tone.
• Performed prior to stretching and developmental posture activities focusing on motor control.

Cryotherapy continued

• Quick stroking with ice applied to the antagonist of the spastic muscle facilities its contraction which reduces tone in the spastic muscle through reciprocal inhibition.
• Apply in the direction of the contraction from insertion to origin.

Brunnstrom vs. Bobath

Brunnstrom
Utilize reflexes to facilitate movement

Bobath
Only encourage normal motion

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Bobath Theory

- Neurodevelopmental Technique (NDT) utilizes handling techniques to facilitate normal movement and automatic postural responses.
- The goal of interventions is to increase sensory input to normalize tone, inhibit abnormal reflexes, and restore motor function.

NDT Techniques

- Key points of control using precise manual contacts at various joints facilitate the desired muscle activation supplying the patient with sensory information of correct movement.
- Bilateral symmetrical movements and regaining proximal stability is encouraged.

Reflex Inhibiting Postures (RIP)

- Avoidance of abnormal movement strategies is encouraged through positions that inhibit spasticity by lengthening shortened muscles.

Humeral External Rotation

- Utilizing humeral external rotation through an elbow key point of control increases activation of trunk extensor musculature.

Prayer Position

- The patient utilizes body on body contact by lacing fingers of both hands together with the affected thumb ABDucted.
- Can be utilized during the performance of bed mobility and upper extremity dressing.

Key Points of Control

- To encourage postural control that is the foundation of movement, NDT uses manual contacts on the shoulder girdle, pelvis, hands, and feet to provide input for normal movement through progressively more challenging developmental postures.
Trunk Inclination

- Cradling the involved upper extremity with the uninvolved provides point of control for clinician to support or resist trunk movement in all planes.

Bobath Hand Hold

- The clinician maintains the patient’s wrist extension, forearm supination with thumb abduction.

Bed Mobility

- Segmental movement with facilitation at the scapula and pelvis encourage normal recruitment.

Dynamic Bridging

- Bridging permits bilateral weight bearing in a RIP to diminish lower extremity extensor spasticity.

NDT Transfer Technique

- Transferring TOWARD the weak side encourages weight bearing, breaks extensor tone by using RIP at UE/LE/trunk, and crossing of midline.
- Traditionally performed WITHOUT a gait belt.

NDT Maximum Assist Transfer

- Maximum Assist – patient forward flexed toward involved side with hands in prayer position while clinician assists at greater trochanters and gluteus maximus.
NDT Moderate Assist Transfer

- As the patient is able to perform normal movement more independently, the clinician provides assistance at the scapula.

NDT Minimum Assist Transfer

- When only minimum assistance through a postural cue to recruit the appropriate muscle for the movement pattern, the hands and knee are utilized by the clinician as manual contacts.

Independent Sit to Stand

- Patient utilizes hand over hand contact on involved lower extremity to encourage weight shifting and normalization of tone during active motion.

Proprioceptive Neuromuscular Facilitation (PNF)

- Utilizing diagonal patterns of movement that cross midline and are spiral in nature, sensory input stimulates motor control.
- Upper and lower extremity patterns are named for the motion occurring at the proximal joint (hip or shoulder)
  - D1 Flexion and D1 Extension
  - D2 Flexion and D2 Extension

PNF Upper Extremity Diagonal 1

<table>
<thead>
<tr>
<th>Diagonal One (D-1) - SHIELD</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1 Flexion: Flexion - ADDuction - External Rotation</td>
<td>“Squeeze my hand, turn, pull up and across”</td>
</tr>
<tr>
<td>Start with arm out to side, hand open</td>
<td></td>
</tr>
<tr>
<td>Close hand, TURN (follow thumb)</td>
<td></td>
</tr>
<tr>
<td>Bring arm up and across face to opposite ear</td>
<td></td>
</tr>
<tr>
<td>D-1 Extension: Extension - ADDuction - Internal Rotation</td>
<td>“Open hand, turn, push down and out”</td>
</tr>
<tr>
<td>Start with arm across face, hand closed</td>
<td></td>
</tr>
<tr>
<td>Open hand, TURN (follow thumb)</td>
<td></td>
</tr>
<tr>
<td>Sweep arm out to side</td>
<td></td>
</tr>
</tbody>
</table>

PNF Upper Extremity Diagonal 2

<table>
<thead>
<tr>
<th>Diagonal Two (D-2) - SWORD COMMAND</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D-2 Flexion: Flexion - ADDuction - External Rotation</td>
<td>“Open hand, turn, push up and out”</td>
</tr>
<tr>
<td>Start with hand “in pocket”, fisted</td>
<td></td>
</tr>
<tr>
<td>Open hand, TURN (follow thumb)</td>
<td></td>
</tr>
<tr>
<td>Bring arm to overhead position</td>
<td></td>
</tr>
<tr>
<td>D-2 Extension: Extension - ADDuction - Internal Rotation</td>
<td>“Squeeze my hand, turn, pull down and across”</td>
</tr>
<tr>
<td>Start in overhead position, hand open</td>
<td></td>
</tr>
<tr>
<td>Close hand, TURN (follow thumb)</td>
<td></td>
</tr>
<tr>
<td>Bring hand back to “in pocket” position</td>
<td></td>
</tr>
</tbody>
</table>
**Diagonal One (D-1): Heel in Pocket**

- **D-1 Flexion:** Flexion - Adduction - External Rotation
  - Start with leg out to side (abducted and extended)
  - Ankle moves into dorsiflexion
  - Bring foot across body with knee flexed - heel to opposite knee ("in pocket")
  - "Foot up, heel in, pull up and across"

- **D-1 Extension:** Extension - Abduction - Internal Rotation
  - Start with "heel in pocket"
  - Ankle moves into plantar flexion
  - Sweep leg out to side
  - "Foot down, heel out, push down and out"

**Diagonal Two (D-2): Fire Hydrant**

- **D-2 Flexion:** Flexion - Abduction - Internal Rotation
  - Start with leg extended and adducted
  - Ankle moves into dorsiflexion
  - Pull leg into abduction and internal rotation "fire hydrant"
  - "Foot up, heel out, pull up and out"

- **D-2 Extension:** Extension - Abduction - External Rotation
  - Start with leg in "fire hydrant" position
  - Ankle moves into plantar flexion
  - Push leg down into extension and adduction
  - "Foot down, heel in, push down and in"

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**Lumbrical Grip**

- Manual contact through the thenar and hypothenar eminence.

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**"The Groove"**

- The clinician’s body position needs to be in the same diagonal as the pattern the patient is performing to ensure appropriate proprioceptive input.

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**Rhythmical Rotation**

- Description: Smooth low rate rotation of the extremity through the long axis of the joint while progressing through the PNF diagonal.
- Indication: Decrease spasticity in entire extremity prior to or during active motion to reduce tone.

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**Rhythmic Initiation**

- Description: Progression from passive → active assisted → active → resisted movement through the diagonal pattern.
- Indication: Can be utilized for passive range of motion. With active motion, technique allows proprioceptive feedback to initiate movement and build strength.
Agonistic Reversals

- Description: Concentric performance of pattern followed by isometric hold at end range then return to start position through eccentric contraction of same muscle group
- Indication: continuous recruitment of agonist muscle group to inhibit spastic muscles through reciprocal inhibition.

Complementary Interventions

- Therapeutic advances continue to explore different applications of traditional techniques and new strategies that can be utilized to diminish spasticity and encourage normal motion.
  - Electrical Stimulation
  - Mirror Therapy
  - Vibration Treatment

Electrical Stimulation

- Application directly to the spastic muscle can induce sensory habituation at the spinal cord level.
- Electrical stimulation applied to the antagonist of the spastic muscle triggers reciprocal inhibition inducing relaxation of the spastic muscle.
- Typical strengthening parameters for NMES utilized with a longer ramp up time.

Mirror Therapy

- Patient is positioned to view non-affected limb in mirror envisioning it as the affected limb while performing motions.
- Reduction of tone in the affected limb may be necessary prior to positioning the limb with the mirror.
- Movement of the non-affected side should promote motions of the antagonistic muscles to reduce tone and encourage motion.

Transcutaneous Electrical Nerve Stimulation (TENS)

- A combination of parameters has been utilized to target different anti-nociceptive responses.
  - Low Rate TENS induces endorphin release that reduces motor neuron excitability.
  - High Frequency Conventional TENS reduces nociceptive input through the gate control theory.

Mirror Therapy Research

<table>
<thead>
<tr>
<th>Population</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>CVA within first 2 weeks</td>
<td>UE Motor recovery, balance, and mobility improvement equal to control group</td>
</tr>
<tr>
<td>TBI subacute or chronic phase</td>
<td>Slightly lower grade spasticity and improved UE motor ability and posture</td>
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Vibration Treatment

- Isolated Muscle Vibration
  - Used after inhibition techniques are performed on spastic muscle.
  - Antagonist to the spastic muscle is placed on passive stretch.
  - Hand held vibration device applied from insertion to origin of the muscle with gentle pressure as patient actively contracts.
  - Reduces spasticity through reciprocal inhibition.

Vibration Treatment

- Whole Body Vibration (WBV)
  - Repetitive stimulation of the sensory motor system through mechanical stimuli to modulate the reflex activity and decrease spasticity.

Complication of Spasticity: Joint Contracture

- Increased mechanical resistance to passive motion may be secondary to alterations in tendon compliance and muscle fiber shortening.
- Mechanical changes in sarcomere length contribute to muscle stiffness as the optimal muscle tension is reset to a shorter resting length.
- This in turn can contribute to increased spasticity.

Common Contractures

- Upper Extremity
  - Frozen Shoulder
  - Elbow, wrist and finger flexion
- Lower Extremity
  - Hip and Knee Flexion
  - Ankle Plantar Flexion

Contracture Management

- Traditional methods aim to maintain muscle length through splinting, positioning and stretching.
- Evidence on effectiveness of interventions varies.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Intervention</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>CVA</td>
<td>Wrist splint vs. no splint</td>
<td>Both lost 17 degrees</td>
</tr>
<tr>
<td>CP</td>
<td>Hamstring Stretching and Quadriceps electrical stimulation vs. Stretching</td>
<td>Combined intervention slightly more effective</td>
</tr>
</tbody>
</table>

Orthotics

- Medicare considers an orthosis a rigid or semi-rigid device that supports a weak or deformed body member, or restricts or eliminates motion in a diseased or injured part of the body.
- Dynamic devices provide static low load prolonged stretch and encourage functional motion.
  - Elbow Wrist Hand Orthosis
  - Wrist Hand Orthosis
  - Knee Ankle Foot Orthosis
  - Ankle Foot Orthosis
Ankle Foot Orthosis

- When knee genu recurvatum is present use of an AFO set in slight dorsiflexion will create a flexion moment at the knee at midstance to limit the hyperextension.

Contracture Management

"The effect of stretching on spasticity and contractures is still largely evidence free; however, there is no evidence that it is harmful."

Stretch to Prevent Contracture
Inhibition Techniques to Reduce Spasticity
Encourage Functional Mobility

Muscle Stretching

- The proposed benefits of slow gentle stretching to prevent contractures varies.
  - Prevent formation of cross bridges in collagen
  - Maintain passive length of soft tissue
  - Decrease excitability of lower motor neurons

Stretching Evidence

- Slow prolonged stretching with frequent consistent application may improve outcomes.

<table>
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<th>Diagnosis</th>
<th>Intervention</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVA</td>
<td>Prolonged shoulder and wrist stretch vs. no stretching</td>
<td>Both lost 13-15 degrees</td>
</tr>
<tr>
<td>SCI</td>
<td>Dorsiflexion prolonged stretch vs. no stretching</td>
<td>Gain of 2 degrees with stretch, Loss of 2 degrees without stretch</td>
</tr>
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</table>

Velocity of Stretch

- Research using EMG monitoring of muscle response to stretch velocity indicates that not all spastic muscle demonstrates the same activation patterns.

<table>
<thead>
<tr>
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<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>Stretch velocity compared through EMG monitoring</td>
<td>&gt; 50% demonstrated increased tone with low velocity stretching</td>
</tr>
</tbody>
</table>
Myofascial Loading

- Myofascial connections that envelop the muscle and neurovascular structures demonstrate loading that may cause sarcomere strain.

Histological examination reveals thickening of myofibril perimysium which is proposed to contribute to passive muscle stiffness in spastic muscles.
- Myofascial release may be beneficial to influence the intramuscular connective tissue.

Transcriptional Profiling

- Exploration is expanding to analysis genetic factors contributing to increases in skeletal muscle extracellular matrix which is associated with increased passive stiffness.

Intrathecal Baclofen

- Programmable perfusion pump is implanted with catheter into subarachnoid space to deliver baclofen.
- Mechanism of action believed to be binding to inhibitory GABA receptor sites at the spinal level.

Pharmacological Management

- Generalized: Oral Medications
- Regional: Intrathecal Baclofen
- Focal: Botulinum Toxin A

Intrathecal Baclofen Benefits

- Reduced systemic side effects as medication is delivered directly to GABAergic neurons in spinal cord.
- Steady symptom management day and night.
Intrathecal Baclofen Complications

- Superficial surgical site infections may be managed with antibiotic therapy.
- Monitor patient for infection at catheter site that can easily spread to central nervous system.
- Catheter malfunction can occur.
- Remind patient about adhering to refill schedule.

Intrathecal Baclofen Research

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Study</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>Systematic review 15 studies</td>
<td>Improved gait quality and gross motor function</td>
</tr>
<tr>
<td>SCI</td>
<td>Systematic review 8 studies</td>
<td>Reduced Modified Ashworth scores and improved function</td>
</tr>
<tr>
<td>MS</td>
<td>12 patients followed pre and 1 year post pump implantation</td>
<td>Fat body mass increased</td>
</tr>
<tr>
<td>SCI</td>
<td>CP</td>
<td>Resting body metabolic rate unchanged</td>
</tr>
</tbody>
</table>

Botulinum Toxin A (BoNT-A)

- Injected Botulinum Toxin A binds to presynaptic nerve endings in the spastic muscle where it inhibits acetylcholine release subsequently diminishing the muscle’s ability to contract.
- During the months after injection, nerve sprouting reverses the neurolytic injection effects.

Benefits of BoNT-A

- Global side effects are avoided as the treatment is locally targeted at the spastic muscle to induce selective weakening of contraction.
- The treatment is used in combination with therapeutic interventions and splinting.

BoNT-A Black Box Warning

WARNING: DISTANT SPREAD OF TOXIN EFFECT
See full prescribing information for complete boxed warning.

The effects of BoNTXs and all botulinum toxins products may spread from the area of injection to produce symptoms consistent with botulinum toxins effects. These symptoms have been reported hours to weeks after injection. Swallowing and breathing difficulties can be life threatening and there have been reports of death. The risk of symptoms is probably greatest in children treated for spasticity but symptoms can also occur in adults, particularly in those patients who have an underlying condition that would predispose them to these symptoms (5.2).

- Monitor patients for signs of adverse effects:
  - Toxic spread - swallowing, breathing, and speech difficulties.
  - Bronchitis and upper respiratory tract infections.

BoNT-A Research

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Assessments</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>Spasticity</td>
<td>All Improved for up to 9 months</td>
</tr>
<tr>
<td></td>
<td>RON</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UE Function</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self-care</td>
<td></td>
</tr>
<tr>
<td>CVA TBI</td>
<td>Physician report of patient satisfaction outcomes</td>
<td>Upper Extremity improved ADL, hygiene, pain, body image</td>
</tr>
<tr>
<td>CP MS</td>
<td></td>
<td>Lower Extremity improved gait, posture, clonus, pain, social life</td>
</tr>
<tr>
<td>SCI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- According to the FDA, safety and efficacy is not yet established and treatment does not replace usual rehabilitation therapies.
Surgical Procedures

- Surgery may be indicated to manage chronic spasticity that is interfering with functional mobility, causing pain and deformity that does not benefit from therapy and pharmacological management.

Selective Dorsal Rhizotomy (SDR)

- The sensory afferent fibers in the dorsal root of the spinal cord are selectively cut to decrease the sensory stimulus triggering the reflex arc and spasticity.
- Therapy must address underlying weakness that is unmasked following procedure.

Z-Plasty

- Small surgical cuts in the tendon of a contracted muscle are made.
- As healing occurs the tendon elongates permitting greater range of motion.
- Common in the Achilles for dorsiflexion and the thumb or finger flexors.

Conclusion

- Spasticity is the result of over activity of the stretch reflex.
- Early intervention is important to prevent contracture that can exacerbate the increased tone.
- Effectiveness of techniques will vary by patient with ongoing reassessment necessary to improve functional outcomes.
- Work across disciplines for consistency and frequency including family members who may be care givers.

1. Spasticity is traditionally defined as _______________ dependent intrinsic resistance to passive movement.
   A. Time
   B. Position
   C. Sensory
   D. Velocity

2. Which of following does NOT play a role in the development of spasticity?
   A. Lower motor neuron lesion
   B. Disrupted descending regulation
   C. Denervation supersensitivity
   D. Hyperexcitable stretch reflex
Spasticity

References continued


References continued
Spasticity
Resource Links

Modified Ashworth Scale

Modified Tardieu Scale

Patient Reported Impact of Spasticity Measure
http://www.parqol.com/page.cfm?id=89


Penn Spasm Frequency Scale

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