Therapy for Maintaining and Gaining Function

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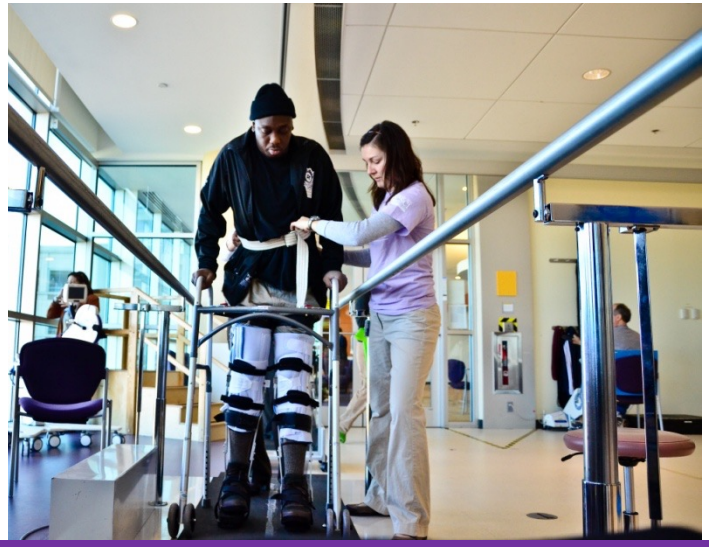

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Objectives

- Following this presentation, participants will be able to:
  - Identify the key components of activity based rehabilitation
  - Apply principles of ABR into their therapy/exercise routines
  - Understand how therapy and exercise can help maintain as well as gain function

Activity-Based Restorative Therapy

- Repeated near-normal activity, specifically below the level of the lesion, intended to:
  - Optimize the neurological system
  - Offset the rapid aging, physical deterioration and secondary complications associated with SCI
- Characterized by:
  - High intensity practice
  - Task-specific and patterned activity
- Goal:
  - Restore CNS function
  - Promote neural recovery and regeneration

Who Can Benefit from ABRT?

- Multiple Sclerosis
- NMO-SD
- AFM
- TM
- Traumatic SCI
- Spina Bifida
- Cerebral Palsy
- ADEM
- GBS
- TBI
- Stroke

Compensate vs. Restore

Traditional Therapy

- Activate nervous system above the level of the lesion
- Low intensity practice
- Non-patterned movements
- Compensates for loss function
- Uses compensatory devices

ABR

- Activate nervous system above and below the level of the lesion
- High intensity practice
- Non-patterned and patterned movements
- Restores lost function
- Minimizes or eliminates compensatory devices

Activity Based Rehabilitation (ABR)

- 5 key components:
  - Functional Electrical Stimulation
  - Locomotor Training
  - Weight Bearing/Loading
  - Patterned Activity
  - Task-Specific Practice

FUNCTIONAL ELECTRICAL STIMULATION (FES)

Therapeutic Electrical Stimulation

TES	NMES	FES	TENS
Therapeutic Electrical Stimulation	Neuromuscular Electrical Stimulation	Functional Electrical Stimulation	Transcutaneous Electrical Nerve Stimulation
Use of electricity to drive a desired nerve response for therapy.	Electricity applied across the surface of the skin over intact peripheral nerve evokes an action potential in the nerve fiber which causes an exchange of ions to drive the muscle to contract.	Application of electrical stimulus to a paralyzed nerve or muscle to restore or achieve function. Also refers to orthotic substitution (Bioness L300).	Pain modulation by exciting peripheral nerves. Common Types: • Sensory • Motor • Noxious

Therapeutic Applications

- Prevent/Reverse disuse atrophy
- Orthotic Substitution
- Strengthening
  - Improve and maintain muscle mass during or following periods of inactivity
  - Maintain/Increase ROM
  - Re-educate/facilitate voluntary contraction
  - Reduce effects of spasticity

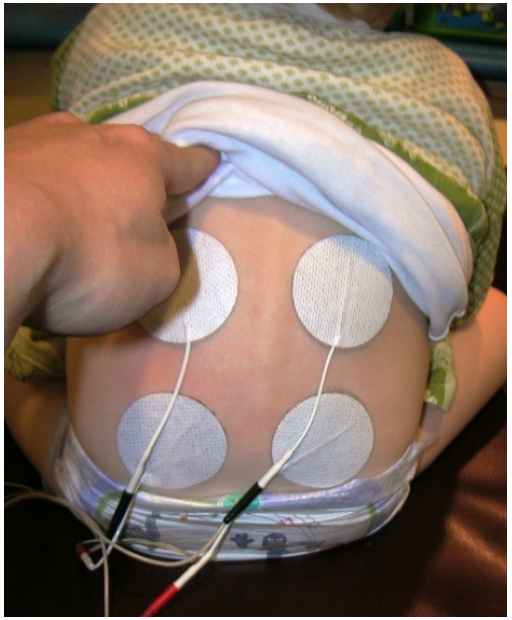
Benefits of FES

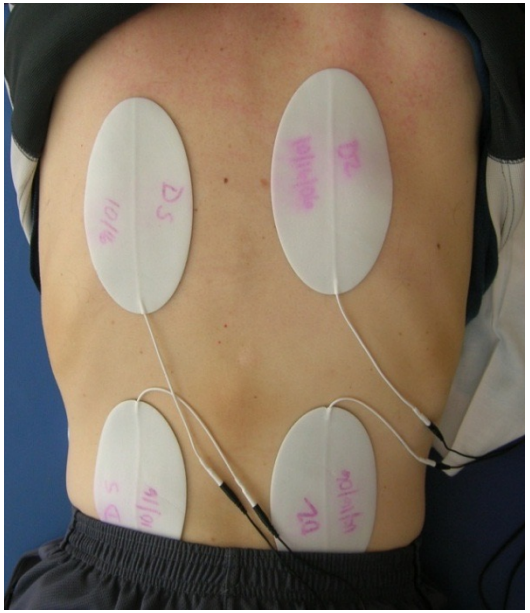
- Maintain muscle health (size, composition, profusion)
- Maintain bone health
- Improve cardiovascular status (endurance, VO2, HR)
- Normalize tone
- Optimize nervous system for recovery
- Improve motor function? Speed recovery?

FES Trunk Examples

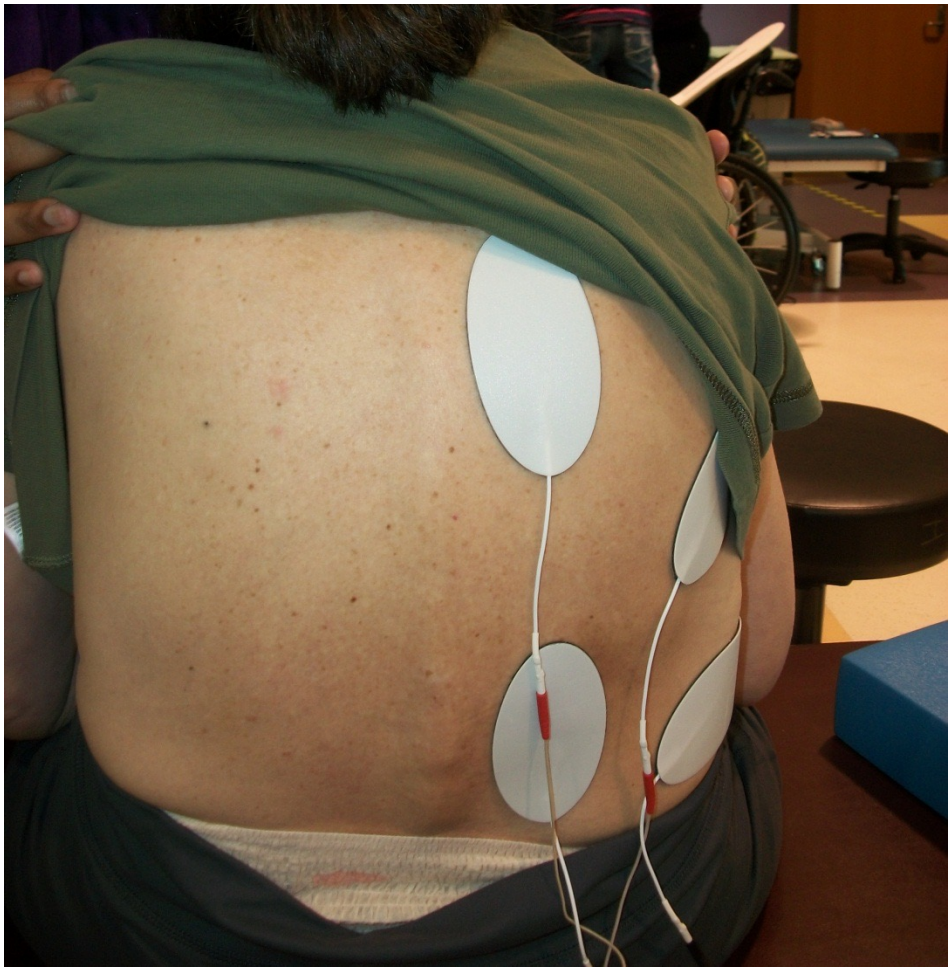
- To paraspinals or lateral trunk flexors to facilitate proper posture
- To abdominals and paraspinals simultaneously to increase core activation and strength
- To abdominals to overcome significant extensor tone pattern

FES to Paraspinals

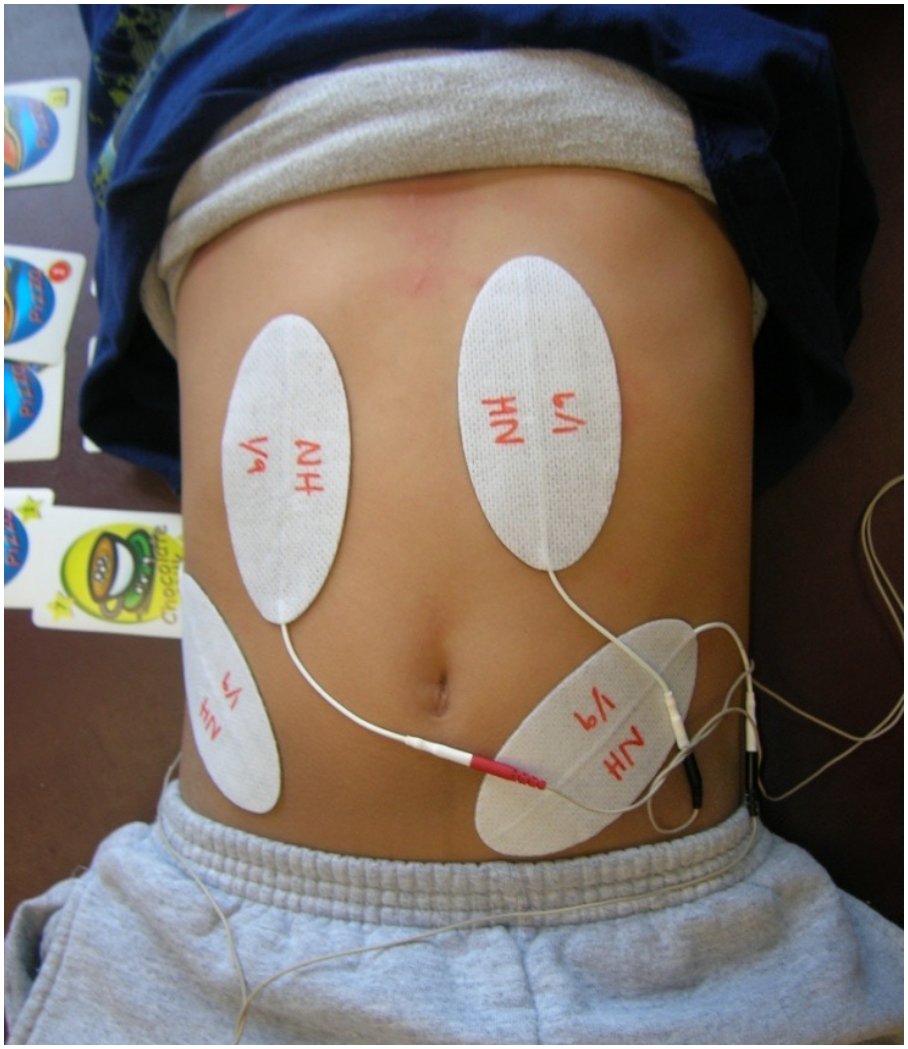




FES to Correct Flexible Scoliosis



Abs of Steel



FES Gross Motor Examples

- Bed mobility:
  - to abdominals during rolling or supine to sit to engage abdominals and mass flexion pattern
- Quadruped/Crawling:
  - to hip flexors to assist in advancing lower extremities, or to abdominals for trunk stability
- Tall/Half Kneeling:
  - to gluteals
- Sit to stand:
  - to gluteals or quadriceps

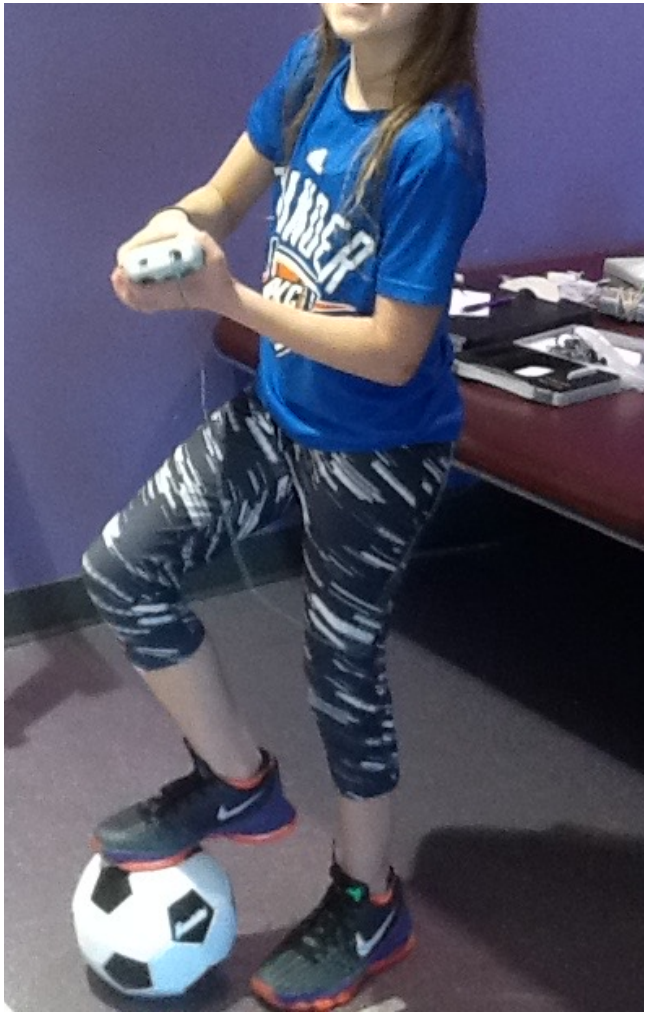
FES to Gluteals During Half Kneeling

FES to Hip Flexors Using Trigger During Crawling

FES Gait Examples

- E-stim to quadriceps, gluteals or abductors during sit to/from stand
- E-stim to weak muscle groups during standing balance
- E-stim to weak muscle groups during gait:

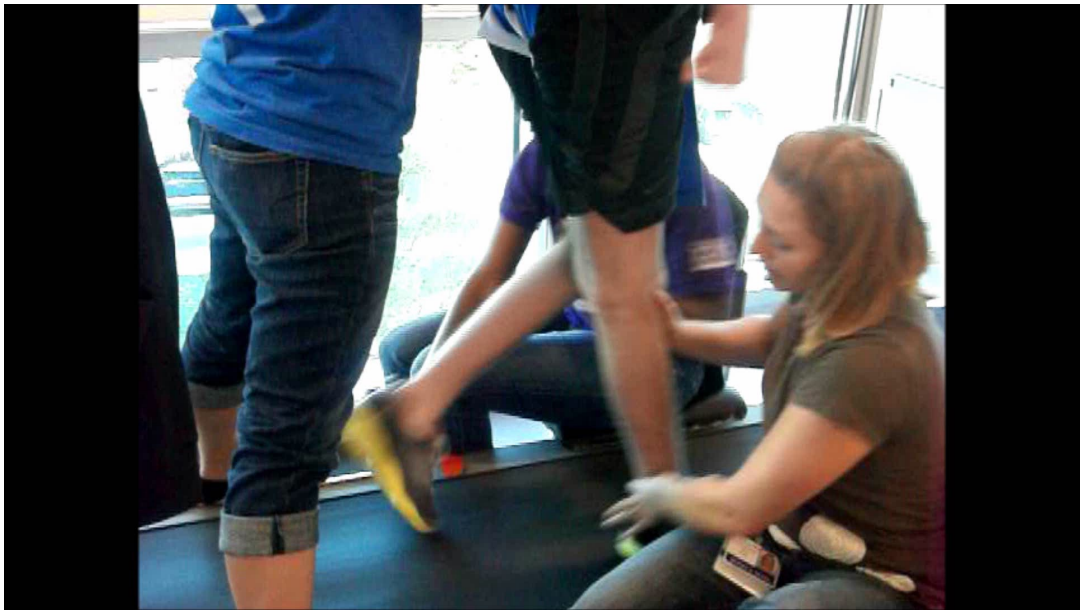
FES to Abductors During Modified Single Limb Stance



FES Orthotic Substitution

- Foot Drop:
  - Bioness Go, Walk Aide
  - Other foot drop FES devices
- Weak Quadriceps or Hamstrings
  - Bioness Plus

Locomotor Training



Locomotor Training

- An activity-based rehabilitative strategy designed to improve sensory, motor and autonomic function, health and quality of life
- Provides sensory cues to re-train neural patterns that will result in effective locomotion
- Emphasizes recovery of motor function using the intrinsic mechanisms of the nervous system, rather than compensatory strategies

Locomotor Training Basics

4 Principles of LT

- Maximize weight bearing on the legs
- Optimize sensory cues
- Optimize kinematics for each motor task
- Maximize recovery; minimize compensation

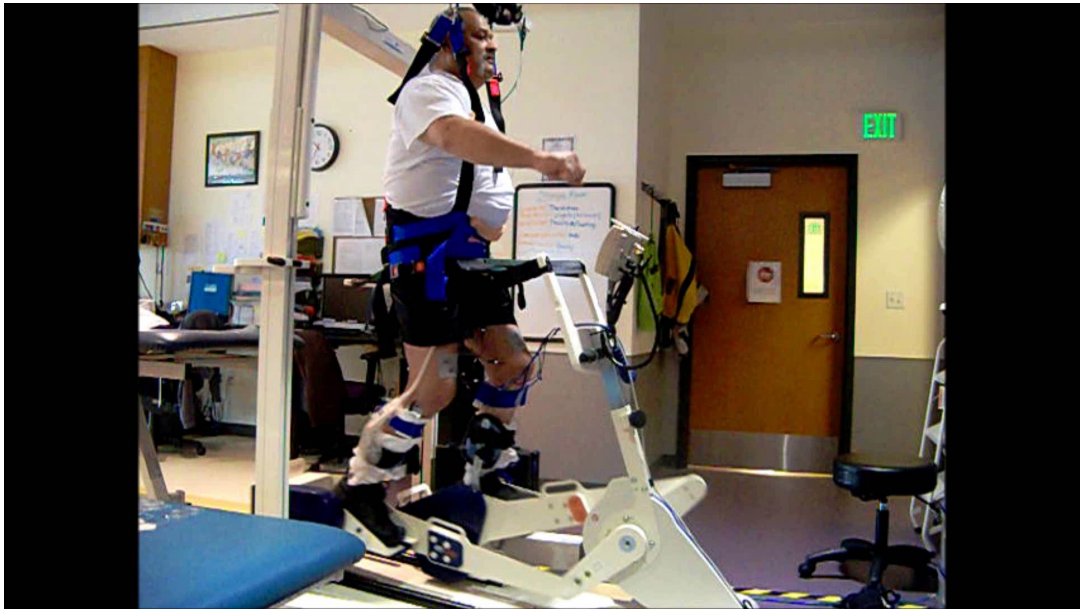
3 Components of Training

- Treadmill training
- Overground training
- Community training

Benefits of Locomotor Training

- Increased walking speed
- Increased walking independence
- Increased walking endurance
- Improved balance
- Motor recovery
- Decreased asymmetry of gait
- Improve gross motor skills
- Improved well being, life satisfaction, and perceived health

Weight Bearing



Weight Bearing

- Loading across a joint
- Promotes joint alignment, longitudinal bone stress, and muscle co-contraction
- Normalized afferent input

Weight Bearing

- LE weight bearing can be achieved through:
  - Quadruped or tall kneel
  - Standing:
    - With or without assistance from a PT
    - With or without bracing- No or minimal bracing preferred
  - Supported standing in standing frame
    - Static stander
    - Dynamic stander
    - Stander with glider component
- UE weight bearing can be achieved through:
  - Seated prop
  - Quadruped
  - Prone positioning

Weight Bearing

Benefits of Weight Bearing

- Improved bowel and bladder function
- Decreased number of bed sores
- Improved range of motion
- Improved autonomic regulation
- Decreased spasticity
- Improved bone mineral density
- Improved cardiovascular function
- Improved motor function
- Improved quality of life

Massed Practice: Patterned Activity

- Repetitive task specific and non-task specific activities
- Promote cortical reorganization
- Repeated multiple times for multiple hours/days
- Improve strength and ROM
- Perfect practice makes perfect
- Incorporate other components
  - Principles of LT
  - FES

Task Specific Practice

- Practice of context specific motor tasks
- Training functional task rather than impairment
- Paired with feedback
- Goal directed
- Repetition
- Incorporate other components
  - Stand at sink to brush teeth
  - FES to ankle dorsiflexion during gait
  - High repetitions of elbow flexion followed by self-feeding

Task-Specific Practice

Don’t Let Bad Habits Persist

- Use it or lose it: Abhorrent patterns and compensatory strategies have to be overcome by rehabilitation
- Patients will figure out how to get things done
- Cortical reorganization responds to non-use as much as therapy
- The body/brain learns what we teach it

Train the Affected Limb

"[In rats,] behavioral experience with the less-affected forelimb early after unilateral [brain] lesions has the potential to increase disuse and dysfunction of the impaired forelimb, consistent with a *training-induced exacerbation of learned non-use*. These findings are suggestive of competitive processes in experience-dependent neural restructuring after brain damage."

Allred, et al. 2005

5 R's

Application of Task-Specific Training

Relevant: meaningful to patient, context specific

Random: facilitates retention, transfer, generalizability

Repetitive: practice assists in skill mastery

Reconstruction: breakdown the task to identify component weaknesses and areas for improvement

Reinforced: timely and positive feedback

Hubbard, Parsons, Neilson, & Carey (2009)

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Additional Interventions

- Robotics
  - Overground, end-effector,
- Whole body vibration
  - Tone reduction
  - Strengthening
- Transcutaneous Spinal Cord Stimulation (TSCS)
  - Cervical
  - Lumbar
- Aquatic therapy
  - Traditional, gait training, aquatic LT
- BFR
- AIH

Locomotor Training and Robotic Gait Training

Additional Considerations

- Acute inflammation
- Fatigue
- Spasticity
- Comorbidities
  - TBI/cognitive deficit