

Outpatient Physical Therapy's Role in Improving Functional Mobility Post-CVA

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Objectives

- Learn objective components of an outpatient physical therapy evaluation status-post CVA
- Identify examination techniques used to identify balance deficits and potential fall risk
- Identify level of assistance required with functional movements and how this can affect patient independence or importance of family/caregiver support
- Discuss general treatment interventions based on impairments identified at initial evaluation in order to improve safe functional mobility

Objective Components of a Physical Therapy Evaluation

- Sensory Integrity
- Joint Integrity & Mobility
- Tone & Voluntary Movement Patterns
- Strength
- Postural Control
- Balance
- Functional Mobility
- Ambulation

Sensory Integrity

- Superficial Sensations

- Light Touch
- Pressure
- Sharp/Dull
- Temperature

- Deep Sensations

- Kinesthesia
- Proprioception
- Vibration

- Combined (Cortical) Sensations

- Stereognosis
- Tactile Localization
- Two-Point Discrimination
- Texture Recognition

Joint Integrity and Mobility

- Passive Range of Motion
- Active Range of Motion
- Joint Mobility
- Soft Tissue Changes
 - Of Note:
 - Tone abnormalities may alter findings
 - Synergy patterns may result in invalid testing as individual joint motion and isolated movements cannot be accurately assessed

Tone & Voluntary Movement Patterns

- **Tone**
 - Definition: Resistance of muscle to passive elongation or stretch as an individual attempts to maintain muscle relaxation
- **Spasticity**
 - Definition: a hypertonic motor disorder characterized by velocity-dependent resistance to passive stretch
- **Modified Ashworth Scale**
 - 0 No Increase in Tone
 - 1 Catch, No Resistance
 - 1+ Catch, Resistance
 - 2 Moderate Resistance
 - 3 Moderate/Severe Resistance
 - 4 Rigid in Flexion or Extension

Typical Patterns of Spasticity in Upper Motor Neuron Syndrome

Table 8.1 Typical Patterns of Spasticity in Upper Motor Neuron Syndrome

Upper Limbs	Actions	Muscles Affected
Scapula	Retraction, downward rotation	Rhomboids
Shoulder	Adduction and internal rotation, Depression	Pectoralis major, Latissimus dorsi, Teres major, Subscapularis
Elbow	Flexion	Biceps, Brachialis, Brachioradialis
Forearm	Pronation	Pronator teres, Pronator quadratus
Wrist	Flexion, adduction	F. carpi radialis
Hand	Finger flexion, clenched fist thumb, adducted in palm	F. dig. profundus/sublimis, Add. pollicis brevis, F. pollicis brevis
Lower Limbs	Actions	Muscles Affected
Pelvis	Retraction (hip hiking)	Quadratus lumborum
Hip	Adduction (scissoring)	Add. Longus/brevis
	Internal rotation Extension	Add. Magnus, Gracilis Gluteus maximus
Knee	Extension	Quadriceps
Foot and ankle	Plantarflexion	Gastroc-soleus
	Inversion	Tibialis posterior
	Equinovarus	
	Toes claw (MP ext., PIP flex, DIP ext) Toes curl (PIP, DIP flex)	Long toe flexors Ext. Hallucis longus Peroneus longus
Hip and knee (prolonged sitting posture)	Flexion	Iliopsoas Rectus femoris, Pectineus
	Sacral sitting	Hamstrings
Trunk	Lateral flexion with concavity	Rotators
	Rotation	Internal/external obliques
COG forward (prolonged sitting posture)	Excessive forward flexion	Rectus abdominis, External obliques
	Forward head	Psoas minor

The form and intensity of spasticity may vary greatly, depending upon the CNS lesion site and extent of damage. The degree of spasticity can fluctuate within each individual (i.e., due to body position, level of excitation, sensory stimulation, and voluntary effort). Spasticity predominates in antigravity muscles (i.e., the flexors of the upper extremity and the extensors of the lower extremity). If left untreated, spasticity can result in movement deficiencies, subsequent contractures, degenerative joint changes, and deformity.

Adapted from Mayer NH, Esquenazi A, Childers MK: Common patterns of clinical motor dysfunction. *Muscle and Nerve* 6:S21, 1997.

Strength

- **Manual Muscle Testing**
 - 0-5 Scale
 - Individual Joint Movements
- **Functional Movements**
 - Shallow Knee Bends
 - Sit to Stands
 - Heel Raises/Toe Raises

Postural Control

- Steadiness
 - Ability to Maintain a Position
- Symmetry
 - Postural Alignment and Position
- Dynamic Stability Control
 - Weight Shift Within Limits of Stability
 - Functional Tasks that Utilize Movement Between Postures
 - Supine<>Sit
 - Sit<>Stand
- Reactive Postural Control
 - Response to Perturbations
- Anticipatory Postural Control
 - Response to Voluntary Extremity Movements

Balance

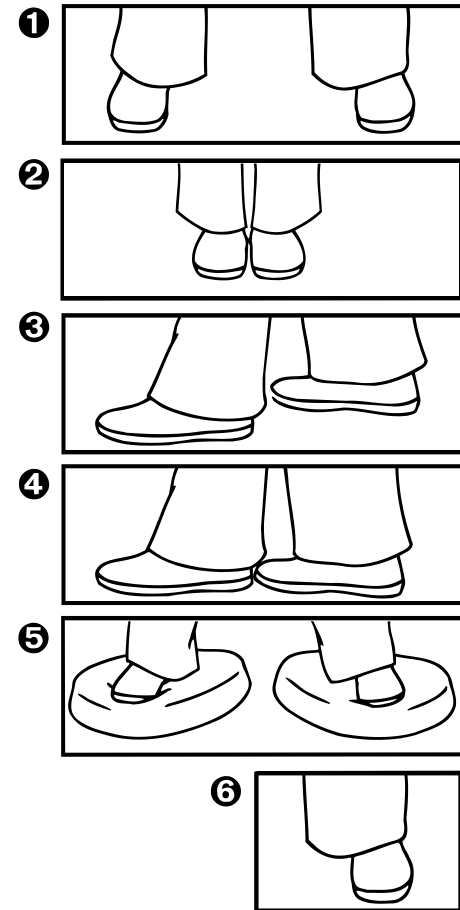
- **Sensory Organization**
 - Somatosensory
 - Vision
 - Vestibular
- **Motor Strategies**
 - Ankle Strategy
 - Hip Strategy
 - Stepping Strategy

NeuroCom – Sensory Organization Test



Static Balance Screen

- Romberg Test
 - Examining Proprioceptive Contribution
 - Eyes Open, Eyes Closed
- Single Limb Stance



Berg Balance Scale

- 14 Functional Tasks
- Static & Dynamic Balance
 - Unsupported sitting/standing, functional reach, transfers, turning, picking objects off floor, single limb stance, stepping
- 5 Point Ordinal Scale
- 56 Possible Points
- Score ≤ 45 = Fall Risk
- One point drop between score of 36-54 = 6-8% increase in fall risk
- High Intrarater and Interrater Reliability
 - $r = 0.95$

Timed Up & Go (TUG)

- Dynamic Balance and Mobility
- Firm Chair, Stand Up, Walk 10 Feet, Turn Around, Return to Chair
- < 10 seconds = Normal
- 11-20 seconds = WNL for frail elderly or individuals with disabilities
- > 30 seconds = impaired functional mobility

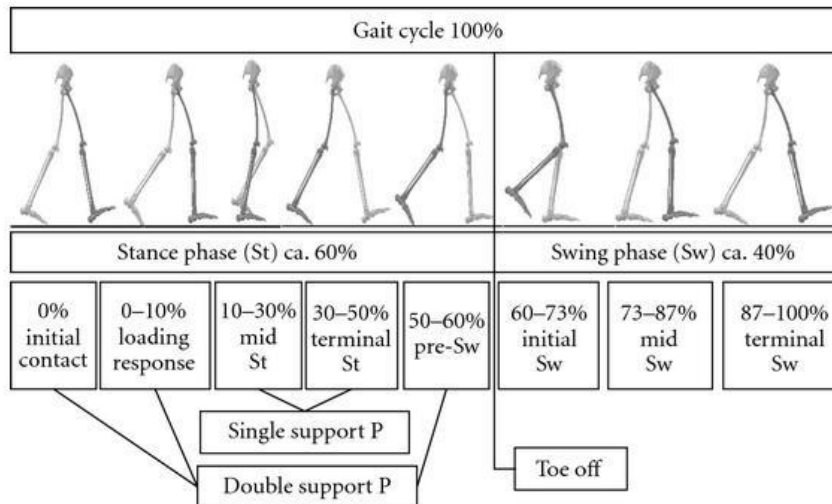
Dynamic Gait Index

- 8 Ambulatory Tasks
- 4-Point Ordinal Scale
- 24 Possible Points
- Normal gait, ambulation with vertical/horizontal head turns, change in gait speed, stepping over/around obstacles, turning
- $\leq 19/24$ = fall risk in the elderly
- $22/24$ = safe ambulators

Functional Mobility & Ambulation

- Functional Mobility
 - Bed Mobility
 - Transfers
 - Ambulation
 - Stairs

- Ambulation
 - Stance Phase
 - Initial Contact, Loading Response, Midstance, Terminal Stance, Preswing
 - Swing Phase
 - Initial Swing, Midswing, Terminal Swing
 - Assessment
 - Movement at each Joint
 - Observe in Different Planes
 - Cadence, Velocity



Weakness/Paresis Affecting Gait

- Plantarflexor Weakness
 - Strong knee extension during stance phase
 - Lack of knee flexion during swing phase
- Quadriceps Weakness
 - Difficulty controlling knee flexion during loading and stabilizing knee during midstance
 - Compensatory knee hyperextension during midstance. Possible trunk flexion with resulting knee hyperextension
 - Toe drag due to decreased knee flexion into preswing
- Hip Flexor Weakness
 - Affects swing phase. Decreased momentum may result in decreased knee flexion and toe drag.
 - Compensatory posterior pelvic tilt and abdominal use, circumduction, contralateral vaulting, contralateral trunk lean
- Hip Extensor Weakness
 - Forward or backward lean
- Hip Abductor Weakness
 - Trendelenburg gait
 - Compensatory ipsilateral trunk lean over stance limb
 - Decreased stability in frontal plan – fall risk

Spasticity Affecting Gait

- Plantarflexor Spasticity
 - Decreased dorsiflexion at heel strike resulting in knee hyperextension, forward trunk lean, or shortened step length
 - Requires compensatory increased workload of hip/knee flexors to clear foot during swing – could result in toe drag, decreased stride, or decreased cadence
 - Lateral foot contact in conjunction with posterior tibialis (equinovarus) or medial foot contact with fibularis brevis (equinovalgus)
- Quadriceps Spasticity
 - Excessive knee extension during loading response
 - Long-term: arthritic joint changes
- Hamstring Spasticity
 - Crouched gait pattern
 - Knee flexion at initial contact
 - Increased quad use required to prevent knee from buckling
 - Decreased step length
- Adductor Spasticity
 - Contralateral drop of pelvis during stance
 - Scissoring gait

Level Of Assistance

- Independent (Timely, Safety)
- Modified Independent
- Supervision (Patient 100%)
- Minimal Assistance (Patient $\geq 75\%$)
- Moderate Assistance (Patient $\geq 50\%$)
- Maximum Assistance (Patient $\geq 25\%$)
- Total Assistance or Not Testable (Patient $< 25\%$)

Developmental Motor Skills

- Mobility
 - Ability to move from one position to another
 - Examples: rolling, sit<>stand
- Stability
 - Ability to maintain postural orientation/stability with the center of gravity over the base of support statically
 - Examples: quadruped, kneeling
- Controlled Mobility
 - Ability to maintain postural orientation/stability with the center of gravity over the base of support dynamically
 - Example: weight shifting, reaching
- Skill
 - Perform coordinated movement sequences in order to investigate and interact with the environment
 - Example: bipedal ambulation, upper extremity reach and manipulation

Stages of Motor Learning

- Cognitive
 - Develop a Cognitive Map
 - An Overall Understanding of the Skill
 - “What To Do”
 - Trial and Error, Heavily Guided By Vision
 - Rapid Improvements
- Associative
 - Refinement of the Motor Strategy is Achieved Through Continued Practice
 - “How To Do”
 - Heavily Guided By Proprioceptive Cues Rather Than Vision
- Autonomous
 - Motor Performance is Largely Automatic After Considerable Practice
 - “How To Succeed”
 - Minimal Cognitive Monitoring

Considerations for Functional Rehab

- Recovery
 - “Re-acquisition of movement skills lost through injury”
- Compensation
 - “Alternative behavioral strategies are adopted to complete a task”
- Neuroplasticity
 - “The ability of the brain to change and repair itself”

Neurofacilitation Approaches

- **NDT**
 - Neurodevelopmental Treatment
- **PNF**
 - Proprioceptive Neuromuscular Facilitation

NDT

- **Emphasis on Postural Control and Normal Movement**
 - Facilitate postural alignment and stability
 - Inhibit excessive tone and abnormal movements
- **Points of Control for Physical Handling:**
 - Shoulder, Pelvis, Hand, Foot

PNF

- Facilitation of Total Patterns of Movement
- Utilization of Synergies
- Rotational and Diagonal Movement Patterns for Extremities
- Essential Components
 - Manual Contacts, Body Position & Body Mechanics, Stretch, Manual Resistance, Irradiation, Joint Facilitation, Timing of Movement, Patterns of Movement, Visual Cues, Verbal Input
- Techniques
 - Rhythmic Initiation, Alternating Isometrics, Rhythmic Stabilization, Slow Reversals, Agonist Reversals, Resisted Progression

Strategies to Improve Sensory Function

- Increase awareness and function of involved side through use
- Examples: stroking, superficial and deep pressure, stretch, approximation, vibration
- Involve family for carryover and safety
- Neglect
 - Encourage awareness/use of environment on hemiparetic side

Strategies to Improve Flexibility and Joint Integrity

- Soft Tissue/Joint Mobilization
- Active Range of Motion
- Passive Range of Motion
- Positioning for Proper Joint Alignment
- Plantarflexor Spasticity
 - Modified Plantigrade
 - Reciprocal Inhibition – Facilitate Contraction of Dorsiflexors
 - Supine with Leg Off Table On Stool
 - Hip Abduction/Extension and Knee Flexion Breaks Up Synergistic Dominance

Strategies to Improve Strength

- Problem: Inadequate Motor Unit Recruitment and Paresis of Agonists
- Isokinetic, PRE
 - Free Weights, Elastic Bands, Machines
- Significant Strength Deficits (<3/5)
 - Powder Board, Sling Suspension, Aquatics
- Combine Resistance Training with Functional Tasks
 - Example: Stair Climbing with Ankle Weights
- Postural Control
 - Use of Elastic Bands or Upper Extremity Free Weights
- Cardiac and Blood Pressure Considerations
 - Eccentric Produce Less Cardiovascular Stress Than Concentric
 - Upright Posture vs. Recumbent/Supine Posture
 - Gradual Progression with Adequate Warm Up/Cool Down
 - Monitor Vitals

Strategies to Manage Spasticity

- Early Mobilization
- Elongation With Sustained Stretch
- Prolonged Pressure
- Rhythmic Rotation
 - Manual technique in which the limb is slowly moved into a lengthened range and then gently rotated back and forth
 - Position in lengthened position and maintain position for extended time, 5-10 minutes
- Activation of Antagonists With Slow/Controlled Movements
- Cold
 - Dampens Neural Firing Rates
- Electrical Stimulation to Antagonist or Vibration
- Soothing Verbal Commands & Cognitive Relaxation Techniques
- Quadriceps Spasticity
 - Prolonged pressure and weightbearing in quadruped or kneeling positions

Strategies to Improve Initial Movement Control

- Promote Normal Postural Alignment and Control/Functional Use of Extremities
- Abnormal Inter- & Intra Limb Control
 - Movements of Limbs are Strongly Linked
- Emphasize Dissociation and Selective Movement Patterns
 - Dissociation – different body segments
 - Selective – out of synergy
- Require Low Force and Slow Movements
- Proprioceptive Loading Through use of Gravity or Slight Manual Resistance
- Functional Tasks Utilizing Variations of Contractions
 - Example: Sit<>Stand
- Activate Weak Muscles In Unidirectional Movements Initially
 - Transition to activation of agonist/antagonist in reduced range, progressing to full
 - PNF Patterns

Strategies to Improve Motor Learning

- Strategy Development
 - Identify Task Elements and Goals
 - Practice
 - May Need to Divide Tasks into Parts
 - Reinforce Correct Movements
 - Correct Errors
 - Practice on Uninvolved Side First, Bimanual Task Practice, Visualization
 - Patient Self-Examines
- Feedback
 - Intrinsic or Extrinsic
 - Use of Visual Inputs Initially
 - Mirror
- Use of Proprioceptive Inputs for Motor Refinement
 - Weightbearing, Manual Contact, Tapping, Stretch, Tracking Resistance, Antigravity Postures, Vibration, Stroking
- Practice
 - Blocked Practice
 - Constant Repetition
 - Variable Practice
 - Practice of similar tasks in serial or random practice orders
 - Better Retention of Skills

Strategies to Improve Postural Control & Functional Mobility

- Rolling
- Supine<>Sit
- Sitting
- Sit<>Stand
- Standing, Modified Plantigrade
- Standing
- Transfers

Neurodevelopment Postures and Potential Treatment Benefits

Table 13.3 Neurodevelopment Postures and Potential Treatment Benefits

Posture	Treatment Benefits
1. Prone-on-elbows	<ul style="list-style-type: none"> • Improve upper trunk, UE, and neck/head control • Weightbearing through shoulders, elbows flexed • Increase extensor ROM at hip extensors • Improve head/neck and shoulder stabilizers strength • Wide BOS, low COG
2. Quadruped	<ul style="list-style-type: none"> • Improve upper trunk, lower trunk, LE, UE, and neck/head control • Weightbearing through hips and shoulders and extended UEs • Improve hip, shoulder, and elbow stabilizers strength • Decrease extensor tone at knees by prolonged weightbearing • Decrease flexor tone at elbows, wrists, and hands by prolonged weightbearing • Increase extensor ROM at elbows, wrists and fingers • Wide BOS, low COG
3. Bridging	<ul style="list-style-type: none"> • Improve lower trunk and LE control • Increase hip stabilizers strength • Weightbearing through feet and ankles • Lead-up activity for bed mobility, sit-to-stand • Wide BOS, low height of COM
4. Sitting	<ul style="list-style-type: none"> • Improve upper trunk, lower trunk, LE, and head/neck control • Weightbearing in upright, antigravity position; can include weightbearing through extended UEs • Functional posture, important for reaching and ADL skills • Improve balance reactions • Medium BOS, medium height of COM
5. Kneeling and half-kneeling	<ul style="list-style-type: none"> • Improve head/neck, upper trunk, lower trunk, and LE control • Weightbearing through hips in upright, antigravity position • Decrease extensor tone at knees by prolonged weightbearing • Increase hip and trunk stabilizers strength • Improve balance reactions • Weightbearing through ankle in half-kneeling • Narrow BOS, intermediate height of COM (kneeling) • Wide BOS, intermediate height of COM (half-kneeling)
6. Modified plantigrade	<ul style="list-style-type: none"> • Improve head/neck, upper trunk, lower trunk, and UE and LE control • Weightbearing through extended UEs and LEs, upright antigravity position • Improve balance reactions • Functional posture, lead-up for standing, stepping and reaching • Decrease tone in elbow, wrist, and finger flexors by prolonged weightbearing • Increase extensor ROM at wrists and fingers • Wide BOS, high COM
7. Standing	<ul style="list-style-type: none"> • Improve head/neck, upper trunk, lower trunk, and LE control • Weightbearing through extended LEs, full upright, antigravity position • Improve balance reactions • Functional posture, important for ADL skills; lead-up for gait • Narrow BOS, high COM

BOS = base of support; COM = center of mass; LE = lower extremity; ROM = range of motion; UE = upper extremity;

Strategies to Improve Lower Extremity Function

- Breaking Up Synergy Patterns
 - Midstance
 - Need to activate hip/knee extensors, hip abductors, dorsiflexors
 - Theraband around thigh in standing and perform lateral side steps
 - Toe Off
 - Need hip extension and knee flexion
 - Bridges or supine with hip extension with knee flexion over side of mat
- Pelvic Control
 - Typically retract and elevate pelvis post-CVA
 - Sitting on therapy ball
 - Lower trunk rotation activities in multiple positions
- Knee Control
 - Reciprocal Actions
 - Heel slides in hooklying or partial wall squats

Strategies to Improve Balance

- Base of Support
- Support Surface
- UE Position/Support
- UE Movements
- LE Movements
- Trunk Movements
- Destabilizing Functional Activities
- Dual Task Training
- Environmental Conditions

Gait Training

- **Parallel Bars and Assistive Devices**
 - If increased UE and stronger LE loading, may promote asymmetry and inhibit development of balance mechanisms
 - Hemiwalker or Quad Cane
 - Excessive weight-shift toward uninvolved limb
 - Rolling Walker
 - Promotes trunk flexion and increased loading of UE

Questions



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