Defeating Trunk Asymmetries in the Treatment of Hemiparesis

Defeating Trunk Asymmetries in the Treatment of Hemiparesis after Stroke or Acquired Brain Injury: Assessment & Techniques to Improve Trunk Control & Limb Function

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Learning Objectives

1. The learner will recognize common trunk deviations associated with hemiparesis from stroke or other acquired brain injury
2. The learner will describe benefits of promoting normal movement patterns to minimize the escalation of secondary impairments related to the development of abnormal movement and muscle tone from a neurological disorder such as stroke or acquired brain injury
3. The learner will identify intervention strategies with consideration for establishing neutral postural alignment in static positions as well as transitional movements and activities of daily living
4. The learner will comprehend accurate and descriptive terminology for defensible documentation of trunk impairment assessment and intervention
5. The learner will support the theory of instilling and maintaining normal movement in the patient's recovery with current peer-reviewed literature on neural plasticity

The Trunk as the Foundation of the Human Body

- A stable, supported and balanced trunk provides a base for alignment and mobility of the head and extremities to carry out our daily activities
- Impairment in the trunk results in alteration of this support system, and thus is a major component to consider in the recovery process
- Proper management of the trunk establishes normal posture and movement patterns that:
  - Maintain normal ranges of motion
  - Assist normal balance reactions
  - Facilitate movement
  - Improve active participation in functional activities
  - Reduce fear (of falling)

Hemiparesis creates an earthquake, a tectonic shift that unsettles the human body's foundation.
ANATOMY: A QUICK RECAP

The MOVERS and the STABILIZERS

Muscles of the Back: Deep Layer
- Transversospinal muscles (aka paravertebral)
- Semispinalis
- Multifidi
- Rotares
- Innervated segmentally by dorsal primary rami (DPRs)
- STABILIZE vertebrae during movements
- Assist with EXTENSION and ROTARY movements

Muscles of the Back: Intermediate Layer
- Erector spinae
- Iliocostalis
- Longissimus
- Spinalis
- Innervated segmentally by dorsal primary rami (DPRs)
- Together, EXTEND vertebral column
- Unilaterally, LATERALLY FLEX vertebral column

Muscles of the Back: Superficial Layer
- Latissimus Dorsi
- With the upper trunk STABILIZED, the latissimus dorsi can ELEVATE/MOVE the trunk.
- Trapezius
- MOVES the scapula in all directions secondary to its multidirectional fibers and STABILIZES the shoulder girdle when weight is felt in the shoulder or hand.
- Levator Scapulae
- MOVES the scapula with cervical spine STABILIZED and MOVES the cervical spine with scapula in STABILIZED position.
- Rhomboids major and minor
- MOVES the scapula (retracts, rotates, and depresses) as well as STABILIZES the scapula to the thoracic wall.

Abdominals
- External Oblique
- Internal Oblique
- Transverse Abdominis
- Bilaterally, MOVE/flex vertebral column
- Unilaterally, MOVE/laterally flex or rotate vertebral column
- Erectus Abdominis
- MOVE/flexes the vertebral column
- Quadratus Lumborum
- When pelvis is stabilized, MOVES/laterally flexes vertebral column
- Bilaterally, assist with extension of trunk

Motor Control and Motor Learning
- Motor Control: a systemic transmission of nerve impulse from the motor cortex to motor units, resulting in coordinated contraction of muscle.
  - Requires access to sensory information, perception of situation and choice of movement plan (coordinate) to achieve (execute) desired outcome
- Motor Learning: when complex processes in the brain occur in response to practice or experience of a certain skill resulting in changes in the central nervous system.
  - Repetition creates and establishes a motor plan; preferred patterns for automatic movement with decreased variability for development of skill
**Components of Motor Control**

<table>
<thead>
<tr>
<th>Process</th>
<th>Action</th>
<th>Body Structures Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensation</td>
<td>Sensory information, feedback from exteroceptors and proprioceptors</td>
<td>Peripheral afferent neurons, brain stem, cerebellum, thalamus, sensory resolving areas in the parietal, occipital and temporal lobes</td>
</tr>
<tr>
<td>Perception</td>
<td>Combining, comparing and filtering sensory inputs</td>
<td>Brain stem, thalamus, sensory association areas in the parietal, occipital and temporal lobes</td>
</tr>
<tr>
<td>Choice of movement plan</td>
<td>Use of perceptual map to access the appropriate motor plan</td>
<td>Association areas in the frontal lobe and basal ganglia</td>
</tr>
<tr>
<td>Coordination</td>
<td>Determining details of the plan including force, timing, tone, direction, and extent of movement of postural and limb synergies and actions</td>
<td>Precordial lobe, basal ganglia, cerebellum, thalamus</td>
</tr>
<tr>
<td>Execution</td>
<td>Execution of the motor plan</td>
<td>Corticospinal and corticobulbar tract systems, brain stem motor areas, and alpha and gamma motor neurons</td>
</tr>
<tr>
<td>Adaptation</td>
<td>Compare movement with the motor plan and adjust the plan during performance</td>
<td>Spinal neural networks, cerebellum</td>
</tr>
</tbody>
</table>

**Principles of Neuroplasticity**

- Use it or lose it: Failure to drive specific brain functions can lead to functional degradation
- Use it and improve it: Training that drives a specific brain function can lead to an enhancement of that function
- Specificity: The nature of training experience dictates the nature of the plasticity
- Repetition matters: Induction of plasticity requires sufficient repetition
- Intensity matters: Induction of plasticity requires sufficient training intensity

**Path to Recovery of Function – Research**

- Research in the past decade shows rehabilitation is effective for recovery of function and mobility after stroke:
  - Must be comprised of a selection of components from different approaches
  - Repetitive task-specific training is beneficial for outcomes in people receiving rehabilitation following stroke
  - Specific interventions to improve sit-to-stand may have a beneficial effect on time required and lateral symmetry during sit-to-stand
- The largest randomized controlled trial to date on stroke rehabilitation found:
  - Functional improvements could be seen as late as one year after the stroke
  - 52% of participants made significant improvements in walking, everyday function and QOL
  - Not dependent on whether they started the training at 2 or 6 months after the stroke
  - Dose was fairly high: each group received 90 min of intervention, 36 x over a 12-16-week period

**Neuroplasticity**

Neuroplasticity is remapping the brain, accessing parts of the brain that can take over a capacity. It is:

- the adaptive capacity of the central nervous system
- the mechanism by which the damaged brain relearns lost behavior in response to rehabilitation
- driven by changes in behavioral, sensory, and cognitive experiences
- dependent on its principles

**Path to Recovery of Function – Rehabilitation**

- The line graph on the right illustrates the differences between what people think it looks like versus what it really looks like.
  - Success: what people think it looks like
  - Success: what it really looks like

Drawing by Demitri Martin
Movement Patterns

- Normal Movement:
  - Reliant on components of motor control and thus is variable, to adapt to any given situation requiring movement

- Abnormal movement:
  - Stereotypical influences from damaged brain cause movement that are obligatory; typical flexor, extensor or mixed synergies
  - Abnormal movement patterns suggest a decrease in adaptability or decrease in ability to accomplish a given task

Normal Movement

- Facilitation of desired movement:
  - Special handling, verbal, visual and other cues to get movement we want
  - Allows the patient to feel the correct movement, be efficient and feel safe while completing the task

- Inhibition of unwanted movement:
  - Special handling, verbal, visual and other cues stop movement we do not want
  - Allows the patient to feel the correct alignment movement, and reduce energy required to complete the task

Abnormal Movement

- Development of abnormal movement from problems such as stroke and brain injury cause a change in the neurological system, affecting signals for normal movement:
  - Motor strength
  - Coordination/ control
  - Timing/ sequencing
  - Cognition
  - Somatosensory and visual perceptual processing

Abnormal Movement – Secondary Impairments

- Physical:
  § shoulder/hip pain
  § shoulder subluxation
  § loss of ROM
  § muscle weakness
  § gluteal atrophy
  § sleep disturbances
  § bowel/bladder problems
  § skin breakdown

- Functional:
  § decreased speed of movement
  § decreased endurance for daily activities
  § decreased balance / stability
  § decreased walking distance
  § dependence on mobility aids
  § use of compensatory movement that is not energy efficient

- Environmental / Societal:
  § Loss of Independence
  § Isolation/depression
  § Increased burden of care for family and caregivers to provide for the person
  § Visual and spatial perceptual loss

Abnormal Movement – Understanding Trunk Righting

- Abnormal postures facilitate abnormal righting and other compensatory strategies to create balance:
  - The person learns this posture is "normal"
  - The poor alignment carries over in all positions – sitting, supine, standing, walking
  - The active side learns to solve mobility goals
    - Overuse creates overflow effect on hemiparetic side
  - The inactive side develops a learned non-use behavior
    - Absent or delayed righting on hemiparetic side

The Problem Solving Sequence

How we approach assessment and intervention techniques for postural retraining and core strengthening

1. Postural Alignment
2. Initiate Movement
3. Prepare the patient
4. Train and re-educate
5. Document to support intervention

As clinicians we move fluidly through this list to alter our approach and constantly re-assess and re-train as our patient improves
Standardized Assessments — Quantifying Your Observation

- Postural Assessment Scale for Stroke (PASS) — Adapted from the Fugl-Meyer to assess the patient’s ability to maintain balance in lying, sitting and standing; good for low level patients
- Trunk Impairment Scale (TIS) — Assesses sitting balance and the motor function of the trunk. Also for lower level patients, who can maintain sitting, but not standing.
- Function in Sitting Test (FIST) — Assesses sitting balance and motor function, designed to be done at bedside
- Burke Lateralpulsion Scale

The Problem Solving Sequence — Observational Assessment

Postural Alignment

- Body alignment over base of support compared to what is expected
- Identify normal and abnormal movement patterns and limitations:
  - Can the patient self-correct?
  - Are postural righting reflexes present?
  - Does the patient demonstrate over-recruitment or compensatory movements?
  - Do they have isolated movement?
  - Is there avoidance or learned non-use?
  - Can you elicit absent movement?
- Consider cognition or perceptual awareness deficits

The Problem Solving Sequence — Descriptive Terminology

Postural Alignment

- Static — sway within base of support
- Dynamic — move or reach out of base of support; righting reactions
- Collapse — passive shortening of the trunk
- Tuck — active shortening of the trunk
- Expanded — passive extension of the trunk
- Elongation — active extension of the trunk
- Weight shift — horizontal movement over base of support
- Lean — bend or incline at an angle to the vertical

1. Postural Alignment
2. Initiate Movement
3. Prepare the patient
4. Train and re-educate
5. Document to support intervention

The Problem Solving Sequence — Initiate Movement

- Therapeutic handling is integral in the facilitation of normal muscle tone, posture and movement to promote the development of more normal, independent and energy efficient function
- Ask for the movement
- Facilitate the movement
- Take the patient through the movement — be sure they have required range
- Key Points of Control
  - Facilitate or inhibit for stable position and movement
  - Proximal and distal points relative to what needs correction
  - Provide simple, concrete cues through tactile, visual, verbal or auditory means
  - Be sure the patient is ready for the transition, i.e. not guarding or resisting your approach

Intervention

- 1. Postural Alignment
- 2. Initiate Movement
- 3. Prepare the patient
- 4. Train and re-educate
- 5. Document to support intervention
The Problem Solving Sequence – Prepare the Patient

- Stretch, mobilize, and increase range if patient does not have it
- Strengthen weak muscles, improve motor recruitment for contraction or motor activation
- Facilitation of movement requires planning, practice, and sensitivity by the clinician – learn how to lead or follow the patient
- Visual perceptual factors
  - Where are the patient’s eyes, limbs, head?
  - Where is their focus, or attention?
- What happens to one body part when another is stable or moving? (Normal movement synergies)
- Are they actively supported on the upper and lower extremities? (Weight acceptance)
The Problem Solving Sequence – Train & Re-educate

- Repetition helps the patient to learn which muscles to activate and which to relax
- Make it a whole body experience
- Make it functional
- Make activity creative, challenging and progressive; even all in the same session

- Supine
- Sidelying
- Hook-lying
- Prone on elbows
- Sitting
- High-sitting
- Tailor sitting
- Side-sitting
- Kneeling
- Half-kneeling
- Quadraped
- Plantigrade
- Standing
- Tandem stance
- Step stance

Remember these from school?
Documentation - Evaluation

Complexity level is determined by:
- The patient’s history
- Findings from our examination
- Clinical decision making to develop the plan of care

Complexity levels of low, moderate, or high is patient-centered, not therapist centered:
- Body systems are musculoskeletal, neuromuscular, cardiovascular, pulmonary, and integumentary
- Body structures are anatomical parts of the body, including the trunk and limbs, as well as organs, considering their roles and the patient’s present condition

Documentation - Evaluation

Activity Realm:
- What mobility-related activities of daily living are they unable to do now?

Participation Realm:
- What is the patient unable to participate in that they did before this radical change in their life?

Documentation - Evaluation

Hemiparesis is a characteristic of clinical presentation:
- Impacts the neuromuscular system
- Affects the trunk and limbs
- In most cases is expected to evolve/change
- Impacts the former activity and participation realms
- Impacts the patient’s present condition

Documentation – To Support Intervention

Setting – what is it that they need to do?
- Meaningful
- Patient position

Preparation – do they have what they need? Are they able to set up a safe environment?
- Wheelchair level
- Ambulatory

Sequence – are they accomplishing the task in an efficient, safe, and repeatable manner?
- Steps in order
- Corrections, adjustments

Execution – are they using normalized methods and maintaining safe, normalized posture?
- Incorporating movement they have, minimizing what they do not need
- Relying on external support including devices, orthoses
- Using efficient strategies
Documentation – To Support Intervention

- Use descriptive terminology
  - Patient position and movement
  - Active, active-assisted or passive

- The Documentation Trifecta:
  - What is the problem?
  - What did you do about it?
  - How did the patient respond?

- You will win every time at documentation if you use this framework to assess, treat, and receive feedback on the treatment you provided.

Conclusions

- Following stroke or acute brain injury, patients have impaired postural control and movement coordination – sensorimotor impairments
- Sensorimotor impairments affect the whole person – their function, independence, life role, family, interaction in the community, i.e. their overall life quality
- Sensorimotor problems can be influenced to improve function; our intervention involves communication, active initiation of the patient, and our guidance and handling to provide the missing components of the sensory experience, postural control, and movement
- Early in recovery, as in the acute rehabilitation phase, intervention is effective
- Each patient has some strengths and abilities

Conclusions

- Knowledge of normal movement patterns in daily activities helps in planning and assisting activities and movement in function
- Communication between the patient, therapists, and caregivers – including nursing staff – in order to establish goals to improve patient function
- Learning is accomplished through practice, where movement and sensory processing are challenged to adapt to the task, improve function and be more energy-efficient.
- Practice promotes continuing improvement and building on movement to enhance ability in future tasks

Conclusions

- Treatment for Adults with Hemiplegia:
  - Accept that the patient will have residual deficits
  - Work with or around these deficits to prevent gross motor compensation
  - Instill more normalized movements
  - Prevent secondary impairments

Every therapist – despite the generality or specialty – has something to offer to any patient!

Weigh the problems you observe and determine what is most important to address first

References


References


Thank you!