The Effects of Brain Injury and Its Influence on Balance Related to Physical Therapy Interventions

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Objectives

1. Identify sensory systems that play a role in balance
2. Identify motor impairments that affect balance reactions
3. Understand how the wide spectrum of brain injury relates to the motor and sensory components that influence balance
4. Understand the role of physical therapy for motor and sensory components to balance following brain injury

What is balance?

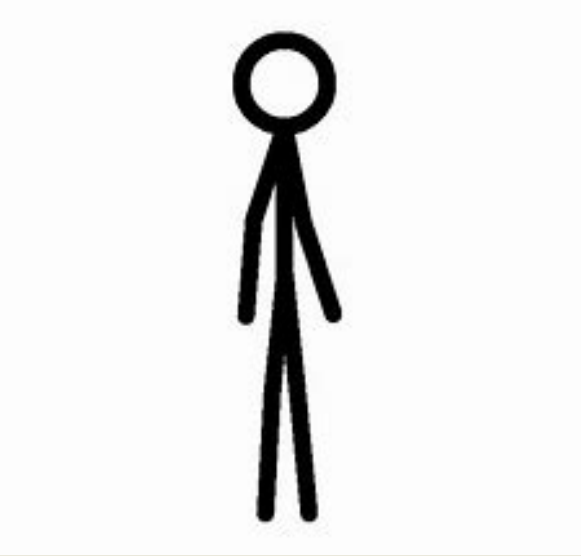
Balance is:

"An even distribution of weight enabling someone or something to remain upright and steady."- Oxford dictionary

Conditions of balance

- Static

Postural control

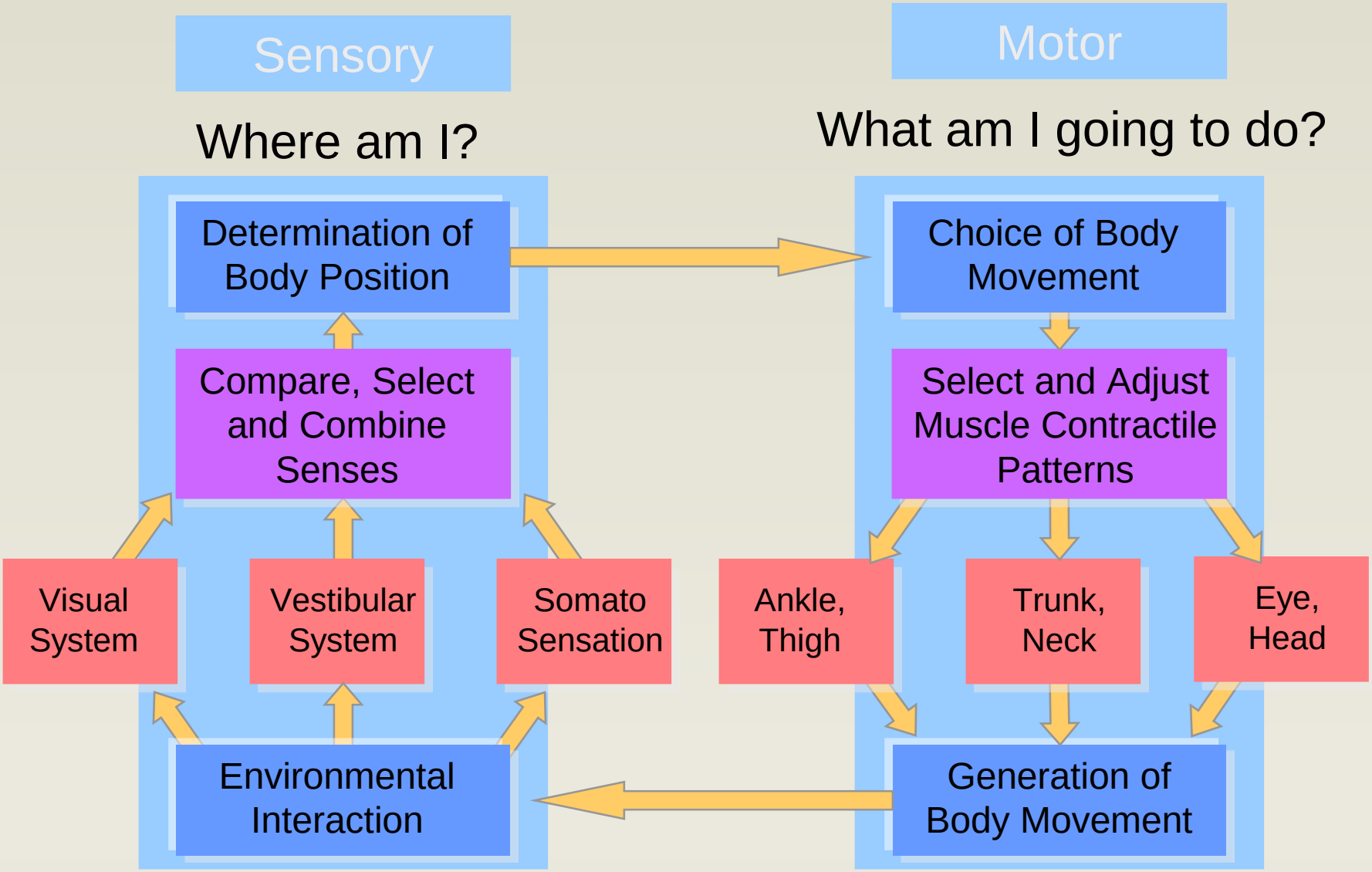


- Dynamic

Postural stability

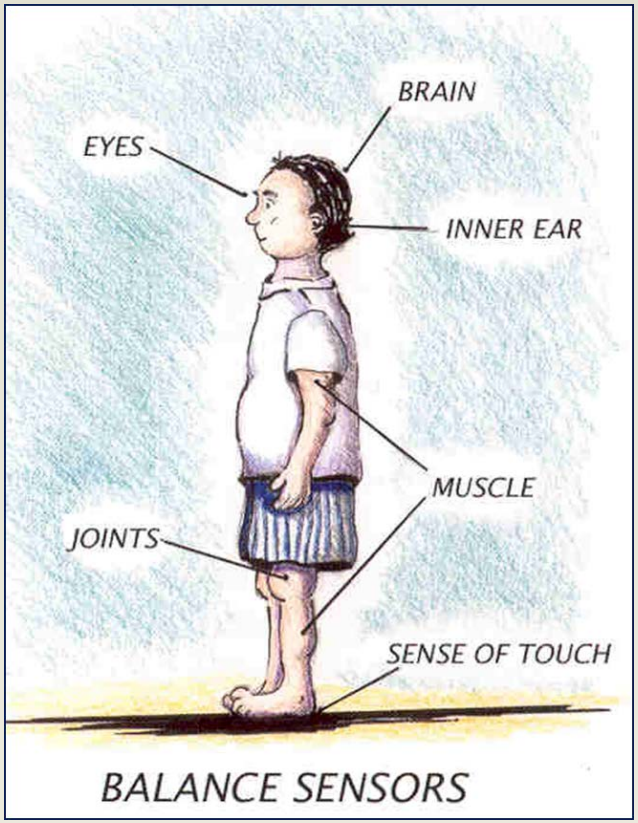
Gaze stabilization

Balance Control



Sensory inputs

- Visual
  - Eye/brain interaction
  - Lighting
  - Movement of self or environment movement
- Somatosensory
  - Muscles, joints, nerves
  - Detects surface changes
  - Affected by base of support (BOS) and can change center of gravity (COG)
- Vestibular
  - Head and eye movement
  - Linear and angular movements


BRAIN
EYES
INNER EAR
MUSCLE
JOINTS
SENSE OF TOUCH
BALANCE SENSORS

Motor components of balance

- Reflexes
- Automatic postural responses
- Anticipatory postural sets
- Voluntary movements

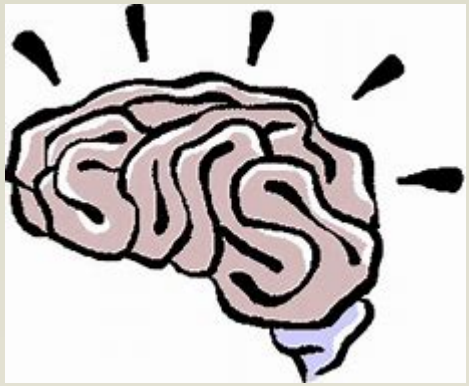
Automatic motor responses

- Brainstem and cortical level responses
- Protective responses for safety
- Very fast responses
- Set movement responses based on stimulus

Voluntary motor responses

- Cortical level
- Purposeful/coordinated activity
- Slower speed responses

Brain Injury



Various degrees of brain injury

Classifications of severity based on the Ranchos Los Amigos (RLA) cognitive scale

RLA I-RLA XII

Impairments and functional deficits are related to area of brain that has been compromised/damaged– focal vs. global effects

Brain injury potential sequelae

- Paralysis on one or both sides of body
- Coordination deficits
- Spasticity
- Changes in vision (double vision)
- Hypersensitivity to touch
- Changes in spatial perception (COG, neglect)
- Vestibular changes (Gaze stabilization, Benign Paroxysmal Positional Vertigo)
- Cognitive changes

Sensory effects of balance

- Visual
  - Skew with double vision
- Somatosensory
  - Hypersensitivity
  - Altered COG
  - Neglect
- Vestibular
  - Gaze stabilization

Motor effects of balance

- Reflexes
  - spasticity
- Automatic postural responses
  - Paralysis
- Anticipatory postural sets
  - coordination
- Voluntary movements
  - Paralysis
  - Coordination
  - Cognition

Assessment of balance

- Strength and tone assessment
- Functional testing
- Computerized testing

Computerized testing

Sensory assessment

- Modified Clinical Test of Sensory Interaction on Balance mCTSIB

- Sensory Organizational Test

  - Looks at postural sway velocity and how processes input from periphery
  - Determines how react to sensory input based on availability and accuracy
  - COG positions
  - Age-based norms

Motor system outputs

- Motor Control Test

- Adaption Test

  - Brainstem and cortical levels
  - Automatic responses, cannot predict
  - Age-based norms

Motor system outputs

- Limits of Stability
- Rhythmic Weight Shift

  - Voluntary level
  - Coordination
  - Cognition
  - Age-based norms

Now what???

Physical Therapy to address those components found lacking on tests

Individualized program vs. generalized programs to address deficits and strengthen assets!

Examples of addressing sensory deficits

- Vision
  - Work closely with OT and neuro-optometrist for addressing any diplopia (e.g prisms, vision therapy)
  - Gaze stabilization
  - Limits somatosensory input (e.g stand with decreased BOS, change of surface)

- Somatosensory
  - COG positioning for static progressing to dynamic
  - Limit visual input (e.g eyes closed on firm surface)

- Vestibular
  - Gaze stabilization
  - Limit vision and somatosensory (e.g corner exercises)

Examples of addressing motor deficits

- Automatic responses
  - Strengthening
  - Wobble board/tilt boards

- Volitional responses
  - Strengthening
  - Weightshifting , stepping activities

Questions????