



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

BMST4004

Neurological Conditions

Trawsnewid Addysg; Trawsnewid Bywydau
Transforming Education; Transforming Lives



www.uwtsd.ac.uk

Research Findings: Strokes

- Post stroke is often a prolonged period of inactivity
- Strength, aerobic training and task-specific exercises
- Strength training increases power output in affected limbs
- Aerobic exercise can increase both work output and cardiorespiratory fitness following stroke
- Functional skills training increases independency following a stroke however physical fatigue can occur post stroke and this may limit the length of time possible for practise.
- Mental practise of specific tasks may offer an alternative and could be combined with physical practise.
- <https://www.stroke.org.uk/>



Research Findings: Parkinson's

- Characterised by jerky, ataxic movements
- Festinating gait
- Inadequate levels of dopamine in the brain
- Rigidity of muscles
- Progressive disease process
- <http://www.parkinsons.org.uk/>



Research Findings: Multiple Sclerosis

- Gradual demyelination of the nervous system
- Immune response targets myelin
- Virtually unknown near the equator possible
- Vitamin D and Smoking are possible environmental factors.
- Low risk genetic component
- MRI and Lumbar puncture aid diagnosis
- <https://youtu.be/7cla8xkJhwM?list=PL8341E5EFBFA85B30>
- <https://www.mssociety.org.uk/what-is-ms>



Concerns relating to physical activity and the older person

- Fear of injury
 - No evidence to support theory that the older person is at higher risk of injury
 - Older person takes long to recover from injury
- Overexertion
 - ACSM 'training in 80-100yrd olds in nursing homes shows no evidence of serious cardiovascular incidence, sudden death, myocardial infarction'
- Falls



Older Athletes: The Ageing Process

- Strength, endurance, bone density and flexibility are all lost at a rate of about 10% per **decade** (50+)
- A **weeks** bed rest will reduce muscular strength by up to 20%
- Health survey for England (2000) 86% of women and 78% of men living in care homes were sedentary i.e. engaged in prolonged periods of sitting or lying



Older Athletes

Recommendations

- Generally: all adults must undertake 150 minutes vigorous and 300 moderate minutes
- Physical activity > exercise
- In addition, ACSM and WHO recommend 2 muscle strength and endurance sessions per week incorporating balance work
- Stretching used before and after exercise (at least 3-5 times per week)



What are the barriers to the older person accessing physical activity and how might these be overcome?



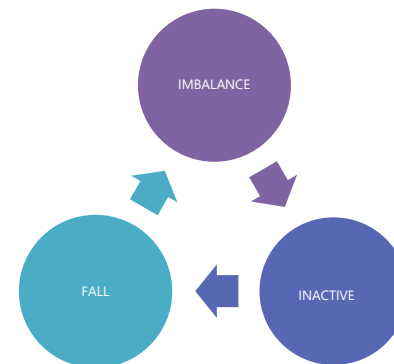
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Health Context of Balance

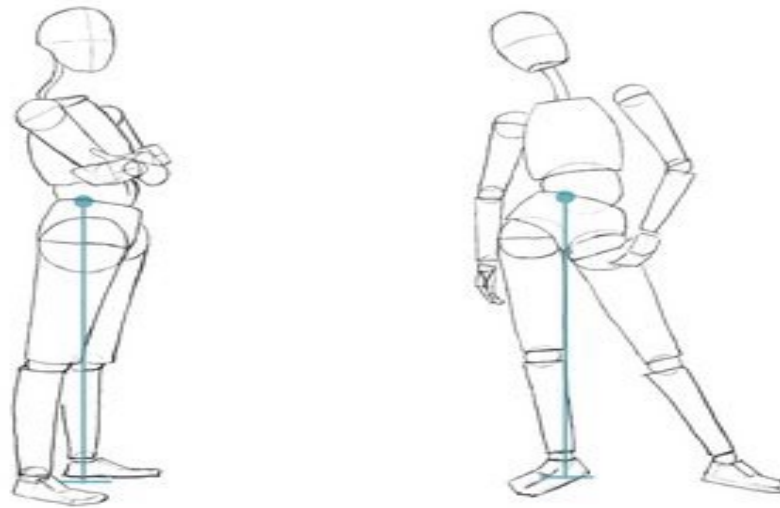
- 1/3 of people over 65 fall each year^{5,6}
- Most common cause of injury death for 65+ ²
- Vicious Cycle



Balance Defined

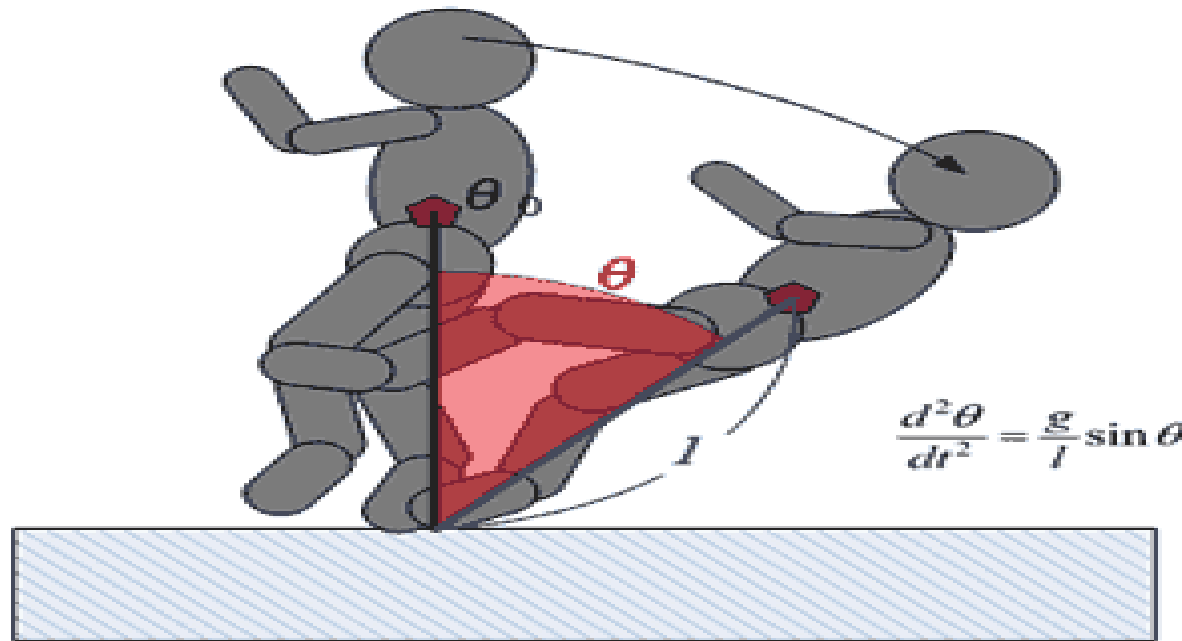
- Balance: Control of centre of mass over base of support (Shumway – Cook, 2001)
- Centre of mass: Centre point of each body segment combined
- Centre of gravity: Vertical projection of centre of mass
- Base of support: Area of object that is in contact with the ground

Centre of Mass



Balance: Control of center of mass
over base of support

Balance: control of center of mass over base of support



Types of Balance

- Steady state (static) balance: Maintain stable position in standing or sitting
- Reactive balance: Recovering from an unexpected perturbation
- Proactive (anticipatory) balance: Activating balance in advance

Balance Systems

Balance is a complex composite of multiple body systems

Motor

Sensory

Cognition

Motor Systems

- Musculoskeletal system: strength and flexibility
- Neuromuscular system: coordination of movement

Sensory Systems

- Peripheral input: Visual, vestibular (inner ear), somatosensory (input from joint and muscle receptors, auditory (hearing))
- Central processing: Receives information from periphery interprets it, and sends commands to motor systems

Cognition

- Multitasking and filtering out distractions while maintaining balance



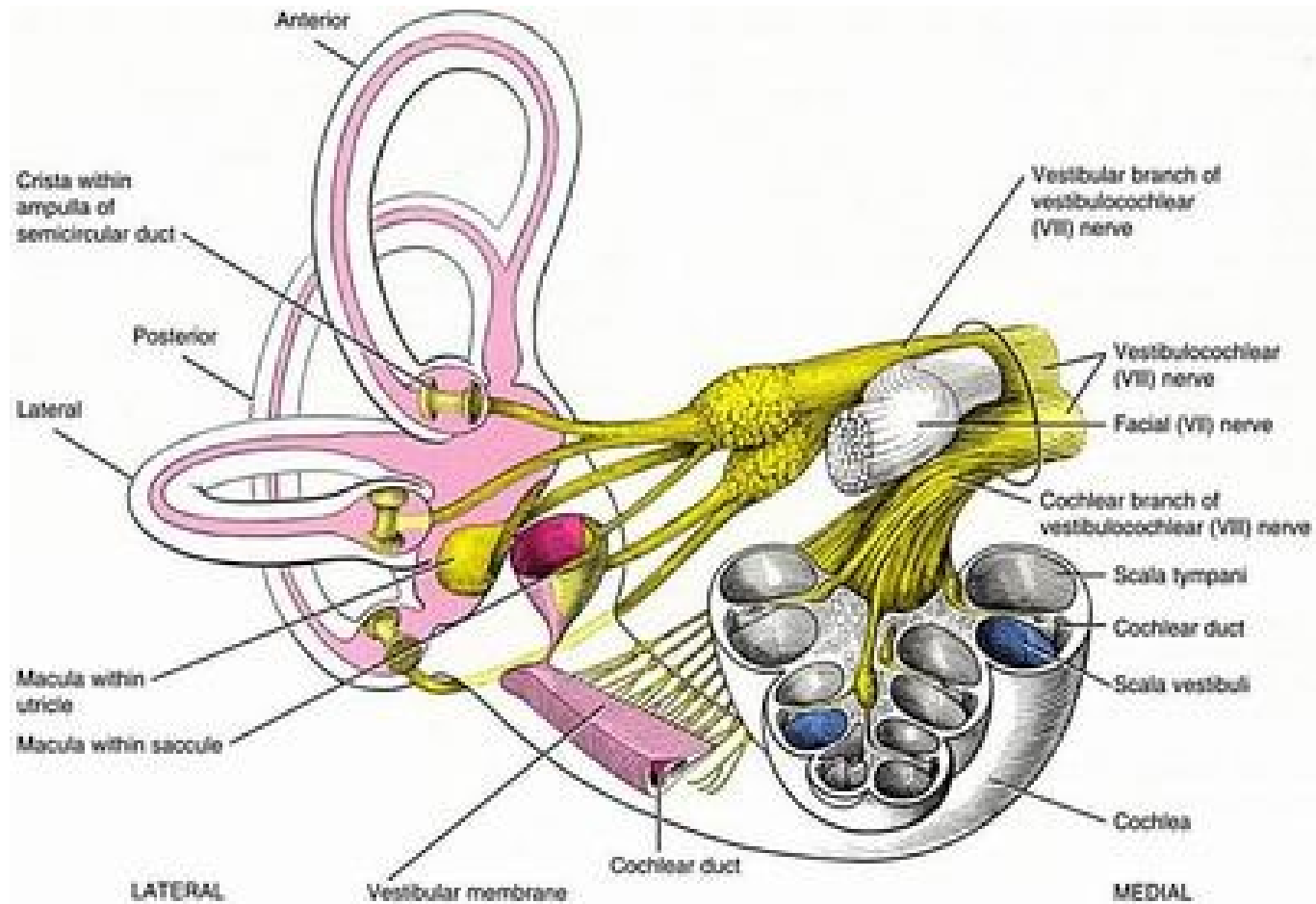
Sensory components of balance

- Vision: Significant portion of balance is dependent on vision. If we close our eyes, we become reliant on our inner ear and somatosensory (body) systems.
- Somatosensory: What your body is telling you. Receptors in your joints and muscles are receiving information of where your body is in space.

Sensory components of balance

- Vestibular system (inner ear): Semicircular canals oriented in 3 different planes.
- Vestibular system: Head movement displaces fluid on hair cells within canals which excites the vestibular nerve.
- Auditory system: Small component of balance (e.g. walking in a sound-proof room)

Inner Ear



Body response to sensory input

Normal body response to perturbation
(pushing patient forward and back)

- A) Mild perturbation: Ankle response (push patient forward, the calf muscles engage)
- B) Moderate perturbation: Hip response (push patient forward, patient leans back)
- C) Large perturbation: Stepping response (patient steps forward to avoid falling)

Dynam Balance - Gait Analysis

- Balance during gait is different than static balance. The center of gravity does not stay within the base of support. The body is in a constant state of imbalance.
- Once a step is initiated, gait is sustained by momentum.

Age related changes to sensory components of balance

- Decreased visual, vestibular, somatosensory (body awareness), and auditory (hearing) function
- Decreased ability to adapt responses (e.g. using your inner ear and your feet)

Age related changes to cognitive components of balance

- Decreased overall attention capacity
- Decreased ability to multitask (e.g. carrying a cup of water while walking)

Abnormal balance

- As the balance system declines, so does the ability of the system to respond correctly
- Individuals with an increased fall rate did not use an ankle strategy

Abnormal balance

Cerebrovascular accident (CVA)—Stroke

- A) Synergistic pattern: Groups of muscles work together in a “stuck” pattern
- B) Increased muscle tone
- C) Cognition (e.g. impulsive behavior)
- D) Impaired body awareness

Abnormal balance

Parkinson's Disease

- A) Dynamic balance problem
- B) Difficulty initiating gait
- C) Moments of freezing during movement
- D) Altered gait cycle

Abnormal balance

Benign Paroxysmal Positional Vertigo (BPPV)

- A) Calcium crystals stuck in the semicircular canals in the inner ear.
- B) Dependent on head position.
- C) Vertigo –sensation that the room is spinning.

Abnormal balance

Orthopaedic cases: (Hip or knee replacement)

- A) Impaired joint range of motion (alters centre of mass during gait and stance)
- B) Altered body awareness (new body part)

Balance tests

Berg Balance scale:

- Discriminates older adults at risk for falls
- Single best predictor of fall status in community dwelling adults
- Sound test with good reliability
- Mainly tests static and anticipatory balance

Berg Balance Scale

- Sitting to standing
- Standing unsupported
- Standing to sitting
- Standing unsupported with eyes closed
- Standing unsupported with feet together
- Reaching forward with outstretched arm
- Pick up object from floor
- Turning to look over right and left shoulder
- Turn 360 degree
- Step on step stool (# times in 20 seconds)
- Tandem stance; Standing on one foot

Balance Tests – Berg Balance Scale

14 item scale for possible 56 points total

- Decrease in Berg score = increased fall risk¹⁴
- Score of 56-54, 1 point drop = 3-4% inc. fall risk
- Each point drop from 54-46, = 6-8% increase
- Below 36, fall risk = 100%
- Limitations: does not test reactive balance; ceiling effect

Balance Tests

Timed up and go test

- Get up from seated position, walk 3 meters, turn around, walk back to chair
- Adults who took > 30 sec were dependent in activities of daily living

Functional reach test

- Standing reaching forward with hand
- Highly predictive of falls among older adults

Balance Tests

Nudge test:

- Moving patient forward, back, sideways
- Ankle vs hip, vs stepping strategy
- Test under different conditions: soft surface, eyes closed, with head movements

Other tests:

- Hallpike - Dix (testing for vertigo), observational gait analysis, dynamic gait index

Treatment of Balance

- Restoring ankle function and muscle facilitation with electrical stimulation
- Restore normal ankle response
- Nintendo Wii fit—balance training system
- Gait training

Treatment of balance

Exercise examples

- A) Calf stretch
- B) Heel / toe raises
- D) Soft surface stance in corner
- E) Sitting to standing