Balancing Acts

OPTIMIZING EXERCISE TO PREVENT FALLS

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Outline

1. Falls for older adults in Canada
2. What is balance?
3. Optimizing exercises to improve balance

Falls in Older Adults

- 35% of adults over age 65 years will fall at least once each year
  - 50% of these people will sustain more than one fall
  - 50% will sustain an injury
- Falls are the leading cause of injury-related hospital admissions in older adults.
- Most common activity at time of fall = walking

Falls Risk in the Non-Faller

If an older person has no history of falls in the previous 12 months (Muir et al. Physiotherapy Canada 2010)

- Modifiable falls risk factors present in 67% of people
- Most common activities leading to a fall
  - Walking
  - Stairs
- Risk of at least one fall in a year is 27%
- Fall risk doubled for every risk factor present

Keeping Your Balance

Balance Control System

It needs to be able to do the following:

- Keeps us steady at rest
- Keeps us steady while moving
- Adjusts to keep us steady in anticipation of moving
- Adjusts to keep us steady to adapt to changing conditions
- Adjusts to keeps us steady in response to a sudden unexpected disturbance

Balance Control Systems

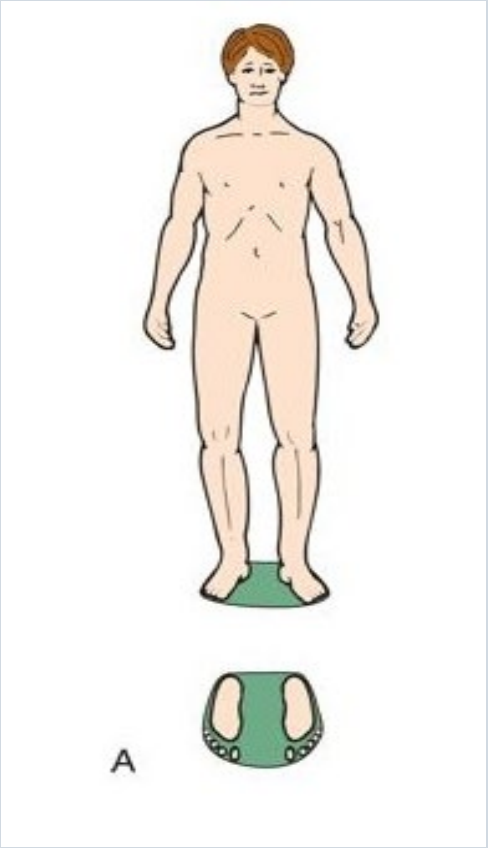
Important terms:

1. Base of support (BOS)
2. Centre of mass (CoM)

Base of Support (BOS)

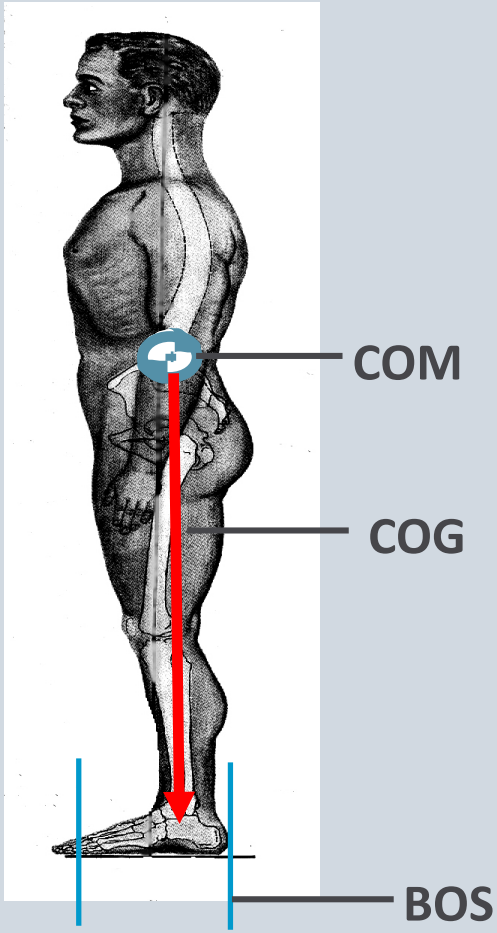
Definition:

- the area beneath a person that includes every point of contact that the person makes with the supporting surface.



(http://www.physio-pedia.com/Base_of_Support)

Centre of Mass (CoM)



(https://www.theguardian.com/stage/2018/mar/26/circus-yann-arnaud-cirque-du-soleil-fatal-fall)

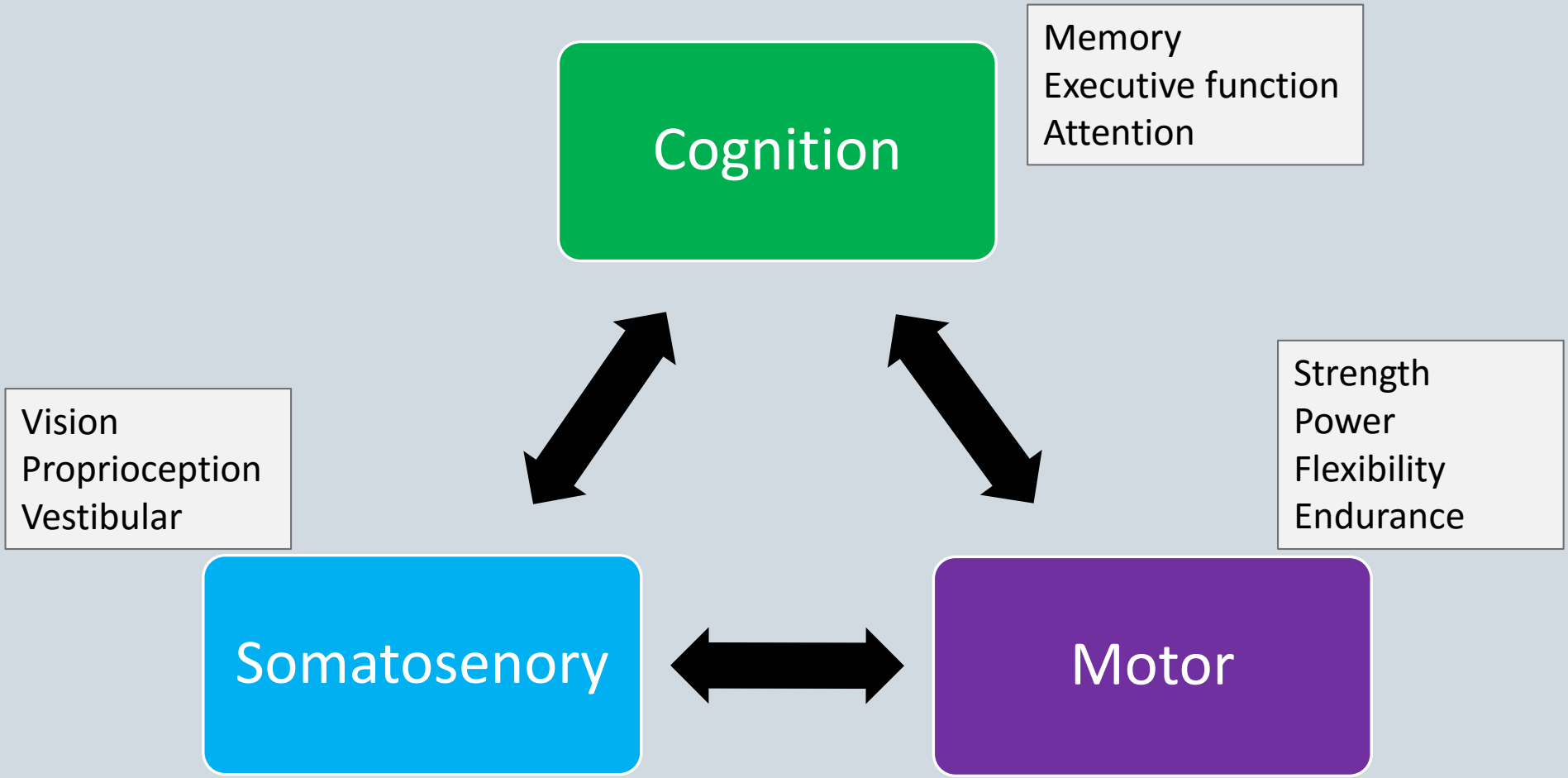
What is balance?

Definition:

- Maintenance of equilibrium
- Control of centre of mass over base of support
- Interaction between person, task and environment

Balance Control Systems

Balance Control System



Systems Framework for Postural Control

8 major components required for the maintenance of postural control:

1. Sensory strategies
2. Cognitive processing
3. Motor system
4. Static stability
5. Dynamic stability
6. Functional Stability Limits
7. Reactive Postural Control
8. Anticipatory Postural Control

Each underlying component and type of control can independently lead to a balance impairment (Horak. Age Ageing. 2008)

1. Sensory Strategies

DEF: Ability to reweight sensory information (vision, vestibular, somatosensory) when input is altered

Systems:

a) Somatosensory
b) Vestibular
c) Vision

2. Cognitive Influence

DEF: Ability to maintain stability while responding to commands during the task or attend to additional tasks (e.g., dual task)

Cognitive processes:

- Attention

3. Motor System

DEF: Includes features related to strength, coordination, endurance and range of motion

Peripheral and central factors:

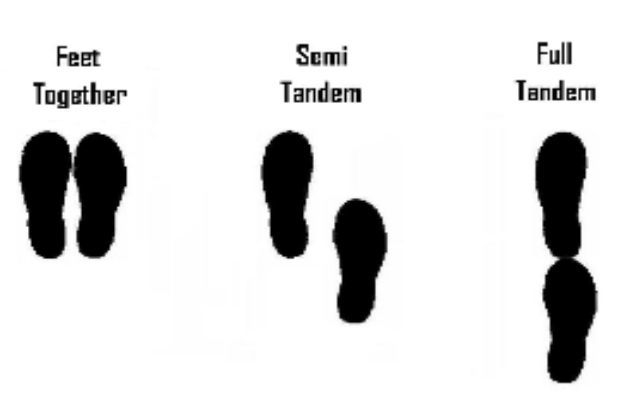
- Muscle properties
- Force production
- Timing
- Sequencing
- Coordination

(http://bodiesinmotionmassage.com/deep-tissue-massage/)

4. Static Stability

DEF: Ability to maintain positions of the CoM in unsupported stance when BOS does not change

- Sitting or standing
  - May include wide stance, narrow, tandem, 1-legged stance



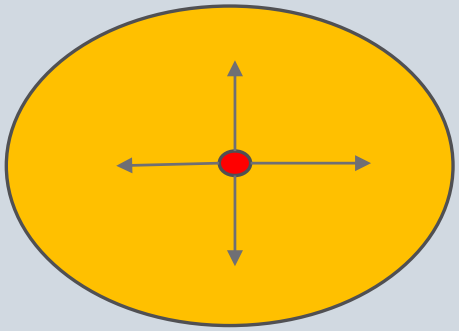
5. Dynamic Stability

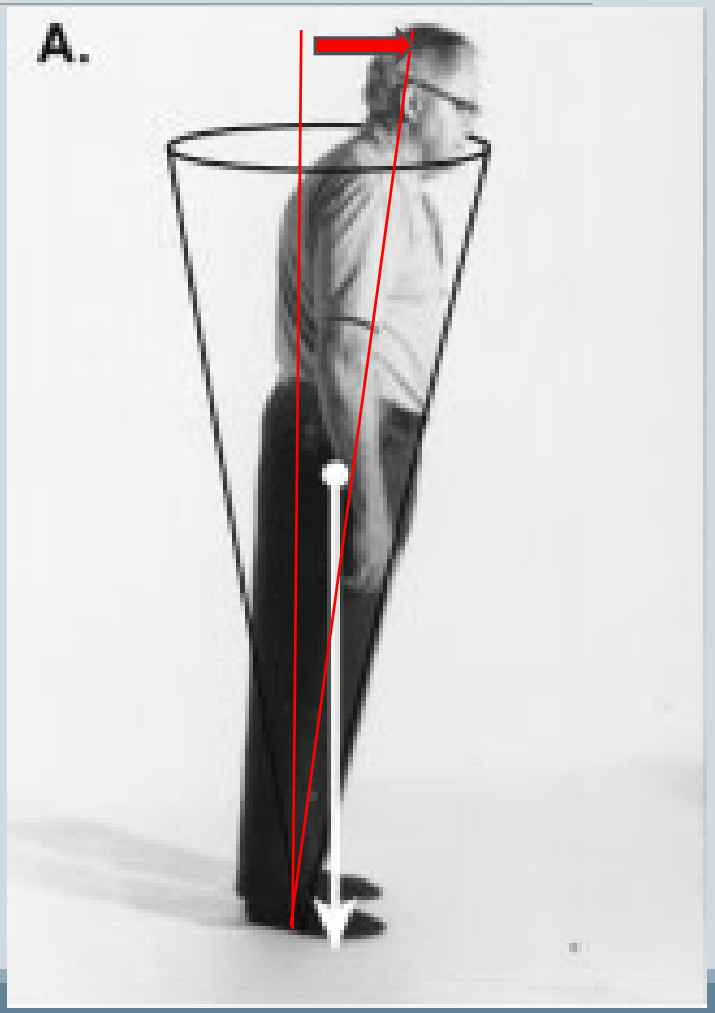
DEF: Ability to exert ongoing control of CoM when the BOS is changing

6. Functional Stability Limits

DEF: Ability to move the CoM as far as possible in the anteroposterior and mediolateral directions within the BOS

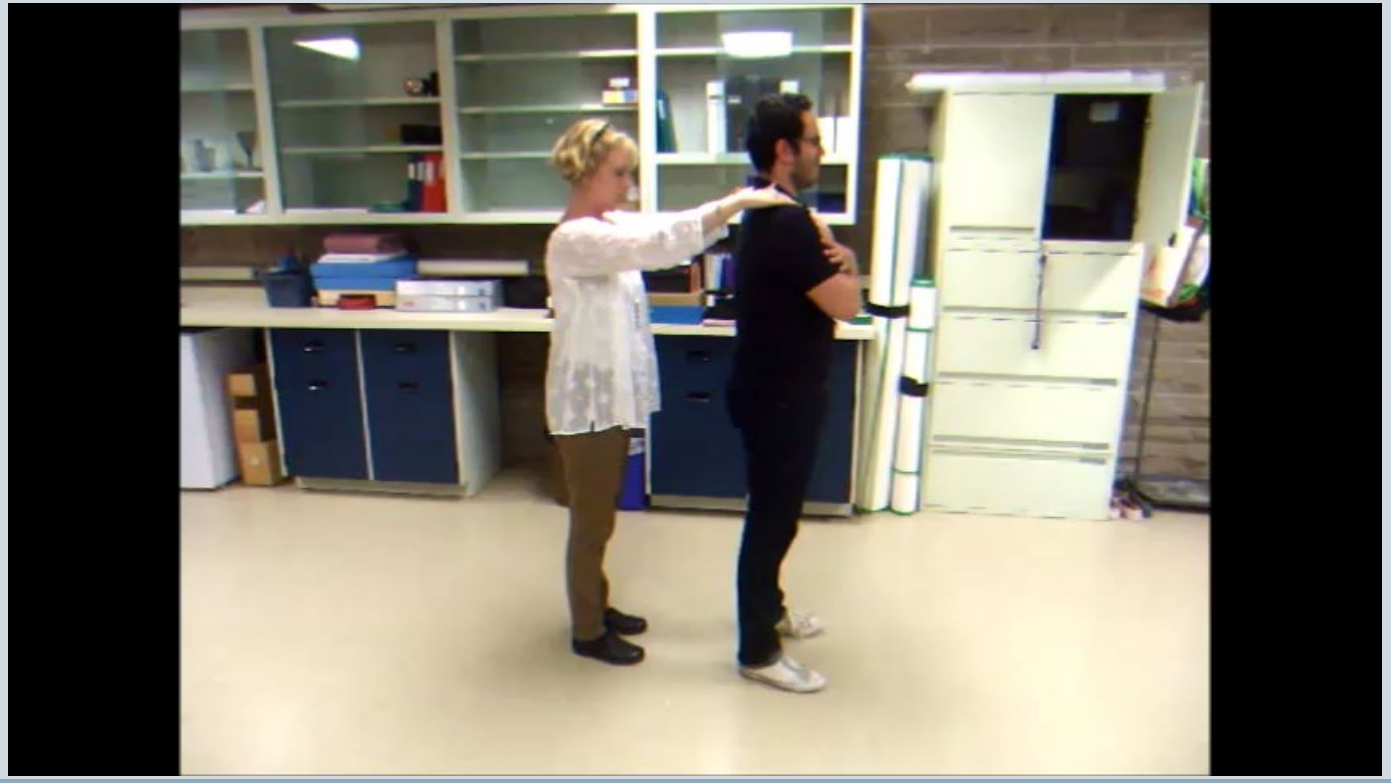
No change in the BOS





7. Reactive Postural Control

DEF: Ability to recover stability after an external perturbation to bring the CoM within the BOS through corrective movements



Reactive Postural Control

Reactive Postural Control

8. Anticipatory Postural Control

DEF: Ability to shift the CoM before a discrete voluntary movement

Finding Your Balance

Balance Training in Older Adults – Falls Prevention Recommendations

(Sherrington et al. Br J Sports Med 2016)

- Fall prevention programs **need to** include balance training
- Exercise programs should aim to provide a **high challenge** to balance by safely:
  - movement of the center of mass and controlling body position while standing
  - narrowing of the base of support
  - minimizing upper limb support, or if not possible then aim to reduce reliance on the arms
  - 3+ hours of exercise each week

Balance Exercise Prescription

1. **Frequency** – 2-4 times a week (Public Health Agency of Canada)
2. **Intensity**
   - High intensity (American College of Sports Medicine)
     - Definition: Highest level of balance exercises that can be tolerated without inducing a fall or near fall
3. **Type**
   - Which component of the Systems Framework demonstrates deficits
4. **Time**

Markers of Balance Exercise Intensity

Verbal and non-verbal markers of intensity

1. Pre-task
   - Time delay to commence task
   - Spontaneous talk from participant about task
     - From comments about the task to participant's capacity to perform the task
     - Increasing difficulty - shift in spontaneous verbalization to safety

2. In-task
   - Increasing difficulty - reduced to 1-3 word verbalizations
   - Postural responses
   - Bracing
   - Postural sway

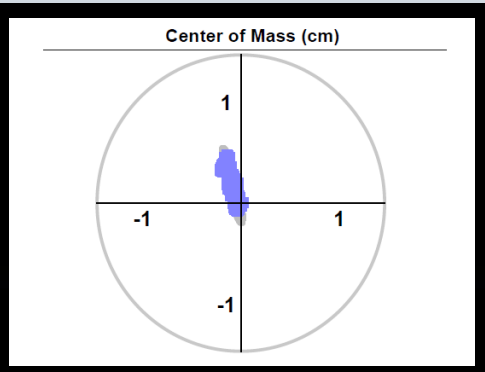
3. Post-task
   - Ask person to describe in their own words how challenging they found the exercise
     - Listen for the content – within ability or testing the limits

(Farlie et al. Phys Ther. 2016;96(3):313-323.)

Balance Exercise Prescription

Rigid surface – eyes open

Feet: shoulder width

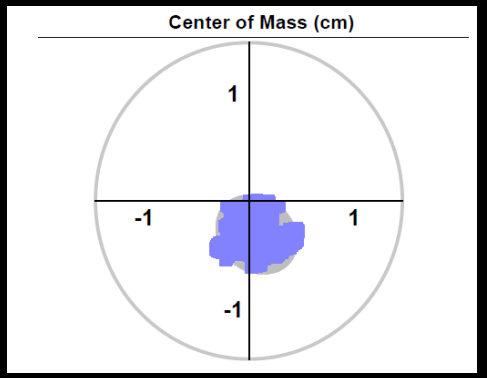


0.13cm^2

Balance Exercise Prescription

Disturbed surface – eyes open

Feet: together

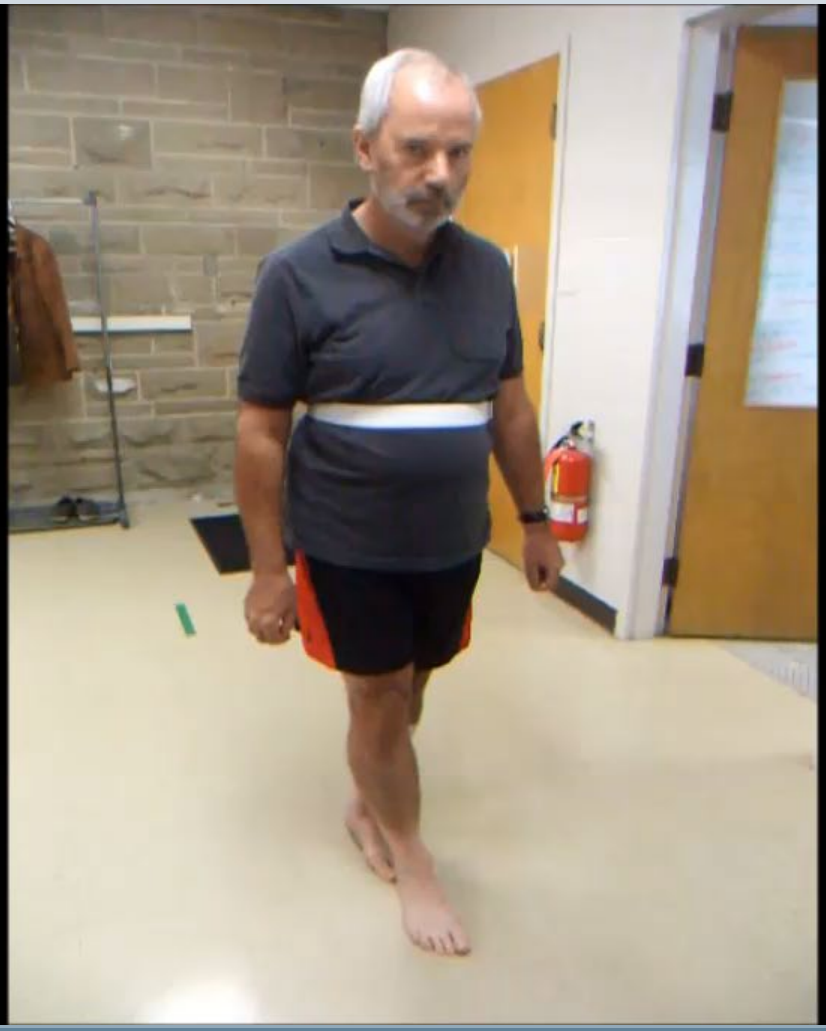


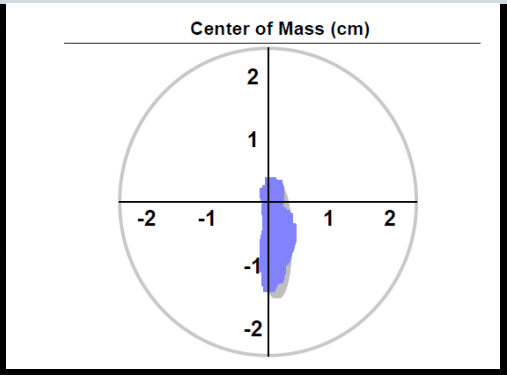
0.39cm^2

Balance Exercise Prescription

Rigid surface – eyes open

Feet: tandem



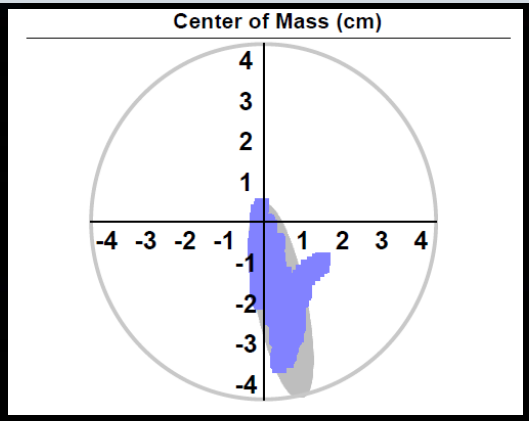


0.56cm^2

Balance Exercise Prescription

Rigid surface – eyes closed

Feet: tandem



5.46cm^2

Balance Exercise Prescription

Rigid surface – eyes closed

Feet: tandem

Balance Exercise Prescription

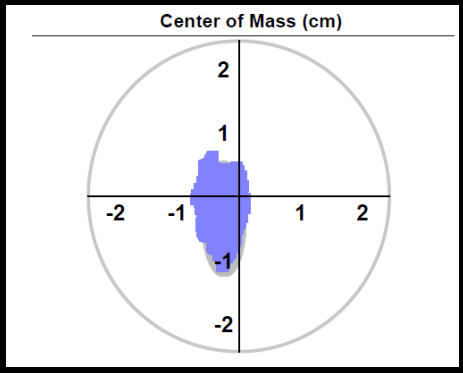
Disturbed surface – eyes closed

Feet: tandem

Balance Exercise Prescription

Rigid surface – eyes open

Feet: single leg stance



0.89cm^2

Balance Exercise Prescription

Rigid surface – eyes closed

Feet: single leg

Interventions to Improve Postural Stability

Work on the components of postural stability that show deficits

- Static function
- Dynamic function
- Limits of stability
- Reactive postural control
- Motor system
  - Address strengthening and endurance of ankle, knee and hip muscles
  - Address range of motion limitations

Manipulating the Level of Difficulty

By changing:

- Base of support
- Support surface
- Sensory inputs
- UE position/supports
- UE movements
- LE movements
- Trunk movements
- Destabilizing functional activities
- Walking activities
- Dual-task training
- Modifying environmental conditions

(O'Sullivan et al. 2014)

Summary

Maintaining independent function of older adults is very important

- Includes preventing falls and injuries
- Falls can happen to anyone
- Prevention starts before the first fall

Balance exercises should be a component of any regular physical activity program

- They are an essential component of preventing falls!!

Questions

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Mobility in Aging Lab

School of Physical Therapy