Gait Training to Improve Balance?

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Does Gait training Improve clinical measures of balance?

Training content that may improve clinical measures of balance

Re-training dynamic balance while walking

Dynamic Balance While walking In health and stroke
Does Gait training Improve Clinical Measures of Balance?

Treadmill Training (+ adjunct) Vs conventional therapy or treadmill training alone

- 8 articles with 275 people
- Duration 4-12 weeks
- Frequency 2-4 x/week
- Sessions 15-30 minutes
- Pedro 6.5/11 (IQR 2)

0.72 (95% CI 0.0-1.4)
Training Content that may influence Balance Recovery

Challenge and Variability
- Obstacle avoidance
- Circuit Gait Training
- Backward Walking
- Stair Climbing
- Eyes closed
- Circular Walking
- Dual Task

Intensity & Feedback
- Step No.
- Session Duration
- Session No.

Cost & Clinical Implementation

VR & Robotic

Treadmill Training

Community Ambulation
Clinical Measures of Balance

- Berg Balance scale
- Dynamic Gait Index
- Timed Up and Go
- Mini Best Test
- Trunk Impairment scale
- Postural Sway
- Limits of stability

• Reliable
• Responsive
• Able to predict:
  - Community ambulation
  - Ability to increase walking speed
  - Falls

Mansfield et al; 2015 Physiotherapy 101 373-380
Madhavan et al Top Stroke Rehabil 24(8) 579-584
Balance, Falls and Falls Risk

Walking and Transfers are the most commonly reported activity associated with a fall

Mobility and Balance are the Highest predictors of falls post stroke
Dynamic Balance while Walking and Stepping

Winter et al, 1995 Gait and posture
Dynamic Balance while Walking and Stepping
A throw and catch

The starting position and velocity of the cone is set to the position and velocity of the subject's CoM at toe-off. Thereafter the cone falls freely under the influence of gravity.

Stability depends on the position AND velocity of the centre of mass
Dynamic Balance while Walking and Stepping
A throw and and catch

Stability depends on the position AND velocity of the centre of mass

Lyon and Day 1997 Exp Brain Res 115 345-356
Difficulties with co-ordinating the throw and catch after stroke

Poor medial foot placement may be caused by Inability to adjust the medial motion of the Centre of Mass

Nonnekes et al 2010 Neurorehabil and Neural Repair 24(4) 393-400
Causes of dynamic balance and walking deficits: Compensations Vs Impairment

Impairment

- Paresis
- Soleus
- Hip abductors
  - Stance
  - Swing
  - Throw
  - Catch
- Sensory Integration
- Visual Vestibular Proprioceptive

Compensation

- Weight Bearing asymmetry
- Reduced anticipatory postural adjustments
- Increased Base of support
- Use of Arm support
- Reduced Walking speed & step length

↑Frontal Plane sway
↓Dynamic Balance
↓Margin of stability
Medio-lateral Antero-posterior
Measuring and Retraining dynamic balance while walking and stepping after a stroke?

Frontal Plane angular momentum $\alpha$ Dynamic gait Index ($r=-0.57$) and BBS (-0.54)

Trunk Acceleration $\alpha$ Timed Up and Go and BBS

Vistamehr et al 2016 J Biomech 49(3) 396-400
Measuring and Retraining dynamic balance while walking and stepping after a stroke?

Wearable sensor technology (e.g. velocity, acceleration)

Byl et al Neuropsychologia 2015 79 332-343
Measuring and Retraining dynamic balance while walking and stepping after a stroke?

**Impairment Based?**
- Soleus
- Swing leg Hip Abductors
- Stance leg Hip Abductors
- Sensation and Sensory integration (visual, proprioceptive, vestibular)

**Task Related Training?**
- Obstacle avoidance
- Visually guided stepping
- Speeding up / slowing down
  - Vary BOS
- Perturbation- based balance training
  - Split belt training
  
  Mieville et al 2018 J Electromyog Kinesiol 41-49
- Encouraging symmetrical weight bearing
  
  Kam et al Gait and posture 53 5-10

Herren et al J Rehabil med 2013 45 616-622
Summary

• Gait training can improve clinical measures of balance

• Increased challenge and intensity of training may be associated with greater effects

• Dynamic balance during walking is affected post stroke

• More research is required to determine whether dynamic balance can be re-trained post-stroke
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