Advancing Locomotor Rehabilitation: Understanding Mechanisms and Walking Specific Motor Learning

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What is the BEST Approach?

- Exercise Therapy?
- Electrical Stimulation?
- Locomotor Training?
- Robotic Training?
- Biofeedback?
- Aerobic Training?
Conclusions:

• Different treatment methods exist for post-stroke gait rehabilitation.

• Availability, mode of application, and costs vary, yet outcomes are largely similar.

• Therefore, choosing an appropriate method may be guided by a pragmatic approach.

Dickstein, 2008
Mean Walking Speed

Self-Selected Walking Speed (cm/s)

Pre     Week1     Week2     Week3     Week4     Week5     Week6     Week7     Week8     Week9     Week10    Week11    Post

0.00     10.00     20.00     30.00     40.00     50.00     60.00     70.00     80.00

Mean Walking Speed
Responders versus Non-Responders
Laboratory Measures
Is walking simply cyclic lower extremity activity?
Walking Performance

CV Fitness
Dynamic Balance Control
Motor Control
Strength

?
Balance Control

Weerdesteyn, 2008

Quality of Life
Fall Frequency
Postural Instability

Physical Decline

Sherrington et. al. 2008

Proposed Model

Walking Capacity
Falls Risk
Balance

Walking Capacity
Balance
Falls Risk
COM Acceleration: Sort by Pp

Symmetrical

Low Pp

High Pp
COM acceleration
- Anterior/posterior
- Vertical
- Medial/lateral

Spatiotemporals
- Step length
- Step width
- Leg angle
- Step cycle characteristics

Foot position relative to the pelvis
- Anterior/posterior
- Medial/lateral
Motor Adaptations

A

step length - 3:1

- slow baseline
- early adaptation
- late adaptation
- early post-adaptation

B

step length - 3:1

- both fast
- both slow

C

percent time in double support

- 4:1
- 3:1
- 2:1
How to determine best practice for walking recovery:
• Combination of therapies
• Contributions of postural stability
• How to classify patients for most effective treatment

Responders versus non-responders:
• How do we identify a priori
• What adjuvant “boosters” are possible for non-responders
  ✓ TMS?
  ✓ tDCS?
  ✓ Other medical or pharmacological?

Use of motor learning/motor adaptations:
• Predict response to intervention
• Assay rates of learning
• Understand walking specific skill acquisition
• Physiological contributions to motor learning (sensory perception, neuroanatomical integrity, etc).
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