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MOVE

MS Center Amsterdam

Background

- Walking limitations
- Various impairments in the neuromuscular system
- Several interventions
- Therapeutic decisions
- Working mechanisms interventions

Aim

- To illustrate the role of gait analysis in the diagnostic work up of patients with walking problems
- To show how gait analysis can help to understand the working mechanisms of interventions that can be applied in neurorehabilitation.

Limit this presentation to impaired push-off

8 phases of normal gait

- Initial contact
- Loading respons
- Midstance
- **Terminal stance**
- **Preswing**
- Initial Swing
- Midswing
- Terminal swing

Initial contact

Loading response

Midstance

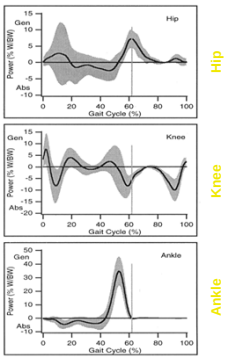
Terminal stance

- >0º Hip-extension
- full knee-extension
- heel rise!

Preswing

- active push-off
- rapid knee-flexion
- rapid hip-flexion

3D gait analysis



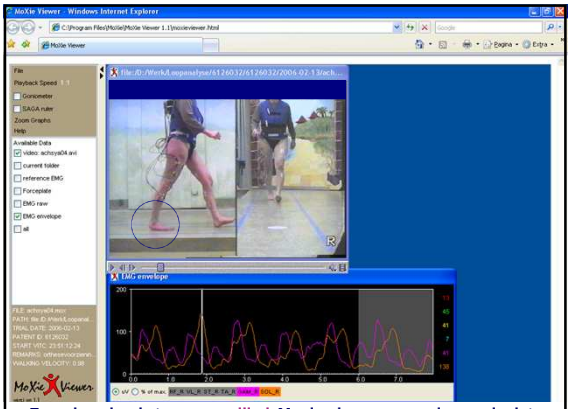
Initial swing

Midswing

Terminal swing

Case

- Woman, 42 years old, MS
- History
  - Decreasing walking distance
- Physical examination
  - Clonus gastrocnemius muscle right
  - Slight paresis calf muscles: heel to toe max 8x right, >15x left, squat 8x
- Gait analysis



Free download at www.smalll.nl. Moxie-viewer, manual, sample data

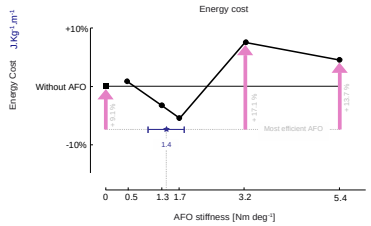
Energy Storing Ankle Foot Orthosis (ES-AFO)

- Store and release energy
- Improves push off?
- Reduces the energy cost of walking?

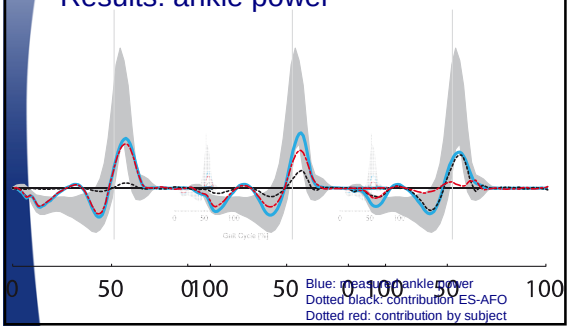
Physical experiment

- 8 Patients (stroke, MS, incomplete SCI) with reduced push-off
- 6 conditions
  - 1 Test shoe
  - 5 ES-AFOs of increasing stiffness
- Outcome measures
  - Energy cost of walking
  - 3D analysis
  - AFO kinetics
    - All AFOs with shoes
    - Results comparable to Gait Analysis
    - Easy to use in clinical practice

Results



Results: ankle power



In sum

- Most efficient ES-AFO is compromise between:
  - Increasing work done by the AFO
  - Decreasing ability to push-off
- For clinical practice
  - An ES-AFO stiffness of 1.4 Nm deg^{-1} AFO is recommended in patients with reduced ankle push-off

Electromyographic biofeedback (EMG-BFB)

- Randomized Controlled Trial (Jonsdottir, Cattaneo et al.)
- 2 x 10 chronic **stroke** patients
  - walk >10 meter without aid
  - manual muscle test grade 1-4
- 3D gait analysis at 0 , 7 and 13 weeks
  - comfortable walking speed, comfortable shoes
- Outcome measures
  - Peak ankle power at push off
  - Height normalized gait velocity (%h/s)
  - Height normalized stride length (%h)
  - Peak knee flexion in swing

Treatments

Intervention	Control
20 sessions (3 x per week) x 45 minutes	20 sessions (3 x per week) x 45 minutes
Acoustic BFB of lateral head gastrocnemius	At least 15 minutes gait training / session

Principles of motor learning
• 1-5th session: improve gait performance
  • constant BFB
  • verbal instructions
• 6-15th session: increase error self-detection
  • different step lengths, variable speed, variable terrain, direction changes
  • Intermittent EMG-BFB
• 16-20th session: transfer
  • BFB mostly withdrawn
	Usual care
	• neurodevelopmental and neurofacilitation approaches
	• task specific training
	• Task oriented training

Results

- Intervention group significantly better on all outcomes except peak knee flexion in swing
- Results maintained at follow up
- Changes in intervention group
  - Peak ankle power at push-off
    - 0.63 → 1.04 W/kg in intervention group only
  - Velocity
    - 28,3 %h/s → 39,6 %h/s
  - Stride length
    - 44.5 %h → 57.6 %h

In sum

- EMG-BFB improves walking speed significantly and importantly (average 0.2 m/s increase)
- Working mechanism (increased push-off → increased stride length → increased speed) supported
- What was the active ingredient in the therapy?
- But what does this mean for persons with MS?

Recommendations

- In studies on gait
  - Characterize the intervention in detail
    - Measure mechanical properties of orthosis
    - Details of biofeedback
    - Contents of the physical therapy
  - Perform a gait analysis to test the hypotheses regarding the working mechanisms
  - Choose outcome measures at the appropriate ICF levels
    - Speed
    - Distance
    - Energy cost
    - Participation

Recommendations

- Don't forget to look for interventions in other disorders of the central nervous system
- Gait analysis, even video only, can improve the identification and treatment of walking problems.
- Push-off does matter

Questions?