New Approaches for Exercise Training in Advanced Multiple Sclerosis

Lara A. Pilutti, PhD
Kinesiology & Community Health
University of Illinois Urbana-Champaign

Outline

• Advanced MS
• Exercise & MS: Problems & solutions
• Potential approaches for exercise training in advanced MS
  – Approach
  – Current Evidence
  – Long-term potential
• Conclusions

Advanced MS

Expanded Disability Status Scale (EDSS)

Advanced MS: Limitations

• Walking impairment
• Loss of physical fitness
  – Strength, aerobic capacity, balance, body composition
• Symptoms
  – Fatigue, depression, pain
• Quality of life
• Participation in daily activities

Exercise Training in MS

• Potential benefits:
  – Walking performance & gait
  – Aerobic and muscular fitness
  – Balance
  – Body composition
  – Symptoms
  – Quality of life
• Current evidence based on patients with mild-moderate MS, not advanced MS disability

Why Limited Research?

Latimer-Cheung et al 2013
Other Limitations

- Barriers to exercise in advanced MS:
  - Availability of facilities/programs
  - Transportation
  - Financial burden
  - Lack of support
  - Limited information

Why Exercise for Advanced MS?

- Importance
  - Limited options for therapy
  - DMT not effective long-term
  - Need alternative approaches to restore and maintain function and independence

Solution: Adapted Exercise

- Adapted exercise approaches:
  - Modified exercises, training approaches and/or equipment that is accessible for individuals with advanced MS

Potential Approaches for Exercise

1. Body-weight supported treadmill
2. Recumbent stepper
3. Adapted home-based resistance exercise
4. Functional electrical stimulation cycling

Body-Weight Supported Treadmill Training

- Approach:
  - Partial or complete body weight support via overhead harness
  - Repetitive, task-oriented gait training
  - Therapist or robotic assistance

Body-Weight Supported Treadmill Training

- Evidence:
  - Some trials in advanced MS
    - Benefits: walking performance, gait, strength, MS symptoms, QOL
    - Benefits generally not maintained when training discontinued

Effects of 12 Weeks of Supported Treadmill Training on Functional Ability and Quality of Life in Progressive Multiple Sclerosis: A Pilot Study

Beer et al 2008; Lu & Yickie 2008; Giusar et al 2011; Schwartz et al 2011; Wier et al 2011
Body-Weight Supported Treadmill Training

- Long-term potential:
  - Limited to specialized training centers
  - High costs
  - Therapist-assisted training inefficient and may limit patient contribution to training
  - Potential as short-term gait rehabilitation tool to regain mobility and function

Potential Approaches for Exercise

1. Body-weight supported treadmill
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Recumbent Stepper Training

- Approach:
  - Bilateral, reciprocal arm and leg pedals – coupled action
  - Large foot pedals, rotating seat, arm and leg strapping
  - Provides full body aerobic exercise in seated position

Recumbent Stepper Training

- Evidence:
  - No published training studies in MS
  - Improved fitness in healthy sedentary
  - Benefits reported in older adults, stroke and PD patients
  - Improved blood pressure, strength, walking, & balance

Recumbent Stepper Training

- Pilot study:
  - 12 participants progressive, advanced MS (EDSS=6.0-8.0)
  - 6 recumbent stepper/6 BWSTT
  - Intervention: 3x/wk, 12-weeks
  - Outcomes:
    1. Safety, compliance & patient experience
    2. Efficacy vs BWSTT

Recumbent Stepper Training

- Primary outcomes:
  - Safety: stepper 2 AEs; BWSTT 5 AEs
  - Compliance: ~89% for both groups
  - Equipment preferred: recumbent stepper

- Secondary outcomes:
  - Improved fatigue and QOL in both groups
  - No change in function both groups
  - Higher training heart rate in stepper group
Recumbent Stepper Training

• Long-term potential:
  – Relatively cost-effective
  – Simple to use
  – Self-driven training
  – Available in many community settings
  – Potential for home use, although large piece of equipment

Potential Approaches for Exercise

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Home-Based Resistance Training

• Approach:
  – Adapted, resistance training exercises suitable for home setting
  – Resistance = bands, free weights, body weight
  – Target strength loss

Home-Based Resistance Training

• Evidence:
  – One previous study in mod-advanced MS
  – Benefits in mild-mod MS and general population
  – Project RETRO:
    • Design: 6-month, home-based resistance training program, using elastic bands (vs no exercise control)
    • Goals:
      1. Safety and efficacy
      2. Secondary benefits

RETRO Intervention

• Home-based PRT:
  – 10 exercises, 2x/wk, 1-2 sets, 8-12 reps
  – Provided log book, training manual, equipment

• Behavioral Component:
  – Theory-based strategies

• In-person visits:
  – Training progression
  – Behavioral strategies

RETRO Exercise Program

• Group-based training sessions:
Behavioral Strategies

- Tools to help maximize program adherence and the potential benefits from exercise
- E.g., self-monitoring, goal setting
- Part of group-based sessions

GOAL SETTING

S.M.A.A.R.T. goals
- Specific
- Measurable
- Adjustable
- Action-Oriented
- Realistic
- Time-Based

GOALS

What are your personal goals for exercise?
What are your personal goals for this study?
What is your plan to achieve those exercise goals?

Strength & Lean Mass

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Control</th>
<th>Exercise</th>
<th>P</th>
<th>n₂</th>
<th>d</th>
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<tbody>
<tr>
<td>Grip strength, kg</td>
<td>27.8 (0.5)</td>
<td>27.7 (0.1)</td>
<td>.69</td>
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<tr>
<td>Knee extensor, Nm</td>
<td>85.8 (6.7)</td>
<td>85.7 (8.1)</td>
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<td>&lt;.00</td>
<td>&lt;.001</td>
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<tr>
<td>Knee flexor, Nm</td>
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<td>31.4 (2.3)</td>
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<td>Shoulder extensor, Nm</td>
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<td>34.0 (2.4)</td>
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<td>.02</td>
<td>.12</td>
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<tr>
<td>Shoulder flexor, Nm</td>
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<td>43.4 (2.2)</td>
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<td>.98</td>
<td>.001</td>
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<tr>
<td>Ankle dorsiflexor, Nm</td>
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<td>12.5 (1.5)</td>
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<td>Ankle plantiflexor, Nm</td>
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<td>.01</td>
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<td>Whole body lean mass, g</td>
<td>42188.0 (952.5)</td>
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<td>.08</td>
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<td>Skeletal muscle mass, g</td>
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<td>18058.7 (146.4)</td>
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</table>

Values are estimated marginal means [95]

Secondary Outcomes

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<tr>
<th>Outcome</th>
<th>Control</th>
<th>Exercise</th>
<th>P</th>
<th>n₂</th>
<th>d</th>
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<tr>
<td>Upper body function</td>
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<td>Cognition – SDMT</td>
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<td>42.9 (2.3)</td>
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<td>.01</td>
<td>.09</td>
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<td>Fatigue – MFIS</td>
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<td>Pain – MPQ</td>
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<td>8.4 (1.9)</td>
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<td>Mental QOL</td>
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<td>17.5 (1.7)</td>
<td>.10</td>
<td>.27</td>
<td>.53</td>
</tr>
</tbody>
</table>

Values are estimated marginal means [95]
Home-Based Resistance Training

- Long-term potential:
  - Cost effective
  - Easily implemented in home/community settings
  - Strategies for promoting compliance and home-monitoring should be considered

Potential Approaches for Exercise

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Functional Electrical Simulation (FES) Cycling

- Approach:
  - Surface electrodes placed over leg muscles
  - Mild electrical stimulation results in muscle contraction and leg cycling

FES Cycling

- Evidence:
  - Benefits largely established in SCI and stroke
    - Improved walking, gait, strength, spasticity, bone & skin health, metabolism, cardiovascular function
  - MS studies (n=4)
    - Preliminary benefits: walking, gait, strength, muscle mass and metabolism, quality of life
    - Limitations: Small samples (8-12 people), no control condition, short-term training

Next Steps: Pilot FES Study

- 6-month trial of supervised FES cycling
- 16 participants with advanced MS
- 2 interventions: FES and passive leg cycling

- Primary outcomes:
  - Safety, feasibility, walking, & fitness

- Secondary outcomes:
  - MS symptoms, cognition, eye & brain imaging

Assessments: baseline, 3 months, 6 months
Other Rehabilitation Considerations

- New approaches can be combined with other strategies:
  - Physical and occupational therapy
  - Assistive devices and orthoses
  - Medical and surgical therapies

Conclusions

- Need for new exercise approaches in advanced MS
- Adapted exercise requires rigorous evaluation in advanced MS for establishing safety, feasibility, and efficacy
- Ultimate goal to develop effective home- and community-based exercise programs for the long-term management of advanced MS

Thank You

- Participants
- Research team:
  - Clinical Exercise Physiology Lab
- Collaborators
  - Rob Motl & Exercise Neuroscience Research Lab

Questions?
Lara Pilutti
lpilutti@illinois.edu