Effect of maximal strength training on gait and balance in persons with Multiple Sclerosis

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Introduction

• Persons with MS have impaired muscle strength and activation. (1-2)
• The decreased muscle activation indicates a CNS phenomenon
• These limitations result in impaired mobility.
Introduction

• Strength training has been used in MS to address mobility deficits
• Relatively low loads and intensities, presumably to limit fatigue
• Improvements seen generally attributed to improved force production
• Higher loads are thought to result in greater CNS activation
• Little research on hi intensity strength training in MS

Introduction

• Fimland (3) hypothesized that maximal strength training in persons with MS would not only improve strength but CNS activation and enhance “neural drive”.
• Using EMG analysis found MST training augmenting the magnitude of efferent motor output of spinal motor neurons.
• No adverse events.
• 1RM improved; effects on mobility were not measured
Introduction

• Hill et al (4) found improved performance in chronic stroke patients after MST in 6MWT and TUG.
• No significant changes in walking economy, peak aerobic capacity, Four-Square Step Test.
• Strength improvements found in both the affected and unaffected leg.
• No adverse events

Purpose and hypothesis

• Effect of MST on mobility measures of gait and balance in pwMS has not been examined.
• The purpose of this pilot study was to examine the effects of MST in pwMS on measures of mobility
• Based on the results of the previous studies, we hypothesize that persons with MS who undergo MST training will experience improvement in mobility
• Secondary hypothesis- how well will the intervention be tolerated
METHODS

• A Pilot pretest posttest non randomized non controlled design was used
• Subjects were recruited from MS specialty practices in NYC
• Study approved by Hunter College IRB

Inclusion/exclusion criteria

• Ability to ambulate for 6min Independently with or without A the study
• Exacerbation or use of Methylprednisolone two weeks before or during the study
• No cognitive, orthopedic, or neurologic limitations
**Pretest/postest measures: Objective**

- Subject characteristics- Age, gender, EDSS, years since dx, medications
- Six minute walk test (6MWT)- total and minute by minute
- Berg Balance Scale
- Unilateral (L&R) leg press one-repetition maximum

**Subjective measures**

- Multiple Sclerosis Impact Scale-29 (MSIS-29)
- Fatigue Severity Scale (FSS)
- Visual Analog Fatigue scale (VAFS)- given before and after each training session
**1RM protocol- based on guidelines**

- Subjects started with very low weights on a standard leg press to get comfortable with performing the exercise.
- Load was increased to a level the patient felt was about 50-75% of their maximum to perform 2-3 reps.
- Single repetitions were performed with increasing weight (2.5-5.0 lb/rep) until only one repetition could be completed.
- The greatest load with a single rep was determined as their 1RM.

**MST training protocol**

- 15 min seated rest
- 5 min aerobic wrmp on recumbent bike
- Muscular Warm Up - 5 repetitions at 50% of 1 RM for initial leg
- 4 sets of 4 repetitions at 85-95% 1RM (VAFS measurements taken immediately before 1st set and after last
- Procedure repeated for opposite leg.
MST training protocol

• 2 MST sessions a week for 8 weeks
• Concentric and eccentric contractions performed in a 1:2 ratio
• The leg not being trained would be held off the leg press machines by examiner to minimize compensatory use
• Verbal exhortations were utilized to facilitate maximal effort

Results: Demographics/subject characteristics

• N=7
• 5 female, 2 male; Average age 52+/-13 years, Range (34-69)
• Average years since diagnosis: 14 years+/-12 years, Range (3-35)
• EDSS: Average of 3.5 +/-1.2, Range (2.5-4.5)
• MSIS-29: Average of 69.1 +/- 18.4, Range (43-81)
Results: BBS

- Pretest ($M = 44.29, SD = 8.34$)
- Posttest ($M = 49.57, SD = 5.83$)
- $p = .008$
Results 6MWT

- Pretest ($M = 1040.04, SD = 429.25$)
- Posttest ($M = 1190.73, SD = 579.95$)
- $p = .045$
Results - 1-Repetition Max

Maximal right sided leg press
• pretest ($M = 146.07$, $SD = 93.36$)
• posttest ($M = 228.93$, $SD = 95.98$)
• $p = .004$

Maximal left sided leg press
• pretest ($M = 142.86$, $SD = 100.87$)
• posttest ($M = 215.00$, $SD = 114.07$)
• $p < .001$

1-repetition Max

<table>
<thead>
<tr>
<th>Pounds (Lbs)</th>
<th>Right Leg</th>
<th>Left Leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>146</td>
<td>143</td>
</tr>
<tr>
<td>Post-Test</td>
<td>229</td>
<td>215</td>
</tr>
</tbody>
</table>

Legend:
- Red: Pre-Test
- Blue: Post-Test
Results

• No significant changes in VAFS, MSQOL, FSS
• No adverse events
• One subject dropped out due to an injury unrelated to the MST

Discussion

• Significant improvements in BBS, 6MWT, and (B) 1RM following 8 weeks of MST.
• No gait training or balance training during this period
• All of these patients had had strength training in the past but at much lower volume and intensity
Mechanism

• Neural drive? - the MST caused greater CNS activation
• Lower extremity strengthening? - MST was responsible for greater force production
• Confidence - most subjects were very surprised at how much they could lift

Limitations

• Study design - non-controlled, non-randomized pretest post-test
• Sample size - 7
• Ceiling effect of the BBS
• Selection bias
Future research

• Larger sample
• Control/comparison group
• Measures-MiniBesttest-
  - Spasticity measures
  - Functional tasks that require muscle strength (e.g. stairclimbing)
• Include other lifts-knee flexion, plantiflexion

Questions/Comments???
Thank You!!!