Impact of Resistance Training on Balance in Multiple Sclerosis

Mary Filipi, PhD, APRN ; M. Patricia Leuschen, PhD: Nick Stergiou, PhD: Jessie Huisinga, MS; Sangeeta Agawral, MS; Lorene Schmaderer, PT; Daryl Kucera ACE

Introduction

Multiple Sclerosis (MS) is the most prevalent progressive neuro-degenerative disease among young adults. For over 12 years, treatment has become available that slows the disease but does not provide a cure. Medication has effectively decreased the number and severity of MS relapses, but patients continue to experience fatigue, muscle weakness and balance problems. Many individuals acquire and live with disability due to this disease process which impedes daily living and decreases quality of life, both for themselves and their families. PT has shown a positive effect in treating pain and mobility in MS but training programs have been discouraged because of the belief that exercise would exacerbate fatigue and MS symptoms. Physical therapy or exercise is either limited by payer source or lack of emphasis by care providers. Little emphasis was placed on structured programs to improve or maintain strength or mobility.

Hypothesis

Standardized, structured resistance training will improve gait, balance and fatigue outcomes in MS patients regardless of level of disability.

Demographics

The study population (n=12) is a cohort of a larger 45 subject study, and are the first 12 MS patients who enrolled and completed a resistance training program for 6 months. A 50 minute bi-weekly exercise participation was required.

Age: Range 24-54 years of age; Mean age for participants was 38.8 years.

Gender: 11 females - 1 male

MS Classification: Participants had either Relapsing/ Remitting or Secondary Progressive MS patients.

Methods

Two groups by the Expanded Disability Screening Score:

1) little or no disability

2) mild to moderate disability measured Information

Testing:

- Modified Fatigue Impact Scale (mFIS)
- Fear of Falling Scale (FFS)
- Berg Balance Scale (BBS)
- Multiple Sclerosis Functional Composite Exam (MSFC)
- Balance Master®
- An 8 camera 3 Dimensional Motion & gait analysis with a Kistler Forced Platform

Data:

- Obtained at baseline, 3 months & 6 months
- Paired T-tests and mixed model analysis were done for data analysis.

A specifically designed resistance and balance exercise program consisting of 3 phases was integrated into the bi-weekly exercise session.

1) Strength training – Stationary machines

2) Balance & dexterity – Squat cages

3) Agility, conditioning & strength – free weights

Figure 1: Means & P-Values for the MSFC, mFIS, FFS, BBS & Balance Master® from mixed model analysis

Test	Baseline	6 months	p-value
MSFC			
9 hole peg - right	23 sec	20 sec	0.034
9 hole peg- left	25 sec	22 sec	0.064
PASAT – 3 seconds	63	74	0.018
PASAT – 2 seconds	46	57	0.017
25 foot walk	7 sec	6 sec	0.087
mFIS			
Physical	23	18	0.007
Fear of Falling Scale	7.5	9	0.009
Berg Balance Scale	51	54	0.049
Balance Master®			
Foam - eyes open	0.87	0.73	0.037
Length of stride	32	38	0.056

Balance & Cognitive Results

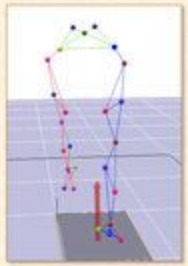
All parameters of the MSFC demonstrated positive impact after exercise showing clinical improvement. Significant PASAT performance changes indicate better concentration and memory. Fatigue decreased. Balance improved and subsequently the fear of falling decreased. (Figure 1)

Figure 2: p-values from t-tests for gait evaluation from baseline to 6 months

Gait Evaluation	p-value
Ground Reaction Forces	
F 1 (↑)	0.018
F 2 (↑)	0.017
Loading Rate (↑)	0.0006
Braking Force (FyB) (↑)	0.003
Propulsive Force (FyP) (↑)	0.025
Ratio FyB:FyP (↑)	0.002
Propulsive Impulse (↑)	0.038
Stance Time (↓)	0.025
Joint Angles	
Range of Motion of Hip (↑)	0.013
Joint Moments	
Peak Knee Extensor @ mid/late-stance (↑)	0.010
Hip Extensor @ early stance/heel strike (↑)	0.003
Peak Hip Extensor @ late stance (↑)	0.035
Joint Powers	
Knee Eccentric Contraction of extensors-power absorption @ K3 - Late stance (↑)	0.001
Hip Concentric Contraction of Extensors – power generation@H3 Terminal stance (↑)	0.006

Gait Results

Ground reaction force testing indicates that MS patients increase movement of the center of mass in all 3 directions after training. The improved values of F1, F2 and loading rate verify more vertical fluctuation while increases in braking force and propulsive force show more movement in the anterior/posterior direction. Increased ROM at the hip after training is indicative of muscle activity needed to increase joint motion. The changes in joint moments indicate an increase in torque (moment) at the hip and knee. This allows for better joint rotation and better support of the body as it moves over the foot during stance. Overall, changes at the knee and the hip for both moments and powers demonstrate a significant increase in the strength of the knee extensors and hip extensors. This increase in strength results in increased knee extensor moment, increased hip extensor moment, increased knee power generation during mid-stance and increased hip power generation during terminal stance. (Figure 2)



Conclusion

This is pilot data of 12 patients from a cohort of 45 Multiple Sclerosis (MS) patients enrolled in a weight resistant and balance program. No differences were noted in performance between groups. Clinical improvement with statistical significance ($p<.05$) between times were noted in the following areas:

- increased speed and accuracy of the right handed 9 hole peg test
- 2 & 3 second PASAT
- lessened physical fatigue by mFIS
- balance on a foam surface with eyes open
- improved Berg Balance testing.
- improvement trends were noted in:
- walking speed
- speed & accuracy of left handed 9 hole peg test,
- length of stride.

Full gait analysis showed increases in strength resulting in increased knee extensor moments, increased hip extensor moments, increased knee power generation during mid-stance and increased hip power generation during terminal stance.

Clinical Implications

Not unlike their unaffected peers, significant clinical and statistical improvement is noted in the overall condition of MS patients with the addition of a structured exercise program. Gait, balance and level of fatigue as well as cognition improve in MS patients who participate in a structured weight resistance program. Exercise should be considered adjunct therapy, used in combination with pharmaceutical intervention for comprehensive care in individuals with MS.

Supported by:

MARS Foundation, University of NE Medical Center, Clinical Research Center, Fast Forward Gym and The NE Biomechanics Core Facility @ University of NE @ Omaha