Background

Multiple Sclerosis (MS) patients often have symptomatic flare-ups which reduce levels of function. Currently, the most accurate assessment and determination of MS patient function is the Multiple Sclerosis Functional Composite Score (MSFC). The MSFC incorporates the standardized score (Z-score) of the Paced Auditory Serial Addition Test (PASAT-3) for cognitive function, 9-Hole Peg Test (9-HPT) for upper extremity function, and timed 25-foot walk (25-TW) for lower extremity function.

One of the most common symptoms experienced by MS patients is severe fatigue potentially aggravated by aerobic exercise. Non-aerobic maximal effort exercise (MEE) is thought to increase strength without increasing fatigue. The IsoPUMP® (Neuromuscular Engineering; Nashville, TN) is a stationary exercise device designed to safely perform and measure MEE using isometric and eccentric leg press and total body lunge exercises. The progressive functional changes of the MS subjects were tracked using the MSFC at specific intervals during the study.

Hypothesis

An observed functional improvement in patients will be reflected in their MSFC, as well as the individual PASAT-3, 9-HPT, and 25-TW tests.

Methods

During the initial visit, subjects completed questionnaires and performed the 25-TW, 9-HPT, and PASAT-3 test. A four-phase exercise protocol was implemented using leg press and whole body lunge exercises performed on the IsoPUMP® bi-weekly for 10 weeks with a single follow-up exercise session during weeks 16 and 22. Subjects were instructed to perform a valsala while exerting their maximal effort against the IsoPUMP® resistance for 4 seconds. This was repeated 3-5 times with minimal rest (60-180 seconds) between repetitions.

A total of 78 subjects, diagnosed with MS for at least 2 years and having Extended Disability Status Scores of 2-6, participated in this multi-center study. Subject distribution and characteristics are listed in Table 1.

Statistical Analysis Method

The effect size was used to determine if there were any significant improvements in function during and after MEE protocol. In interpreting the data, the effect size was derived by subtracting the baseline (Week 0) score from the corresponding weeks and dividing the result by the standard deviation for each week; therefore, effect size = (Δ mean/standard deviation for corresponding week). The effect size was used to determine if an improvement in function and strength was noted from baseline to subsequent weeks:

1. midway through exercise: (2) end of exercise protocol; (3) 6 weeks after discontinuing exercise; and (4) 3 months post-intervention. Interpretation of significance ranges from mild (≥ 0.3), to moderate (≥ 0.5), and to highly significant (≥ 0.7).

Results

Table 1. Subject Demographic Characteristics Summary (n=78)  

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean (±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time since Diagnosis (years)</td>
<td>10.1 ± 2.7</td>
</tr>
<tr>
<td>Sex</td>
<td>Male (n=47) 56.9 (±20)</td>
</tr>
<tr>
<td>Race</td>
<td>White (n=46) 57.3 (±20)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>70.5 (±20)</td>
</tr>
<tr>
<td>Education</td>
<td>Bachelor (n=39) 32.0 (±20)</td>
</tr>
<tr>
<td>Employment Status</td>
<td>Employed (n=56) 60.0 (±32)</td>
</tr>
<tr>
<td>Handedness (%)</td>
<td>Right (n=64) 81.0 (±44)</td>
</tr>
</tbody>
</table>

Figure 1. IsoPUMP® exercise equipment. Top: Leg press demonstration. Right: Total body lunge demonstration.

An observed functional improvement in patients will be reflected in their MSFC, as well as the individual PASAT-3, 9-HPT, and 25-TW tests.

Discussion

Non-aerobic MEE improved cognitive and lower extremity functionality but upper extremity function did not show similar improvements. The statistically insignificant decline in 9-HPT function may reflect the chronic deteriorating nature of the underlying disease process. With the other MSFC Z-scores demonstrating a significant effect size, overall function achieved mild sustained improvement. This is considerably significant, since MS typically predisposes patients to decline in function over time.

While the results are statistically significant, it is important to assess the impact that the changes in functionality has on our population’s daily living. Therefore, future studies should determine if MS subjects that benefited from the Maximal Effort Exercise intervention perceived an improvement in their quality of life.

Acknowledgement

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References


Conclusion

An improvement in the overall functionality of MS subjects undergoing ten-weeks’ non-aerobic progressive MEE was achieved and was maintained even three months after discontinuing this protocol. Although there was a slight drop in the overall (MSFC) effect size twelve weeks after the intervention, there was a continuous increase in cognitive function and the increased lower extremity function gained was also maintained. Upper extremity function, as denoted by the 9-HPT, never achieved a statistically significant effect size.