GAIT CHANGES IN PATIENTS WITH PROGRESSIVE MULTIPLE SCLEROSIS

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INTRODUCTION
Multiple sclerosis (MS) is a chronic inflammatory disease of the central nervous system of unknown etiology. The clinical manifestations and presentations of MS are varied depending on the location and severity of pathologic injury. Its symptoms include muscle weakness, sensory disturbances, spasticity and gait ataxia. Clinical evaluation of gait is difficult because systems including muscle function, motor control and integration of movement may be affected by MS leading to subtle and obvious changes in locomotion capabilities. Identification of effective therapies for MS have been significantly hindered due to the largely unpredictable clinical course of the disease and the limited understanding of its etiology and pathogenesis. The purpose of this study is to determine if gait analysis can detect ambulation changes of patients with progressive MS.

PROCEDURES
Eighteen patients (7 women, 11 men, mean age 49 ± 8.5 years) with MS of differing levels of disability participated in this study. Each patient was evaluated by a neurologist to confirm the diagnosis of progressive MS. The Kurtzke Expanded Disability Status Scale (EDSS) was used to quantify the severity of the disease for each subject. EDSS scores were determined through a neurological examination with scores ranging from 0 (normal neurological exam) to 10 (death from MS). All subjects participated in five separate gait evaluations over the course of eighteen months (0, 1, 26, 52 and 78 weeks). A set of 21 reflective markers were placed on bony landmarks as described by Kadaba et al. (1989). Data from at least three complete gait cycles was collected for both the right and left side of the body. Gait analysis instrumentation included a six camera ExpertVision System (Motion Analysis Corporation, Santa Rosa, CA) which was used to collect three-dimensional trajectory data of the reflective markers at a sampling rate of 60 frames per second. Data analysis was performed using Analyze software (Meglan, 1991.) to obtain temporal-distance (TD) parameters. A one-way ANOVA with repeated measures was utilized for data analysis.

RESULTS AND DISCUSSION
Analysis of the TD parameters (Table 1) yielded several trends. On an absolute scale, all TD parameters, with the exception of step width, exhibited a decrease over time. Significant differences were found in the velocity between visits 3 and 4 (p=0.07) (Graph 1) and cadence between visits 4 and 5 (p=0.04) (Graph 2). As compared to normal adults, the MS patients displayed significant differences in their ambulation characteristics. At
the onset of the study, the MS patients had a mean cadence of 92.5 step/min which is approximately 19% slower than normal subjects reported by Perry and Kadaba et al. (112-115 step/min). At the conclusion of the study, MS patients demonstrated a decreased mean cadence 23% slower as compared to normal adults. Mean stride length values followed a similar pattern. MS patients had a 26% shorter stride length (102 cm) compared to normal adults (138 cm). As a result of decreased cadence and stride length, MS patient’s velocity (81 cm/s) was 39% slower than normal (133 cm/s) (Perry, Kadaba et al.) which progressed to 45% slower (73 cm/s) at the conclusion of the study. EDSS scores worsened in seven of the eighteen patients (39%) with three patients experiencing scores that increased by more than 1.0 from their initial to final evaluation.

**SUMMARY**

Changes in TD parameters, with the exception of step width, were detected in the majority of the MS patients over the 18-month time period. Significant changes were noted in the patient’s velocity and cadence parameters. Although the average step width of the MS patients was larger than adult normals, it’s difficult to ascertain why this parameter remained relatively unchanged throughout the study. Most likely, the limitations in change are related to the subject’s anthropometrics and stability requirements. Further clinical investigation of the relationship between changes in EDSS score and gait TD parameters will be undertaken.

**Table 1: Comparison of gait parameters**

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>Velocity (m/s)</th>
<th>Stride Length (m)</th>
<th>Step Width (m)</th>
<th>Cadence (step/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.78(0.07)</td>
<td>0.99 (0.07)</td>
<td>0.15 (0.01)</td>
<td>90.25 (3.46)</td>
</tr>
<tr>
<td>1</td>
<td>0.81(0.07)</td>
<td>1.02 (0.07)</td>
<td>0.16 (0.01)</td>
<td>92.53 (3.91)</td>
</tr>
<tr>
<td>26</td>
<td>0.77 (0.07)</td>
<td>0.98 (0.06)</td>
<td>0.16 (0.01)</td>
<td>91.93 (3.05)</td>
</tr>
<tr>
<td>52</td>
<td>0.74(0.07)</td>
<td>0.97 (0.07)</td>
<td>0.16 (0.01)</td>
<td>87.0 (3.82)</td>
</tr>
<tr>
<td>78</td>
<td>0.73 (0.08)</td>
<td>0.95 (0.07)</td>
<td>0.16 (0.01)</td>
<td>87.54 (4.13)</td>
</tr>
</tbody>
</table>

**Graph 1: Mean cadence for MS patients**

**Graph 2: Mean velocity for MS patients**

**REFERENCES**


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