Presentation #56

The Application of a Novel Sensitive Gait Assessment Method to Optimize the Evaluation of Patients with Degenerative Cervical Myelopathy

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Introduction: Disrupted locomotion plays a significant role in the disability of individuals with degenerative cervical myelopathy (DCM), more so as the disease progresses. Current gait assessments fail to demonstrate sensitivity of subtle gait changes in DCM. The purpose of this study is to define the significance of using spatio-temporal gait parameters in the assessment of the DCM population, to define severity of disease particularly in the earliest stages and to measure change in the natural history of the disease and most importantly assess change secondary to intervention. The objectives of this study were to characterize altered locomotion in patients with DCM using a novel computerized gait assessment tool and to assess the changes in gait parameters with standardized myelopathy outcomes tools.

Methods: A prospective observational cross sectional study (n = 107) was conducted in patients with a diagnosis of DCM (including CSM and OPLL; positive MRI for spinal cord compression, 1 clinical symptom and 1 neurological sign). A computerized GAITRite walkway analysis, Modified Japanese Orthopaedic Association Assessment (mJOA) and the Berg Balance Scale (BBS) were administered. Analysis: Paired T-tests were used to compare the severity groups to a control group and discriminant functional analysis was used to define the most significant parameters in creating a general gait profile for DCM.

Results: The 5 parameters of variability (stride time SD, swing time SD, stance time SD, DST SD, SST SD) detect mild instabilities of gait even when parameters such as velocity, base of support, step and stride length remain normal. Step and stride length and base of support are parameters that detect mild changes of gait, however, are dependent on height, weight and gender, thus not reliable in confirming mild deficit. The above mentioned spatio-temporal parameters detect very early changes in the disrupted gait pattern ($p < 0.05$), prior to clinically detectable gait impairment. As severity increases to moderate or severe, velocity, cadence, single and double stance time, and variability in stepping show significant ($p < 0.05$) differences from normative values.

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Conclusions: With mild DCM gait impairment is not obvious from clinical observation alone. However, with computerized gait analysis we have identified the cardinal spatio-temporal parameters that are useful in detecting subtle differences that can be applied longitudinally while others are more discriminant among a cross sectional sample. Velocity, stride length, base of support and double stance time, are more useful as parameters to be used longitudinally. Whereas, the 5 parameters of variability (stride time SD, swing time SD, stance time SD, double stance time SD and single stance time SD) are useful for discrimination among groups when detecting even the most subtle differences. The identification of the most sensitive parameters for DCM is unique as other neurological and musculoskeletal disorders rely on different parameters to detect disease. The impact of being able to detect subtleties in this disease is very progressive for the field as it enables clinicians and researchers to study the disease with much more accuracy. Thus enhancing the measurement in efficacy studies and early detection of disease. This measurement capability provides insights for both clinical and research settings.

Table 1. Control and DCM values of significant spatio-temporal gait parameters that define the disease severity.

	Control	Mild (17-15) X (SD)	Moderate (14-12) X (SD)	Severe (< 12) X (SD)
Velocity	134 (14)	126 (18)	106 (28)	76 (27)
Step Length	70 (5.40)	65.3 (8.60)	57.6 (11)	46 (10)
Stride Length	141 (11)	131 (17)	116 (22)	94 (22)
Base of Support	8.3 (2.50)	10.5 (3)	10.7 (3.90)	14 (4)
Step length Difference	1.3 (0.90)	2.1 (1.80)	2.3 (1.60)	2.8 (2.80)
Stride Time SD	0.027 (0.02)	0.046 (0.03)	0.065 (0.05)	0.047 (0.04)
Swing Time SD	0.013 (0.005)	0.023 (0.01)	0.029 (0.03)	0.019 (0.01)
Stance Time SD	0.023 (0.01)	0.037 (0.28)	0.054 (0.05)	0.039 (0.02)
Double Stance Time SD	0.017 (0.005)	0.027 (0.02)	0.045 (0.04)	0.031 (0.02)
Single Stance Time SD	0.014 (0.007)	0.226 (0.01)	0.029 (0.03)	0.027 (0.02)

This table defines values of each spatio-temporal parameter that is sensitive to differences in the control and mild DCM groups. Yellow variables only approach significance for a difference between the control and mild groups. White variables show significant differences between all groups and controls, however, can be dependent on height, weight, and gender. Blue variables can be compared among any individual and show the values that identify all severity groups as well as normative values for comparison

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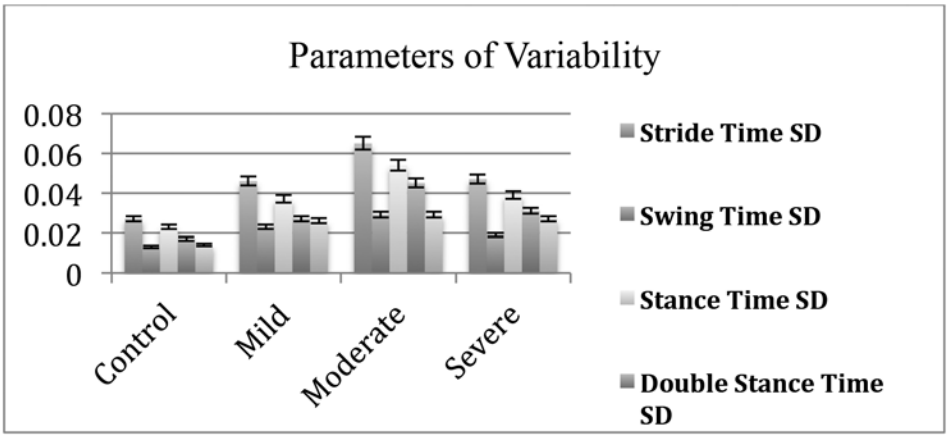

Figure 1. Defines visually how the 5 parameters of variability change across disease severity, showing that variability of gait increases as severity increases.

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