INTRODUCTION

Idiopathic Scoliosis (IS), is a sub-class of paediatric spinal deformities that is of unknown origin, and is characterized by a complex three dimensional curvature of the spine that is accompanied by spinal disorientation of the thoracic cage and postural dyscontrol [1-3]. With the aim of guiding clinical decisions and enhancing clinical outcomes, previous work has identified risk factors that are associated with curve progression that include skeletal maturity, gender and family history. [1] Recently emergent hypothesis have proposed possible associations between asymmetric vertebral loading, muscle imbalance, vertebral deformity and curve progression [2]. In recognition that traditional models of clinical management have focused on the assessment of posture in an upright standing position [3], we propose to expand current clinical models to include a variety of tasks that are more typical of activities of everyday life. The present work situates itself within an ongoing project that is focused on the enhancement of our understanding of the relationship between the structure and biomechanical function of the spine. At this initial stage, the primary objective is to develop preliminary observations about differences in postural stability and alignment between sitting and standing postures. This initial analysis will guide the development of mechanical models of spinal stability for children living with IS.

METHODS

Children and youth diagnosed with IS were recruited from an outpatient Orthopaedic Clinic located in the Hospital for Sick Children. Participants were invited to participate if they were aged between 8 and 16 years old, diagnosed with IS, have a spinal curvature between 15 and 45º, and have no secondary neurological or musculoskeletal conditions.

Each participant underwent a biomechanical assessment in the Biomechanics and Assistive Technology Laboratory located in the Rehabilitation Sciences Building at the University of Toronto. This assessment included the evaluation of sitting, and standing posture, gait, and mobility. Specifically, posture in quite sitting and standing was recorded for a duration of 1 minute, followed by maximal trunk flexions (AP&ML: 5 trials), and walking (5 trials). Muti-axile forceplates (AMTI®) were used to record the ground reaction forces, and centre of pressure (COP) under the base of support (Sampling Frequency (SF) = 1000 Hz). An Mx Control Motion Capture system (Vicon Inc™) (SF: 100 Hz) recording the 3D co-ordinates of markers positioned bilaterally on the Heel, Metatarsal, Lateral Maleolus, Lateral Condyle, Mid-shank/Mid-Thigh, Anterior Superior Iliac Spine, Posterior Superior Iliac Spine, S1, C7, T12, Inferior Border of Each Scapula, and Acromions. In addition, a portable accelerometer (Microstrain™) was positioned on the Sacrum (S1), and in the thoracic region of the spine (C7). (SF: 1000 Hz). Initial analysis has focused on quantifying changes in postural stability and alignment between the standing and sitting postures. Ongoing work is focused on the analysis of the trunk mobility (AP, ML flexion), and the validation of trunk mobility measurements with accelerometers for the purpose of clinical evaluation and ambulatory monitoring.

RESULTS

This initial pilot project recruited a sample of 9 children diagnosed with IS (aged: 12 ± 2). Initial analysis of this cohort has focused on differentiating postural alignment and stability between the sitting and standing postures. Notably, AP and ML RMS COP displacement was observed to be significantly greater in standing (8 ± 5 mm; 6±3mm) than that observed with sitting. (3±2 mm;3±3 mm). (p<0.05) Importantly, this observed ML RMS displacement represents 5 and 2 % of the full range of COP displacement when performing maximal ML bilateral trunk flexions in standing and sitting respectively (Range of ML COP displacement: 128 ± 52 mm, 141±28 mm).

DISCUSSION & CONCLUSIONS

The initial analysis of this cohort has revealed decreased RMS displacement of the COP in both the AP and ML directions when sitting. Within the context of traditional perspectives related to postural stability, this may be attributed to a decrease in the number of joints, associated degrees of freedom and increased base of support. However, importantly, in recognition that youth spend significant periods of their day in a relatively static sitting postures [4], further attention towards the development of models of vertebral loading and spinal stability in these conditions are warranted. Ongoing work by our team is focused on expanding this analysis to develop further insight in the alignment of the underlying skeletal structures with mechanical loading, and also the frequency and duration of asymmetric postures that may be assumed throughout the day in children with IS.

REFERENCES


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