Intra-Limb Coordination Changes After Botulinum Toxin Injection in Two Six-year-old Children with Spastic Diplegia: A Case Report

Human Performance and Biodynamics Laboratory

[1]Dora J. Gosselin, [1]Benjamin L. Long, [2]Bettina M. Gyr, [3]Martin L. Tanaka
[1]Winston-Salem State University, [2]Wake Forest School of Medicine, [3]Western Carolina University

Background and Purpose

Patients with cerebral palsy (CP) commonly have poor selective motor control (SMC) resulting in reduced coordination between joints during movement tasks. Reduced joint coordination, or the inability to dissociate adjacent joints, results in massed synergistic strategies of movement during walking. These less mature patterns are not efficient strategies for many phases of gait, therefore, improved coordination between joints may allow for favorable changes during the gait cycle. Chemodenervation using botulinum toxin A (BoTN-A) is a commonly used intervention to reduce muscle spasticity. By reducing the hyper-excitability of the stretch reflex, SMC may improve, allowing for better disassociation between lower extremity joints.

The objective of this case report was to examine the effects of intra-muscular BoTN-A injections on hip-knee and knee-ankle intra-limb coordination during walking in a patient with spastic diplegic CP.

Case Description

Three-dimensional gait analysis was performed pre and five-weeks post intervention, on two 6-year-old patients with spastic diplegic CP. The intervention consisted of BoTN-A injections bilaterally in the medial hamstrings, rectus femoris, and gastrocnemii with post-injection casting. Continuous relative phase analysis, a measure of coordination, was found between the hip-knee and knee-ankle for each leg. Root mean square (rms) differences were calculated between patient data and a database of typical walkers. The rms difference between the patient and the typical population was also calculated following BoTN-A treatment. Both pre and post treatment data were compared to the typical data set using an analysis of the means and a visual analysis. Changes of one or more standard deviations in either direction were thought to represent true clinical differences rather than variability due to testing.

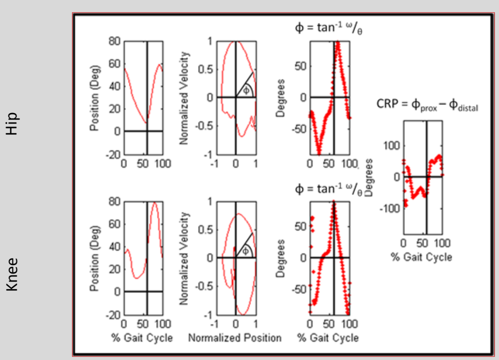

Figure 1: An example of the process for determining CRP using kinematics and velocity.

Outcomes

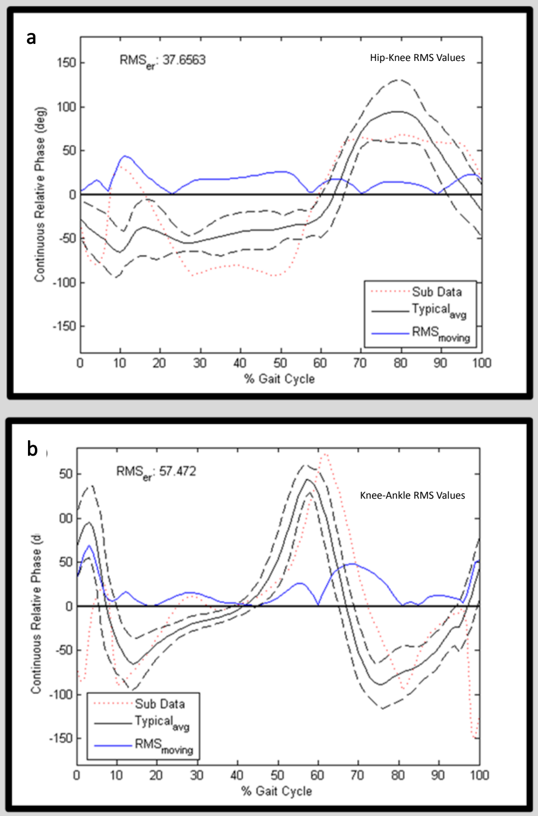

Figure 2: Comparison of rms values of typical walkers and Subject 2 as well as a moving rms value. Moving rms values demonstrate the difference between the typical walkers and Subject 2 at any given point during the gait cycle. The most significant differences are found during early stance and swing. Figure 2a represents hip-knee rms values and figure 2b represents knee-ankle values.

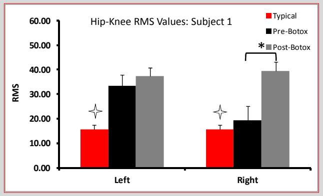

Figure 3a: Data demonstrates a significant difference between hip-knee rms values of typical walkers and subject 1, pre and post BoTN-A. Post BoTN-A, the subject demonstrated an increase in rms values on both the left (+6%) and the right(+34%); however, significance was found on the right.

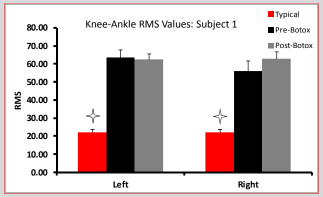

Figure 3b: Data demonstrates a significant difference between knee-ankle rms values of typical walkers and subject 1, pre and post BoTN-A. The changes in rms post BoTN-A were not significant with no change on the left (0%) and increase on the right (+4%).

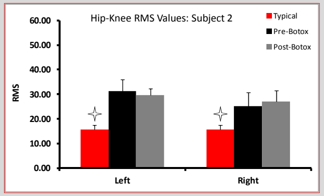

Figure 4a: Data demonstrates a significant difference between hip-knee rms values of typical walkers and subject 2, pre and post BoTN-A. The changes in rms post BoTN-A were not significant with no change on the left (0%) and increase on the right (5%).

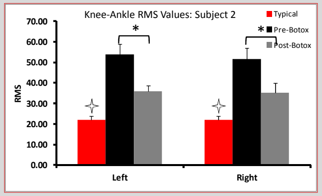

Figure 4b: Data demonstrates a significant difference between knee-ankle rms values of typical walkers and subject 2, pre and post BoTN-A. The changes in rms post-BoTN-A were significantly less: right (-12%) and left (-13%).

Conclusion

BoTN-A may have benefits for increasing the intra-limb coordination at the knee-ankle for some children with spastic diplegia. This case study demonstrates that there are likely factors, other than spasticity, that contribute to a child's response to BoTN-A and, that in some cases, intervention with BoTN-A may result in decreases in intra-limb coordination.

References available upon request.