INTRA-LIMB COORDINATION CHANGES AFTER BOTULINUM TOXIN INJECTION IN A CHILD WITH SPASTIC DIPLEGIA: A CASE REPORT

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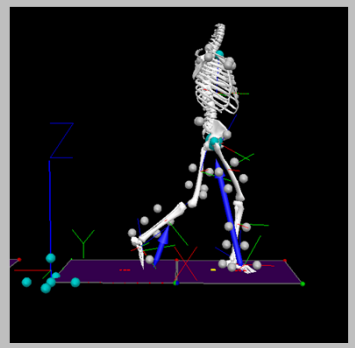
Introduction

Patients with cerebral palsy (CP) commonly have poor selective motor control (SMC) resulting in reduced coordination between joints during movement tasks[1]. Reduced joint coordination, or the inability to dissociate adjacent joints, results in massed synergistic strategies of movement during walking[2]. 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[3]. By reducing the hyper-excitability of the stretch reflex, SMC may improve, allowing for better disassociation between lower extremity joints.

Objective

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.



Methods

Three-dimensional gait analysis was performed pre and five-weeks post intervention, on a 6-year-old patient. Continuous relative phase analysis, a measure of coordination, was found between the hip-knee and knee-ankle for each leg[1,4,5]. A baseline was established for the patient by calculating the root mean square (rms) differences between the patient data and a database of typical walkers evaluated over the entire gait cycle. In addition, the rms difference between the patient and the typical population was also calculated following BoTN-A treatment to determine if the gait had improved. Both pre and post treatment data were compared to the typical data set using independent t-tests. Differences in the pre-treatment and post-treatment values were determined using a matched pairs t-test. Significance was set at $\alpha<0.05$. In addition, a moving rms window was used to identify qualitatively where differences between the patient and typical data base occurred during the walking cycle.

Intervention

The intervention consisted of BoTN-A injections bilaterally in the medial hamstrings, rectus femoris, and gastrocnemii with post-injection casting.

Analysis

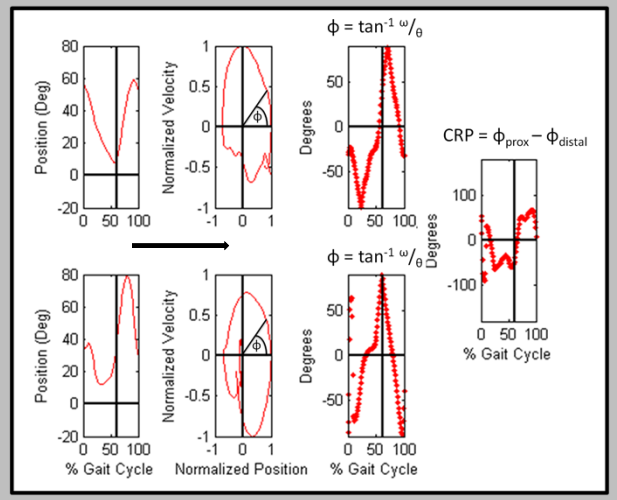


Figure 1: Graphical Representation of the analysis process.

Results

Independent t-tests revealed significant differences ($p<0.05$) for all combinations of intra-limb coordination when compared to the typical data base. These data include all combinations of pre and post BoTN-A injection, left and right sides, for both hip-knee and knee-ankle. Matched pairs analysis showed no significant difference in rms values for hip-knee coordination between pre and post BoTN-A for either leg ($p_{right}=0.182$, $p_{left}=0.359$). There was, however, a significant decrease in knee-ankle rms values indicating improved knee-ankle corrdination following BoTN-A for both the right (21.4%, p=0.010) and left legs (23.6%, p=0.025). The rms moving window showed the largest deviation to occur during early stance and early swing bilaterally for both pre and post conditions.

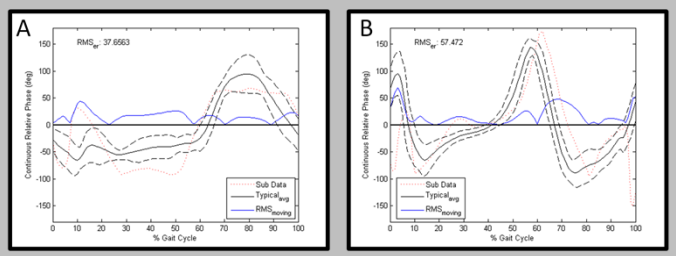


Figure 2: Continuous Relative Phase over the gait cycle for Hip-Knee (A) and Knee-Ankle (B) coordination.

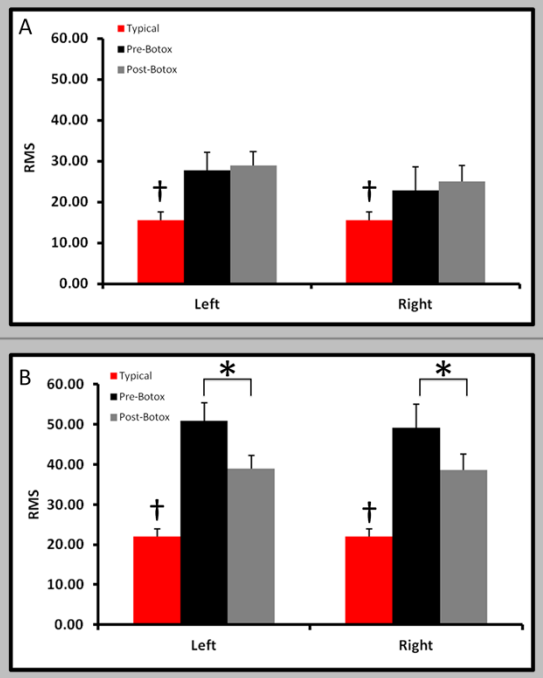


Figure 3: Root mean squared values for Hip-Knee (A) and Knee-Ankle (B) coordination.

† Significant difference with other two conditions

* Significant difference between two conditions

Conclusions

Patient demonstrated impaired lower extremity joint coordination prior to BoTN-A injections.

BoTN-A injections improved the coordination between the knee and ankle but not between the hip and knee.

Along with physical therapy, bracing and casting, BoTN-A injections may offer an effective means to increase intra-limb coordination.

References

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