

Calf Muscle Morphology and Intramuscular Fat after the First Botox Injection in Children with Spastic Cerebral Palsy: A 12-month Longitudinal Study

Zhongzheng Wang¹, Antea Destro¹, Alexandra Åhblom^{2,3}, Sven Petersson^{4,5}, Ferdinand Von Walden^{2,6}, Eva Pontén^{2,6}, Cecilia Lidbeck^{2,6}, Ruoli Wang¹

¹KTH MoveAbility, Dept. Engineering Mechanics, KTH Royal Institute of Technology, Stockholm, Sweden

²Division of Paediatric Neurology, Dept. Women's and Children's Health, Karolinska Institutet, Stockholm, Sweden

³Theme/Functional Area Occupational Therapy & Physiotherapy, Women's Health and Allied Health Professionals, Karolinska University Hospital, Stockholm, Sweden

⁴Dept. Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden

⁵Dept. Medical Radiation Physics and Nuclear Medicine, Karolinska University Hospital, Stockholm, Sweden

⁶Dept. Paediatric Orthopaedic Surgery and Paediatric Neurology, Astrid Lindgren Children's Hospital, Karolinska University Hospital, Stockholm, Sweden

Email: zhowan@kth.se

Summary

Calf muscle morphology and intramuscular fat content were measured using magnetic resonance imaging (MRI) in children with spastic cerebral palsy (SCP) before and 12 months after their first botulinum toxin type A (BoNT-A) injection. Though increased muscle volume with unchanged normalized muscle volume was observed, the muscle growth might be compromised by concurrent fat infiltration.

Introduction

Though BoNT-A injection is effective for reducing muscle over-activity in children with SCP [1], concerns on muscle atrophy and loss of contractile tissues following the BoNT-A injection exist [2]. This study aimed to explore the potential changes of calf muscle morphology and intramuscular fat content 12 months after the first lower limb BoNT-A injection in children with SCP.

Methods

In this longitudinal study, we recruited 10 children with SCP (5 girls, average age 9.1 years, bi-/uni-lateral 4/6, Gross Motor Function Classification System GMFCS I/II 8/2) naïve to muscle tone reduction treatment. All children received injections to the gastrocnemius on the most affected side. Other injected muscles included soleus (SOL), tibialis posterior, flexor hallucis longus, and extensor hallucis longus. The most affected side was chosen for analysis. The study was approved by the Swedish Ethical Review Authority.

MRI was performed before and 12 months after the first BoNT-A injection using a 3.0-Tesla MR scanner. Evaluated muscles included medial gastrocnemius (MG), lateral gastrocnemius (LG), SOL, and tibialis anterior (TA). Muscle volume was quantified using T1-weighted MRI while normalized muscle volume was calculated as muscle volume divided by the production of height and weight. Intramuscular fat fraction (IFF) was assessed using Dixon MRI [3]. The Wilcoxon signed-rank test was applied to identify the muscle volume, normalized muscle volume, and IFF changes after BoNT-A injection, with a significance level set at 0.05.

Results and Discussion

Muscle growth, indicated by increased muscle volume, was observed in MG ($p < 0.001$), SOL ($p = 0.003$), and TA ($p = 0.001$)

12 months after the BoNT-A injection (**Figure 1**, top row). However, normalized muscle volume remained unchanged in the examined muscles (**Figure 1**, middle row). Limited studies have investigated long-term changes in normalized muscle volume following BoNT-A injection. De Beukelaer et al. observed a 16% decrease in MG normalized muscle volume in children with SCP 6 months post-injection [4]. The discrepancy may be attributed to the inclusion of participants with more limited motor functioning (GMFCS III) and a shorter follow-up period of 6 months in their study. Higher IFFs were observed in MG ($p = 0.002$), SOL ($p = 0.026$), and TA ($p = 0.027$) 12 months after the BoNT-A injection (**Figure 1**, bottom row).

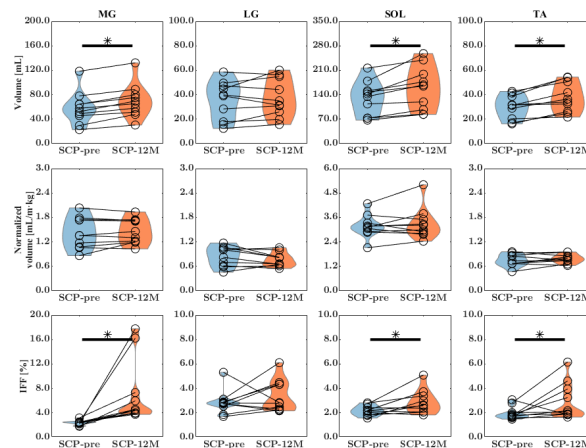


Figure 1: Muscle volume (absolute and normalized) and IFF before (SCP-pre) and 12 months (SCP-12M) after BoNT-A injection.

Conclusions

Muscle growth was not hampered 12 months after BoNT-A injection in high functioning children with SCP. Fat infiltration occurred both in the injected calf muscles and TA that was not injected. This could indicate that fat infiltration may also occur as part of the natural history of cerebral palsy.

References

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