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Lower limb muscle growth in unilateral and bilateral cerebral palsy

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This commentary is on the original article by Barber et al. To view this paper visit http://onlinelibrary.wiley.com/doi/10.1111/dmcn.13149/abstract

Cerebral palsy (CP) describes a group of motor disorders caused by damage to the developing brain. One consistent finding in research is that muscle volume is smaller in individuals with CP as a result of delayed physical growth and reduced muscle growth rates. This contributes to overall reductions in muscle strength and functional capacity.[1] The study by Barber et al.[2] presents data on medial gastrocnemius muscle growth rates in unilateral (UCP) and bilateral cerebral palsy (BCP). This is the first study to compare muscle growth rates among different types of CP and typically developing children.

One interesting finding of the study was that children 2 to 9 years of age with UCP had lower growth rates than those with BCP; when muscle volumes were expressed relative to body mass. One explanation is that children with UCP typically reach standing and walking milestones earlier than their bilaterally affected peers, which may alter the timing of neuromechanical loading and muscle growth. Children with BCP may have a slower growth rate initially and only catch up later in childhood. Interestingly, the group with UCP in this study demonstrated minimal changes in muscle growth from age 2 to 9 years. This may indicate an overcompensation of the unimpaired limb, leading to an insufficient loading stimulus and muscle activation of the impaired limb.

Another finding by Barber et al. was that BCP growth rates were similar to that of the typically developing group. This might be explained by the largely pre-pubertal age group included in the study. At age 2 to 9 years, children with BCP may still be receiving an adequate weight-bearing stimulus, enabling them to maintain a similar growth rate to that of the typically developing group. If muscle growth rates of the lower limb muscles were tracked into puberty the difference may be more pronounced.

The study also found that muscle volume expressed relative to body mass was not different between UCP and BCP. This finding was surprising given the fact that ambulant children with UCP have been shown to perform better on lower limb functional tasks and strength tests than those with BCP.[3] There are a number of explanations for these findings. First, children with UCP may have similar muscle volumes to their bilaterally affected peers, but may be better at recruiting and coordinating the available muscle mass for force production.[4] Second, similar muscle volumes but lower muscle strength in the BCP group could indicate differences in muscle morphology. Children with CP are reported to have greater collagen accumulation and thickened endomysium; findings which have also been shown to be significantly correlated with function.[5] Children with UCP may have a similar muscle volume but a greater proportion of contractile tissue compared to that of BCP muscles.

The limitations with CP research lie within the diversity of symptoms and treatments. Variations in muscle growth patterns and recovery from treatment are difficult to account for in a cross-sectional study. In the study by Barber et al., it is difficult to show how much of the reduction in growth rates in these groups was due to individual intervention and natural history, as many of the children received botulinum toxin injections. Additionally, muscle growth rates, as shown in this study, did not

necessarily follow a linear trajectory with age. Applying a polynomial fit to such data could also help to fully capture growth patterns in this population.

The study highlights important potential differences in the underlying mechanisms of muscle growth in UCP and BCP. Longitudinal studies which assess both muscle growth and the response to treatment throughout childhood need to be carried out to enhance our understanding of early intervention in this population. A knowledge of the composition of CP muscle (including the proportion of contractile and connective tissue) would provide further information on muscle growth differences in UCP and BCP compared to typically developing children.

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