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O73

Does real-time feedback on ankle power alter dynamic motor control in children with cerebral palsy?

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1. Introduction

A common gait limitation in cerebral palsy (CP) is a reduced ability to generate power at the ankle during push off. This may be due a number of factors, such as muscle weakness or disrupted neuromuscular control. It has been shown that with the use real-time feedback, children with CP can improve key gait parameters such as knee and hip extension [1]. However, it is not known if children can improve ankle power, or, how they would achieve this change at the neuromuscular level. The use of synergy analysis to describe dynamic motor control (DMC) in CP is growing and has been shown to be predictive of treatment outcomes [2].

2. Research Question

Does real-time feedback on ankle power alter dynamic motor control in children with CP?

3. Methods

Twelve children with CP (age: 10 ± 2.8, GMFCS: I–II) received 3D gait analysis at comfortable walking speed (CWS) on an instrumented treadmill (GRAIL, Motekforce Link). Gait kinematics and kinetics were recorded in real-time using the Human Body Model [3]. Electromyography (EMG) of 8 muscles (gluteus meduis, rectus femoris, vastus lateralis, semitendinosus,tibialis anterior, peroneus longus, gastrocnemius medialis and soleus)were recorded following SENIAM guidelines. Children then underwent a two minute walking trial, at the same prior CWS, in which they were provided with real-time feedback on ankle power at push off for the most affected leg. Feedback was visualised by a colour coded 'power-bar' (Fig.1). Visual and auditory rewards were given when ankle power reached the target improvement of at least 10%. EMG data were band-pass filtered at 20-400Hz, rectified, and low-pass filtered at 10Hz. EMG envelopes were normalised to gait cycles and to peak dynamic activity (PDA) during baseline walking. Peak activations were calculated for gastroc. and soleus. EMG data were concatenated over all strides for all muscles and input to a non-negative matrix factorization algorithm (NNMF) to calculate synergistic activation of muscles.

4. Results

In response to feedback children achieved significant improvements in peak ankle power at push off from 0.98 ± 0.45 to 1.42 ± 0.6W/Kg (effect size: 0.81, $p < 0.001$). Peak activation of the gastroc. and soleus increased significantly ($p < 0.001$, Fig.2). While there were changes in activation of muscles, there was no significant change in the variance accounted for (VAF) by one synergy (0.79 ± 0.06 vs. 0.79 ± 0.03) and no clear changes in synergy pattern or weighting of muscles towards this synergy.

5. Discussion

Children with CP show the ability to greatly improve ankle power generation at push off with real-time feedback. This is coupled with an increased activation of the gastroc. and soleus muscles. Although there was a change in the level of activation of muscles there was no change in the VAF by one synergy. This result suggests that in the short term at least, DMC is not altered in response to feedback on ankle power and that increased power generation is driven by overall increased activa-

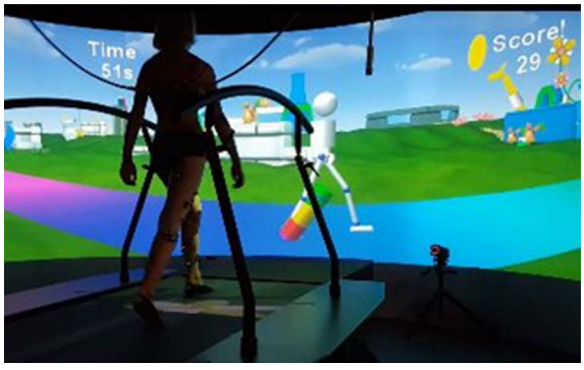

Fig. 1. Real-time feedback of ankle power at push-off.

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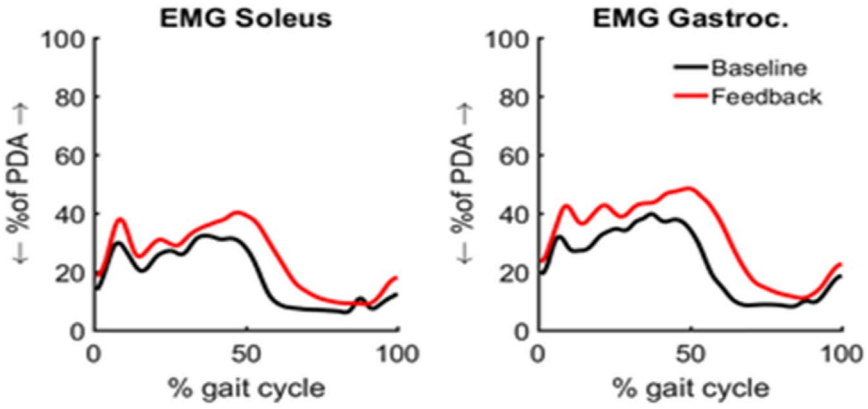

Fig. 2. Group mean muscle activation at baseline vs. feedback.

tion of muscles. Further studies are needed to clarify whether feedback training will promote refined control of the novel gait pattern with isolation of calf muscle action and reduced co-contraction.

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