Neuromuscular Responses to Fatigue of Coordination Impaired Swimmers: Implications for Para Swimming Classification

Dawn N. O'Dowd[1], Yu-Hsien Lee[1], Emma Hodson-Tole[2], Adrian Burden[1], Tomohiro Gonjo[3] and Carl J. Payton[1]
[1] Manchester Metropolitan University Institute of Sport, Department of Sport and Exercise Sciences, Manchester, UK
[2] Department of Life Sciences, Manchester Metropolitan University, Manchester, UK
[3] Heriot-Watt University, School of Energy, Geoscience, Infrastructure and Society, Institute for Life and Earth Sciences, UK
Email: D.ODowd@mmu.ac.uk

Summary

The World Para Swimming (WPS) classification system does not currently account for event distance when assigning swimmers to a class, yet races range from 50 m to 400 m. This study indicates different neuromuscular responses to a fatiguing effort of our newly proposed coordination assessment, between swimmers with and without coordination impairment. Thus, coordination impaired swimmers may be disadvantaged in distance events compared to swimmers with other impairment types.

Introduction

Para sport classification systems seek to minimise the impact of impairment on the competition outcome. Our research aims to provide an evidence-base for a new, more objective, and scientifically rigorous classification system for physically impaired swimmers. We are developing new coordination assessments for those with central motor and neuromuscular impairment (CMNI) focusing on movement speed, variability and smoothness [1,2]. This study compares the neuromuscular response of CMNI and non-coordination impaired swimmers to a fatiguing effort of this new coordination assessment using surface electromyography (sEMG) and accelerometry.

Methods

Six highly trained Para swimmers with coordination impairments (CMNI group; cerebral palsy hemiplegia [$n = 3$], cerebral palsy tetraplegia [$n = 1$], and traumatic brain injury [$n = 2$]) and five highly trained control swimmers participated (CTRL group: non-disabled [$n = 3$], Para swimmer with a limb deficiency but no coordination impairment [$n = 2$]).

Wrist acceleration and sEMG data were captured during unilateral upper limb tapping at maximal effort to volitional fatigue (3 minutes maximum) [1,2].

Within-trial variability of acceleration between tapping cycles was quantified using variance ratio (VR). sEMG data were wavelet transformed to resolve the total intensity of the signal in time and frequency domains [3]. Maximum sEMG intensity was extracted from each tapping cycle and the mean value was used to normalize sEMG intensity. Trials were divided into five sections (early, early middle, middle, late middle and end), with mean sEMG frequency (Hz) and intensity (a.u.) calculated for each section.

Results and Discussion

Within-trial movement variability was greater in CMNI than CTRL swimmers (CMNI VR: 0.58 ± .19; CTRL VR: 0.27 ± 0.17, p <.01; Figure 1). Mean sEMG frequency seemed to decrease progressively as intensity increased progressively, in the CMNI but not the CTRL group (Figure 2).

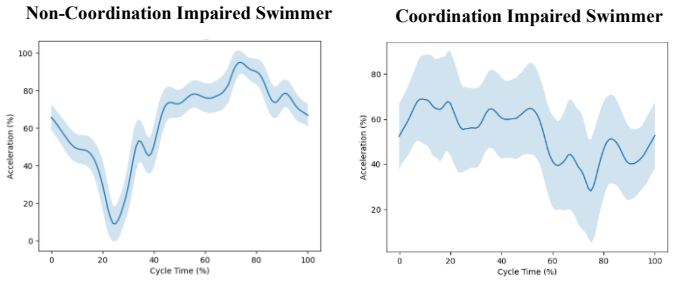

Figure 1: Exemplar ensemble average acceleration curves from a fatiguing coordination test. Shading is the SD of all tapping cycles.

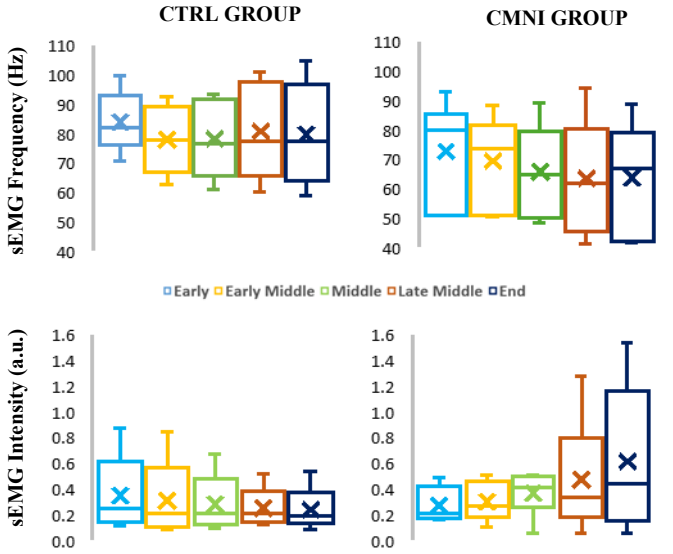

Figure 2: Triceps Brachii sEMG frequency (top row) and intensity (bottom row) in each section of a fatiguing coordination test.

Conclusions

Neuromuscular responses to a coordination assessment performed to fatigue differ between swimmers with and without coordination impairment, suggesting event distance may be relevant to classify coordination impaired swimmers.

Acknowledgments

Research funded by De Luca Foundation.

References

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