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Spinal and supra-spinal excitability during dynamic situations in sport – method development and pilot application in cross-country skiing

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INTRODUCTION:
An athlete's efficient performance is mainly dependent on efficient motor control during partly highly dynamic situations. The motor control can be divided to spinal and supra-spinal components, which's contribution can be quantified using Hoffmann-reflex (H-reflex) and volitional wave (V-wave) methods, respectively, during both isometric (Aagaard et al. 2002) and dynamic conditions (Alkjaer et al. 2013). However, it is unknown how feasible these responses would be to study more challenging multi-joint dynamic tasks like cross-country skiing. Purpose was to develop this methodology for complex skiing techniques for future examination of spinal and supra-spinal control mechanisms during specific phases (e.g. gliding/balance control) related to performance level, fatigue status or other factors.
METHODS:
Two former male Elite skier performed numerous trials using V2 skating technique on roller skies at treadmill (2° incline) velocities of 12 (slow) and 18 km/h (fast). H-reflex (m. soleus; conditioned with 15% Maximal M-wave [Mmax]) was measured 30, 70, 110 and 580 ms after the ground contact of the roller ski to get the H-reflex responses during short-latency reflex (SLR), medium-latency reflex (MLR), highest force production and mid-glide phases, respectively. V-wave responses were measured with identical delays, but with supramaximal stimulation intensity (125% Mmax). Both H-reflex and V-wave were normalized to Mmax. All date are presented descriptively as mean and standard deviation, as it was a methodological pilot study, which provides essential first steps in developing and implementing a complex method for measurements of spinal and supra-spinal excitability and discusses challenges and practical measures to have repeatable and valid measurements of V-wave, M-wave and H-reflexes during a highly dynamic sport disciplines.
RESULTS:
H/Mmax ratio was reduced from SLR to MLR (Slow -16.7%; Fast -31.1%) and highest force (Slow -33.3%; Fast -19.8%) while being similar or elevated during mid-glide phase (Slow 3.8%; Fast 67.0%) compared to SLR. Opposite to H-reflex, V/Mmax increased from SLR to MLR in slow (19.1%) and fast (22.1%) velocities. However, velocity-related differences were observed at highest forces (Slow 64.7%; Fast -19.8%) and mid-glide phase (Slow 53.0%; Fast 5.8%) compared to SLR.
CONCLUSION:
Comparable pattern of H-reflex has been observed previously during drop jumps (Taube et al. 2008), where H-reflex was reduced, and cortical activation enhanced from ground contact toward voluntary activation. H-reflex and V-wave methods seem to be potential tools to investigate motor control during skiing which could be utilized, for example, to examine training and fatigue-related changes in motor control of numerous dynamic situations and in particular nordic skiing and possibly other skiing disciplines.

Topic: **Neuromuscular Physiology**

Presentation **Oral**