



Grant Information Summary:

Motor Evoked Potential Differences between Concussed and Non-concussed Athletes as Determined by Transcranial Magnetic Stimulation

Practical Significance Statement

Acutely concussed collegiate athletes demonstrate motor command transmission differences (via motor-evoked potentials) compared to non-concussed athletes over 1 to 10 days post-head injury.

Study Background

The assessment of sport-related concussions is currently based on self-reported symptoms, neurological examination, and neurocognitive testing. Direct objective assessment of the physiologic integrity of cortical pathways via transcranial magnetic stimulation (TMS) of evoked motor potentials (MEPs) may provide more meaningful neuroanatomic and neurophysiologic assessment of the severity of concussion. The ability to accurately assess the physiologic integrity of the cerebral

cortex and motor pathways through TMS-MEP techniques among acutely concussed athletes has not been examined. The information gained from evaluating MEPs in subjects with sports-related concussions would provide direct evidence for the pathophysiologic processes associated with mild traumatic brain injury.

Objective

To determine if MEPs are different between acutely concussed and non-concussed athletes.

Design And Setting

A matched-cohort, time-series design was used with testing conducted in a collegiate athletic training facility.

Subjects

Eighteen collegiate athletes (12 males, 6 females, age 20.4 ± 1.3 years, height 177.6 ± 7.1 cm, mass 78.0 ± 7.1 kg) participated in this study. Specifically, nine subjects with acute concussions (less than 24 hours since time of injury) were matched to 9 control subjects.

Measurements

Transcranial magnetic stimulation was applied over the motor cortex with MEPs recorded from bilateral upper limbs. Testing was done 1, 3, 5, and 10 days post-concussion. MEP thresholds (%), latencies (msec/m), and amplitudes (MEP:M_{max} ratio) were assessed in all subjects. Central motor conduction time (CMCT) was calculated from MEP, M response, and F wave latencies.

Results

Adjusted median MEP latencies were significantly different between testing days ($F_{3,24} = 4.1$, $P=0.02$) with longer latencies noted on days 5 (26.5 ± 0.47 msec/m) and 10 (27.1 ± 0.48) compared to days 1 (25.7 ± 0.49) and 3 (25.5 ± 0.5). Lower thresholds were smaller on days 1 and 3 compared to days 5 and 10 ($F_{3,48} = 0.36$, $P=0.02$). Ulnar MEP amplitudes were

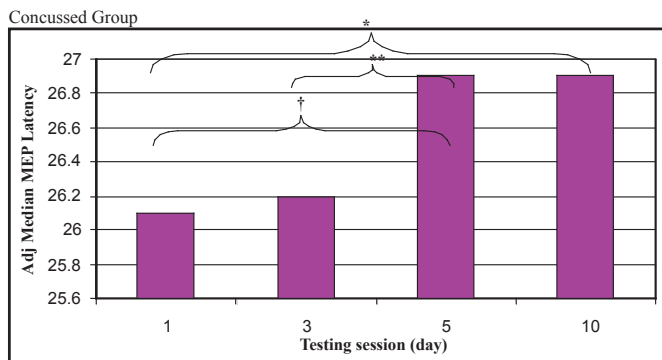
smaller on day 3 ($F_{3,48} = 8.78$, $P=0.001$) compared to days 1, 5 and 10.

Conclusions

Acutely concussed collegiate athletes demonstrate MEP changes over a span of 1-10 days post-injury, providing direct electrophysiologic evidence for the acute effects of concussion.

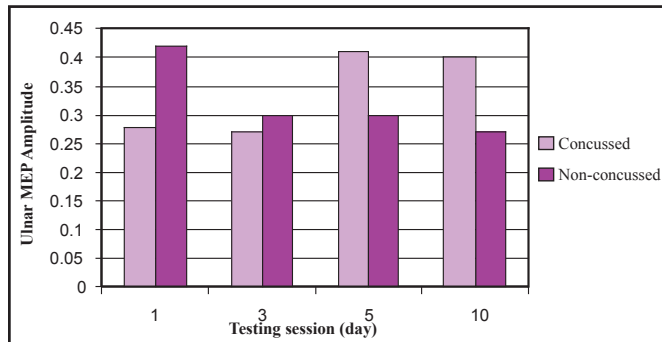


Figure 1. Demonstration of the application of transcranial magnetic stimulation to elicit a motor evoked potential.



* Significant difference days 1 & 10 ($P=0.01$), **days 3 & 5 ($P=0.04$), † days 1 & 5 ($P=0.02$)

Figure 2. Adjusted median MEP latencies (msec/m) among concussed subjects



Significant day by group interaction ($P=0.03$)

Figure 3. Ulnar MEP amplitudes (normalized to Mmax amplitude) in concussed and non-concussed subjects.

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Scott C. Livingston, PhD, PT, ATC, SCS received his Doctor of Philosophy degree in Kinesiology (with an emphasis in Sports Medicine) from the University of Virginia in 2006. Dr. Livingston is currently a member of the Physical Therapy faculty at George Washington University and has over 18 years of clinical practice experience in orthopaedic and musculoskeletal physical therapy. His research interests include: pathophysiology of mild traumatic brain injury among athletes, neuropsychological assessment of the concussed athlete, transcranial magnetic stimulation, and electrotherapy.

Publication & Presentation List

Livingston SC, Ingersoll CD. Reliability of motor evoked potentials obtained using a transcranial magnetic stimulation technique in non-concussed subjects. *International Journal of Neuroscience* 2006. (In Press).

Livingston SC, Ingersoll CD. "MEP Amplitudes Induced by Transcranial Magnetic Stimulation are Reduced in the Acutely Concussed Collegiate Athlete". Society for Neuroscience Annual Meeting. 2006. Atlanta, GA.

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