

Cutaneous Silent Period Characteristics are Dependent on the Organization of Upper Limb Muscles

Nathan R. Eckert^{1,2}, Anthony W. Meek¹, Krista Smith¹, Jason C. Williams¹ and Zachary A. Riley¹

¹Department of Kinesiology, School of Physical Education and Tourism Management, IUPUI

²Department of Kinesiology, School of Public Health, Indiana University

Cutaneous silent periods (CSPs) are inhibitory spinal reflexes mediated by small diameter A- δ fibers, serving to protect the body from harmful stimuli (Leis et al., 1992; Kofler, 2003). Currently, CSPs are believed to only inhibit the extensor muscles of the upper limb halting motions such as reaching, while exciting flexor muscles to withdraw the limb. The present study sought to determine if CSPs could be evoked in both extensor and flexor muscles of the upper limb, thereby providing further insight into the organization of the spinal circuitry associated with this reflex. 22 subjects performed contractions with seven muscles from the hand, forearm, upper arm, and shoulder while muscle activity was recorded with electromyography. Subjects were electrically stimulated (10x perceptual threshold) with 20 individual pulses delivered to each digit II (radial nerve) and digit V (ulnar nerve) of the right hand during each contraction. Results demonstrated significant main effects ($p < 0.001$) across muscles for the key dependent variables of the CSP: onsets ($F_{[6,21]} = 15.42, p < 0.001$), durations ($F_{[6,21]} = 65.39, p < 0.001$), and % of suppression ($F_{[6,21]} = 91, p < 0.001$), similarly for both nerves stimulated. Distal muscles presented with the earliest onset times, longest duration of inhibition, and largest amount of inhibition. Moving proximally, the onset times became later with duration and the amount of inhibition decreasing. Linear regressions showed that the distance of the muscle from the spinal cord (cm) was a significant predictor of the duration (digit II $r^2 = 0.43$; digit V $r^2 = 0.46$) and amount of inhibition (digit II $r^2 = 0.51$; digit V $r^2 = 0.48$). The results demonstrate the occurrence of CSPs throughout the upper limb, with the greatest inhibition of distal muscles, leading us to hypothesize that the corticospinal tract, specifically direct cortico-motorneuronal connections, are directly influenced by the inhibitory input.

Mentor: Zachary A. Riley, Department of Kinesiology, School of Physical Education and Tourism Management, IUPUI