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Presentation Abstract

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Presentation Title: H and T reflexes evaluated by a biologically-realistic neuromuscular model

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Abstract: Both H (Hoffman) and T (tendon) reflexes have been used to study spinal cord excitability by activating the reflex pathway that links Ia afferents, spinal motoneurons (MNs) and muscle. Some experimental studies have shown that both reflexes are subject to reciprocal inhibition, with similar levels of inhibition observed in both cases. In this study we have used a complex neuromuscular model of the spinal cord and innervated muscles to investigate the effects of the reciprocal inhibition on both H and T reflexes (http://remoto.leb.usp.br and a new version soon to be released for public use). Each spinal neuron (MNs and interneurons) was appropriately modeled following a simplification of the Hodgkin-Huxley formalism. Also included in the neuromuscular model are peripheral afferents subjected to electrical stimulation and a representation of the muscle spindle, hence allowing the simulation of stretch and T reflexes. In a control condition, both electrically- and mechanically-evoked reflexes had similar amplitudes, ~25% of the maximal direct muscle response (M_{MAX}). The H-reflex had a latency of ~28ms, whereas the T-reflex had a latency of ~37ms. Roughly the same number of MNs was recruited by the afferent activity evoked by either the electrical or mechanical stimulation. Reciprocal inhibition was obtained by a simulation of electrical stimulus applied to the common peroneal nerve, with a conditioning to test (C-T) interval of 3 ms. For the T-reflex, 9 ms was added to the C-T interval in order to account for its more distal stimulation point. The H-reflex was inhibited by ~40% of its control value, whereas the amount of inhibition observed in the T-reflex was ~53% of its control value. This difference between H and T reflexes was not statistically significant ($p > 0.05$),

supporting the hypothesis that the post-synaptic inhibitory effect is similar in both H and T reflexes. The inhibition de-recruited approximately the same amount of MNs in both cases, with a more pronounced effect on high-threshold cells. These simulations are in accordance with previous experimental reports from both cats and humans. Each element of the neuromuscular system was modeled individually and the results reflect emergent properties of the complex spinal circuitry model. Several other studies can be carried out using this system, such as: *i)* effects of the fusimotor drive on the T-reflex amplitude; *ii)* the interplay between motoneuronal persistent inward current, which is related to spasticity after spinal cord injury and stroke, and reciprocal inhibition on the genesis of spinal reflexes; along with several other scenarios concerning human neurophysiology.

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SPINAL CORD

REFLEX

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