

# Stimulation of the Deep Peroneal Nerve as a Method for Inhibition of the Stretch Reflex in Spastic Ankle Extensor Muscles

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**Abstract—Inhibition of the triceps surae stretch reflex by stimulation of the deep peroneal nerve was investigated in ten spastic persons. The stretch reflex was reduced significantly at stimulation levels between 2 and 4 times motor threshold of the tibialis anterior muscle when the triceps surae was relaxed. Regarding the stretch velocity dependency of the stretch reflex, stimulation significantly increased the velocity threshold and decreased the area under the velocity – reflex relation.**

**Index Terms-- stretch reflex, reciprocal inhibition, electrical stimulation**

## I. INTRODUCTION

Individuals with spasticity have been reported to exhibit increased stretch reflexes in the triceps surae with decreased stretch velocity thresholds when compared with healthy individuals [1]. Stretch reflexes in the triceps surae may be reduced by reciprocal inhibition when stimulating the antagonist deep peroneal nerve. In this study, the characteristics of this reciprocal inhibition was investigated in a group of ten spastic stroke individuals.

## II. METHODS

Stretches of the triceps surae were elicited at several stretch velocities by a motor, which imposed ankle movements. The deep peroneal nerve was stimulated from subthreshold up to 4 times the motor threshold of tibialis anterior, using monophasic current controlled trains of 5 pulses at 200 Hz and 1 ms pulse width.

## III. RESULTS

Inhibition increased with stimulation level in relaxed triceps surae. At the maximum stimulation levels used (between 2 and 4 times motor threshold of tibialis anterior) the stretch reflex was reduced significantly to  $25 \pm 6$  (S.E.) % of the unconditioned value for soleus (Sol) EMG ( $29 \pm 7$  % for medial gastrocnemius (MG) EMG and  $68 \pm 4$  % for mean ankle moment) at an optimal conditioning-test interval of  $141 \pm 15$  ms for Sol EMG ( $156 \pm 14$  % for MG and  $144 \pm 11$  for mean ankle moment). Figure 1 displays example recordings. In precontracted triceps surae, the stretch reflex at these highest stimulation levels was reduced to  $66 \pm 11$  % of the unconditioned value for Sol EMG ( $78 \pm 10$  % for MG and  $63 \pm 15$  % for mean ankle moment) at an optimal conditioning-test interval of  $143 \pm 18$  % for Sol. ( $122 \pm 16$  % for MG and  $125 \pm 26$  % for mean ankle moment). These maximal inhibitions in precontracted muscles were only significant in Sol EMG and ankle moment, but not in MG EMG.

Subsequently, the stretch velocity dependency of the triceps surae stretch reflex inhibition was investigated for dorsiflexion velocities of the ankle up to 190 deg/s. The area under the stretch velocity – stretch relation decreased significantly with stimulation level for relaxed triceps surae. At the highest stimulation levels, it was significantly reduced to  $61 \pm 7$  % of the unconditioned value for Sol EMG ( $56 \pm 10$  % for MG EMG and  $44 \pm 5$  % for mean ankle moment). The threshold of the stretch velocity - reflex relations increased significantly with stimulation level. At the highest stimulation levels, there was a significant threshold change of 25 deg/s for Sol EMG and 31 deg/s for MG EMG with respect to the unconditioned values (8 deg/s for Sol and 14 deg/s for MG). The slopes of the stretch velocity – reflex relations were not significantly dependent on stimulation level. At the highest stimulation levels, there was only a significant change in slope in comparison with the unconditioned state in Sol, not in MG EMG. Again, in precontracted muscle, only a relatively small inhibition occurred. At the highest stimulation levels, the area under the stretch velocity – reflex relation for precontracted triceps surae was reduced with  $13 \pm 16$  % of the unconditioned value for Sol EMG ( $3 \pm 20$  % in MG EMG and  $28 \pm 7$  % in mean ankle moment). This inhibition

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was only significant for the mean ankle moment, but not for Sol and MG EMG.

#### IV. CONCLUSIONS

It was concluded, that the stretch reflex of triceps surae in spastic stroke individuals can be extensively reduced by reciprocal inhibition, when stimulating the deep peroneal nerve. However, a large inhibiting effect was only found at stimulation levels of several times the motor threshold of tibialis anterior. Therefore, extensive reciprocal inhibition cannot be achieved independent of a large contraction of the tibialis anterior.

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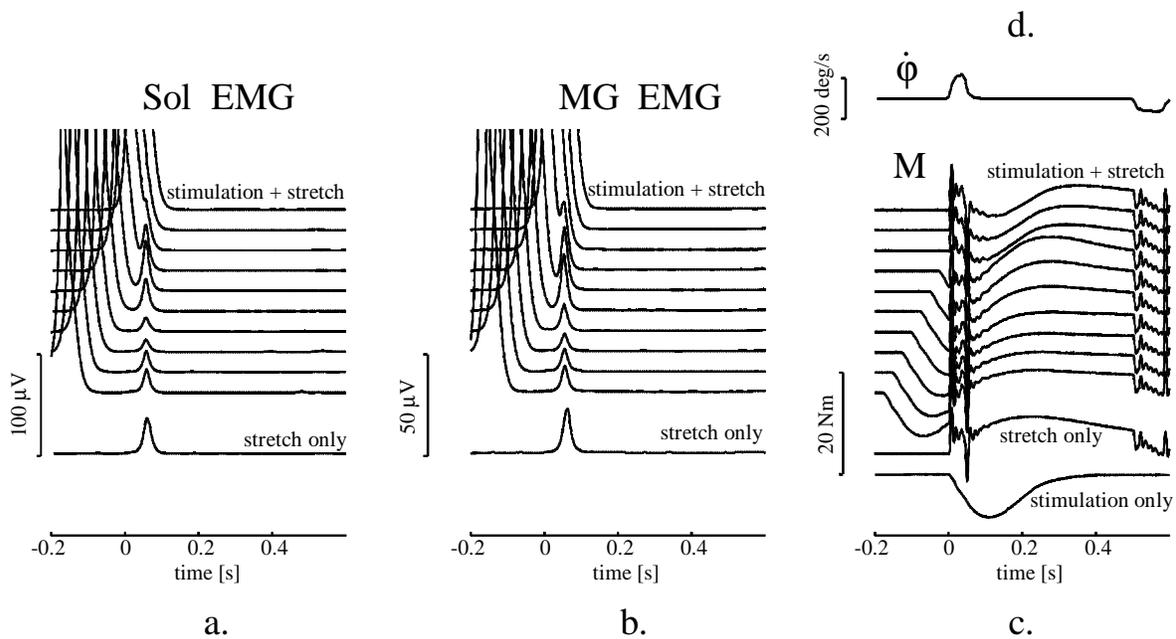


Fig. 1. The dependency of the stretch reflex in relaxed triceps surae on the conditioning-test delay  $t_{CS}$  (subject 10, stimulation level:  $3 \times MT$ ). Shown are the averaged recordings of Sol EMG (a) and MG EMG (b), ankle joint moment (c) and angular velocity (d).