EFFECTS OF AGEING ON MOTOR UNIT ACTIVATION PATTERNS AND REFLEX SENSITIVITY IN DYNAMIC MOVEMENTS

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INTRODUCTION

Contraction type has been found to affect the excitability of the spinal motorneuron pool, as measured with the H-reflex method [1]. It has been hypothesized that the lower H-reflex in eccentric contractions might be due to an increase in presynaptic inhibition. [2]. Contraction type may also affect the activation patterns related to recruitment and firing rate at the same relative force levels [3].

The purpose of the present study was to examine whether H-reflex excitability and muscle activation patterns would differ between action-types and age groups with the same relative surface EMG levels.

METHODS

10 YOUNG (26.9±3yr. 177.8±7cm 74.6±8kg) and 13 OLD (70.4±5yr. 175,1±5cm 81,8±10kg) physically active males volunteered as subjects in the study. The study was conducted in two sessions (separated by 1-2 weeks), one for the intramuscular EMG, and another for the H-reflex measurements. During the measurements the subjects performed isometric (ISO), concentric (CON) and eccentric (ECC) submaximal plantar flexions while seated in a motorized ankle dynamometer. Activity levels were calculated as passive, 20 and 40% of the RMS of surface EMG in Soleus (SOL) muscle in isometric MVC.

Surface EMG was also measured in Gastrocnemius Medialis (GM). For intramuscular EMG recordings four bipolar fine-wire electrodes were inserted into the Soleus around the surface electrode. The intramuscular EMG recording was analyzed utilizing the intramuscular MU spike amplitude-frequency histogram (ISAF) analysis [4]. In H-reflex measurements stimulation intensity was set at 25% of M_{max} and the reflex amplitude was related to the corresponding M-wave amplitude.

RESULTS AND DISCUSSION

As expected, the maximal isometric voluntary contraction force was lower in OLD (12%, n.s.). No differences were found in SOL or GM activation.

In both groups, and in all activation levels, the H/M ratio was lowest in ECC (n.s.) and higher in active compared to passive contractions (Figure 1). H-reflex excitability was 9-69% higher in YOUNG compared to OLD depending on the activation level and contraction type.

No significant difference between contraction types was found in either mean spike amplitude or frequency (Figure 2). This would indicate similar MU activation pattern, given that the activity level, and not the force, was the same in ISO, ECC and CON. As expected, there was an increase in both amplitude and frequency with activation level. This increase was more pronounced in amplitude, which would indicate a stronger contribution from motor unit recruitment compared to rate coding. The mean spike frequency was higher in YOUNG in dynamic contractions (Figure 2). This is in accordance with earlier findings of age related differences in firing rate in other distal extensors [5].

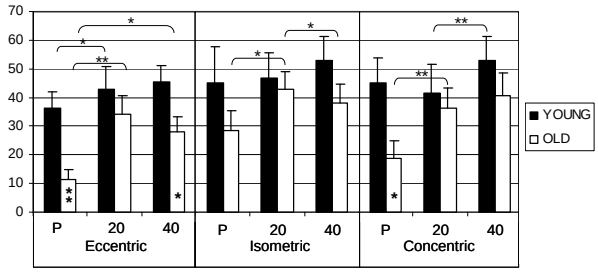

Figure 1: Mean H/M ratio (%+SE) in passive (P), 20 and 40% activation. *: p<0.01, **: p<0.005, ***: p<0.001.

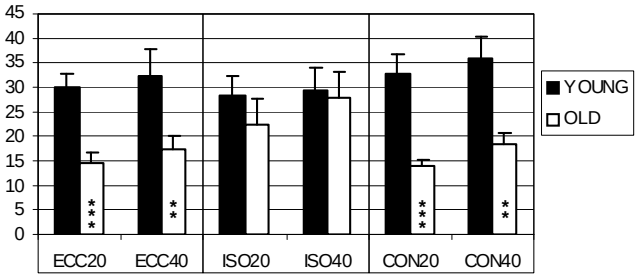

Figure 2: The mean spike frequency (+SE) in eccentric (ECC), isometric (ISO) and concentric (CON) contractions at 20 and 40% activation. **: smaller than in YOUNG p<0.01, ***: p<0.001.

CONCLUSION

Our present findings show a lower mean spike frequency and H/M-ratio in elderly, as well as a lower H/M-ratio in ECC contractions. Based on earlier findings, the reason for a lower H-reflex excitability in OLD was most likely an increase in PI [6]. It is, however, unlikely that PI is a major factor behind the age-related reduction in spike frequency, as the H/M reduction was significant also in CON contractions where the role of PI is not significant.

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