RELIABLE MEASUREMENT OF THE TRICEPS SURAE STRETCH REFLEX

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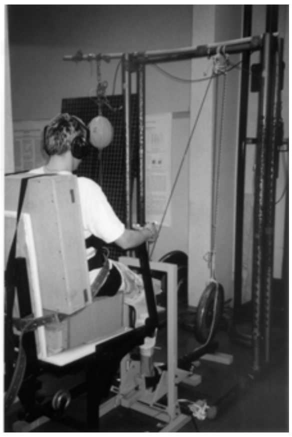
INTRODUCTION: Reflex occurrence and its modulation play an important role in motor control. In their diagnostics, it is important to assess them reliably. A special platform with a leverage system to induce foot movement was constructed to analyze the triceps surae stretch reflex. The aim of this research was to establish the reliability of reflex measurements with this measurement device.

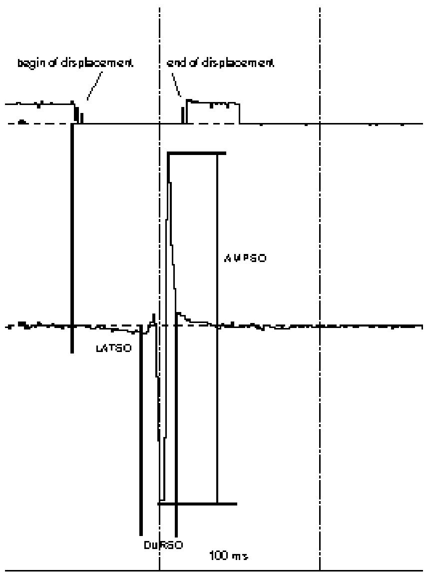
METHODS: The measurement device has four basic parts (Figure 1): a foot platform, a lever, a weight and a seat. At the lateral sides of the foot platform was a bearing fixed to an iron framework. The foot platform had an adaptive system to hold the foot on the foot platform so that the axis of rotation of the ankle joint was aligned with that of the foot platform. A vertical displacement of the foot was stabilized with a knee block.

Figure 1: A special platform with a leverage system



Displacement of the foot platform was caused by a 15 kg weight. The speed of the weight was regulated by a computer-controlled electro-motor. The weight was lowered onto the lever, which transferred the weight's movement to the foot platform. At the axis of rotation, the lever was fixed to the iron framework of the foot platform. The axis of rotation of the lever was 0.25 m away from the foot platform and 0.45 m away from the weight and was fixed to the frame. During the measurement procedure, the subject was fastened to the seat with a belt around his shoulders and waist, respectively. Six adult males (age 30.5 ± 5.1 years, height 180.3 ± 4.4 cm, and body mass 71.3 ± 4.6 kg) participated in the study. Each was asked to sit relaxed on the seat with his right foot clamped to the pedal. The ankle and the knee angles of the right leg were set to 90 and 120 degrees, respectively. Angular displacement of the foot platform was measured with an electronic goniometer (Penny and Giles, G35, Blackwood Gwent, GB). Additionally, a switch was built between the foot platform and the frame to provide a signal of a start of the foot platform movement. Electromyograms (EMG) were recorded from the soleus (SO), using surface electrodes placed over the belly of the muscle. The EMG signal was recorded with Biotel 88 (Glonner, Munich, Germany). The foot platform displacement was induced by lowering the weight with a constant velocity onto a leverage system to move the foot platform. A displacement (10 deg) of the foot platform was performed at 57 deg/s. Two measurements were made. Between the first and second measurements the subjects stood up, took their foot from the foot platform, and went for a short walk. Nine stimuli were recorded each time. Data were acquired at 1000 Hz and averaged. The start of the foot platform movement was used as a trigger point. The EMG signal was analyzed for a latency (time between the start of the foot platform movement and instant of EMG signal occurrence), amplitude of EMG response, duration of EMG response, and area of EMG response (Fig. 2). A statistical significance of the differences between the first and second measurements was tested with the paired-samples t-test (two-way).

Figure 2: EMG signal of SO for one subject



LATSO – latency of stretch reflex.
DURSO – duration of stretch reflex signal of SO.
AMPSO – peak to peak amplitude of stretch reflex signal of SO.

RESULTS AND DISCUSSION: A duration LATSO was similar to those in the literature (Kyröläinen and Komi, 1994; Weiss et al., 1986). There were no statistical differences in any of the observed EMG parameters between the first and second measurements, while the correlations in results between both measurements were very high (Table 1). These results showed that the conditions under which the reflex testing was performed were reproducible. Even though the velocity of the weight was controlled by an electro-motor, there were some uncertainties (as controlling the exact position of the weight's landing) as to load transmission to the foot platform. However, it seemed not to impair the reflex release significantly.

Table 1: Differences Between the First and Second Measurements

		First measurement		Second measurement			
Parameters	Unit	Mean	SD	Mean	SD	[a]Sig	[b]r
LATSO	Ms	43.65	3.68	43.00	2.64	0.373	0.92
DURSO	Ms	18.07	3.64	19.09	3.18	0.258	0.84
AMPSO	MV	1.40	0.83	1.60	0.86	0.397	0.81
AREASO	MVs	29.15	17.32	33.96	17.44	0.421	0.70

[a]Sig - level of significance of t-test.
[b]r - correlation value.
AREASO – area of stretch reflex signal of SO.

CONCLUSIONS: Based on the results, it was possible to conclude that the special foot platform with a leverage system was relevant for the measurement of the short-latency stretch reflex.

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