MEASUREMENTS OF MUSCLE FIBER CONDUCTION VELOCITY AT THE M. BICEPS AND M. TRICEPS BRACHII UNDER ISOMETRIC LOAD

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INTRODUCTION

Muscle fiber conduction velocity (MFCV) is related to physiological characteristics which are dependent on the contractile properties of different fiber types. Animal research showed that the soleus muscle with 24% FT fibers had a significantly lower conduction velocity than the M.extensor digitorum longus with 98% FT fibers (2). So far, MFCV measurements in humans have been restricted to the M. biceps brachii because its long fibers allowed the use of conventional electrodes. In other muscles the fibers are considerably shorter. To be able to place electrodes between motor point and the end of the fiber in small muscles, very short electrode assemblies are necessary. A unit with two pairs of interlaced electrodes with an inter-electrode distance of only 5 mm was built, to allow the measurement of the MFVC in short fibered muscles. Using this electrode assembly, in the present study the MFCV was measured in two muscles of different fiber composition (1). The intraindividual day-to-day reproducibility and the variability between subjects was determined for the MFVC.

METHODS

Eight students of the physical education department were tested on three different days. MFVC measurements were taken from the biceps and triceps brachii at 20, 40, 60, 80, and 100% of the maximum voluntary contraction (MVC) as well as in isometric dynamic explosive contractions. Three trials were collected in each condition. The angles between trunk and arm, arm and forearm, wrist and force transducer system were kept at 90 degrees. The freedom of movement in the shoulder and elbow joint was mechanically restricted. The wrist was fixed in an U-shaped device and connected to a piezoelectric force transducer. The subjects were able to monitor their force application as a voltage trace on an oscilloscope.
The electrode assembly (with integrated preamplifiers) had a size of 40 x 16 x 4 mm. It was positioned at a site between motor point and tendon insertion. The electrodes were repositioned until a maximum cross correlation between the two EMG signals could be found (mean $r = .92$, $n = 864$). The skin was abraded until the impedance was below 20 KOhm. The recordings were taken from the long head of the triceps and the common head of the biceps between the motor point and fiber insertion. The electrode sites were marked to allow for day-to-day recordings from the same site.
The signals were recorded at a frequency of 25 KHz and stored after AD-conversion on an IBM-AT-PC. The MFCV was determined using a cross-correlation technique (3).

RESULTS

1. Intraindividual comparisons revealed for the isometric static and dynamic contractions in seven from eight subjects increased MFCV values in the triceps ($p = .05$) as compared to the biceps brachii. For all subjects the following mean values were found:

	Biceps	Triceps
Mean MFCV dyn.	4.0 m/s	5.2 m/s
Mean MFCV stat.	4.5 m/s	5.7 m/s

2. Although the relation between force and MFCV is non-linear in single subjects the mean MFCV values for all subjects increase with the level of force ($r=.98/p=.01$).

3. The MFCV of both muscles were sicnificantly lower for isometric dynamic as compared to isometric static conditions ($p=.01$).

4. Table 1 shows the inter- and intra-individual coefficients of variability within an experimental session, between days and between subjects.

CV (%)	isometric static		isometric dynamic	
	biceps	triceps	biceps	triceps
CV intra	4.6	7.6	5.2	5.8
day/day	9.6	15.3	6.1	16.6
CV inter	14.2	24.5	10.4	23.4

Table 1. Coefficient of Variability of MFCV

DISCUSSION

Table 1 shows that the difference of the MFCV between subjects is higher than the inter-day variability. Therfore, the MFCV seems to be appropriate for individual analyses. The variabilities within a testing session and between days appear to be low. It should be noted that the triceps MFCV was significantly higher than the biceps MFCV. Because of the higher FT fiber percentage in the triceps this result may reveal a relationship between fiber type and MFCV. The significantly lower MFCV in isometric dynamic contractions could be caused by different recruitment strategies in static and dynamic force production. The MFCV appears to be a reproducible and predictive parameter in the description of physiological properties of muscles of different fiber composition.

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