

A COMPARISON OF NEUROMUSCULAR PROPERTIES OF KNEE EXTENSORS AND ELBOW EXTENSORS IN MALE SPORTS STUDENTS

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INTRODUCTION: The purpose of this paper was to investigate the individual shape of the force-velocity relation of knee and elbow extensors and their activation rate during MVC. These movement independent neuromuscular properties differed considerably intra-individually as well as inter-individually. They are related to fiber distribution, efficiency, and endurance of the muscle and are therefore important in training science.

METHOD: 8 male sports students (24.4 ± 1.6 yrs, 76.4 ± 6.8 kg, 1.82 ± 0.06 m) performed isometric and dynamic movements on an inclined press pushing a sledge with the legs and with the arms, respectively. The measured data of force, velocity, and position as functions of time were used to determine, amongst others, the activation rate A and Hill's muscle properties a , b , and c for the knee extensors (Siebert, Sust, Thaller, Tilp & Wagner, 2007) and elbow extensors (Kickmeier, 2007; Kickmeier, Thaller & Windisch, 2008), thus obtaining the force (f) – velocity (v) relation $f = c/(v+b) - a$ of the muscles. We calculated the isometric force $f_{iso} = c/b - a$, and $b_n = b/l$, l denoting the length of the muscle (Siebert, Sust, Thaller, Tilp & Wagner, 2007), as well as the maximum contraction velocity v_{max} and the maximum power p_{max} . Differences between muscle groups were assessed with t-tests.

RESULTS AND DISCUSSION: There was no significant correlation ($r < 0.4$) for the activation rate A , f_{iso} , v_{max} , b_n , and a/f_{iso} between knee and elbow extensors. The maximum power p_{max} correlated with $r = 0.77$ across the two muscle groups. Comparing the muscle groups, there was no difference in the mean value of b_n and a/f_{iso} , whereas the activation rate A , f_{iso} , v_{max} , and p_{max} differed significantly ($p < 0.05$). Figure 1 shows the values of b_n for every subject.

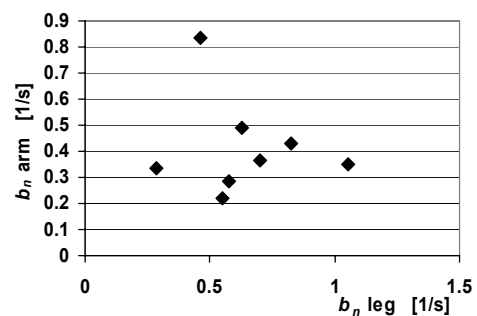


Figure 1: Comparison of b_n

The methods for determining the muscle parameters were similar for elbow and knee extensors and the underlying mathematical models were essentially the same, so a comparison between the muscle groups was admissible. The value of a/f_{iso} describes the shape of the force-velocity relation and is connected to the efficiency and endurance of the muscle, the value of b_n correlates with the fiber composition in the muscle (Sust, Schmalz & Linnenbecker, 1997). The mean values of these two parameters did not differ between elbow and knee extensors, but for every individual subject the values for knee and elbow extensors did not correlate (see Fig.1 for the parameter b_n).

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