Behavior of Vastus Lateralis Fascicle Length under Different Force Levels of Eccentric Contraction

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Introduction

It has been documented that eccentric muscle training is a very important stimulus for the longitudinal adaptation of the muscles. In particular, fiber length has a profound effect on muscle excursion range, maximum shortening velocity and maximum muscle power [1]. The magnitude of the muscle fiber lengthening during the eccentric training may be an important parameter for the effectiveness of the longitudinal adaptation. Due to tendon compliance, elongation of the whole muscle tendon unit (MTU) does not provide accurate information on the level of the muscle fibers. Therefore the assessment of the fiber length during eccentric contractions can be very important for the development of effective training interventions.

Hence the present study investigated the muscle fiber behavior of the vastus lateralis (VL) during an eccentric contraction in humans, by directly measuring the changes of fascicle length with ultrasonography in vivo. The tasks of different force levels with 65% and 95% of maximal voluntary contraction (MVC) were compared.

Methods

Seven sport students participated in the study, their body mass was 79.7±22.7kg. All subjects performed eccentric knee contractions (Knee angle 25°-100°, angular velocity 90°/s) at 65% and 95% of their MVC, on one leg. Although the knee joint axis and the axis of the dynamometer were carefully aligned, the knee joint changed its position. This might have a significant influence on the resultant joint moments [3]. Therefore the knee and hip joint angles and their position were monitored, using a motion analysis system (Vicon 624). Reflective Vicon markers were placed on anatomical landmarks according to Arampatzis et al. (2004) [5]. Figure 1 shows the experimental setup.

The exerted moments measured by the dynamometer were synchronously registered to the kinematics by the Vicon system at a sampling rate of 1000Hz. The resultant moments around the knee joint were calculated according to Arampatzis et al. (2004) [5].

Results

For statistical analysis 6 repetitions for each subject and force level (65% and 95%) were selected. Time and moment data were normalized, to movement duration and MVC values.

There were no statistical differences in the knee angle characteristics between both force levels.

Conclusions

The aim of this study was to investigate the fascicle length behavior of the vastus lateralis muscle by different force levels during eccentric knee contractions. We found no linear relation between knee angle and VL fascicle length. In contrast, at the beginning of movement, we found a slight decrease in fascicle length. This slight decrease of the fascicle length at the beginning of the knee flexion, despite a lengthening of the vastus lateralis muscle-tendon unit, can be explained by the tendon compliance [1, 7]. The non found differences in fascicle elongation between the two conditions (65 % vs. 95 % MVC) reveal that the amplitude of the force level during eccentric knee extension contractions does not affect the lengthening of the fascicle.

References