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ASSESSMENT OF INDIVIDUAL PARAMETERS IN HUMAN MUSCLE MODELLING

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Assuming homogeneous muscle density, muscle volume is a determinant of muscle mass, a parameter, which is needed to gain insight into the specific muscle tension and to determine energy cost and muscle efficiency of certain contractions through modelling[2]. For in vivo measurement of muscle volume, magnet resonance imaging (MRI) is considered to be the most useful non-invasive imaging device. Despite recent improvements in image processing, a muscle reconstruction by MRI is still laborious and not widely applicable. Therefore we investigate whether it is possible to assess the individual muscle volumes within the triceps surae muscle group (TS) by means of easily measurable parameters based on a theoretical consideration. Magnetic resonance images of the right calf of 13 male subjects were acquired and each muscle of the TS was reconstructed. Muscle length (lm), the maximum anatomical cross-sectional-area (ACSAmax) and muscle volume were obtained from the 3D-Models. In general, muscle volume can be expressed as a fraction of the product of maximum anatomical cross sectional area (ACSAmax) and muscle length (lm). The size of the fraction depends on muscle shape and its coefficient of variance among the examined population was considerable low (SO 6%, GM 4%, GL 7%) in the present study. The product of ACSAmax and lm was, therefore, suitable to assess muscle volume (RMS 4 to 7%).
The non rigidity of tendon has a profound influence on the force-length-velocity relationship of the muscle (contractile element) and consequently on its force generating potential. The development of the ultrasound technique enabled the investigation of the mechanical properties of tendon from different muscle-tendon units in vivo in the last years. However, earlier in vitro studies have demonstrated that static and cyclic short term mechanical loading can affect tendon compliance[2]. Although numerous in vitro studies have demonstrated the acute effects of long-lasting static and cycling mechanical loading on tendon compliance, there is little information about the in vivo effects of long-lasting submaximal and maximal mechanical loading on the compliance of tendon and aponeurosis. Therefore, in a series of experiments we examined the strain-force relationship of the gastrocnemius medialis and vastus lateralis tendon and aponeurosis of young and old adults before and after three fatiguing protocols: a) a sustained submaximal isometric contraction, b) submaximal concentric isokinetic contractions until task failure and c) maximal isokinetic contractions until task failure. The results show that neither static nor cyclic long-lasting mechanical loading that produces strains of 2-6% has an acute effect on the in vivo strain-force relation of the tendon and aponeurosis at the lower extremities. Warm-up exercises precondition the tendons and minimize the possibility of an alteration in their mechanical properties. Muscle is unable to sustain the force for a sufficient duration during fatiguing contractions to induce an alteration in tendon properties.

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muscle, modelling, assessment

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