

# Muscle tissue composition and physiological responses to low-level contractions

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## ABSTRACT

Musculoskeletal disorders in the upper extremities are a major problem in the industrialized world and often associated with chronic pain in the shoulder and forearm region.

The aim of the dissertation was to investigate whether the time course of the tissue oxygenation ( $TO_2$ ) is limiting the endurance during a prolonged low-level contraction performed to exhaustion, and to investigate the effect of force development on muscle activity and  $TO_2$  in the forearm muscles during submaximal isometric wrist extensions at low load levels and during computer mouse tasks. The aim was also to develop a method based on quantitative ultrasound image analysis to characterise muscle tissue composition in terms of intensity and structure in the ultrasound images, to investigate the reproducibility, and to use the method for characterisation of the ultrasound images of *m. supraspinatus* and *m. vastus lateralis*.

In the first part of the thesis, a steady state level below resting level of the  $TO_2$  was found during the prolonged contraction until exhaustion. The result showed that the point of exhaustion was not related to a decrease in the  $TO_2$ , which may indicate a potential accumulated effect of the decreased  $TO_2$  on muscle endurance. During the brief contractions, the steady-state  $TO_2$  was inversely related to the muscle activity and the exerted force. During the computer mouse tasks, no significant differences in the  $TO_2$  appeared relative to the pre-exercise resting level.

In the second part of the thesis, no significant differences in grey-scale intensity were found between two different days, indicating that the method was reproducible.

The intensity of the image of the muscle tissue from the thigh muscle was higher, and the structures calculated were larger than the shoulder muscle, indicating that *m. vastus lateralis* contained more non-contractile components than *m. supraspinatus*, and that the structure of the thigh muscle was coarser. The two image analyses supplemented each other and gave a more complete description of the muscle tissue composition than the mean grey-scale intensity alone.

In conclusion, the point of exhaustion was not related to a decrease in the  $TO_2$ , which may indicate a potential accumulated effect of the decreased  $TO_2$  on muscle endurance. Furthermore, the thesis indicates the potential of using the ultrasound analyses to screen for musculoskeletal disorders and muscular diseases, but to justify such a step, investigations on patients compared with healthy controls have to be completed to estimate the sensitivity and specificity of the method in relation to e.g. musculoskeletal disorders.