

A CROSS SECTIONAL MRI STUDY OF THE M. RECTUS FEMORIS MORPHOLOGY IN CYCLISTS, RUNNERS AND SPRINTERS

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INTRODUCTION

Muscles are highly adaptable. In response to internal and external stimuli they remodel their volume by changing their length and their physiological cross sectional area (PCSA). A recent comparison of knee extension torque in cyclists and runners has indicated that cyclists have a shorter m. rectus femoris (RF) compared to runners, but that the PCSA is similar in both groups [1]. It was argued that this difference was related to a difference in use of the RF in these sports. However, inferring muscle morphology from torque data is prone to error. Therefore, the aim of this study was to study RF morphology more directly. For this purpose we assessed the RF morphology by taking MRI scans for three types of athletes: cyclist (C), distance runners (D) and sprinters (S).

METHODS

Athletes were recruited at sport clubs and assigned to the C, D or S group based on performance criteria. A total of 45 cross sectional MRI scans (weighed T1; 1.5 T Philips S15/ACS scanner) were made of the right upper leg to create muscle images (figure 1). The images were analyzed using Easyvision to quantify the RF muscle belly length, muscle belly width in left-right (L-R) direction and anterior-posterior (A-P) direction as well as muscle volume. This data was fed into a 3-D model of the RF [2] to estimate the muscle fiber length and PCSA. Differences in muscle belly length, L-R and A-P width, volume, fiber length and PCSA between the groups were tested using a one-way ANOVA.

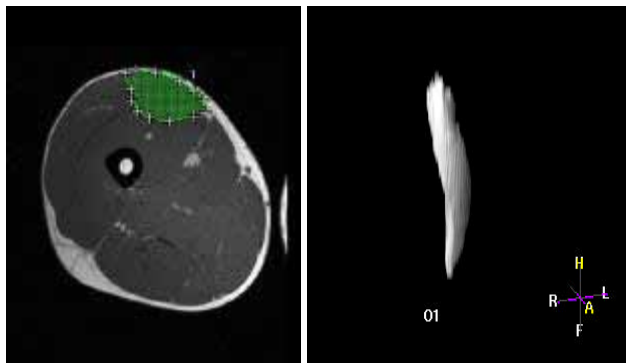


Figure 1: Left panel: region of interest of the m. rectus femoris in cross sectional slice of the upper leg. Right panel: reconstruction of m. rectus femoris volume and the used frame of reference (R=right, L=left, H=head, F=feet and A=anterior)

RESULTS AND DISCUSSION

Each group consisted of nine subjects. There were no significant differences between the subjects in the respective groups in terms of age, height, weight and femur length.

Table 1: Morphological data for m. rectus femoris. Significant differences are indicated by * ($P < 0.05$)

Parameter	Cyclists	Distance Runners	Sprinters
volume (cm ³)*	317.3 ± 46.7	338.4 ± 58.5	393.6 ± 74.8
belly length (cm)	33.3 ± 2.5	34.0 ± 2.7	34.4 ± 2.5
L-R width (cm)	7.4 ± 0.6	7.6 ± 0.7	7.9 ± 0.9
A-P width (cm)	5.1 ± 0.6	4.6 ± 0.7	5.6 ± 1.2
fiber length cm	10.4 ± 0.6	10.4 ± 0.8	10.8 ± 0.93
PCSA (cm ²)	30.7 ± 4.3	32.6 ± 5.4	36.5 ± 6.2

Table 1 summarizes the data from the analysis of the MRI images and the model predictions. Statistical analysis revealed that muscle volume was the only parameter that was significantly different between the groups. Post-hoc tests revealed that this was attributed to the difference between the cyclists and the sprinters. It should be noted that the differences in A-P width ($P=0.068$) and PCSA ($P=0.08$) approached significance.

The volumes measured in this study were 106-155% larger than values reported from anatomical studies on cadaver material [3]. Likewise, estimates for fiber lengths were 33-38% larger and PCSAs were 65-82% larger in this study compared to previous studies [3]. These differences probably reflect the high training level of the subjects that participated in this study as well as possible shrinkage of cadaver material.

CONCLUSIONS

The data of this study do not support the hypothesis that a difference in the RF knee extension torque between cyclist and runners results from morphological adaptations [1]. Alternative explanations like length dependent muscle activation and differences in co-contraction levels to explain the results of Savelberg and Meijer (2003) are discussed.

REFERENCES

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