Morphological Profiles of the Quadriceps Femoris of Varsity Athletes

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Introduction: Sport athletes often show event-related muscular profiles that are possibly associated with their competitive and training activities. Thus, investigation of the muscular profiles in athletes can enlighten the association between muscle-specific hypertrophy and sport-specific movement performance. With respect to the movement of the lower extremities, rowing and pedaling mainly consist of repetitive multi-joint leg extensions (simultaneous extensions of knee and hip joints), which are largely contributed by the quadriceps femoris. On the other hand, several types of joint motions are involved in field sports. It is hypothesized that the quantitative profiles of the quadriceps femoris are similar for the athletes who routinely repeat leg extensions (oarsmen and cyclists) but not for the athletes not regularly performing leg extensions (field sport athletes; such as lacrosse players). This study tested the hypothesis.

Methods: T1-weighted MR images of the whole right thigh were obtained from 14 varsity oarsmen, 8 male cyclists, 13 male lacrosse players and 10 untrained men. The anatomical cross-sectional areas (ACSAs) from the origin to insertion of each muscle of the quadriceps femoris (vastus lateralis, vastus medialis, vastus intermedius, and rectus femoris) were measured. The muscle volume of each muscle was determined by summing in-series ACSAs which were multiplied by the slice thickness (1 cm), and the relative muscle volume to body mass (normalized volume) was calculated.

Results and Discussion: The normalized total volumes of the quadriceps femoris were significantly greater in the oarsmen and cyclists than in the untrained men, and that of the cyclists was significantly greater than that of the lacrosse players. Likewise, the normalized vastus lateralis volumes of the oarsmen and cyclists were significantly greater than those of the lacrosse players and untrained men, and the normalized volumes of the vastus medialis and vastus intermedius were significantly greater in the oarsmen and cyclists than in the untrained men. In contrast, the normalized rectus femoris volume of the lacrosse players was greatest of the four groups, while no statistical differences were shown among the other three groups. It was made clear that the varsity oarsmen and cyclists had hypertrophied monoarticular vasti (lateralis, medialis, and intermedius), whereas the lacrosse players had hypertrophied biarticular rectus femoris. These results strongly suggest that the varsity athletes demonstrate muscle-specific hypertrophy among the synergistic muscles comprising a muscle group, depending on the sport-specific motions involved during competitive and training activities.