**DIFFERENCES IN DAMAGE TO THE KNEE FLEXOR MUSCLES AFTER ECCENTRIC KNEE FLEXION**

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**INTRODUCTION:**

Strains of the knee flexor muscles, including the biceps femoris (BF), the semitendinosus (ST), the semimembranosus (SM), and the gracilis (G), frequently occur during sports activities [4]. It has been shown recently that each of these muscles is different architecturally (i.e., muscle weight, muscle volume, fiber length, and pennation angle), as well as functionally (i.e., their ability to contribute to internal or external rotation) [2]. However, the specific muscle that works during eccentric knee flexion is unclear.

The purpose of this study was to use detailed measurement to clarify the differences in the damage to the knee flexor muscles after eccentric knee flexion and to expand the knowledge of preventing strain of the hamstrings. We hypothesized that damage to each knee flexor muscle after eccentric knee flexion will be different due to architectural and functional differences.

**METHODS:**

Seven healthy male volunteers (Age: 25±1 yr) participated in this study. Each subject was evaluated in a prone position during one repetition of maximum flexion (1-RM) of the right knee followed by a session of eccentric knee flexion exercises (5 sets of 10 at 120% of the 1-RM, following Foley, et al.’s study [1]) using a plate-loaded machine. T2-weighted transverse spin-echo magnetic resonance images of the thigh (Magnetom Symphony, SIEMENS; TR = 2000 ms; TE = 30, 45, 60, 75; slice thickness = 10 mm; interslice gap = 12 mm) and blood samples were obtained immediately before and immediately after evaluation, as well as 1 and 3 days after evaluation. For comparison, T2 relaxation time of the only the ST muscles (BF: 22±7%, SM: 15±10%, ST: 53±11%, G: 60±9%, p<0.01). Three days after evaluation, T2 relaxation time of only the ST increased (109±49%, p<0.01), while that of the other muscles did not increase (Figure 1). This result about the ST, that is, the highest T2 relaxation time three days after evaluation, was the same as Nosaka, et al.’s study [3]. Figure 2 shows a typical MR image of the thigh three days after evaluation. The value of serum creatine kinase was highest 3 days after evaluation (p<0.01), which was the same result as Stupka, et al.’s study [5].

**RESULTS:**

Immediately after evaluation, T2 relaxation time increased in all muscles (BF: 22±7%, SM: 15±10%, ST: 53±11%, G: 60±9%, p<0.01). Three days after evaluation, T2 relaxation time of only the ST increased (109±49%, p<0.01), while that of the other muscles did not increase (Figure 1). This result about the ST, that is, the highest T2 relaxation time three days after evaluation, was the same as Nosaka, et al.’s study [3]. Figure 2 shows a typical MR image of the thigh three days after evaluation. The value of serum creatine kinase was highest 3 days after evaluation (p<0.01), which was the same result as Stupka, et al.’s study [5].

**DISCUSSION:**

The results of this study denote that damage to the knee flexor muscles after eccentric knee flexion is different, and the ST was especially affected 3 days after evaluation. There are two explanations for this result. First, the architecture of the ST may make it more likely to be affected. The ST is a parallel fibered muscle with a long fiber length, therefore there are many sarcomeres in series in the muscle illustrating an eminent potential for the ST to shorten at long distances. In some subjects, the gracilis, also a parallel fibered muscle with a long fiber length, was damaged more than the BF or the SM, which are unipennate muscles characterized by short fiber lengths. Thus, the ST and the G may be easily torn during this exercise. Secondly, the ST may have a specific function to act during eccentric knee flexion. Of the hamstrings muscles, the BF and the SM act as “power muscles” to produce the main knee flexion torque and are not easily damaged. On the other hand, the ST and the G act as “subordinate muscles” to help produce subordinate torque against excessive loads higher than the individual maximal voluntary contraction. Additionally, a specific neuromuscular mechanism may exist in the ST during knee flexion.

**REFERENCES:**


