RELATIONSHIP BETWEEN MOMENT-JOINT ANGLE CHARACTERISTICS OF KNEE FLEXION AND ARCHITECTURE OF HAMSTRINGS MUSCLES IN HUMAN

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INTRODUCTION

There have been few biomechanical studies that tried to investigate individual variations of human musculoskeletal parameters, e.g., moment of inertia or ratio of fascicle-tendon structure length. Additionally, many synergist muscles that have different moment arm one by one have often been analyzed as a single muscle. However, we need to pay more attention to musculoskeletal differences among individuals, which have a possibility to result in different characteristics of force generation and moment-joint angle relationship. The purpose of this study was to investigate how individual variations of architecture of hamstrings muscle tendon complex, which are agonists of knee flexion, influence moment-joint angle relationship.

METHODS

Ten healthy males (age, 26.4 ± 2.9 yrs; height, 174.5 ± 5.0 cm; mass, 72.0 ± 6.0 kg) participated in this study. A dynamometer (MYORET RZ-450: Kawasaki, Japan) was used to measure isokinetic knee flexion moment. All measurements were performed from the left leg. We measured three maximal-effort voluntary contractions at 30 degree/sec, with different hip joint angles. Subjects were tested at 0 and 90 degrees of hip flexion (Figure 1). We firmly fixed subject's thigh and trunk on the apparatus with straps so that their body did not move while testing. Each testing was performed with sufficient rest. We measured subject's muscle architectural property using ultrasonography. Muscle thickness was measured by B-mode ultrasonography (SSD-2200, Aloka, Japan) at two sites, i.e., posterior thigh at 40% (upper thigh) and 70% (lower thigh) of the thigh length (Figure 2).

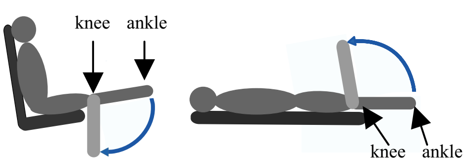

Figure 1: Experimental positions.

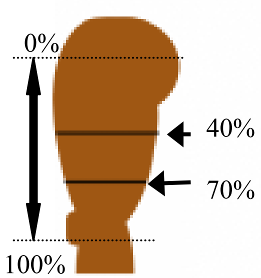

Figure 2: This picture shows the point we measured in muscle thickness measurement. One is 40% of the thigh length (upper thigh), and the other is 70 % (lower thigh).

RESULT AND DISCUSSION

Figure 3 shows the relationships between the ratio of the upper and lower thigh thickness and the ratio of the knee flexion moment at 0 and 90 degrees of hip flexion. In both cases, the knee flexion angles are at 30 degrees. It was found that subjects whose relative muscle thickness of upper thigh is larger tended to be able to generate larger relative strength when the hip flexion angle is 90 degrees. And there was a significant correlation between the ratio of the upper and lower thigh thickness and the ratio of the knee flexion moment at 0 and 90 degrees of hip flexion ($R=0.828$ $p<0.01$). Several studies have focused on relationship between sprint performance and thigh muscle thickness of upper and lower parts [1,2]. There remains some uncertainty whether the ultrasonography data obtained from skin surface have enough accuracy to address individual differences. Currently we are proceeding with examination using MRI to obtain more reliable architectural data of hamstrings.

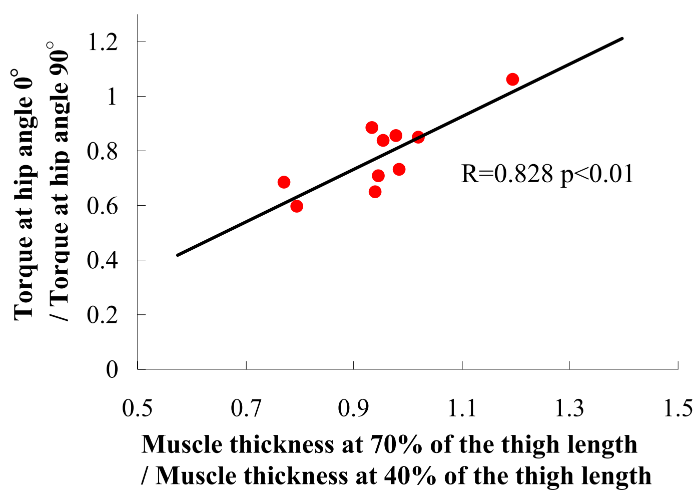

Figure 3: The relationships between the ratio of the upper and lower thigh thickness and the ratio of the knee flexion moment at 0 and 90 degrees of hip flexion. Both of knee flexion angles were at 45 degrees.

CONCLUSIONS

It is likely that differences among individuals in the architecture of hamstrings muscles result in differences of moment-hip angle relationship of their knee flexion.

REFERENCES

1.Kumagai K, et al.. *J Appl Physiol* **33**, 811-816, 2000.
2.Abe T, et al.. *Med Sci Sports Exerc* **31** (10), 1448-1452, 1999.