早稲田大学審査学位論文

博士（スポーツ科学）

概要書

Morphological and mechanical properties of human fascia lata and implications for motor performance

人間の大腿部深筋膜の形態的・力学的特性と身体運動パフォーマンスとの関連性

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Chapter abstract

Chapter 1

In this chapter, the previous cadaveric studies of the morphological and mechanical properties of the deep fascia were summarized. Recent *in vivo* experiments which investigated the interaction between fascial structures and their neighboring muscles were also reviewed.

Chapter 2

In chapter 2, the characteristics of the fascia lata were examined in detail using human cadavers. Fascia lata specimens were taken from the anterior, lateral, medial, and posterior sites of the thigh. Thickness and fibers' direction of each specimen were measured as the morphological properties. Tensile test was performed in both longitudinal and transverse directions to measure the mechanical properties (e.g. stiffness, Young's modulus, and hysteresis) of the fascia lata. The lateral site of the fascia lata was thicker and rich in the longitudinal directed collagen fibers. Direction-dependent differences of the mechanical properties were shown at every site. These site- and direction- dependent properties of the fascia lata may match and optimize underlying muscles' contractions.

Chapter 3

In chapter 3, *in vivo* measurement was performed to investigate the behavior of the fascia lata during muscle contractions. Shear wave velocity (SWV) of the rectus femoris (RF), vastus lateralis (VL) and its overlayered fascia lata was measured during sub-maximal isometric knee extension (20, 40, 60% of MVC) and at rest. Measurements were conducted both in the

longitudinal and transvers directions of the thigh. The muscles and fascia lata became stiffer as the contraction intensity increased. Besides, the fascia lata showed anisotropic behavior which is stiffer in the longitudinal than the transverse direction. These results suggest that the fascia lata can act as a spring which contributes to elastic energy storage, myofascial force transmission, and limb stability.

Chapter 4

The aim of chapter 4 was to investigate the hypothesis that the morphological and mechanical properties of ITB are site-specific and change according to the alteration of joint angles by both cadaveric and *in vivo* experiments. The morphological and mechanical properties of cadaveric ITB was examined at 5 different sites (over the proximal, medial, and distal sites of VL, superior boarder of patella, and midway of femur and tibia). The SWV of living human ITB was measured from 5 sites (refer to cadaveric study) at 9 different joint angle configurations (hip 0, 40, 90° x knee 0, 25, 90°). Cadaveric ITB showed site-specific thickness and stiffness. *In vivo* test demonstrated that ITB stiffness increases by the hip flexion and knee extension. These site- and joint angle-dependent mechanical properties of ITB could be related to the injuries of ITB.

Chapter 5

The main findings of this thesis were generalized in chapter 5. It was discussed that how the fascial structures interact with the underlying muscles during motor performance and fascial tissue related injury. Future directions were also noted to apply these findings to improve the human motor performance and prevent fascial tissue related injuries.