BIOMECHANICAL CHARACTERIZATION OF THE HUMAN FASCIAE OF THE ABDOMINAL REGION: SUPERFICIAL VS DEEP FASCIA

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Introduction

The multilayered organization of the fascial system (FS) ensures continuity from the skin to the deepest plane, being a key structure for force transmission. FS substrates have different implications for disorders and, consequently, for treatment planning [1]. Recently, FS biomechanical characterization and variety in accordance with specific anatomical sites are being studied [2]. Historically, the first superficial fascia (SF) to be described in relation to hernias was the abdominal one (known in the lower abdomen as *Scarpa Fascia).* The abdominal deep fascia (DF) is a trilaminar structure known as *rectus sheath* (aponeurotic fascia). Figure 1. Loose connective tissue grants the independent sliding between different layers, excepting along the linea alba where they fuse each other's [1]. Despite the clinical importance, the literature still lacks data on the comparison of mechanical properties of superficial and deep fascia of the abdominal region. Therefore, we have considered this open topic as the focus of this work.

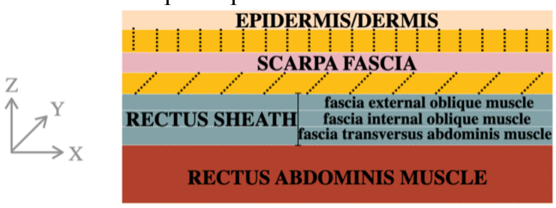

Figure 1: Below the arcuate line.

Methods

Fasciae patches have been harvested from the abdominal region of a fresh-frozen human donor (male, 86 y/o, no clinical history of fascia alterations), according to Body Donation Program [3]. The patches have been cut into strips (Figure 2a) and tested (Model Match-1, ©Biomomentum) with uniaxial tests. The same orthogonal directions have been considered for both SF and DF, i.e., cranio-caudal (CC, along the *y* axis) and latero-medial directions (LM, along the *x* axis) Preconditioning cycles were applied before a 1) failure (strain rate: 1%/s) and 2) stress-relaxation protocol (strain rate: 15%/s, resting time: 300s).

Results

The biomechanical characterization of the SF and DF of the abdominal region was studied in terms of anisotropic and viscoelastic behavior, highlighting significant differences between the two structures independently from the subject bias (Figure 2b). In particular, DF revealed a clear anisotropy, characterized by an elastic modulus along CC (within the linear region) of about six times lower with respect to the LM direction, while strain at break along LM was about 50% the one obtained from CC samples. Moreover, SF showed a tensile strength up to one order of magnitude lower with respect to DF along the same direction.

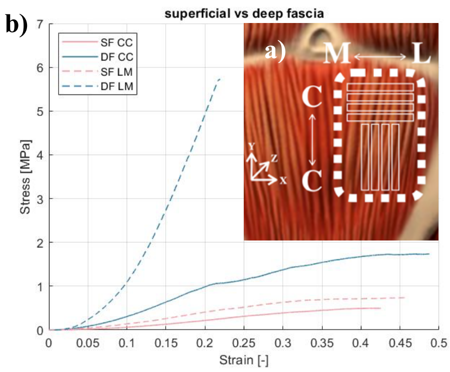

Figure 2: a) Anatomical landmark for the harvested patches and cutting directions b) example of test results.

Discussion

The variability between SF and DF, according to different directions, is a further proof of their structures and roles. In-depth knowledge of FS mechanical properties has direct applications in tissue engineering and clinical treatment planning (e.g., hernias repair).

References

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3. A. Porzionato et al, Quality management of Body Donation Program at the University of Padova, Anat Sci Educ, 5(5):264-272, 2012.

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