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PERSPECTIVES

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Possible Applications for Fascial Anatomy and Fasciaology in Traditional Chinese Medicine

Yu Bai[1], Lin Yuan[1]*, Kwang-Sup Soh[2], Byung-Cheon Lee[2], Yong Huang[3], Chun-lei Wang[3], Jun Wang[4], Jin-peng Wu[1], Jing-xing Dai[1], Janos Palhalmi[5], Ou Sha[4], David Tai Wai Yew[6]

[1]*Department of Anatomy, Southern Medical University, Guangzhou, China*
[2]*Biomedical Physics Laboratory, Department of Physics and Astronomy, Seoul National University, Seoul, Korea*
[3]*Department of Traditional Chinese Medicine, Southern Medical University, Guangzhou, China*
[4]*Department of Anatomy, Shenzhen University School of Medicine, Shenzhen, China*
[5]*East-West Biomedicine Limited, Monorierdo, Hungary*
[6]*Department of Anatomy, The Chinese University of Hong Kong, Hong Kong, China*

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Abstract
Research using medical imaging instruments such as computed tomography and magnetic resonance imaging has led to the proposal that the fascial network distributed over the human body is the anatomical basis for the acupoints and meridians of traditional Chinese medicine. Therefore, we put forward a new theory of anatomy called fascial anatomy. In fascial anatomy, a human body is divided into two major systems. One is the supporting-storing system of unspecialized connective tissues. The other is a functional system. An undifferentiated non-specific connective tissue network, with the participation of the nervous and the immune systems, constitutes the supporting-storing system of the human body. The various differentiated functional cells in the body that are supported and surrounded by the supporting-storing system constitute the functional system. The discipline that studies the supporting-storing system and the mutual relationship between this system and the functional system in a living human body is called *fasciaology*. The establishment of fascial anatomy and fasciaology opens a new research field in anatomy; consequently, fasciaology will play a significant role in biological medicine and traditional Chinese medical research, as well as future clinical practice.

1. Introduction

Meridian and collateral theory is the basis of traditional Chinese medicine (TCM). Much work has been carried out to find the anatomical component of meridians and collaterals; however, their existence is still disputed [1]. In the visible Chinese human project, a national basic research program of China, the computer constructed areas rich in fascial connective tissues were found to be very close to the locations of meridians and collaterals [1–3]. Based on the visible Chinese human digital datasets, virtual three-dimensional (3-D) structures of the areas rich in fascial connective tissues along meridians in the body's trunk and limbs were constructed [4]. They revealed a line-like structure similar to that

*Corresponding author. Department of Anatomy, Southern Medical University, 11/F Life Science Building, 1838 Guangzhoudadao Street North, Baiyun District, Guangzhou 510515, China.
E-mail: yuanl@fimmu.com

of acupoints and meridians or collaterals [5]. Furthermore, these fascial strings were also close to virtual meridians in distance. More fascial connective tissue areas were constructed into 3-D structures, and more line-like structures were found. After the 3-D structures of all fascial connective tissues throughout the body had been constructed, a body-shaped connective tissue network appeared. Subsequently, based on computed tomography and magnetic resonance images of living human bodies, the 3-D structures of fascial connective tissue were constructed [6]. Similarly, fascial connective tissue also appeared in a line-like pattern and was co-localized with traditional Chinese meridians. Furthermore, using dynamic ultrasound, "*Deqi*" (a sore and numb feeling at acupoints) was found to occur only when a needle penetrated or stimulated the connective tissue of the fascia [7]. The histological composition of meridians has been regarded as non-specific connective tissue, including loose connective tissue and fat tissue [8–11]. The effective sites of acupuncture are therefore thought to be fascial connective tissue, including, amongst others, cells and tissues inside sites such as nerve endings, capillaries, fibroblasts, undifferentiated mesenchymal cells and lymphocytes.

The fascia of the human body is homologous in structure to the extracellular matrix of a single germ layer organism, the mesoglea of a diploblastic organism, and the mesenchyme of a triploblastic organism. Their common function is to sustain stability of the internal environment of an organism [12]. During evolution, the constitutive elements of organisms can be summarized into two types of systems (Figure 1), which are (1) the supporting and storing system containing adipose and loose connective tissues and (2) the functional systems composed of specialized cells. In other words, the fascial network, the mesenchyme, and the extracellular fluid are homologous, and their common function is to sustain stability of the internal environment of an organism. The mesoderm further evolves into organs and systems with specific functions, including the locomotor, urinary, reproductive and circulatory systems [13]. Mesenchyme remnants then differentiate into connective tissues that are distributed throughout the body. The network of fascial connective tissues provides support for the functional systems, which are composed of specialized cell [14]. The functions of the connective tissues play an important role in maintaining a longer life span for the organism. Organisms whose fascia systems are not well evolved have shorter life spans; conversely, those organisms with well evolved fascia systems have longer life spans.

Consequently, two new terms have been defined. First, fascial anatomy is a new anatomical theory

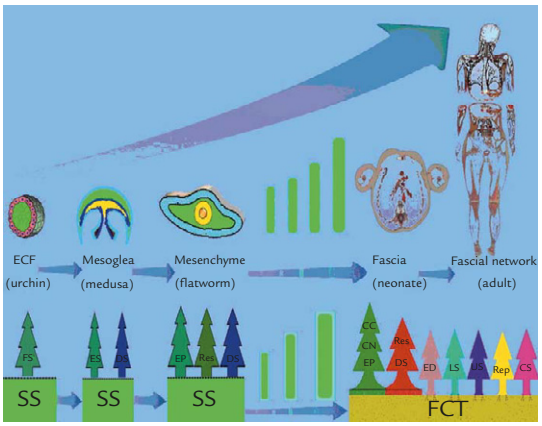

Figure 1 Schematic diagram showing that the fascia of the human body is homologous in structure to the extracellular matrix of a single germ layer organism, the mesoglea of a diploblastic organism, and the mesenchyme of a triploblastic organism. SS=supporting-storing system; FS=functional system; CC=cerebral cortex; CN=central nerve; EP=epidermis; Res=respiratory system; DS=digestive system; ES=endocrine system; LS=locomotor system; US=urinary system; Rep=reproductive system; CS=cardiovascular system; FCT=fascial connective tissue; ECF=extracellular fluid.

[4,6,8]. According to fascial anatomy, each living organism is composed of two major systems. One is the supporting-storing system, which is composed of a network of unspecialized connective tissues. The other is the functional system, which contains organs and tissues surrounded by the supporting-storing system. Second, fasciaology is the research field that studies the supporting-storing system and the mutual relationships between the above two major systems in a living organism. The theories of fascial anatomy and fasciaology highlight the significance of fascial research, which is important not only in the field of TCM but also in other fields of biomedical research and clinical therapy. TCM theories may be scientifically interpreted through the use of fasciaology.

2. Anatomy of Fascia

2.1. The origin of fascia

The fascia network is homologous with the extracellular matrix of a single germ layer organism, the middle lamella of a two germ layer organism, and the mesenchyme of a three embryonic layer organism. When the structures are retrospectively displayed and modeled, the components of an organism during each period can be summarized into two major systems (Figure 1). Functional systems are composed of cells with specific functions. They