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Introduction: Why this book?

KEY POINTS

- Outline of the concept of this book
- The conceptual framework for health care
- Definition of the movement system
- Definition of fascia as the body's communication network
- Importance of fascia's role in body movement
- The principles of therapeutic touch
- Definition of Myofascial Induction Therapy and its relation to other myofascial approaches

Introduction

The fascial structure constitutes a complex network which links all the systems of the body **(Fig. 1.1)**. In the past 10 years we have witnessed a dizzying increase in research related to fascial tissue. This research is bringing together more and more scientific disciplines, such as biology, physics, biochemistry, and neuroscience. Simultaneously, systemic reasoning is becoming more evident in health care. Clinical trials increasingly support the need to include fascial approaches in treatment protocols.

Before carrying out research on biological structures like the human body we have to study anatomy. Nothing that happens in the body can be "antianatomical." We always look at the anatomy for confirmation of the clinical diagnosis. Gross anatomy, which is usually performed on embalmed cadavers, allows anatomical structures to be topographically located; however, the interrelation between structures is often distorted or broken.

The opportunity to carry out anatomical dissections of unembalmed cadavers, which have been preserved only at low temperatures, has allowed us to approach the construction of the body from a different perspective – the perspective of continuity and integration (see Chapter 3). This knowledge is reflected in the analysis of body movement at all levels of construction, from microstructures to macrostructures, which brings clinical reasoning closer to the totality of the body's response to each movement requirement (see Chapters 5 and 6). The presence of unspecialized connective tissue – the connective tissue located between anatomical structures (e.g., between muscle fibers, between fascicles, between muscle epimysia, and between muscles and neurovascular tracts) – that links anatomical components to create an uninterrupted communication network has necessitated a change in movement paradigms (see Chapter 7). We now know that this tissue is richly innervated, has contractile capacity, and *actively* participates in movement (see Chapter 8).

For example, to drink a cup of coffee we activate 32 muscles controlled by the stimuli of numerous mechanoreceptors, which act with great precision and, in sequences, adjust to interoceptive and exteroceptive information. By grasping the cup, Merkel's receptors act, recognizing the texture and shape of the cup. The deformation (stretching) of the skin of the hand is detected by Ruffini receptors; Meissner's corpuscles respond when the fingers slide slightly to improve the grip; and Pacinian corpuscles control the degree of pressure created by holding the cup. The process is carried out with

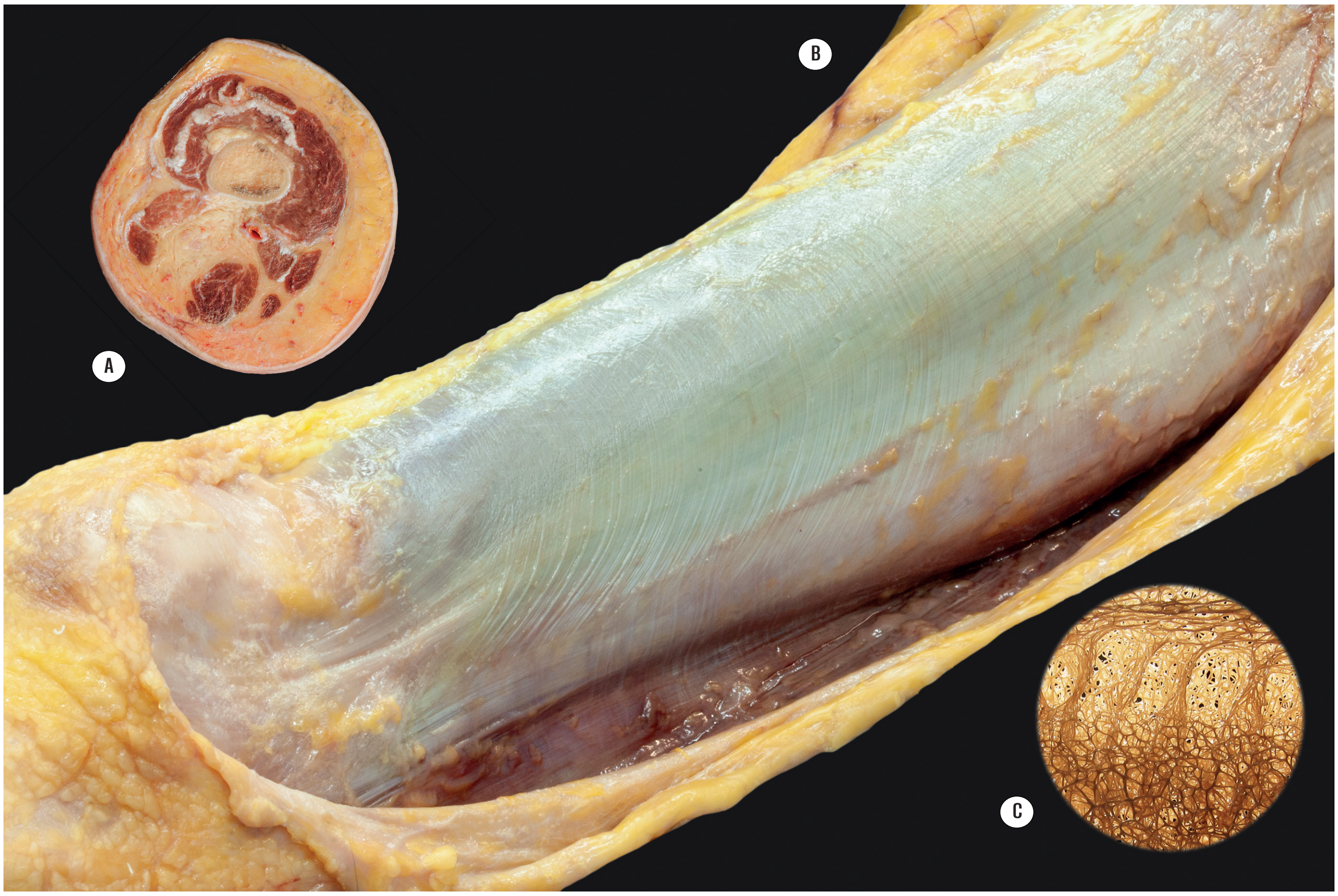

Figure 1.1

Continuity of the superficial and deep fascia of the thigh. **A** Cross-section of the thigh. Note the compartmental structures that create space for the movement of the muscles, bones, and neurovascular tracts. **B** Anterolateral aspect of the knee and thigh. **C** Cross-section of a loofah. The fibrous distribution resembles fascial architecture

extreme precision which allows the brain to choose the motor units of the muscles involved to perform the task efficiently without excessive expenditure of energy.

Van der Wal (2009) states that mechanoreceptors do not understand muscles or ligaments or capsules, but rather the strain of their deformable environment (meaning the fascial tissue). Therefore, the activity and role of a mechanoreceptor is defined not only by its functional properties but also by the *architecture of its environment*. This means that it is the architecture of the fascial system that encodes the mechanoreceptive information. Therefore, whether an Aδ fiber or a type C fiber encodes nociceptive information or other interoceptive information will depend on the architecture of the tissue environment (see Chapter 8). It should be noted that mechanoreceptors are not exclusively subject to their mechanical environment but also to the experiential environment, expectations, and the experience of other sensory systems such as vision. The scientific discoveries and clinical experiences outlined above have led to the need to review and update our knowledge of the fascial system.

This book brings the reader closer to fascial architecture, which is demonstrated and discussed based on numerous photographs and videos of dissections of unembalmed cadavers. The objective of this book is not only to focus on the topographic anatomy of the fascia, although this is widely illustrated and discussed, but rather to demonstrate the continuity of the fascial system and its dynamic links with the other systems of the body.

These observations invite us to change the existing paradigms related to body movement and to relate them to clinical procedures. In Part 2 of the book a wide range of clinical procedures is extensively discussed and is supported by graphic materials.

Research, development, and innovation (R&D and I)

The best way to predict the future is to create it.

Abraham Lincoln

The last decade has been characterized by extensive and rapid changes in all areas of our lives. The amazing and vertiginous advances in the field of communications are obvious examples of this process. These innovations define our lifestyle – our employment, leisure, and personal relationships. This progress can be defined by three words (and letters):

- **Research (R): c**reation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies, and understanding.
- **Development (D):** application of the results of research or any other type of scientific knowledge.
- **Innovation (I):** activity that results in advances leading to completely new horizons or substantial improvements in existing horizons, differing substantially from what already exists and leading to something novel.

Searching for a health care model: The conceptual framework (Fig. 1.2)

Health conditions in all fields of health sciences, particularly in medicine, do not escape the R&D and I process. The spectacular development of high technology and the discovery of new drugs allow medicine to prolong our lives and optimize our quality of life. The World Health Organization defines health as: "A complete state of physical, social and mental wellbeing, and not merely the absence of disease or infirmity" (WHO [1946] 2012). It is worth asking if the current health model addresses this definition. This is difficult to answer due to the fact that there is no universal model of health care that is specifically associated with the chronic processes of pain and dysfunction.

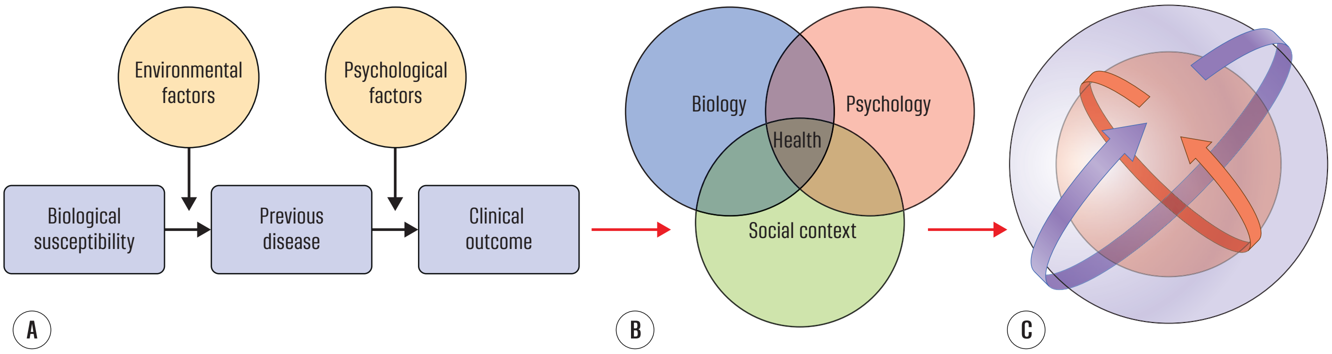

Figure 1.2

Conceptual models of health (care). **A** The biomedical model (Abdelnour & El-Nagi 2017). **B** The biopsychosocial model. Each domain has some shared features related to health:

- Biology: gender, illness, disability, genetics, immunology, medication, and neurochemistry
- Psychology: learning and memory, attitudes, personality, behavior, emotions, post-traumatic stress
- Social context: social support, family background, cultural traditions, socioeconomic status, and education

C The enactive model. This concept is based on the experience of the person in their environment (outer circle). The inner circle represents the organism. The orange band represents the organism's nervous system which is inseparable from a changing environment (purple band)

A biomedical model is a surrogate for a human being, or a human biologic system, that can be used to understand normal and abnormal function from gene to phenotype and to provide a basis for preventive or therapeutic intervention in human diseases. (National Academies Press 1998)

The biomedical model

The biomedical model (with its reductionist or dualist reasoning which endorses a linear relationship between stimuli and disease) was (is?) very successful in medicine and, in only a 100 years, has allowed us to double life expectancy for our species in a time when most human deaths have been caused by infectious diseases (caused by agents such as fungi, viruses, germs, bacteria, parasites, or toxins), trauma, or genetic defects. According to this model, a biological predisposition in the presence of environmental factors or tissue insults produces diseases, i.e., "a verifiable evidence of a pathological state, evidenced by medical investigations" (Abdelnour & El-Nagi 2017).

Medicine studies these agents with precision and categorizes them. Through research it discovers their nature and identifies signs and symptoms. Once the main cause of a disease was determined, medicine knew how to attack the agent with drugs or the routes of infection with preventive measures such as hygiene or vaccination. With the help of high technology, medicine studies the affected organs and the nature of the disorder and establishes therapeutic protocols. And then, medicine succeeds! Medicine has this amazing knowledge and the means to repair or even replace affected organs and maintain their function with the help of drugs.

Medicine applies the same reasoning to pain. According to Cartesian reasoning (the dualistic perspective), "pain occurs in an immaterial mind," and according to reductionist reasoning, "the pain is often considered to be in the brain" (Stilwell & Hartman 2019). The biomedical model of health focuses on biological factors and usually excludes psychological, environmental, and social influences. "This model does not recognize *illness,* which is the patient's own perception of health" (Abdelnour & El-Nagi 2017), nor are the reasons for the illness at the center of the biomedical model (Stilwell & Hartman 2019).

Reductionism was (is?) necessary for the development of science; however, it has its limitations.

At the present time, however, the highest mortality occurs due to chronic or degenerative diseases, such as cardiovascular, hepatic, and immune deficiencies, cancer, metabolic disturbances, connective tissue diseases, or ulcers. Reductionist reasoning (the biomedical model) has limited possibilities to deal with these complex diseases since they have multiple causes and it is necessary to consider how one cause is related to another and to the individual patient (requiring systemic reasoning from the perspective of the behavior of complex systems).

A complex biological system – such as the human body which is the opposite of a simple system – manifests itself as an entity of global behavior (each component relates to the other), and the total is more than the sum of its parts. Of greater relevance is the interrelation between the components, rather than the individual properties of a single component. The systemic properties are destroyed when the system is sectioned into isolated elements. Therefore, complex systems are not fragmentable and are characterized by irreducibility (see Chapter 2).

At present it is well known that psychosocial factors may influence most biological treatments. In recent years the biopsychosocial model has gained in popularity and has become the mainstream ideology of contemporary health care.

The biopsychosocial model

As the biomedical model could not explain the complex nature of health conditions, Engel proposed the biopsychosocial model (Engel 1960, 1977, 1980). This model considers three domains in its understanding of health, diseases, and health care: biological (age, gender, genetics), psychological (mental and emotional factors), and sociocultural (interpersonal relationships). Following the principles of von Bertalanffy's General System Theory (see Chapter 2), Engel focused on the close interrelation or interaction of the individual with behavioral, psychological, and social dimensions. These three domains faced the same demand for scientific verification of their role in health care.

Engel's proposal was initially related to psychiatry. However, because it did not separate the individual and their personal circumstances from the medical condition, it was well received and extended to other medical specialties. The utility of the model was validated in clinical trials (Chen et al. 2015, Drossman 1998, Greenberg 2005). Over the last 40 years it has become an increasingly accepted model and is currently considered the clinical standard for medicine, physiotherapy, and other health science care (Gatchel et al. 2007, Daluiso-King & Hebron 2020).

The introduction of the biopsychosocial model to the field of musculoskeletal disorders was initiated by Waddell (1987, 2004), and this introduced a new concept into the treatment of low back pain (Jull 2017).

The model allowed for the conceptualization of holistic evaluation and linked science and humanism (Beilock 2017). However, authors claimed that greater precision was needed to achieve an accurate biopsychosocial understanding of the patient. Jull (2017) states that the "biopsychosocial model does not provide any specific guidance to what interventions should be implemented." "This is a weakness as domains can feasibly be interpreted as interventional models" (Ghaemi et al. 2009 cited in Jull 2017).

An example of a biopsychosocial model distortion can be seen in the interpretation of pain, particularly of chronic pain. Frequently, attention is focused "on pathoanatomical (biological) causes of pain, while psychosocial factors are neglected, ignored" (Stilwell & Hartman 2019). At the same time, the requirement to determine a specific diagnosis notably increases the tendency to relate the painful processes to psychosocial factors to the point of triggering a kind of stigmatization of patients who suffer from them (Jepsen 2018, Synnott et al. 2015) (see Chapter 17). "Fragmenting a patient's pain into components inappropriately considers humans as linear and dissociable (i.e., able to mechanistically separate into distinct parts) and is contrary to the intent of Engel's proposition" (Stilwell & Hartman 2019). The biopsychosocial model continues to be dominated by the biological component.

An important contribution in the development of the biopsychosocial model is linked to the interpretation of pain and focuses on the central nervous system and its bioplasticity. The motto "all pain is in the brain" was coined by Butler and Moseley (2003). This concept deeply influenced health care providers, particularly in physical therapy. The concept focuses on the leading role of the brain in the perception and experience of pain (Moseley & Butler 2017). However, over the last few years, authors have been questioning if attributing the perception of pain exclusively to the brain (neurocentrism) will lead to a return to dualistic reasoning. Thacker (2015) points out "that pain is not an afferent input" and "the only entity sufficient for the experience and perception of pain is the person." Clinical experiences invite the enlargement of the biopsychosocial model toward the patient-centered model.

Beyond the biopsychosocial model

> Any aspect of cognition, ranging from attention onwards, cannot be understood exclusively by studying the brain.

The enactive approach

In previous models clinical reasoning and outcomes have focused mainly on the *biomechanical body*, disregarding the mind/consciousness as a by-product of the brain without *causal* importance (Gallagher 2012 cited in Øberg et al. 2015).

Following the principles of General System Theory, Stilwell & Hartman (2019) suggest updating the biopsychosocial model by focusing on the fact that the person is a "dynamic whole – embedded in an environment." The authors state that "the mind is not only connected to the body, but the body influences the mind." In their analyis of pain behavior, they suggest evolving the biopsychosocial model toward the *enactive approach.* The enactive approach to cognition was first proposed by Varela, Thompson, and Rosch in 1991 (Weber & Varela 2002, Di Paolo & Thompson 2017).

The authors consider that cognition comes from bodily action and serves bodily action; that is, cognition is an *embodied* action. It should be understood as a means of obtaining an internal representation of a corresponding external reality. Cognition is thus best understood as "enactive"; that is, as a form of practice itself (Ye et al. 2019). Although of great interest, a more extensive discussion of this topic is beyond the scope of this book.

Body perception and movement (body schema – body image)

There is a tradition of ambiguous terminological usage and conceptual misusage of *body schema* and *body image* in clinical studies (Gallagher 1986). *Body schema* is defined as system of preconscious, subpersonal processes that play a dynamic role in governing posture and movement (Head 1920). *Body image* is a "conscious idea or mental representation" (an intentional state) that "one has of one's own body" and includes perceptions, mental representations, beliefs, and attitudes (Gallagher & Cole 1995). In the therapeutic process we focus on changes in body image thus influencing the body schema.

A wide range of intrinsic and extrinsic input can alter a individual's body image state. Beyond the biomechanical construction of the body, touch can improve the patient's perception of the body by promoting the reorganization of the body image (Longo & Haggard 2012). Therapeutic processes that involve sustained touch (such as movement induction in the MIT approach) can cause significant effects on functional connectivity patterns (brain plasticity) in cortical areas that process the interoceptive and attentional value of touch (such as the right insular cortex) and the posterior cingulate cortex. Thus, touch can be a fundamental element in "learning or relearning processes" (Cerritelli et al. 2017).

A systemic approach to therapeutic movement and health care

Transforming society by optimizing movement to improve the human experience. (APTA 2015)

In health care in recent years the inclusion of movement approaches has been observed to be an essential factor in well-being. It should be emphasized that in a biological structure, such as the human body, movement should be carried out on the basis of interconnection and integration of neuromuscular and neurocognitive processes (Pilat 2018). APTA (2015) defines movement as "the activity that involves metabolic changes, structural increases, morpho-functional changes, maturation, physical dimensions, motor, cognitive, psychological, affective and social activity." Sahrmann defines *movement system* as "a system of physiological organ systems that interact to produce movement of the body and its parts" (Sahrmann 2017, Sahrmann et al. 2017). To achieve this goal, it is essential – again – to apply systemic reasoning in order to facilitate the integration of and interaction between the aforementioned bodily components (Voight & Hoogenboom 2017, Pilat 2017).

Farina et al. (2019) state that: "The integration is an essential feature of complex biomechanical systems, with coordination and covariation occurring among and within structural components at time scales that vary from microseconds to deep evolutionary time." Integration exists at multiple levels of organization of the living organism in such a way that levels can interact with adjacent levels to result in complex patterns of structural and functional phenotypes. These findings justify the need to focus on systemic reasoning in relation to body movement.

Metabolic aspects of the fascial system

As discussed above, research shows that the fascial system has an obvious impact on body movement. This also involves the management of substances that inhabit the circulatory system and are elemental to the metabolic behavior of the body. It is suggested that the condition of mechanical tissue (including the behavior of fascia) can modulate endocrine and immunological responses.

The biomechanical behavior of fatty tissue and its relation to fascia is an example of the systemic behavior of the fascial system (Abuhattum et al. 2015). The superficial fascia develops fibrous septa, which define the continuity, shape, length, diameter, quantity, disposition, and dynamics of the adipose lobes.

The increased rigidity of the extracellular matrix generates a kind of physical barrier that prevents the expansion of adipocytes. Consequently, lipids ingested in the diet cannot be absorbed and deposited in fatty tissue and instead circulate in the blood (hyperlipidemia) and are deposited in other tissues (Hara et al. 2011).

It should be noted that the constraints on the adipocyte's ability to expand (therefore limiting its accumulation of lipids), as a result of the rigidity of its environment (fascial compartments), "increases collagen deposition and consequently the risk for many clinical conditions, including diabetes, hypertension, coronary atherosclerotic heart disease, and some forms of cancer" (Hausman et al. 2001).

Fascia and therapeutic movement

Fascia as a system

A system can be defined as a group of interrelated elements, consisting of both structural aspects (elements, ranges, communication networks, and information) and functional aspects (the ability of the system to perform the task for which it was intended). In order to function properly a system requires the interdependency of all of its components through the nonlinearity of its interrelations (von Bertalanffy 1968). Each system is made up of subsystems and at the same time it is embedded within a suprasystem. For the system to function properly coordinated reciprocal action between the three levels is essential (see Chapter 2).

In anatomical research, in the topographical approach applied to embalmed cadavers, the concept of *fascia* relates mainly to some anatomical structures, for example, the tensor fasciae latae, palmar fascia, plantar fascia, thoracolumbar fascia, etc. This nomenclature (and its analysis) suggests a series of unrelated elements instead of a unique and continuous configuration that links the body structure (Pilat et al. 2016). Moreover, such an approach makes it difficult to analyze the morphology and function of the dissected elements when integrated into a higher level of organization (Huijing 2009).

Anatomical studies of unembalmed cadavers (fresh cadavers) have allowed a different vision and a more thorough analysis of anatomical connections. While preserving the natural appearance of the latter ("inside the body"), these studies have also permitted the linking of clinical findings (Thiel 2000, van der Wal 2009), thus creating a new vision of the fascia different to the traditional "fibrous sheet" that "hides" the muscle (Pilat et al. 2016).

It has been proposed that fascia be defined as a functional and structural (anatomical) continuity system, characterized by the integration and interconnection of its components (see the extensive discussion of this topic in Chapter 3). Thus, fascia can be considered to be a continuous and uninterrupted communicational network through which information related to movement flows between and within the muscular, vascular, visceral, and neural structures. This system brings together different types of cells with diverse activities (in a similar manner to, for example, the cardiovascular or nervous systems) and is associated with other body systems through an uninterrupted and innervated structure of functional stability formed by the tridimensional collagenous matrix.

Fascia as a continuous network: From micro- to macrostructure

DNA: The beginning of the journey

The discovery of the DNA double helix, the structural coherence of which conceals the morphogenetic and informational potential of life, opened the way to modern biology. It also marked the beginning of close collaboration between biology and physics. The relatively simple interactions between different nucleotide pairs reveal the almost infinite capacity to store information in the DNA heteropolymer. It is the intimate connection between interaction and information that constitutes the factory of living matter. Biological complexity is based on specific interactions between molecules. Those interactions create complex networks that are balanced by their interconnection. These networks control and regulate the exchange of signals that govern intracellular functions and multicellular behavior during the development of the organism (see Chapter 5).

Functions of the extracellular matrix

To comply with the role outlined above, an efficient communication system is essential. Information must flow efficiently between different layers of construction, from micro- to macrostructures, which are integrated into the systemic dynamics. The essential structure in this process is the extracellular matrix (ECM) and its protein behavior.

The mechanical and biochemical behavior of the ECM depends on the balance of its constituent components (water, proteins, and polysaccharides) which fulfills the functional requirements of the tissues. Mechanosensitive cells immersed in the ECM (e.g., fibroblasts and their phenotypes) secrete collagen and elastin proteins. These cells form a continuous communication network and through their membranous proteins (integrins) control the intrinsic tension of the matrix. By activating the actin filaments within its cytoskeleton, some of the fibroblast phenotypes (e.g., myofibroblasts) can contract, especially in emergent and/or pathological conditions. Alterations in the mechanical properties of the matrix are interpreted and may affect the motility, proliferation, differentiation, and apoptosis of cells. Within the ECM, the structure and function complement each other in the search for its optimal behavior (McKee et al. 2019). The collagenous network of the ECM is linked to the dynamics of the fibroblasts (that are anchored in the network) and ensures the plasticity (adaptability) of the system. This intercellular communication system is essential to maintain optimal conditions in the body.

Using an unconventional approach, some authors have studied the topic of the interconnection of biological networks. Mae-Wan Ho (1993) and Hameroff and Penrose (2014) have proposed a reading of the living organism as a closely related set, by virtue of a quantum coherence that governs the hierarchy, relationships, and intercommunication of all components. In this set each part communicates in a nonlocal (instantaneous) way with the whole, guaranteeing a fluid harmony of development (due to the communicational interpenetration of many levels of structure), being much more than the Cartesian "vital principle." It is tempting to use nonlinear principles to explain (justify) how systems work – and hence how the fascial network works. However, we must be cautious, since this way of understanding the universe is "novel" and there is still a lot of room for error in its interpretation.

Mechanical properties of the fascial network (see Chapter 7)

The universal model of muscular contraction based on the gliding of filaments of actin and myosin, described over 50 years ago by Huxley & Simmons (1971), has supported the Newtonian analysis of body movement characterized by the action of levers. In this model myofibrils, arranged in series, act as independent motors that approximate myotendinous or myoaponeurotic junctions therefore triggering movement. However, the discovery of the ultrastructure and mechanobiology of the sarcomeral unit has given shape to a new model of myofibrils embedded inside the extracellular matrix, which at the same time participates (via its own dynamics) in the contractile phenomenon (Yucesoy 2010, Maas & Sandercock 2010). The shortening of the myofibril exerts a force from within the myofascial structure (endomysium, perimysium, and epimysium) and resembles more the principles of the tensegrity model (see Chapter 6) (Gillies & Lieber 2011) than a simple linear analysis (movements arranged in series). Most contractile forces are directed to myotendinous units, but approximately 30 percent of them use "epimysial" (lateral) transmission paths which are parallel to the tendinous paths (Huijing 2007). The muscle does not act as an isolated and independent entity. Instead, collagenous linkages between epimysia of adjacent muscles, such as the neurovascular tracts, provide indirect intermuscular connections. Usually, these lateral connections and the consequences of their presence are not taken into consideration in most researchers' designs related to body movement. However, in recent years, several studies have indicated mechanical interactions between adjacent muscles, including myofascial force transmission, in research models and clinical trials. There are three main areas of research:

- Alterations in movement patterns due to the existence of pathological conditions, i.e., spasticity or the presence of post-traumatic and postsurgical scars (Smeulders & Kreulen 2007, de Bruin et al. 2011, Abdollahi et al. 2014).
- Analysis of muscular dynamics in healthy subjects, focused on muscular synergisms (Yu et al. 2007, Yaman et al. 2013, Carvalhais et al. 2013).

- Analysis of the muscular microstructure (fibers) related to the participation of the intrinsic connective tissue (fascial system) (Huijing & Jaspers 2005, Huijing 2007, Purslow 2010, Zhang 2012).

It should be pointed out that the concept of myofascial force transmission implies any kind of transmission from the full surface of a myofibril, excluding direct participation in the myotendinous or myoaponeurotic unit where force is transmitted in the aponeurosis or tendon and myomyonal continuum – in other words, through the connections between myofibrils arranged in series (Huijing 2002).

The most significant findings obtained from dissections of unembalmed cadavers are described below (Pilat et al. 2016):

- There is continuity of the fascial structure both at extrinsic and intrinsic levels of the construction of the body.
- There are parallel "epimysial" paths for the transmission of contractile force. An example of this phenomenon is the aponeurotic expansion (lacertus fibrosus) of the biceps brachii muscle of the forearm or the continuity between the pectoral and brachial fasciae.
- The epimysium and perimysium may act as pathways for the transmission of muscular force.
- Numerous fibers in long muscles terminate their path without reaching the extremities of the tendon or aponeurosis.
- Muscles are laterally connected to adjacent structures such as blood vessels or peripheral nerves.
- The neurovascular tracts wrap around and reinforce the blood and lymph vessels and the peripheral nerves; they are strong candidates for being an important route in force transmission (Huijing 2009).
- Intramuscular and perimuscular connective tissue acts as a protective net in the case of trauma related to the tendon or muscular belly (Bernabei et al. 2016).

Fascia as a mechanosensitive structure

A strong connection between fascia and the autonomic nervous system has been identified (Haouzi et al. 1999). This involves a network of mechanoreceptors known as interstitial mechanoreceptors (group III and group IV free nerve endings), each of which has two subgroups with low and high levels of mechanosensitivity related to cell architecture, as described below:

- Group III muscle afferents are found, for example, in perimuscular fascia and the adventitia of muscle blood vessels and respond to deforming stimuli such as pressure and stretch (Lin et al. 2009). Neural action potential firing through nerve terminals is linked to specific mechanical deformation and extracellular matrix interaction. Stimulation of group III and IV muscle afferents has reflex effects on both the somatic and autonomic nervous systems, including an inhibitory effect on alpha motoneurons, an excitatory effect on gamma motoneurons, and an excitatory effect on the sympathetic nervous system (Kaufman et al. 2002).
- Through the mechanoreceptors the fascial system is in a continuous process of internal communication (Vaticon 2009):
    - somatosomatic
    - somatovisceral
    - viscerovisceral
    - viscerosomatic
    - psychovisceral
    - visceropsychic.

Therapeutic touch

"Several studies demonstrated that the stimulation of C-tactile afferent fibers, essential neuroanatomical elements of affective touch, activates specific brain areas and the activation pattern is influenced by [the] subject's attention" (Cerritelli et al. 2017). Therefore, touch cannot be understood solely in terms of proprioceptors, rather it is a very powerful form of communication that requires the participation of both the practitioner and the patient. It is the only reciprocal, bidirectional sense: When you touch you are touched. The therapeutic impulse received by the patient will be received as feedback by the practitioner consciously or unconsciously. "Touch has been always regarded as a powerful communication channel playing a key role in governing our emotional wellbeing and possibly perception of self" (Cerritelli et al. 2017). It is a genuine communication in which the practitioner's intention (optimal state of mind) has a clear relevance. In order to achieve an evaluative and therapeutic touch it is not enough to be familiar with anatomy and physiology; the practitioner must master the "intention" of touching. "Intention" means focusing one's attention on listening to the condition and needs of the tissue. The practitioner has to facilitate the changes resulting from the therapy to attain healing at a more holistic level. This is explained by the following question: What do we touch – the body or the individual person? Touch is understood, humanistically and interpersonally, as being able to calm and heal (Carter & Drew 2012).

What is Myofascial Induction Therapy (MIT) and why this approach?

MIT is a therapeutic concept in manual therapy that is aimed at the functional restoration of the altered fascial system. MIT is a process of evaluation and treatment in which the practitioner transfers a slight force (traction and/or compression) to the target tissue (Pilat 2012), facilitating the recovery of the dynamics of the fascial system. The application of the procedures can be defined as a combination of sustained pressure, specific positioning, and very smooth gliding. The term "induction" is related to the facilitation of movement rather than a passive stretching of the fascial system. The result is a reciprocal reaction from the body involving a biochemical, metabolic signaling reaction and, ultimately, physiological responses. This process aims to reshape the quality of the extracellular matrix of the connective tissue to facilitate and optimize the transfer of information to and within the fascial system (see Chapter 5) (Chiquet et al. 2003, Wheeler 2004, Pilat 2017). It is a process controlled by the patient's central nervous system in which the practitioner acts as a facilitator.

In general, MIT is recommended mainly for patients with orthopedic, neuro-orthopedic, post-traumatic, and degenerative dysfunctions related to the myofascial system. The remodeling of restrictions and recovery of tensional equilibrium allows the fascial dynamics (communication) to be re-established. The therapeutic action concentrates on the provision of resources for the adjustment of homeostasis. The final objective is not the establishment of stable hierarchies but rather the facilitation of an optimal adaptation to the demands of the environment (Pilat 2018) in order to change the painful symptoms and recover the altered function. The main objective of treatment through the MIT approach is to allow the patient a prompt and, as far as possible, optimum restoration of the body's homeostasis and its resilient capacity (see Chapter 13). The result (change in body image, improvements in functional abilities) should be evaluated and appreciated not only by the practitioner but also by the patient. MIT is intended to be a patient-centered focused treatment (Pilat 2015).

MIT and other myofascial approaches

It is not an easy task to locate MIT in a historical context. Adstrum and Nicholson (2019), in their paper "A history of fascia," provide a comprehensive analysis of the development of knowledge related to fascia through the centuries and its clinical context. Listed below are the therapeutic approaches that are most relevant to MIT and their proponents:

- Andrew Taylor Still (1899) – holistic treatment of soft tissue, based on manipulation and stretching
- Ida Rolf (1990) – Rolfing®
- Robert Ward (1997) – was the first person to coin the term "Myofascial Release" in the 1960s
- John F. Barnes (1970) – John F. Barnes' Myofascial Release Approach®
- Carol Manheim (2001) – Myofascial Release
- Pilat (2003) – Inducción Miofascial
- Cantu, Grodin and Stanborough (2012) – Myofascial Manipulation
- Thomas Myers (2009) – Anatomy Trains®
- Luigi Stecco (Stecco & Stecco 2019) – Fascial Manipulation®.

From this brief summary we can conclude that there is a wide range of approaches to clinical work with fascial tissue. And what about MIT? Its roots can be found in the concepts of different manual therapy approaches. Its practical applications share many elements of the other models of fascial work mentioned above, such as Myofascial Release (e.g., Ward 1997, Manheim 2001, Barnes 1970, Cantu et al. 2012).

Then what is the difference between MIT and other myofascial approaches? The following text published by Leon Chaitow in an Editorial in the *Journal of Bodywork and Movement Therapies* (2017) explains:

> *Recent reviews of current research into the use of Myofascial Release (MFR) (Leahy and Mock 1992, Manheim 2008) – also described in many studies as Myofascial Induction Therapy (MIT) (Pilat, 2014, Pilat, 2017, Fernández-Pérez et al. 2008) – strongly suggest that this gentle soft tissue manipulation approach is clinically effective – whether self-applied, or provided as part of a therapeutic interventions* [sic]. *Since the two approaches (see below) are virtually identical, the question arises as to which name is more appropriate? As Pilat (2014) has explained, in relation to his preferred term, Myofascial Induction, this has implications beyond a local tissue response (i.e. "release"):*
>
> > *The term "induction" relates to the correction of movement facilitation, and not a passive stretching of the fascial system. This is primarily an educational process, in the search for restored optimal homeostatic levels, recovering range of motion, appropriate tension, strength, and coordination. The final aim of the therapeutic process is not establishment of stable hierarchies, but facilitation of optimal and continuous adaptation to environmental demands, with maximum efficiency.*
>
> *Pilat (2018) explains the subtle difference between induction, and release, as follows:*
>
> > *Clinicians familiar with myofascial release (MFR) note the many similarities between it and MIT. With different nuances, they are based on the same concept of clinical reasoning and complement each other. MIT is characterized as manual tissue remodeling, always avoiding arbitrary stimulus application (altered force intensity and direction), focusing on the intrinsic natural tissue response ...*
>
> *MFR (MIT) appears to have increasing degrees of evidence, as safe and effective manual therapy approaches, in management of musculoskeletal pain and dysfunction.*
>
> *CONCLUSION: Returning to the question in the title of this editorial as to whether the method should be called Myofascial Release or Myofascial Induction? – the latter would seem to be more appropriate.*

Conclusion

The abundant scientific information that has been made available in recent years, as well as the needs and demands of patients, reinforces the requirement for a contemporary model of health care. The MIT approach searches for a systemic perspective and allows treatment to be focused on the patient (person). This global perspective facilitates the improvement of the patient's body image.

In the pages of this book the reader will find details on the topics outlined in this chapter accompanied by an extensive array of illustrations, among which are photographs of fascia obtained from dissections of unembalmed cadavers. This experience of anatomical and photographic work enriched the author's knowledge of fascial tissue and allowed him to understand its relevance to body movement. The reader is invited to join this fascial adventure.

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Definition and characteristics of fascia and the fascial system 2

KEY POINTS

- The anatomical evidence relating to fascial nomenclature
- The local (topographic) approach and the systemic approach
- Definition and characteristics of the fascial system
- Discussion of the attributes of the fascial system
- Differentiation and comparison of closed and open systems
- Definition of a complex biological system
- The systemic approach to fascial structures
- Fascia as a complex biological system

Definition of fascia

What is fascia?

Everything that exists is within.

Answering this question correctly is quite a challenge.

The term "fascia" comes from the Latin term for "a band, bandage, swathe, ribbon" (Merriam-Webster Dictionary 2017). The Federative Committee on Anatomical Terminology (later renamed the Federative International Committee on Anatomical Terminology) (2008) defines it as follows: "*fascia* consists of sheaths, sheets or other dissectible connective tissue aggregations … It includes not only the sheaths of muscles but also the investments of viscera and dissectible structures related to them."

In light of this a broad definition of fascia is needed in order to fully explain the body's biomechanics and pathomechanics. Providing this definition is not an easy task, since even among researchers there is a wide range of views on what fascia is and what nomenclature we should use to classify it (Langevin & Huijing 2009, Schleip et al. 2012, Kumka & Bonar 2012, Swanson 2013).

In the opinion of this author, fascia can be described as the unifying structure of body dynamics, which is a continuum of fibers embedded in the fundamental (ground) substance, connecting the components of the body without interruption (Pilat 2003).

Recently, Adstrum et al. (2017) published a proposal from the Fascia Nomenclature Committee in the form of a request to the Federative International Committee on Anatomical Terminology. Since fascia is mostly perceived in two ways, and following the earlier proposal from Stecco & Schleip (2016), the authors suggest two definitions for fascia based on its morphology and functionality.

Morphological definition:

A fascia is a sheath, a sheet or any other dissectible aggregation of connective tissue that forms beneath the skin to attach, enclose and separate muscles and other internal organs.

Functional definition:

The fascial system consists of the three-dimensional continuum of soft, collagen-containing, loose and dense fibrous connective tissues that permeate the body. It incorporates elements such as adipose tissue, adventitiae and neurovascular sheaths, aponeuroses, deep and superficial fasciae, epineurium, joint capsules, ligaments, membranes, meninges, myofascial expansions, periostea, retinacula, *septa, tendons, visceral fasciae, and all the intramuscular and intermuscular connective tissues including endo-/peri-/epimysium. The fascial system interpenetrates and surrounds all organs, muscles, bones and nerve fibers, endowing the body with a functional structure, and providing an environment that enables all body systems to operate in an integrated manner.*

In order to understand the concept of fascia as a system, the terms related to it must be defined. It is recommended that fascia be analyzed as a complex biological system composed of a group of elements (a system), influenced by extrinsic factors (a suprasystem), and in relation to internal components (subsystems).

Definition and characteristics of a system

A system can be defined as a group of interrelated elements, consisting of both structural aspects (elements, ranges, communication networks, and information) and functional aspects. In order to function properly a system requires the interdependency of all of these elements.

The systemic approach began to dominate in the second half of the twentieth century, initially through the work of biologist Ludwig von Bertalanffy (1901–1972). Since Descartes a scientific method has evolved based on two related hypotheses:

- that a system can be divided up into its components in such a way that each component can be analyzed as a separate entity, and
- that components can be added to the system in a linear fashion to understand the whole system.

GST establishes that the properties of a system cannot be described in terms of its separate elements. A system can only be understood when it is studied as a whole, involving all of the interdependencies of its parts. The information content of a “piece of information” is proportional to the amount of information that can be inferred from the information (Kuhn 1974).

In his General System Theory (GST) von Bertalanffy (1968) affirmed that both hypotheses are false and that, on the contrary, a system is characterized by the interrelations (interactions) of its components and by the nonlinearity of these interrelations. We are embedded in a system, and at the same time we represent a system made up of many systems. Therefore, a systemic approach to fascial tissue, analyzing it as a complex biological system, is recommended.

Definition of terms

Systemic analysis requires the definition of the following terms: element, pattern, object, event, system, acting system, component, interaction, mutual interaction, pattern system, and interdependency. See Table 2.1 for the full list of definitions.

Table 2.1 Definition of terms (according to Kuhn, 1974)

Term	Definition
Element	Any identifiable entity
Pattern	Any relationship of two or more elements
Object	A pattern as it exists at a given moment in time
Event	A change in a pattern over time
System	Any pattern whose elements are related in a sufficiently regular way to justify attention
Acting system	A pattern where two or more elements interact
Component	Any interacting element in an acting system
Interaction	A situation where a change in one component induces a change in another component
Mutual interaction	A situation where a change in one component induces a change in another component, which then induces a change in the original component
Pattern system	A pattern where two or more elements are interdependent
Interdependent	A situation where a change in an element induces a change in another element

Conceptual basis of a system

The conceptual basis of a system is described below.

- A system is a group of interacting elements organized to achieve a specific objective or specific objectives.
- The objectives are the system’s raison d’être that integrate all of its parts.

- Variation in or alteration of one of the system's parts affects the other parts and, for that matter, the entire group.
- The level of complexity of the system depends on the quantity of elements included in it, as well as the quantity and the variety of relationships that exist among them.
- The specialized functions (parameters) of the system are:
    - ► entries or input (coming into the system: energy, material resources, information) that are:
        - ▷ serial (emanating from the previous system directly associated with the system in question)
        - ▷ random (potential input that may randomly activate)
        - ▷ feedback-based (feeding the system with products created through its own output);
    - ► processes or transformations (conversion, transformation, flow);
    - ► output or results (obtained by processing the input; this is the result of the operation of the system):
        - ▷ the output of one system can be converted into input for another, which will process it by converting it to other output, repeating this cycle indefinitely
        - ▷ when different combinations of input are present, or if they are combined in different sequential orders, different output situations may result;
    - ► boundaries of a system – defined as the group of its interacting components.

Levels of complexity of a system (Fig. 2.1)

Analysis of a complex system involves all the component parts (system), the influence of extrinsic factors (suprasystem), and the interaction of the internal components (subsystem). The parts are defined as follows:

- *System*. A group of elements that interact in order to achieve a common objective.
- *Subsystem. A* group of parts and interrelations that are found, structurally and functionally, within a major system.
- *Suprasystem*. The group of processes that provides the system with resources from outside its environment.

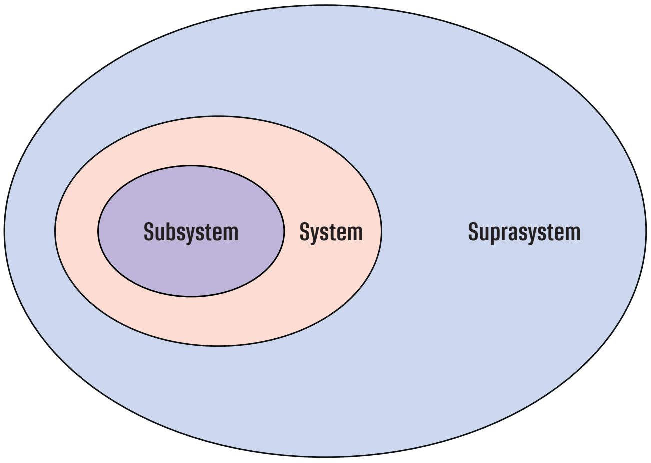


Figure 2.1

Levels of system complexity

- All of these (system, subsystem, and suprasystem) are *systems*.

Classification of systems

A system can be classified according to the following criteria: type, make-up, response, internal mobility, predetermination of its operation, and level of dependency. For details on classifying a system according to its characteristics see **Table 2.2**.

The main criteria to consider when analyzing the human body as a complex system are the types of systems. Systems can be divided into closed and open systems:

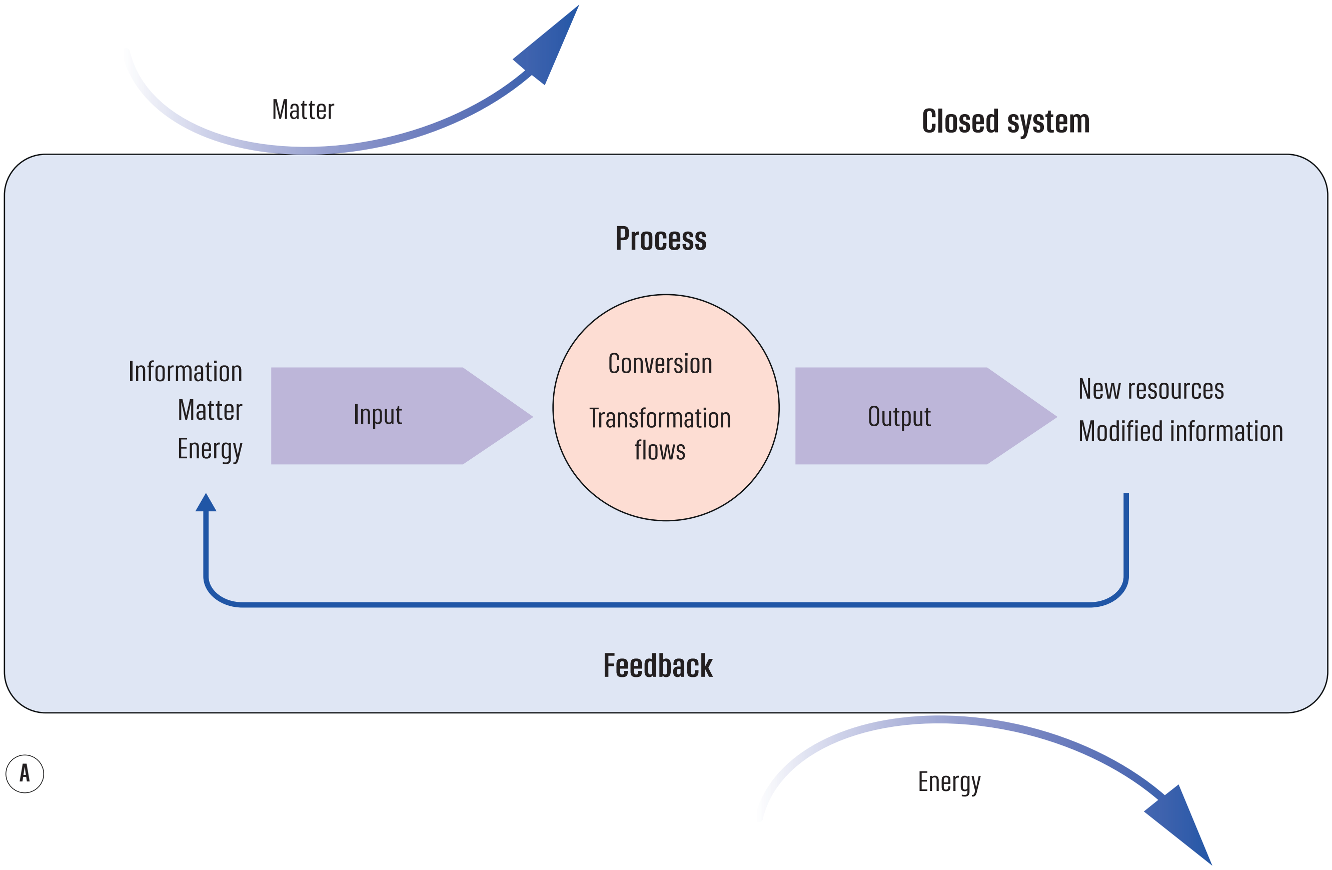
- *Closed system* **(Fig. 2.2)**. A system is considered to be closed when its interactions occur only with

Table 2.2 Classification of systems

Classification parameters	Characteristics
Constitution	Physical or abstract
Nature	Closed or open
Response	Passive, active, or reactive
Internal mobility	Static, dynamic, or homeostatic
Predetermination of its behavior	Probabilistic or deterministic
Grade of dependency	Dependent, independent, or interdependent

its components and not with its environment; no outside element enters or exits the system. A closed system reaches its maximum state (equilibrium) once it is balanced with the external environment. Its systems can be fixed, rhythmic, or constant, as would be the case with closed electrical circuits.

- *Open system* (Fig. 2.3). All living systems are characterized as open. An open system is one that receives



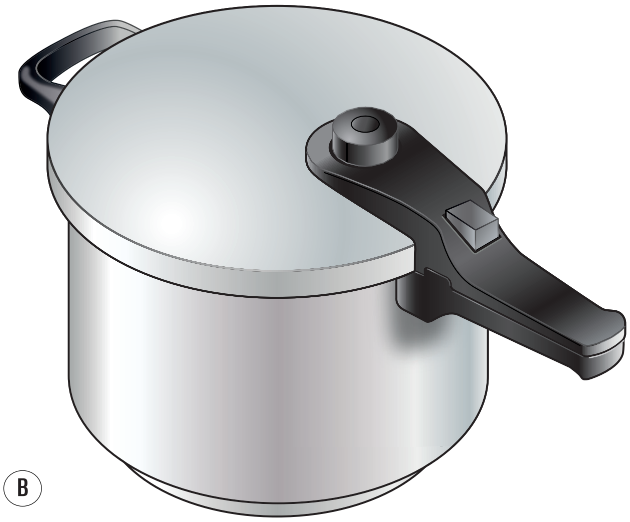


Figure 2.2

A The closed system model and its specialized functions (parameters). A system's *input* is defined as the movement of information or matter-energy from the environment into the system. *Output* is the movement of information or matter-energy from the system to the environment.
B A pressure cooker is an example of a closed system

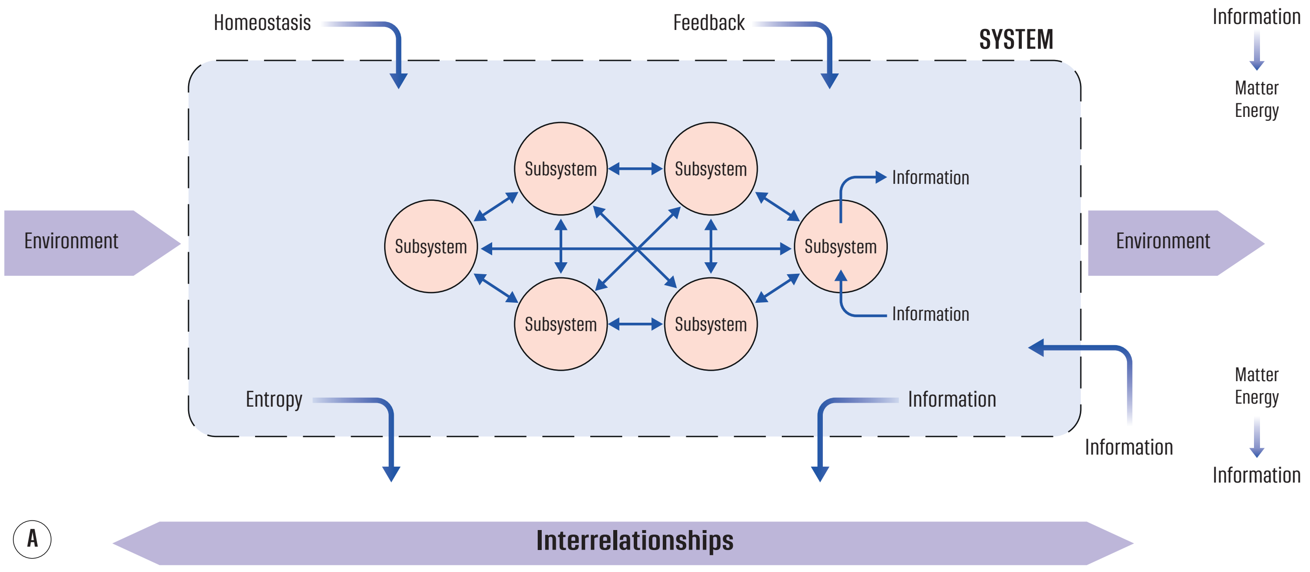


Figure 2.3

A The open system model and its specialized functions (parameters) showing the exchange of information between the subsystems, the system and its environment. **B** A cooking pot is an example of an open system

input from the environment and/or outputs into the environment. This includes systems that bring in and process elements (energy, material, information) from their surroundings. An open system continually interacts with and feeds itself from its environment in a dual manner, meaning that it influences and is influenced. This ensures its continuity (viability, negative entropy, teleology, morphogenesis, equifinality). If these actions cease to occur, the sustainability of the system is jeopardized. In order to avoid confusion, two basic terms should be defined: entropy and negative entropy. System entropy is how the system wears either over time or through its operation. Highly entropic systems tend to wear out due to their own systemic processes. These systems must have rigorous control systems and mechanisms for review and reworking and must continually adapt to avoid wearing out over time. In a closed system, entropy is constantly increasing and is positive. Conversely, in open biological systems, entropy can be reduced or transformed into negative entropy, meaning that a more complete and organized condition can be created with a greater capacity for transforming resources. This is possible because in open systems the resources used to reduce entropy are taken from the external environment. In this way, living systems maintain a stabilized state and can avoid increasing entropy, improving their order and organization. Thus, open systems can reach higher levels of organization (negative entropy), while the organization of closed systems can only be sustained or deteriorate. In an open system, output returns to the system as resources or information, which allows the system to self-monitor and correct based on the feedback. For a comparison of the advantages of open systems over closed systems see **Table 2.3**.

Table 2.3 Comparison of open and closed systems

Open system	Closed system
Constantly adjusts its stability Is in a constant process of adaptation to the requirements and flow of energy	Remains in equilibrium Absence of entropy
Interacts continually with the environment in a dual manner	Does not interact
Influences and is influenced	
Can grow, change, and adapt to the environment, and even reproduce under certain environmental conditions	Does not react
Competes with other systems	Does not compete
Collects information on the environment that surrounds it to be able to satisfy its demands	Does not act Maintains only its own balance
Absorbs supplies (input) and converts them into products, particularly if the environment demands rapid or extensive changes	Does not react Cannot survive due to lack of adaptation

Open systems gravitate toward higher levels of organization (negative entropy), while closed systems can only sustain or decrease their levels of organization.

Table 2.4 The main characteristics and activities of a system (according to von Bertalanffy, 1968)

Characteristic	Activity
Totality	System modifications are independent of the initial conditions
Entropy	Systems tend to retain their identity
Synergy	The whole is greater than the sum of its parts
	Any change to any part affects all others and sometimes the entire system
Purpose	Systems share common goals
Equifinality	System modifications are independent of the initial conditions
Equipotentiality	Allows the remaining parts to assume the functions of extinct parts
Feedback	Constant exchange of information
Homeostasis	Tendency to remain stable
Morphogenesis	Tendency to change
Adaptability	Have a fluid exchange with the environment in which it develops
	Learn and modify a process
	Respond to internal and external changes over time
Stability	Maintenance of balance through the continuous flow of energy and information
	A system is said to be stable when it can be maintained in optimal condition through the continuous flow of materials, energy, and information
	The stability of a system occurs when it can maintain its operation and work effectively (maintainability)
Maintenance	Property of being able to perform constantly
	A system uses a mechanism of maintenance to ensure that the various subsystems are balanced and the whole system is in equilibrium with its environment

Primary characteristics of a system

The study of systems can follow two general approaches. A cross-sectional approach addresses the interactions among various systems, while a developmental approach addresses the changes in a system over time. When all of the forces of a system are balanced to the point that changes no longer occur, the system is considered to be stable or in a *steady state*. *Dynamic equilibrium* is considered to exist when the system components are in a state of change, but at least one system variable is within a specified range. *Homeostasis* is the condition of dynamic equilibrium between at least two system variables. Kuhn (1974) asserts that all systems gravitate toward equilibrium, and that a prerequisite for the longevity of a system is its ability to maintain a stationary state or a steadily oscillating state. The characteristics of systems are described in **Table 2.4**.

Hypothesis for considering the human body as a system

- Each system carries out tasks with the purpose of fulfilling set objectives in accordance with its dependence on the superior system to which it belongs. For example, the cellular dynamic determines how a tissue functions.
- Living organisms are open systems (all of the system components, at each level of the organism's structure, can receive the benefits provided by the surroundings and return transformed resources to the surroundings).
- A system's functions depend on the interrelation of its parts. Feedback is one of the primary aspects of the development of the system (for example, variations in respiratory rate depend on the level of oxygenation of the blood).

Fascia as a system

> *Characteristics of organization, whether of a living organism or a society, are notions like those of wholeness, growth, differentiation, hierarchical order, dominance, control, and competition.*
>
> von Bertalanffy (1968)

It has been proposed that fascia could be described as a functional and structural (anatomical) continuity system characterized by the integration and interconnection of its components. To that end, fascia can be considered to be a continuous and uninterrupted communication network through which information travels that is related to movement generated between and within the muscles and vascular, visceral, and neural structures. This *system* brings together different types of cells with diverse activities (for example, in a similar manner to the cardiovascular or nervous systems), and is associated with other body systems through an uninterrupted and innervated structure of functional stability formed by the tridimensional collagenous matrix **(Fig. 2.4)**.

> An organism is more than the sum of its parts by virtue of the new properties that emerge from the relationships between its parts.

The fascial system represents a complex communication structure that provides mechanoreceptive information (Kapandji 2012). This process occurs not only as a result of its topographical distribution, but also because of the *manner* in which it interrelates with the other organs, specifically the muscles (Lancerotto et al. 2011, Pilat 2010). Its fibrous construction allows it to adapt to the body's tension requirements, both intrinsic and extrinsic (Langevin et al. 2011, Swanson 2013). The tension paths created from appropriate (optimal) biomechanical frameworks can in this way redirect the body's dynamics. The density, distribution, and organoleptic characteristics of the system differ depending on the path (Benjamin 1995), but continuity is essential because it drives the fascia to function as a single, synergistic entity that absorbs local stimuli and redistributes them to the entire system. The inherent synergy of the fascial system helps the human body to be relatively independent of gravitational pull and also provides a great capacity to adapt in accordance with external and internal requirements or in relation to the energy and nutrients available in the environment (Nakajima et al. 2004). Aside from its structural role, fascia distributes the stimuli that the body receives. Its sensory network registers thermal, chemical, pressure, and movement impulses. In addition, it analyzes, categorizes and transmits them to the central nervous system (Craig 2003). In turn, the central nervous system redirects the impulses and sends instructions to the organs. In conclusion, fascia should not be described just as a passive support structure but rather as a "dynamic and adaptable system" (Swanson 2013) with a great potential for action.

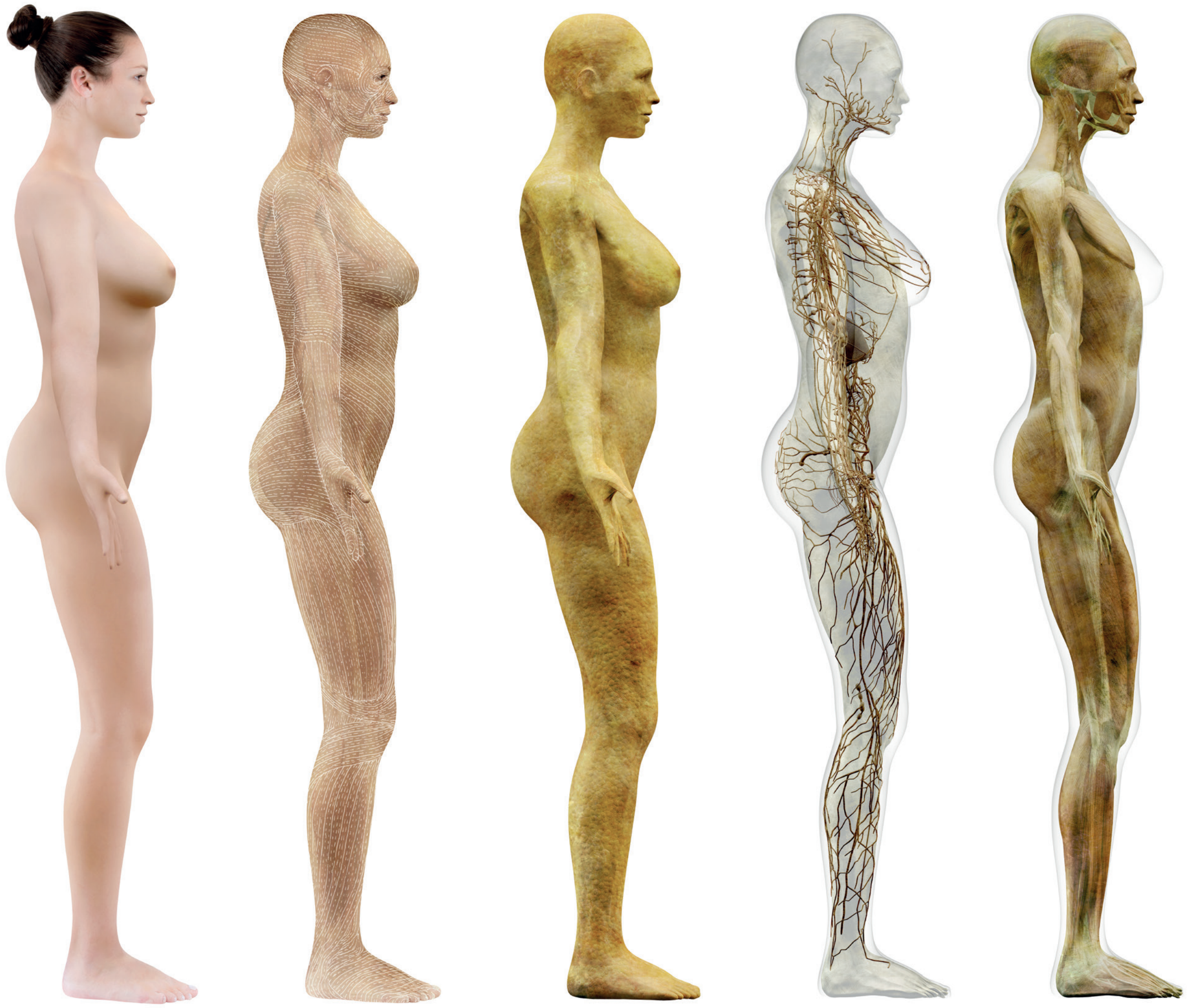


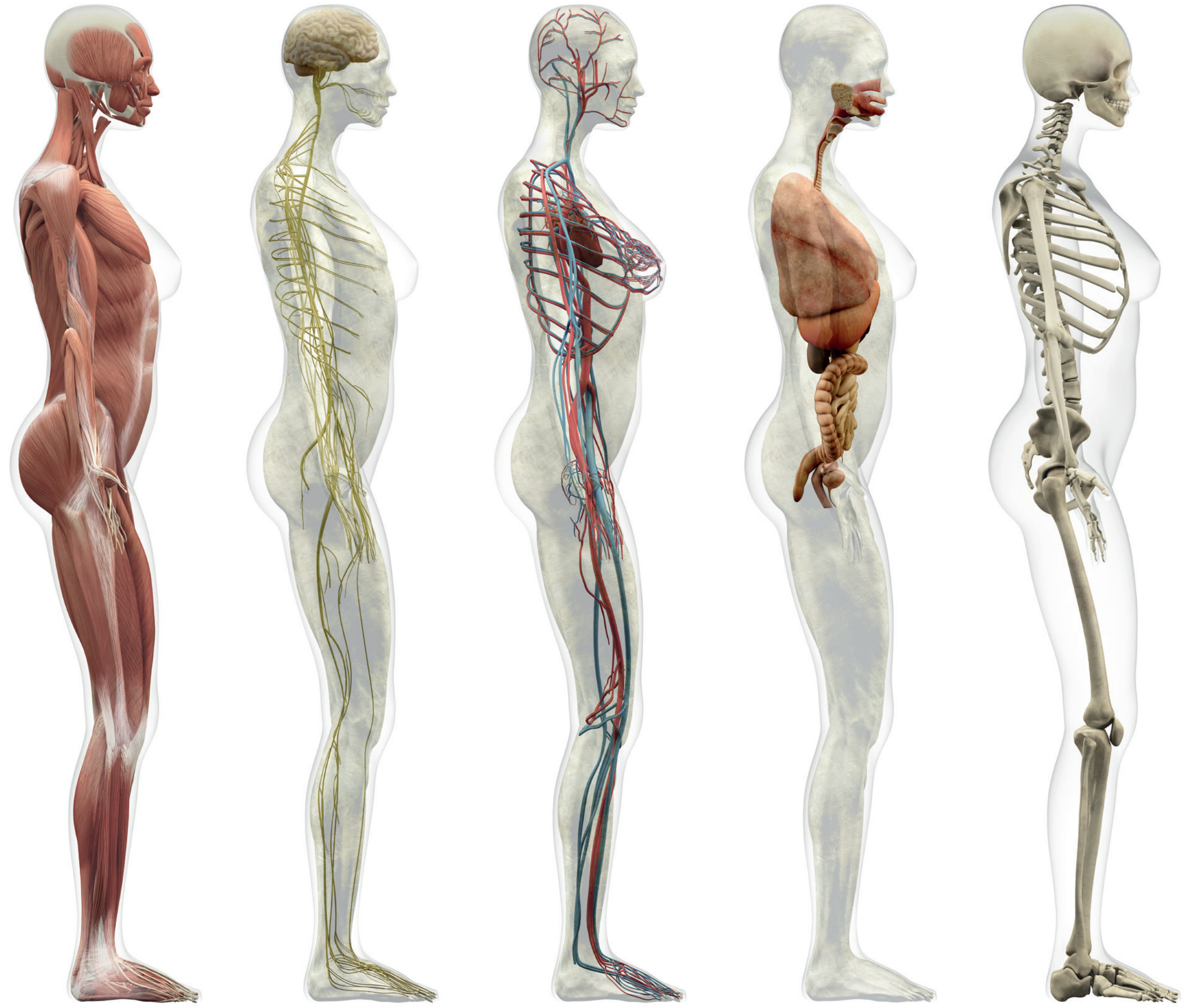
Figure 2.4

Fascial continuity throughout the body. All body systems are surrounded and interpenetrated by fascia and communicate with each other through the continuous fascial network

Fascia as a complex biological system

A biological (or organic) system is a complex network of biologically relevant entities that work together to carry out physiological functions in a living being.

- The classic orthodox model used in biology has frequently led to reductionist (mechanism) approaches through which biological components can be analyzed individually and which are governed by linear aggregation laws.
- Biological entities are complex systems (multicellular organisms) in which the total is not equal to the sum of its parts, and therefore they are not able to be separated and broken down.
- In biological entities, the cause–effect relationship is linked to multiple variables, meaning an effect may not always have the same cause and the same cause does not always have to have the same effect.
- Biological systems (and specifically the fascial system) are self-regulating and use decentralized control



Muscular system (myofascia)

Nervous (neuroconnective) system

Circulatory system

Digestive system (viscerofascia)

Skeletal system

Figure 2.4

(continued)

mechanisms in which various subunits (for example, molecules of a cell, cells of an organism, or organisms of a group) adapt their activities themselves, based on limited local information (intercellular communication).

- As an evolutionary feature, the human organism, like other complex biological systems, has developed a centralized control (central nervous system, CNS). Clearly self-regulation is not always the best method to coordinate subunits in a system.
- The absence of a central authority leaves a system (molecules, cells, or organisms) open to opposing actions among its subunits, because they are responding to different local conditions rather than the shared situation of the entire system (for example, cancer).
- The ability of the subunits to communicate is essential for the evolution of the centralized control, since without such abilities this control paradigm cannot be implemented.

- This task is only possible through the appropriate flow of information, with the purpose of obtaining optimal system performance, in other words, functional (dynamic) stability (Taleb 2013).

Conclusion

We are far from a consensus on the nomenclature relating to fascia. The difficulty is that international, interdisciplinary, and transdisciplinary consensus is required. It has been recommended that the terms fascia and fascial system be widely adopted and used in communications in the bioscientific areas.

Subsequent chapters will focus on fascia as a *system* and attempt to analyze it using anatomical, histological, embryological, architectural, and neurological approaches.

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