Fascia and Its Implication in Manual Therapy

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1. Why Fascia?
    a. Connective tissue continuum throughout the body forming a body-wide cellular signaling system[1]
    b. Forms a "trideminsional metabolic and mechanical matrix"[2]
    c. Active structures that play key roles in the function of many components of the body, especially in the musculoskeletal system[3]
    d. High clinical relevance
2. Anatomy and Functions of Fascia[4]
        i. Historically considered as rather inconsequential, a "packaging material"[5]
    b. Expanded Definition of Fascia
        i. Includes all fibrous connective tissues
            1. Fascia of skin (superficial fascia); deep fascia; special arrangements in limbs; tendons; ligaments; investing tissue of muscle and connective tissue within muscle; bone; fascia of major organs and great body cavities; fascia surrounding blood vessels, nerves, viscera, and meninges
        ii. Creates "structural continuity that gives form and function to every tissue and organ"[2]
        iii. The "trideminsional metabolic and mechanical matrix"[2]
        iv. Focus of Presentation
            1. Fascia of skin (superficial fascia), deep fascia, investing tissue of muscle and muscle groups, connective tissue components of muscle
    c. General Anatomy of Fascia
        i. Superficial and Deep Fascia
            1. Superficial Fascia
                a. Loose connective tissue
                b. Deep to dermis
                c. Binds dermis to underlying structures (e.g., deep fascia)
                d. Single continuous layer
                e. Highly variable amount of adipose tissue
                f. Allows gliding between dermis and deeper structures
                    i. Multiple sheets of collagen
                        1. Allows for the gliding
                        2. Elastic fibers (elastin) allows skin to return to original position
                g. Transmits tortuous vessels to & from dermis
            2. Deep Fascia
                a. Dense regular connective tissue

b. Between superficial fascia and underlying tissue (e.g., muscle)
    i. Multiple sheets of collagen
        1. Collagen fibers parallel within sheet
        2. Different orientation of collagen in each adjacent layer (sheet)
        3. Allows tensile strength in many different directions
c. Continuous throughout body, but named regionally (e.g., thoracolumbar fascia)
d. Forms intermuscular septa

ii. Muscle Fascia
1. Epimysium, perimysium, endomysium
    a. Epimysium
        i. Continuous with epitendineum
        ii. Acts as a “surface tendon”
        iii. Transmits forces along muscle length
        iv. Sometimes continuous with deep fascia, sometimes separate (e.g., thoracolumbar fascia)
    b. Perimysium
        i. Surrounds muscle fascicles
        ii. Blends with epimysium at muscle surface
        iii. Runs entire length of muscle
        iv. Continuous with endotendineum
        v. “Internal tendon” – transmits forces
    c. Endomysium
        i. Surrounds individual muscle cells
        ii. May also be involved in force transmission

iii. The Fibroblast
1. Predominant cell of fascia
2. Important in mechanotransduction (see below)

iv. Innervation of Fascia
1. Fascia has a rich nerve supply, in fact, the CNS receives the largest quantity of sensory nerves from myofascial tissues[6]
    a. Free nerve endings
        i. Nociception
        ii. Exercise-induced delayed onset muscle soreness[7]
        iii. Interstitial receptors
            1. Largest group
            2. Stimulation affects ANS[6]
                a. May alter local fluid dynamics, including plasma extravasation
                    i. Changes viscosity of extracellular matrix
                b. May increase vagal tone

i. Results in “hypothalamic tuning and “deep and healthy relaxation”[6,8]

b. Encapsulated nerve endings (e.g., Pacinian corpuscles, Ruffini endings)[6]

1. Proprioception

a. Muscle relaxation

2. Understanding innervation may lead to improved treatments

d. Functions of Fascia

i. Resists/restricts movement (does not stretch)

ii. Contains and separates muscle groups into compartments

1. Osteofascial compartments

2. Along with muscle fascia creates an “ectoskeleton”

a. Osteofascial compartment + Muscle Fascia = Ectoskeleton

i. Osteofascial compartments

1. Intermuscular septa

2. Bony attachments

ii. Muscle fascia

1. Epimysium, perimysium, and endomysium

b. Ectoskeleton + muscle = myofascia

i. Myofascia

1. Allows force transmission not only to tendons but also CT structures associated with muscles and groups of muscles

2. Individual muscles do not act alone and should not be considered separately[9]

3. Even agonists and antagonists may be coupled

4. Effects biomechanical interactions of musculoskeletal structures[10,11]

5. Coordination of Muscle Activity

a. Example – Thoracolumbar Fascia

i. Integrates muscles of upper and lower limbs, pelvis, and spine

ii. Coordinates pendulum-like movements of walking and swimming

iii. Link between transversus abdominis muscle and control of segmental motion

iv. Importance of “the core” to improve altered intersegmental motion (spinal instability) in LBP

b. Key text resource: Anatomy Trains (Myers, 2020, Fourth ed.)[12]

3. Helene Langevin and the Fascia Renaissance

a. Current Director of National Center for Complementary and Integrative Health

    b. Described fascia as connective tissue continuum throughout the body
    c. May form a body-wide cellular signaling system[1]
    d. Theory of Mechanotransduction
4. Mechanotransduction
    a. Convert physiologic mechanical stimuli into biochemical responses
    b. Three processes: mechanocoupling, cell-cell communication, effector cell response
    c. Mechanocoupling
        i. Physical load can trigger changes to cytoskeleton
        ii. Thought to be important in effects of manual & mechanotherapies
            1. E.g., massage, manipulation (including fascial manipulation), acupuncture, exercise, yoga
    d. Cell-cell communication
        i. Via gap junctions
        ii. Stimulus in one location to elicit changes in distant cells
    e. Effector cell response
        i. Mechanical loading can lead to changes in protein synthesis
        ii. Can lead to remodeling of extracellular matrix[13,14]
5. Clinical Relevance
    a. Enthesopathy-type injuries
        i. Where intermuscular septa attach to bone
    b. Overuse injuries, especially lower (pelvic) and upper (pectoral) extremities[15]
    c. Myofascial pain syndromes (MFP) – important
        i. Fascia can become rigid and fibrotic due to inflammation[16]
        ii. Multiple facial layers affected (superficial, deep, muscle)[17]
            1. Affects biomechanical interactions[10]
        iii. Causes loss of efficient gliding among fascial layers[18]
            1. Can result in increased tissue thickness, found in chronic low back and neck pain[19,20]
            2. Can result in persistent pain and loss of mobility[6,21-23]
6. Fascia and Manual Therapy (MT)
    a. Manual therapy (MT) commonly used to treat connective tissues, including fascia[16]
    b. Myofacial pain syndromes (MFP) commonly treated with MT
        i. Effects of MT on MFP
            1. MT has initial localized inflammatory reaction on fascia[24]
            2. MT has long-term anti-inflammatory effect on fascia[16]
            3. MT decreases stiffness within fascia[25]
            4. Multiple layers of fascia affected[17]
                a. Deep fascia – 73%, Superficial fascia – 55%, Muscle – 43%
                b. Deep fascia alone – 23%, Deep & Superficial – 22%, Deep & Muscle – 18%
                c. Average = 3.0 $\pm$1.2 layers
            5. Facial Manipulation approach developed by Stecco[10,26,27]
                a. Treat areas of “densification” to allow fascial layers to glide more smoothly over one another

        b. Decreases concentration of unbound water toward normal inside deep fascia as seen on MRI[28]
        c. Clinical trials showing effectiveness, e.g., in low back pain[29,30]
        d. Each point should be treated as distinct pathologic entity[17]
    c. Avoid therapeutic overreach
        i. "Fascia Distortion Model" as a treatment was developed in the 1990s. The theory states that all musculoskeletal complaints can be traced back to three-dimensional deformations/distortions of the fascia. There is no empirical evidence to support this theory that all musculoskeletal pain is related to fascia.[31]
7. Primary Resources
    a. Chapter 14 in spinal anatomy textbook (Cramer and Bakkum, 2014)[4]
    b. Fascia Research Society:[32] Home - Fascia Research Society
        i. International conferences: Sixth International Fascia Research Congress, September 10-14, 2022, Montreal, Canada.
    c. Textbook: Anatomy Trains (Myers, 2020, Fourth ed.)[12]

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