Vital Importance of the Connective Tissue System

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Objectives:

• Describe the layers and subunits of the connective tissue system. (CT)
• Summarize the role collagen, ground substance, and other CT elements may affect movement patterns
• Define the terms tensegrity, thixotropy, as they relate to stress-strain curves
• Distinguish the effect of stretching on length-tension vs. CT elements
• Describe common IASTM interventions to improve mobility of the CT system

Integument

Skin layers

Epidermis: thin skin
Epidermis: thick skin

Connective tissue development
• Ectoderm and Mesoderm gives rise to the CT of skin and fascia above and around muscle tissue.

Fascial Layers
• Superficial
• Deep = Aponerotic & Epimysial
  • TLF, TFL, rectus sheath...
• Intermuscular
• Visceral

Remember: This is Fascia
Living tissue is hydrated and dynamic

analogous...
Dynamic nature of living tissue

- The way we think about movement in the human body is clouded by the way we learned anatomy
  - Cadaver tissue, hard muscles, web-like fascia
  - Surgery observation; as soon as you cut into it you have changed it.
  - AND what we observe in surgery = tourniquets used; even though living tissue, not the same

Functions of muscles

- We learn action but as we move in real world multiple
  - ERs become IRs past 90 degrees

Remember: This is Fascia
Jean-Claude GUIMBERTEAU, MD: strolling under the skin

Skin: more complex that we learned

Retinacula Cutis

4th International Fascia Congress

- Benchmark sciences filling in the gaps of traditional anatomy
Skin layers

What is understood in radiology?
- Fascial herniations
- Morelle-Lavale lesions
- Compartment syndrome; fasciotomy
- Gr 4 AC joint

Fascial Components
- Fibroblasts
  - Make and secrete all fibers of areolar connective tissue
- Collagen fibers
  - Strongest and most abundant; cross linking leads to immense tensile strength
- Elastic fibers
  - Rubber like proteins which allow tissue to return to original shape
- Reticular fibers
  - Connect vessels and nerves; have more give than collagen
- Ground substance
  - Extracellular matrix that holds interstitial fluid via sugar-protein molecules that soak fluid like a sponge; with increased inflammatory response it becomes more viscous

The Colloidal Matrix

Viscoelastic properties of skin

Fascial Contributions
- Support structure, tension, and suspension for tissues; “scaffolding”
- Fluid mobility; high amount of plasticity
- Connecting multiple muscles = functional kinetic chain
- Has been shown to have myofibroblasts
  - Contraction of myofibroblasts influences movement?
Muscles within the Fascial layers

• Twitch of skin – horse, cow, pig...
• Hair stand up - Arrector Pili
• Myofibroblasts

Viscoelastic properties

Viscoelastic properties: Collagen

• Dermis is made up of 80% collagen, dry weight, and of that collagen, 85% is type I
• Type 3 collagen is ~15% of dermal collagen, but is higher in immature tissue
• With age, ratio of type 1:3 collagen increases
• Increased collagen fiber density with age = decreased ground substance space

Viscoelastic properties: Thixotropic Effect

• Thixotropy is the property of certain gels or fluids that are thick (viscous) under normal conditions, but flow (become thin, less viscous) over time when shaken, agitated, or otherwise stressed.

Viscoelastic properties: Creep and Hysteresis

• In relation to manual therapy, creep is the distortion of tissues as a function of pressure over time
• Hysteresis is the exchange of heat and energy as tissues are distorted; permanent deformation. Microtrauma.
• With MFR 90-120 seconds is the time for generally the first barrier (R1) to release and push into new range of extensibility.
• Tendon Hysteresis in 5-10 minutes(Kabo 2001)

Viscoelastic properties: Ground substance - with GAGs

• Glycosaminoglycans
  ▫ Proteoglycans and repeating disaccharide units
  ▫ Commonly hyaluronan and chontratin sulfate; including dermatan sulfate
  ▫ Bind water in normal healthy tissue and proteins
  ▫ In aged skin, less binding to water and bind more to elastic material = thickened

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What really happens when we stretch?

- Sensory endpoint theory (Weppler & Magnusson 2010)
  - Very little evidence that Torque/angle curves shift; even w/ 8 weeks
  - More likely that the perception of the stretch sensation occurs later in the application of similar force
  - PF stretch doesn’t change reflex pathway (Hayes 2012)

Soft tissue mobility: Folding

- CT ability to compress upon itself
- Shoulder Elevation= inferior capsule and axillary fold stretched, but also superior and anterior structures need to fold
- End Range hip flexion in supine = hams and glute flexibility, but also anterior hip folding

Fascia encapsulates and supports
**Tensegrity**

- “Tensional integrity”
- Fuller 1950’s first visualized by the sculptor Kenneth Snelson (Snelson, 1996). Fuller defines tensegrity systems as structures that stabilize their shape by continuous tension rather than by continuous compression.
- Micro: studies of both cultured cells and whole tissues indicate that cell shape stability depends on a balance between microtubules and opposing contractile microfilaments.

**Mechanical CT Changes**

- **Inflammation or Trauma**
- **ECM response**
- **Ground substance viscosity**
- **Collagen cross-linking/Collagen cross-linking**

**Cascade of events:**

- Ge et al. 2008 studied involvement of central sensitization mechanisms in local pain syndromes.
- Pain perception may result from a deregulation in peripheral afferent and central nervous system pathways—“chronic excitability.”

**Trigger Points**

- Lower levels of oxygen, nutrients, blood perfusion.
- Increased calcium levels, leading to excessive chronic muscle contracture, spasms.
- Stress can lead to abnormal excess afferent stimulation.
- Can have shortening of sarcomeres.
Fascial mechanics
- Translating forces = “Slings”
- Lats to TLF to contra glute max and down lateral thigh = ITB Tx

Myofascial Lines
- Work of Thomas Myers
- Myofascial Tracks = muscles, tendons, ligaments and fascia
- Bony Stations = joints or insertional sites at bony landmark
- Can be static or motion driven
  - Picture: Pec minor, biceps, coracobrachialis, rectus abdominis
  - Or ab scar restricting shoulder or lumbar motion

Superficial Back Line
Includes:
- Plantar fascia
- Achilles tendon and Gastrocnemius
- Hamstrings
- Sacrotuberous ligament
- Thoracolumbar fascia
- Erector spinae
- Scalp fascia

Lateral Line
- Often involved with leg length differences and pelvic obliquities
  Includes:
  - Peroneals
  - Anterior ligament of the head of fibula
  - ITB and TFL
  - Superior fibers of glute max, medius
  - External and internal obliques
  - Splenius capitis and SCM
The Spiral Line

The Serape=double spiral
Includes:
- Splenius capitis and cervicis
- Rhomboids
- Serratus anterior
- Ext/Int obl. & ab aponerosis
- TFL and ITB
- Tib anterior
- Peroneals
- Bicep femoris to sacrotuberous ligament
- Lumbar fascia and erector spinae

Myofascial Lines

- Fascial planes and CT restrictions affect dynamic movement – scar adhesions
- Body takes the path of least resistance
- Interventions with traditional manual therapy
- Interventions with negative pressure applications: www.MyofascialDecompression.com
- Interventions with IASTM
- Manual therapy for lymphatic flow

Regional Interdependence

Both picture thoracic extension; but may be restricted for different reasons

Consider Regional Interdependence

“A best-practice model for managing patients with musculoskeletal complaints has yet to be identified.”
- Tim Flynn (JOSPT 2007)

Consider hip strength for runners with foot pain, or
Use of foot orthosis as a method of treating PFPS

Compensations and Adaptations

The body can have different restrictions of the musculoskeletal system in different positions.

Why does IASTM work?

- Bridge to the IASTM picture
- Mechanical connective tissue change
- Fascial plane restriction and scar adhesions
- Trigger points and metabolic exchange
- Fluid mobility
- Counterirritant; C fiber instead of A fiber; Gated

Pain generating mechanisms

- Receptors in TL Fascia (Schilder 2014 Pain)
  - Muscle pain could be more akin to projection hyperalgesia, and not an “issue in the tissue.”
- IE: PF pain – likely cartilage or other soft tissue restrictions?
  - Grooves in PF joint in cadavers
- OR IE: THR patients that have the same hip pain come back 6 months later
IASTM = Instrument Assisted STM

- Mostly a Pro-inflammatory approach
  - Some techniques are for flushing in acute phases
- Effect at the superficial fascia level, deep fascial membrane, epimyseum
  - mechanoreceptors
Where are the Pacinian corpuscles?
= Where are the Meisner corpuscles?
= Where are the Ruffini corpuscles?
=

IASTM

- Self trigger point tools – theracane, TrP tools...
- Snowman with a hat, PAs
- Belt techniques for hip and shoulder
  - Are you just moving the joint? Or are you also with an inferior hip glide pushing through RF trigger point region, and other contractile tissue that may reset sensitivity thresholds
- Negative pressure devices

IASTM

- ASTYM
- Graston
- SASTM
- FAKTR
- Iamtools
- GuaSha Orthopedic
- Target Point
- Fuzion Tool
- BioEdge

= GuaSha

Negative Pressure

Ultrasound

With Myofascial Decompression
MFD Techniques

Negative Pressure

Negative Pressure

Negative Pressure

Proof of Concept Study

Proof of Concept Study
GuaSha and IASTM

Basic Steps:
• Watch the area with movement patterns
• Sweep area with hands/fingers
• Trace and isolate with Vectoring
  ▫ 4 directions, find most limited.
  ▫ Compare contralateral
  ▫ Add in rotational vector as well

IASTM techniques
• Superficial scrape
  ▫ Sense percussive info from tool
• Scrape parallel fibers
  ▫ Into the motion barrier =
    ◦ direct - subacute and chronic
  ▫ Away from motion barrier
    ◦ indirect - acute or irritable
  ▫ Diagonal and perpendicular
  ▫ Add movement

Contraindications
• Eyes; genitalia?
• Unhealed wounds
• Hemophilia, leukemia, active TB
• Thrombocytopenia
• Later stages of pregnancy
• Influenza of fever
• Moderate/severe anemia
• Moderate/severe cardiac conditions, high BP
• Vasculitis
• Cancer active
• Skin elasticity disorders-EDS??

Precautions
-Patients that are over eager
  ▫ addictive personalities, chronic pain?
- Blood thinners
- Healing or thin skin
  ▫ Elderly, Psoriasis
- Pregnancy
- Areas of ecchymosis
  ▫ Previous STM
- Venous stasis and varicose veins
- DM; tissue healing and neuropathy
- Swollen tissue
  ▫ especially pitting edema

Results?

Outcomes?
Future Studies

- Perfusion and Diffusion MRI with MFD vs Graston vs ASTYM vs other tools/techniques/modalities
- Pre, during, and 8-48 hrs after for different Tx
- Fascial changes on magnified MRI
- Local metabolic change; on a nano level

IE: why does US work in some patients?

References


Thank You!!

References

Books:

Journals:

Other recommended CE work

- www.ptrehab.ucsf.edu/education/continuing-education
- Janda courses or Movement Links
- MyofascialDecompression.com
- Kaiser Residency and fellowship
- IPA PNF and FM
- Great Lakes MFR course
- Kinetacore.com
- Spinalmanipulation.org
- Myopain seminars
- Systemicdryneedling.com