AMERICAN COUNCIL ON EXERCISE

Fascia Training

MICHOL DALCOURT

UNIVERSITY OF ALBERTA – EXERCISE SCIENCE

CREATOR - ViPR

ADJUNCT FACULTY – University of San Francisco

DIRECTOR - Institute of Motion

Past FACULTY – SCHOOL OF HEALTH SCIENCES at NAIT College

#ACESYM13

FASCIA ...

- Outline the Architecture of Structure and How It Adapts to Forces

- The reveal the importance of considering all visco-elastic components in human function

- Identify the Need for 3-D Variation in Training

- To set general guidelines for Fascial training

- To showcase drills that will have a positive effect of the collagen matrix of the body

- How diet / lifestyle with alter Fascia's behavior

- Questions


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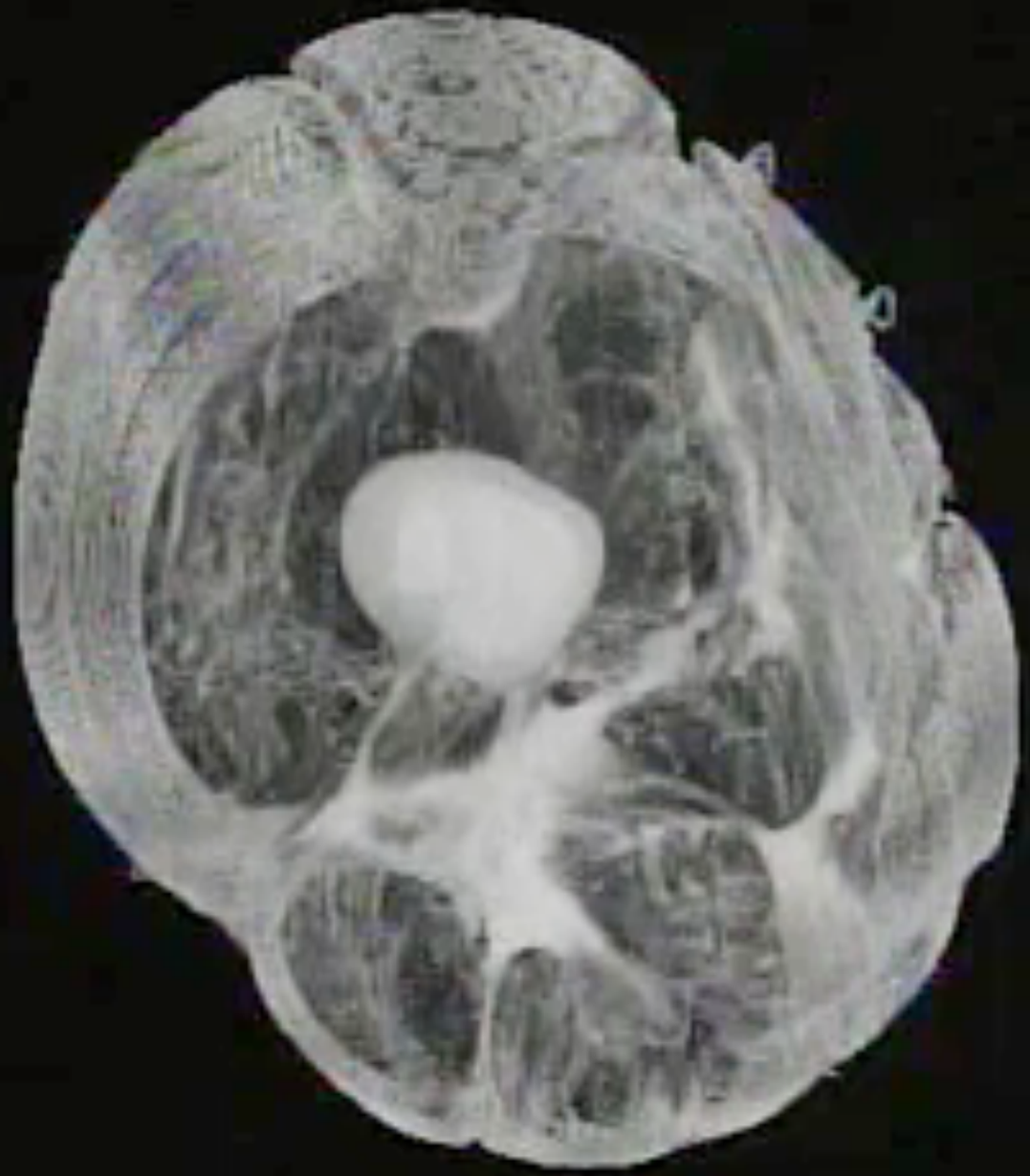

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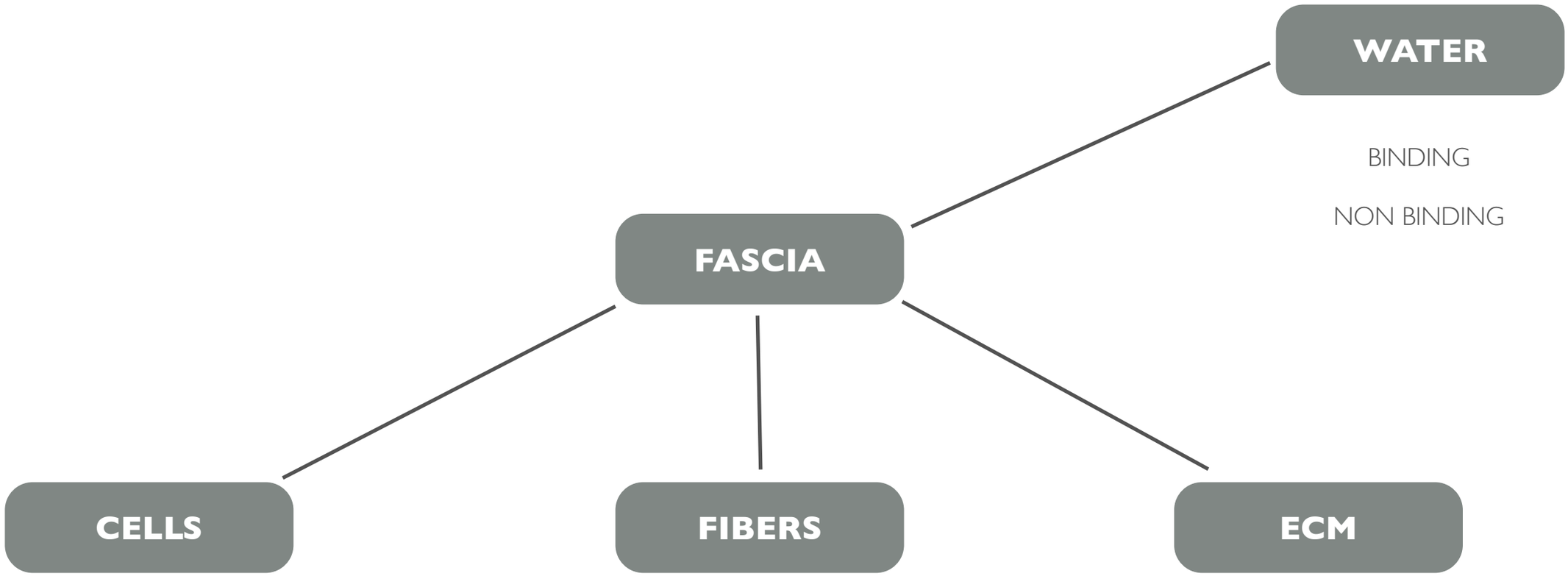
“The muscle-bone concept presented in standard anatomical description gives a purely mechanical model of movement. It separates movement into discrete functions, failing to give a picture of the seamless integration seen in a living body. When one part moves, the body as a whole responds. Functionally, the only tissue that can mediate such responsiveness is the connective tissue.”

- Schultz, Feitis – THE ENDLESS WEB

FASCIAL ARCHITECTURE



FIBROBLASTS

MAST CELLS

ADIPOSE CELLS

MACROPHAGES

COLLAGEN

RETICULAR

ELASTIC

GROUND SUBSTANCE

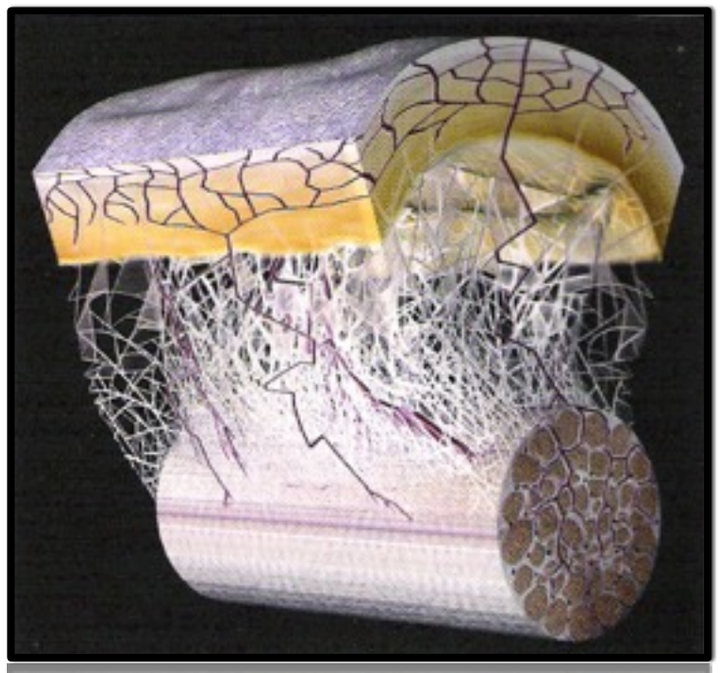
PROTEOGLYCANS

HYALURONIC ACID

MechanoTransduction

How our Bodies Dissipate Force and Why?

"refers to the many mechanisms by which cells convert mechanical stimulus into chemical activity"



MechanoTransduction

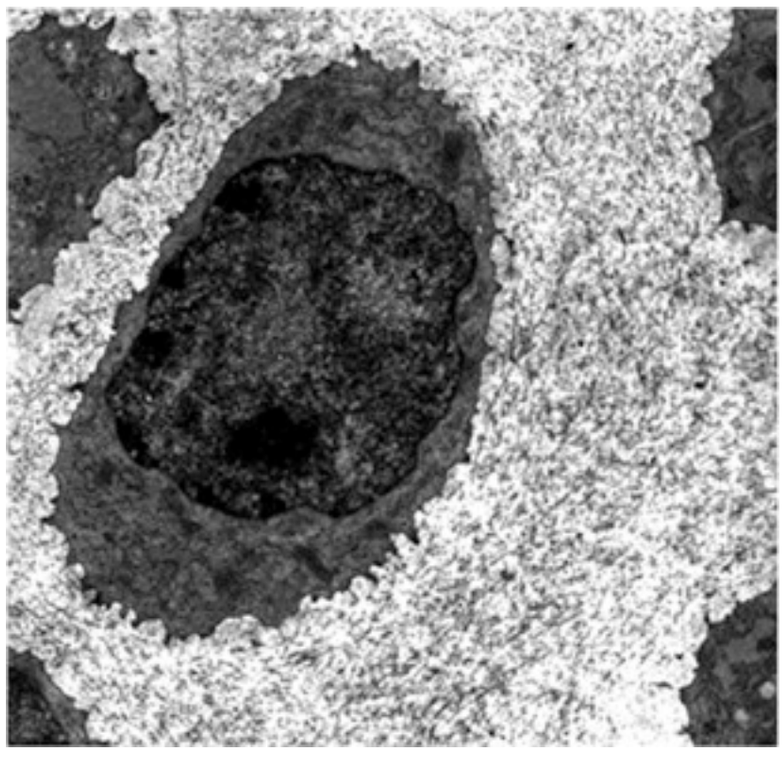
Davis's Law:

connective tissue (collagen) is laid down (remodels) along lines of stress

MechanoTransduction

Extracellular Matrix →

This is the non-living substance that surrounds the cells. ECM is synthesized and maintained by connective tissue cells (fibroblasts in fascia, osteoblasts in bone)



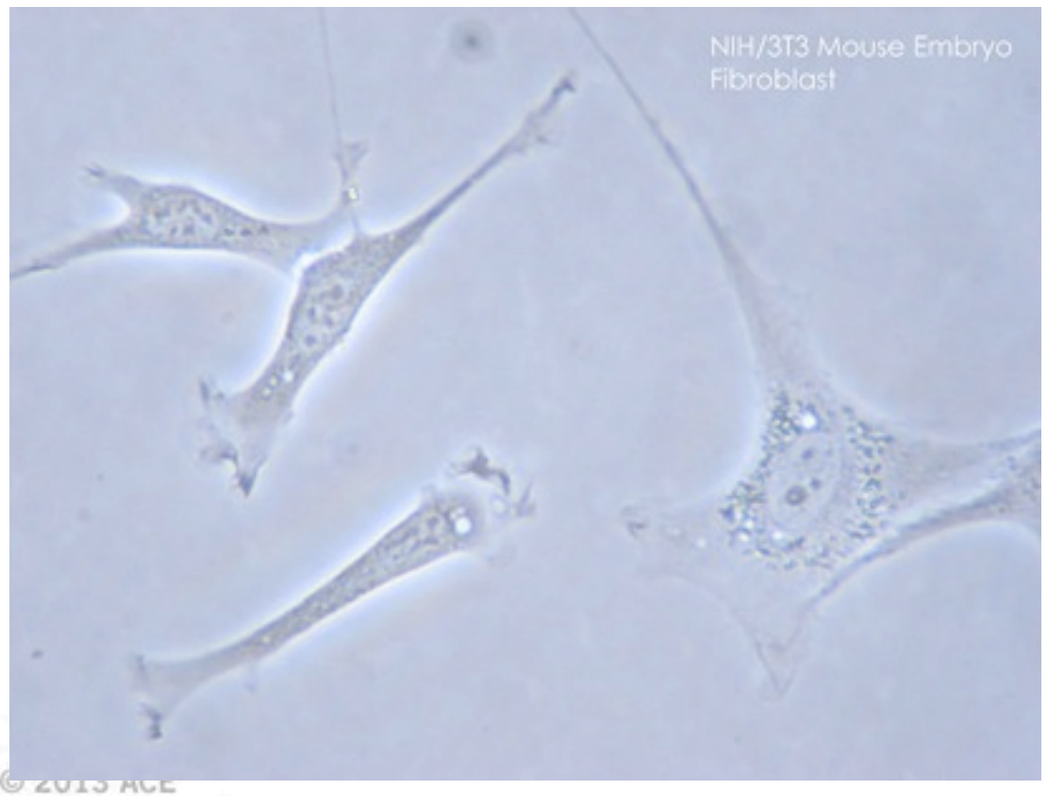
MechanoTransduction

Fibroblasts ⟶

Is a cell that synthesizes and maintains the extracellular matrix

They provide a structural framework (stroma) for many tissues

They play a critical role in wound healing

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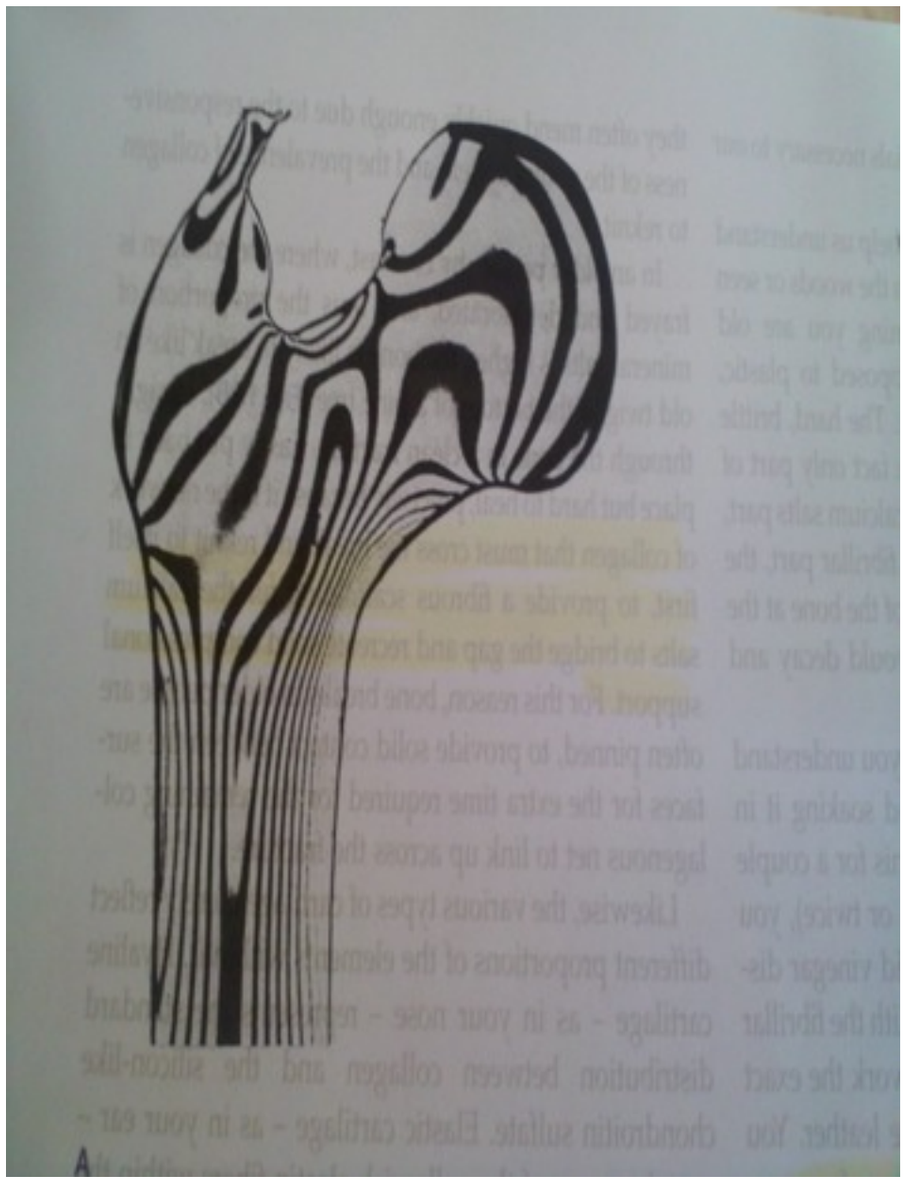
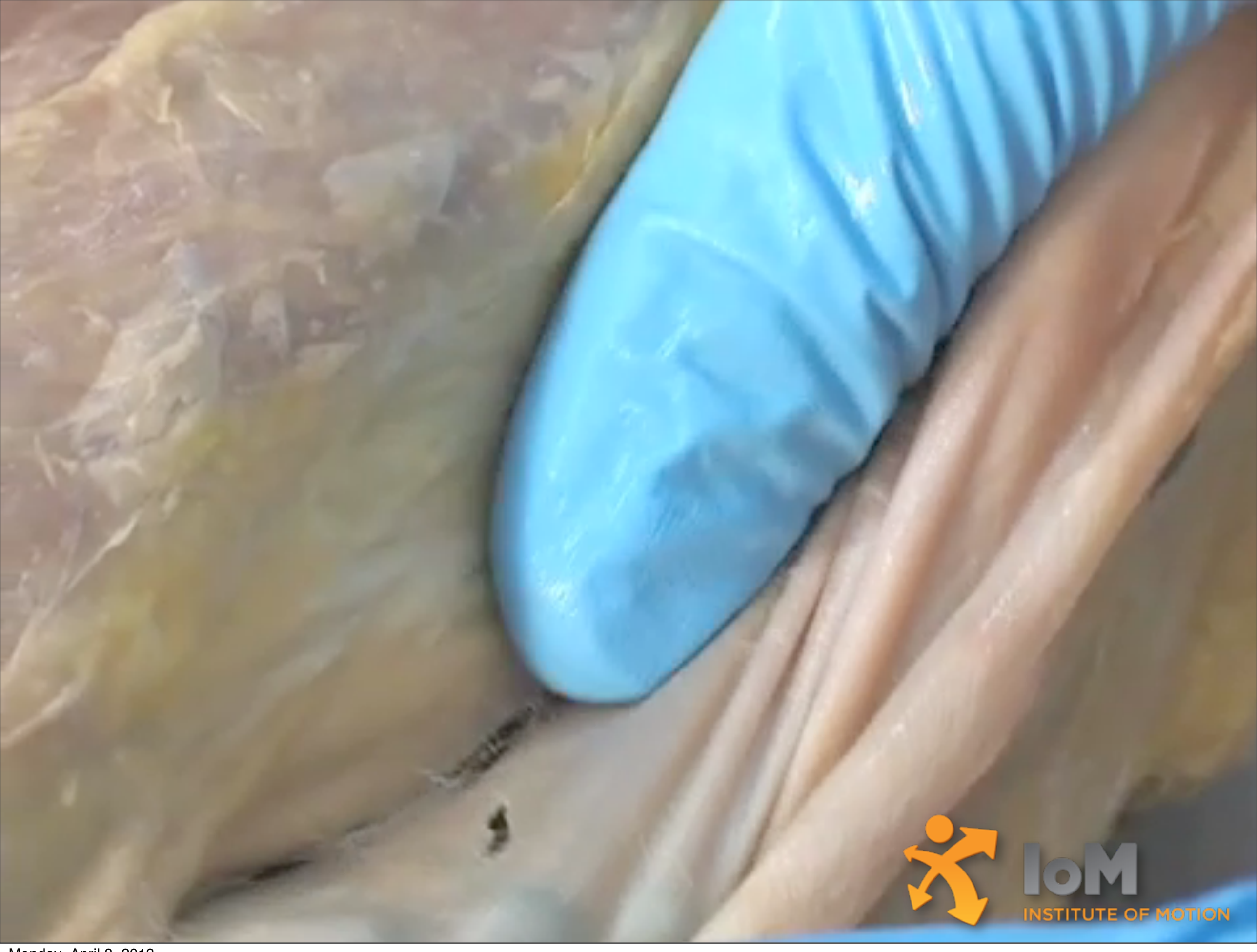
CONNECTIVE TISSUE STRUCTURE



Trabecular Patterns

Fascial Strain Patterns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Este é um modelo
de dois músculos.
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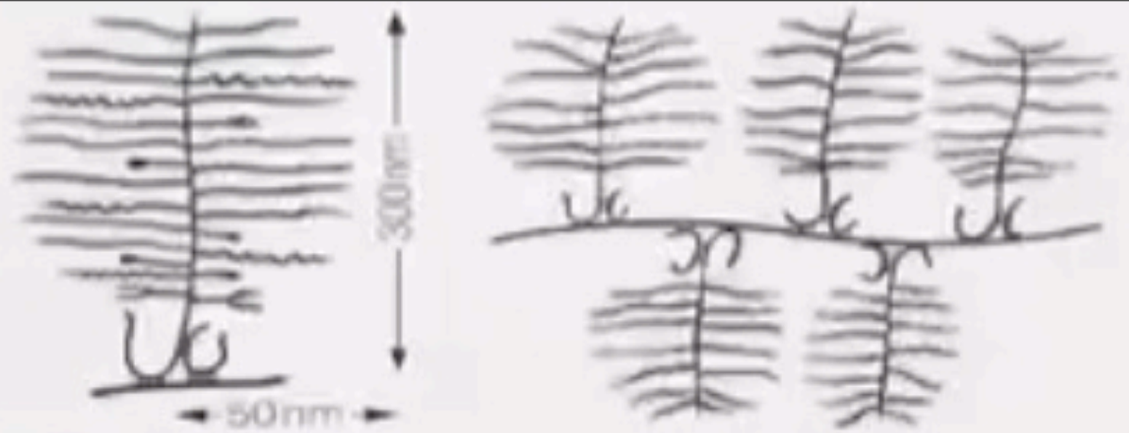
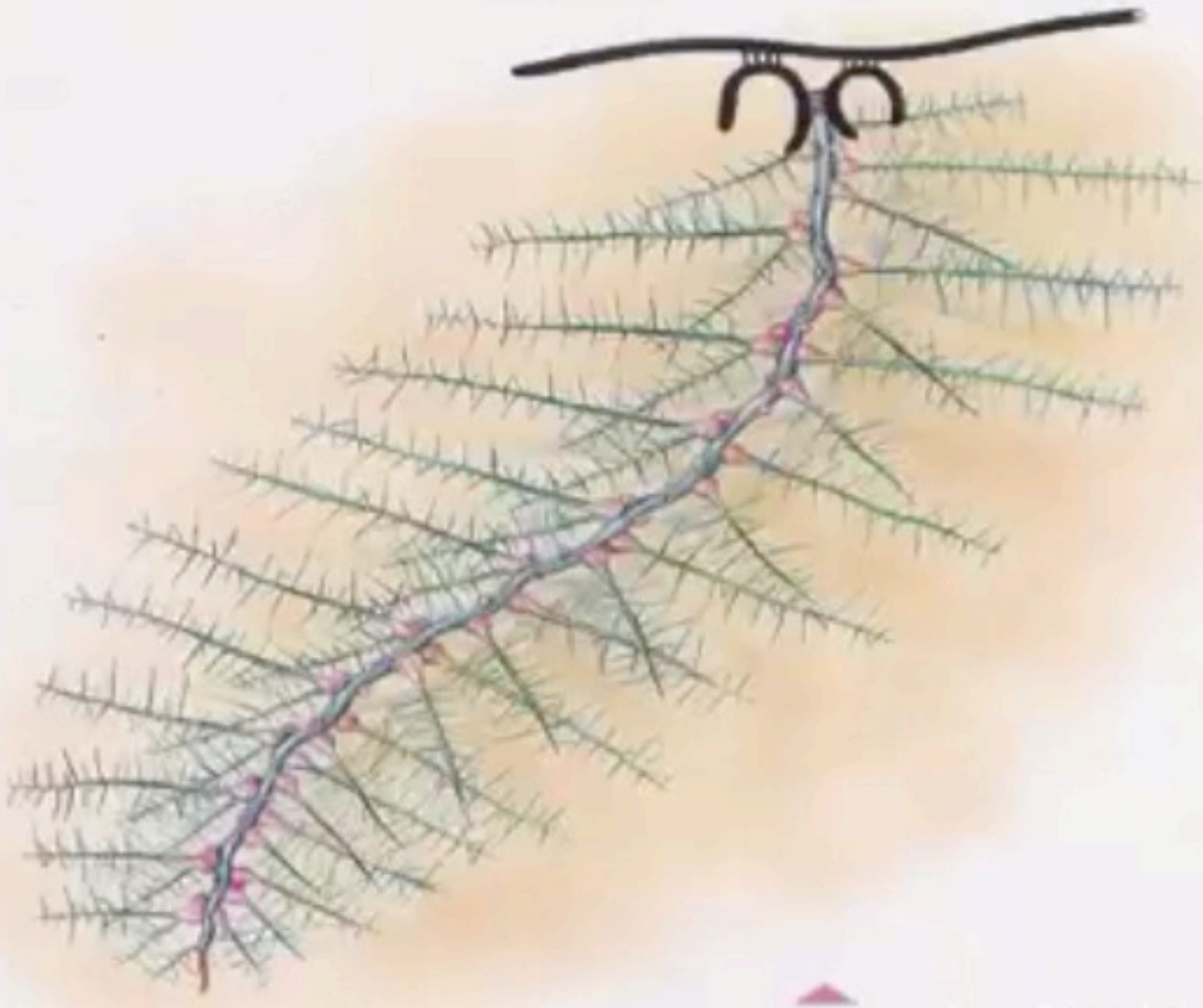
SPONGE-LIKE PROPERTY OF FASCIA



Proteoglykanmoleküle binden an Eiweißfäden und bilden so das sog. Molekularsieb



Struktur eines Proteoglykans

- The vast majority of the volume of fascia is water

- Most of the water is not 'free water', rather, 'bound water' in which the H_2O molecule bind in an orderly fashion along the surface of the sugar-protein fibrils within the ground substance

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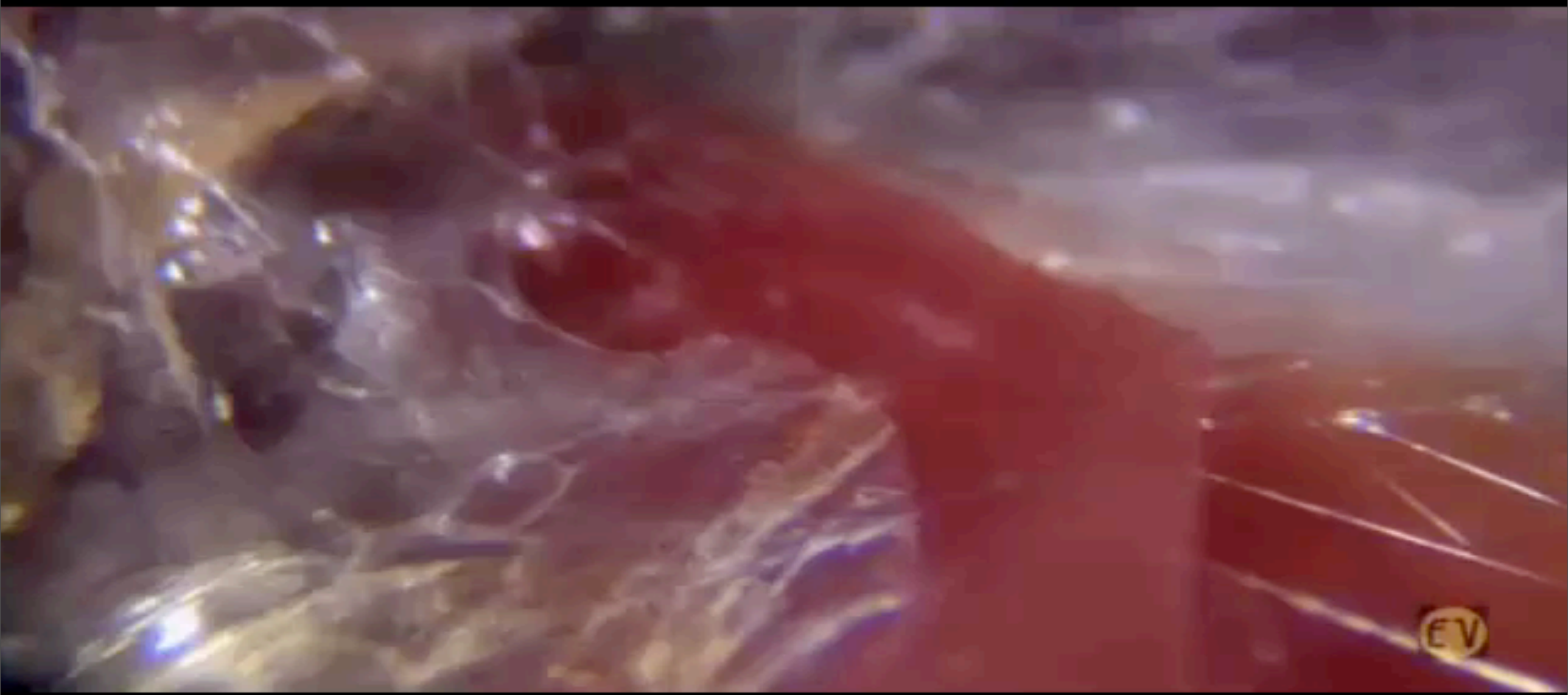

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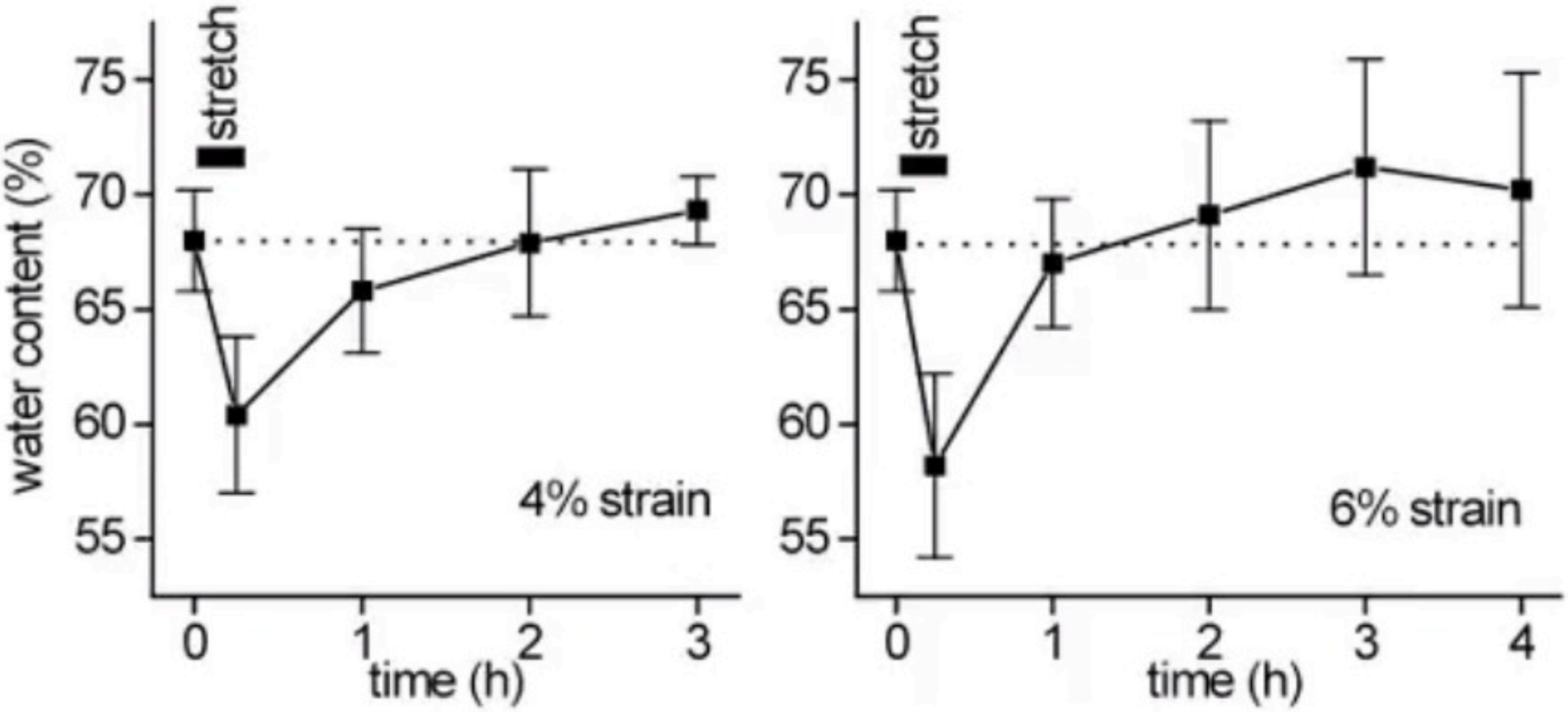
Hydration effects – strain hardening

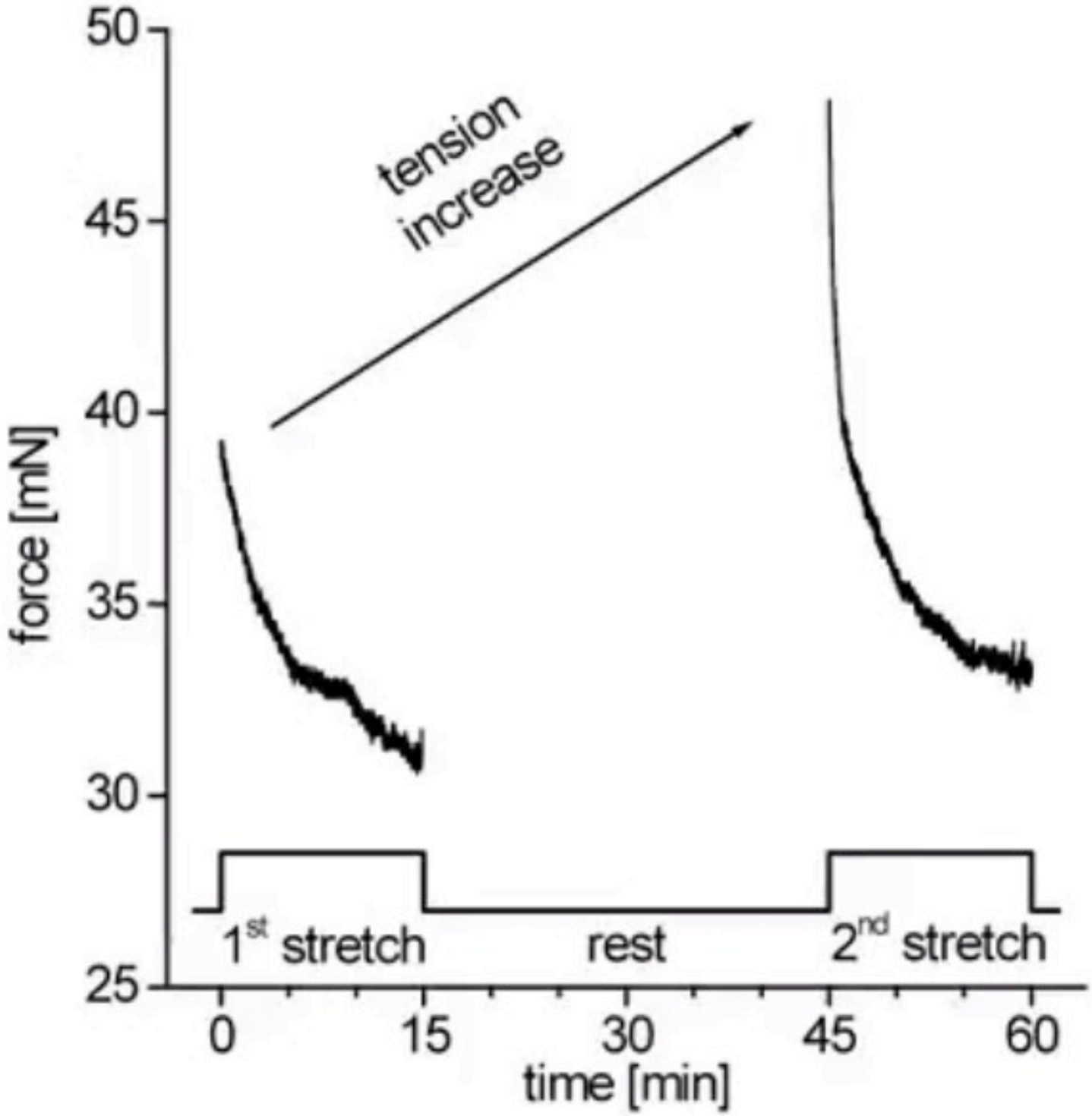


More stretch results in an ‘osmotic return’

- Energy return Mechanism (The visco-elastic effect) - muscle, fascia, skin

Hydration effects – strain hardening

Second Stretch Shows a Tension Increase



Hydration Effects on Fascia

In Vitro Experiments show that:

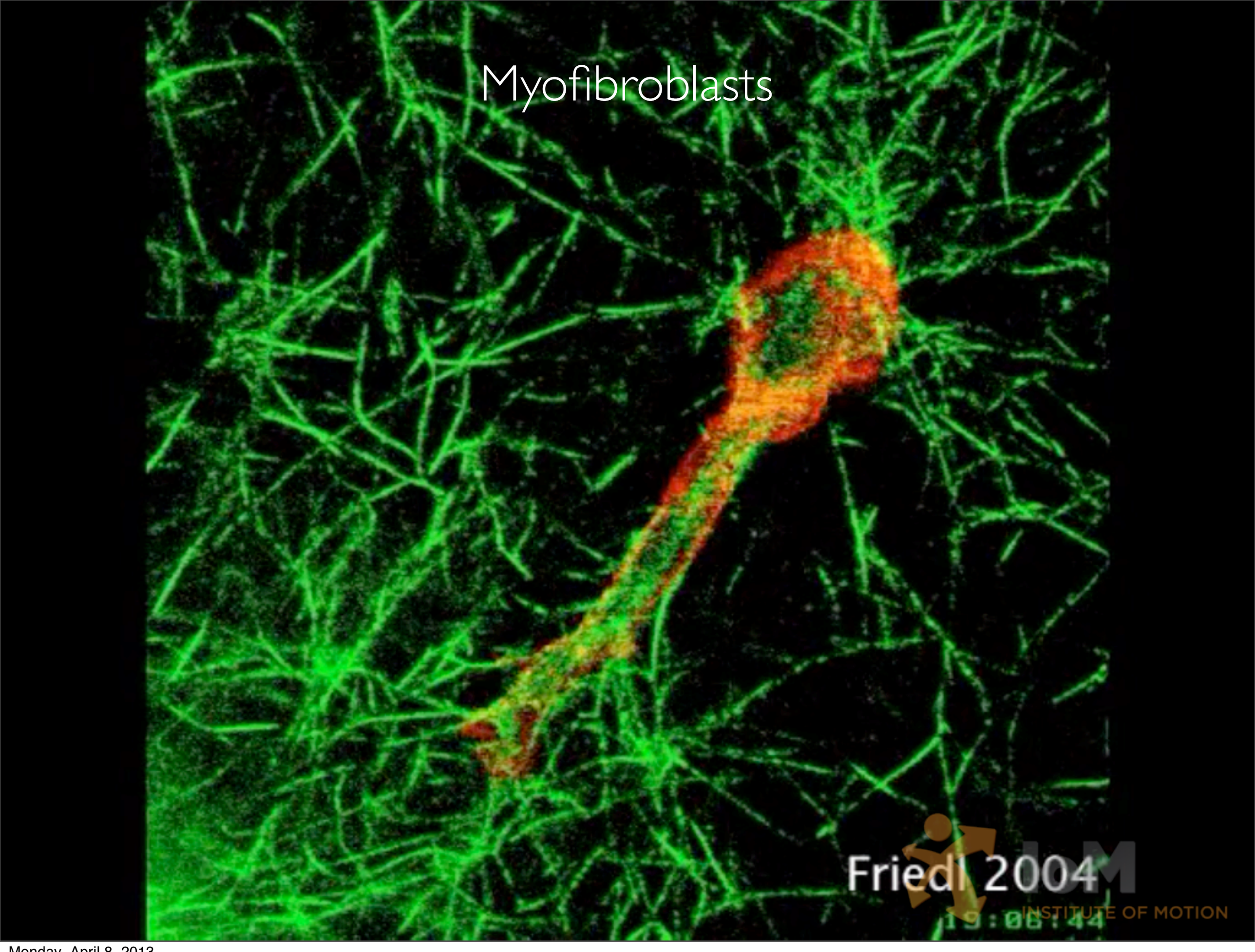
Increased hydration goes along with an increase stiffness
(Schleip, Klingler, 2009)

Temperature Effects on Fascia

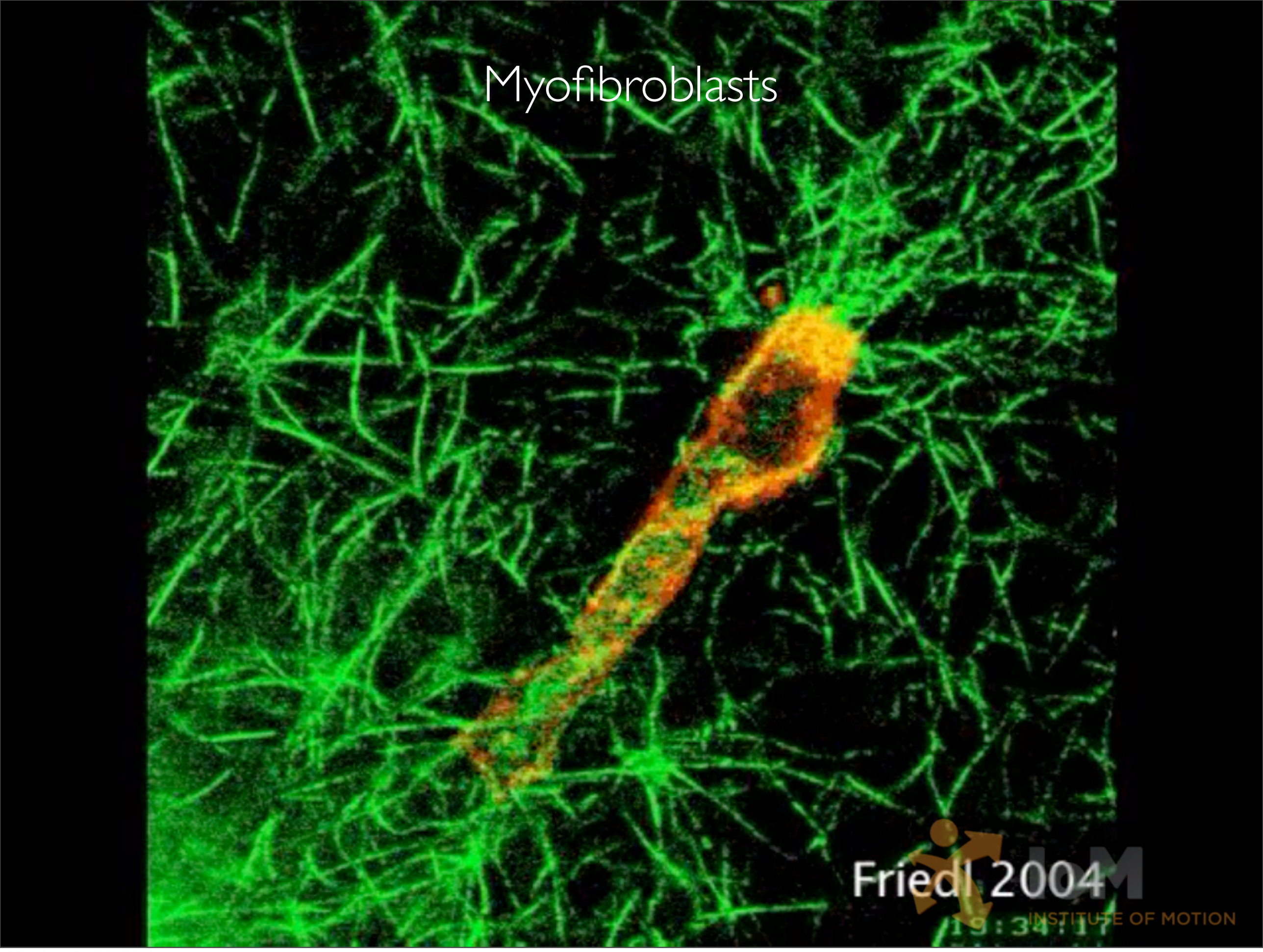
Heat enhances process of taking up water and drainage

Myofibroblasts

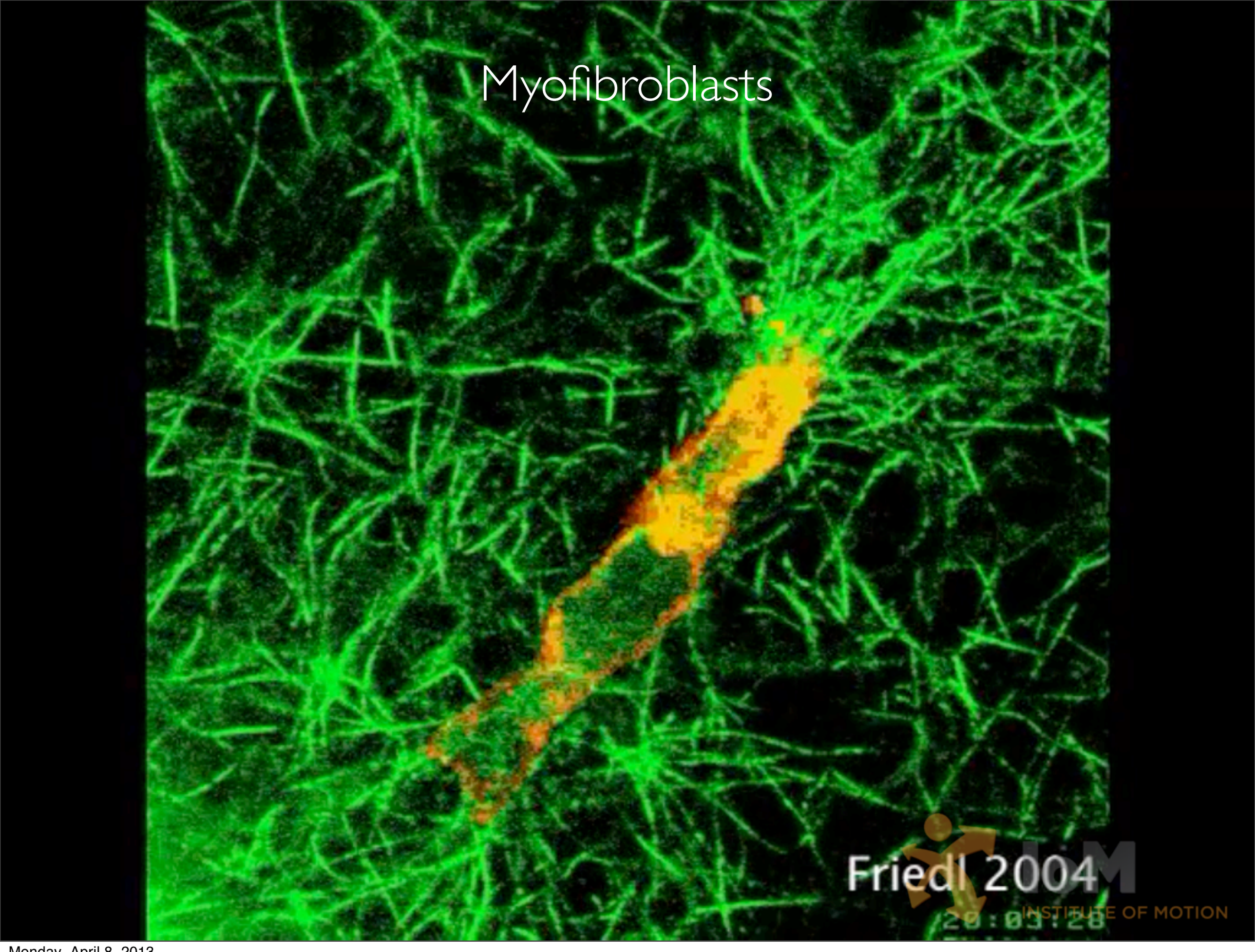
Myofibroblasts



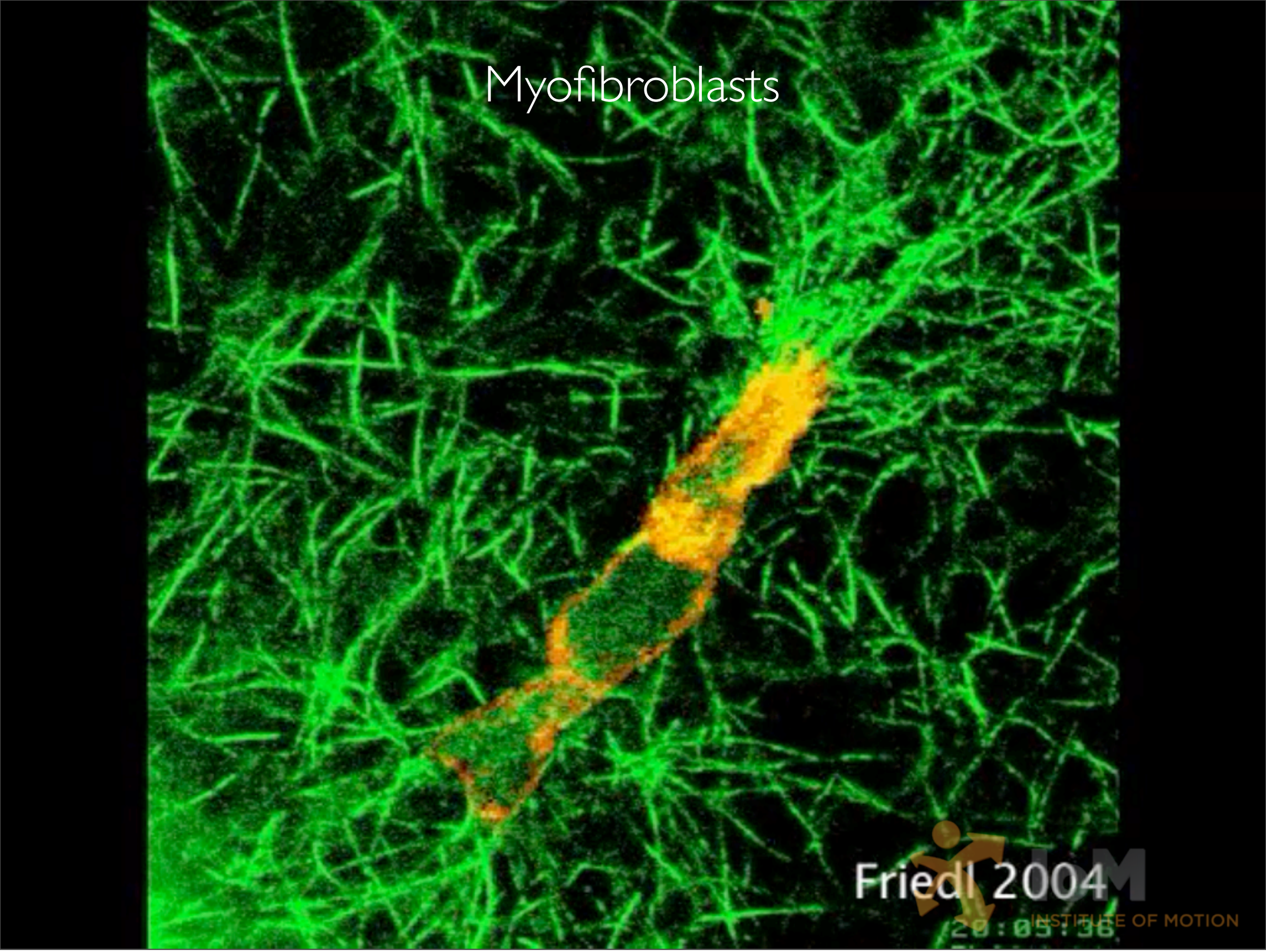
Myofibroblasts



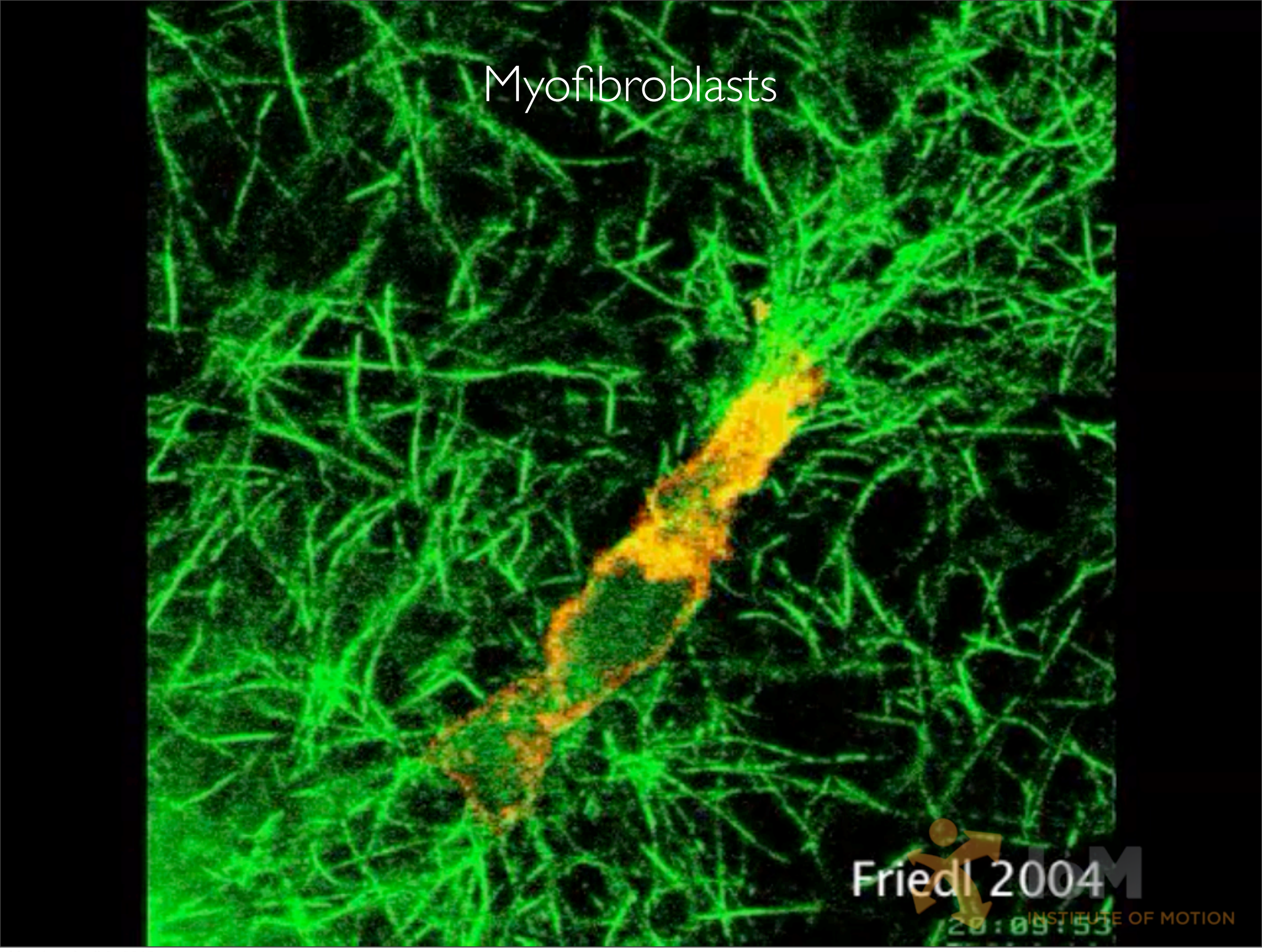
Myofibroblasts



Myofibroblasts

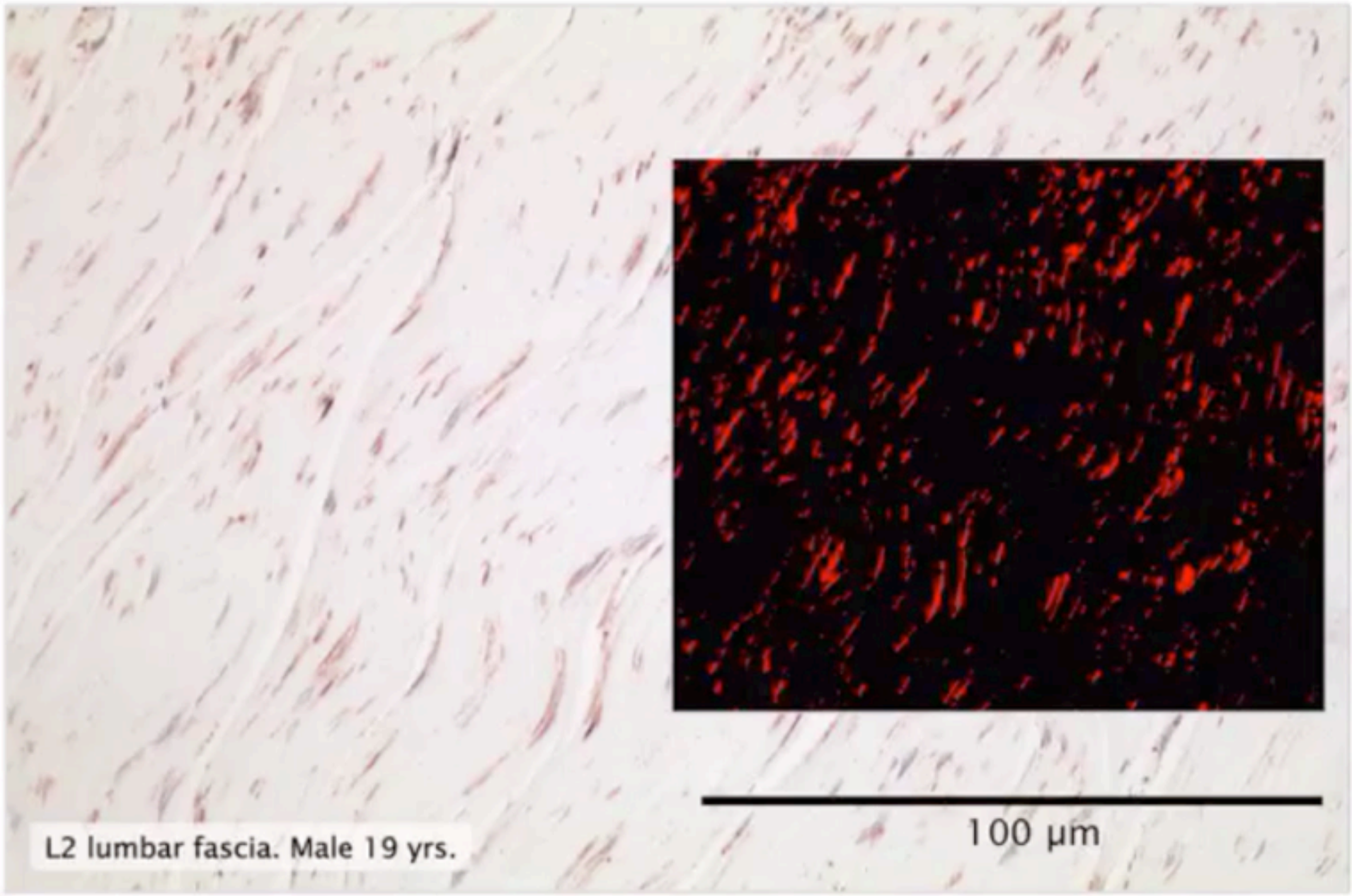


Myofibroblasts



Myofibroblasts

Identification of Myofibroblasts (MFB´s)



FASCIAL BEHAVIOR

- 9 TIMES MORE PROPRIOCEPTORS IN FASCIA THAN IN MUSCLE
- RHYTHMICAL MOTION (WALKING / CYCLING) WEAKLY STIMULATES FASCIA WHERAS LOADING (FORCEFULLY) STRONGLY STIMULATES IT
- MYOFIBROBLASTS ARE STIMULATED BY MECHANICAL MEANS, AND NOT THROUGH THE NERVOUS SYSTEM (NO KNOWN NERVES TO MYOFIBROBLASTS)
- FASCIA IS ORGANIZED ACCORDING TO THE FORCES RECEIVED AND TRANSMITTED THROUGH THE BODY (DAVIS' LAW)
- FASCIA IS VISCOELASTIC
- FASCIA CAN CONTRACT (LIKE SMOOTH MUSCLE)
- VECTOR VARIABILITY (DIMENSIONALIZATION OF MECHANICAL FORCE) WILL MAXIMIZED FASCIAL GROWTH
- THE BALANCE OF THE BONES IS BASED UPON THE BALANCE OF THE SOFT TISSUE
- FASCIA IS MORE STIFF AND MUSCLE IS MORE COMPLIANT (AND HAS A SIGNIFICANT IMPACT ON JOINT STABILITY)

NEURO MYOFASCIAL SYSTEM

FACTS

<u>FASCIA</u>

- ONE OF THE FABRICS THAT HOLD US TOGETHER
- TRANSMITS FORCE
- REPLENISHING FASCIA TAKES TIME (HOWEVER WILL HAPPEN), AND IS MEDIATED BY THE MECHANICAL ENVIRONMENT THAT WE EXPOSE IT TO
- FASCIA THAT IS ELASTIC / DYNAMIC / RESILIENT RESPONDS MUCH BETTER TO UNEXPECTED EVENTS
- 24 - 48 HOURS POST EXHAUSTIVE WORKOUT, WE ARE MORE PRONE TO INJURY (DUE TO SHORT TERM TISSUE DEGRADATION AND REMOVAL OF WATER)
- TRAINING IN INTERVALS WILL HELP RESTORE WATER BALANCE IN TISSUE (EXERCISE SQUEEZES OUT WATER FROM FASCIA - 5 MINS OF RECOVERY EVERY 30 MINS WILL HELP HYDRATE 'DRY' TISSUE)

NEURO MYOFASCIAL SYSTEM

FACTS

- MOST INJURIES ARE CONNECTIVE TISSUE INJURIES AND NOT MUSCULAR INJURIES (THE BEST WAY WE CAN TRAIN IS TO BUILD RESILIENCY / ELASTICITY INTO OUR SYSTEM)

- FASCIA IS THE SYSTEM OF STABILITY AND MECHANO-REGULATION (Varela & Frenk, 1987)

- EVERY CELL IN THE BODY IS HOOKED INTO, AND RESPONDS TO - THE TENSIONAL ENVIRONMENT OF THE FASCIA (Ingber 1998)

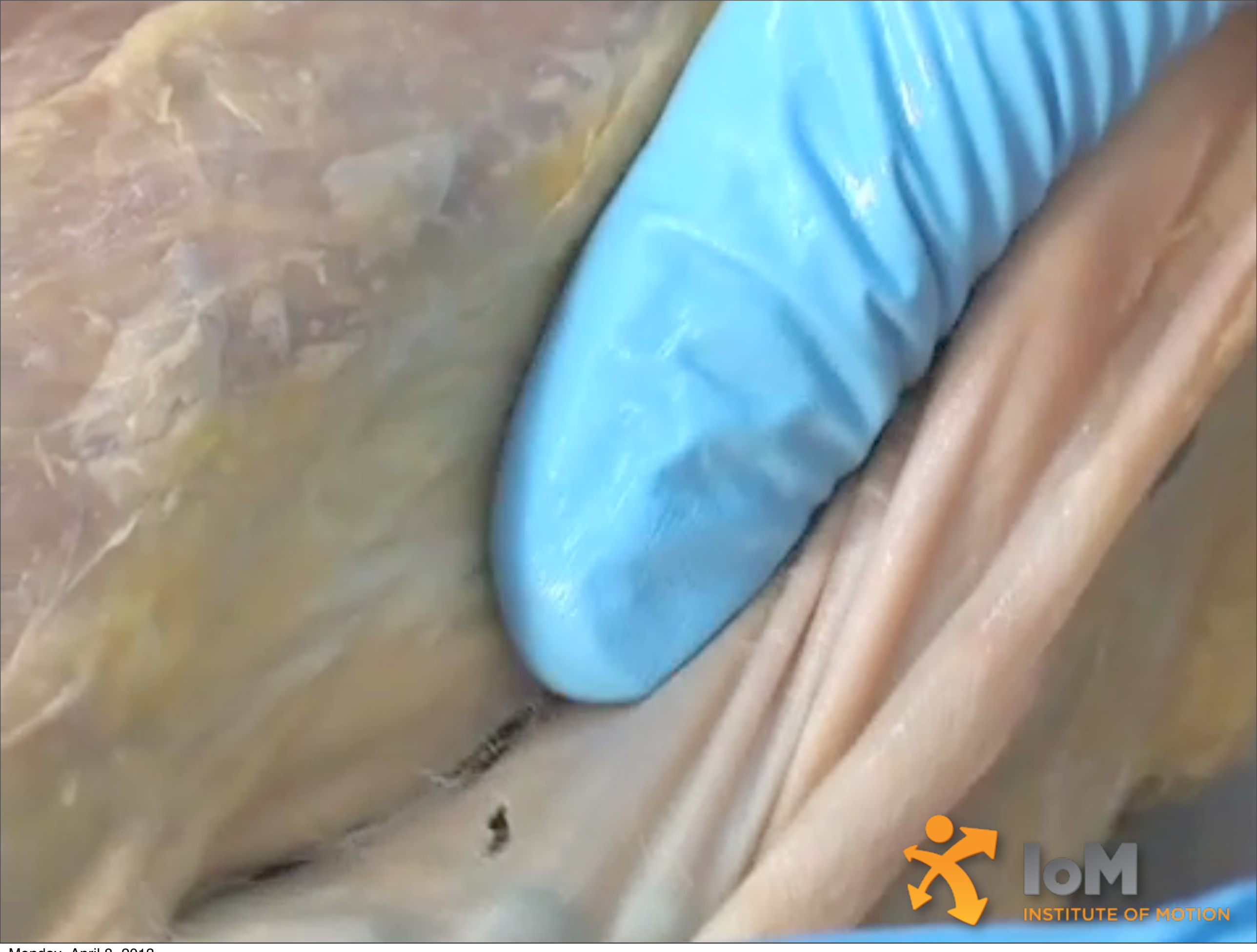
- ALTER YOU MECHANICS, AND CELLS CAN CHANGE THEIR FUNCTION (Horwitz 1997)

NEURO MYOFASCIAL SYSTEM

FACTS

ISOLATION VS. INTEGRATION

- THE EFFECT FROM AND ON NEIGHBORING MEDIAL OR LATERAL MUSCLES (Peter Huijing and Areolar Tissue)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NEURO MYOFASCIAL SYSTEM

FACTS

ISOLATION VS. INTEGRATION

- THE EFFECTS FROM AND ON MUSCLES THAT ARE CONNECTED PROXIMALLY AND DISTALLY (Myers and Anatomy Trains)


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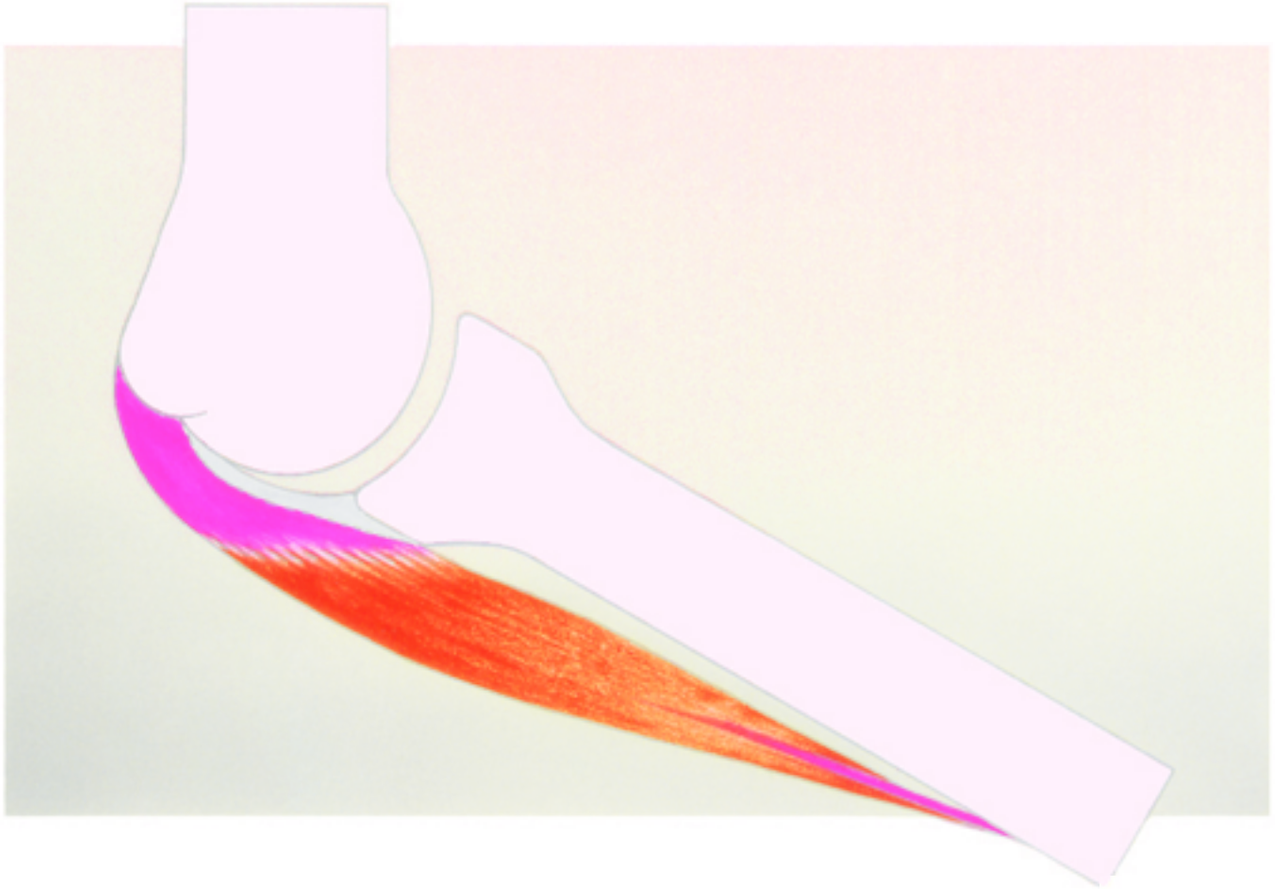
NEURO MYOFASCIAL SYSTEM

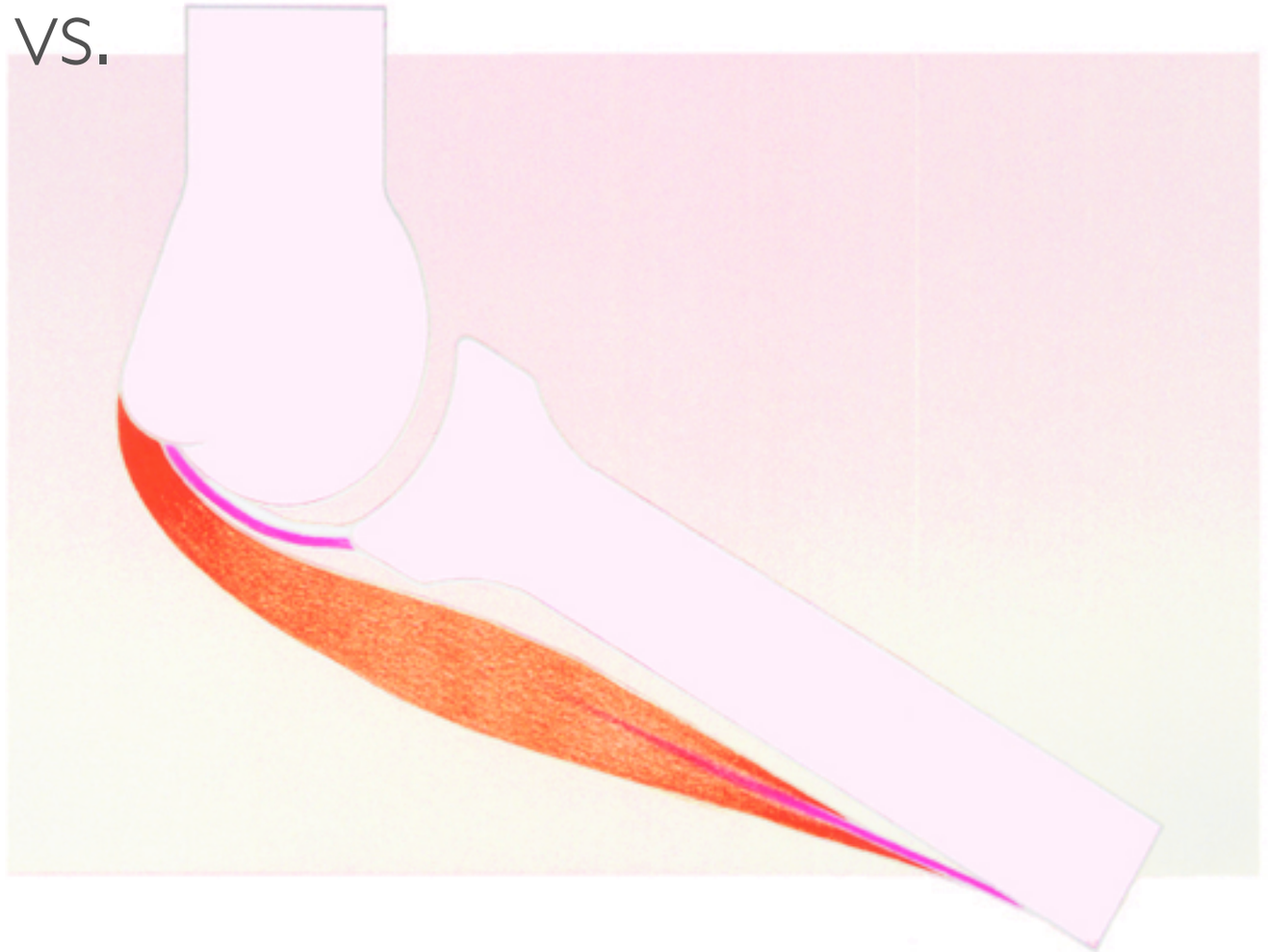
FACTS

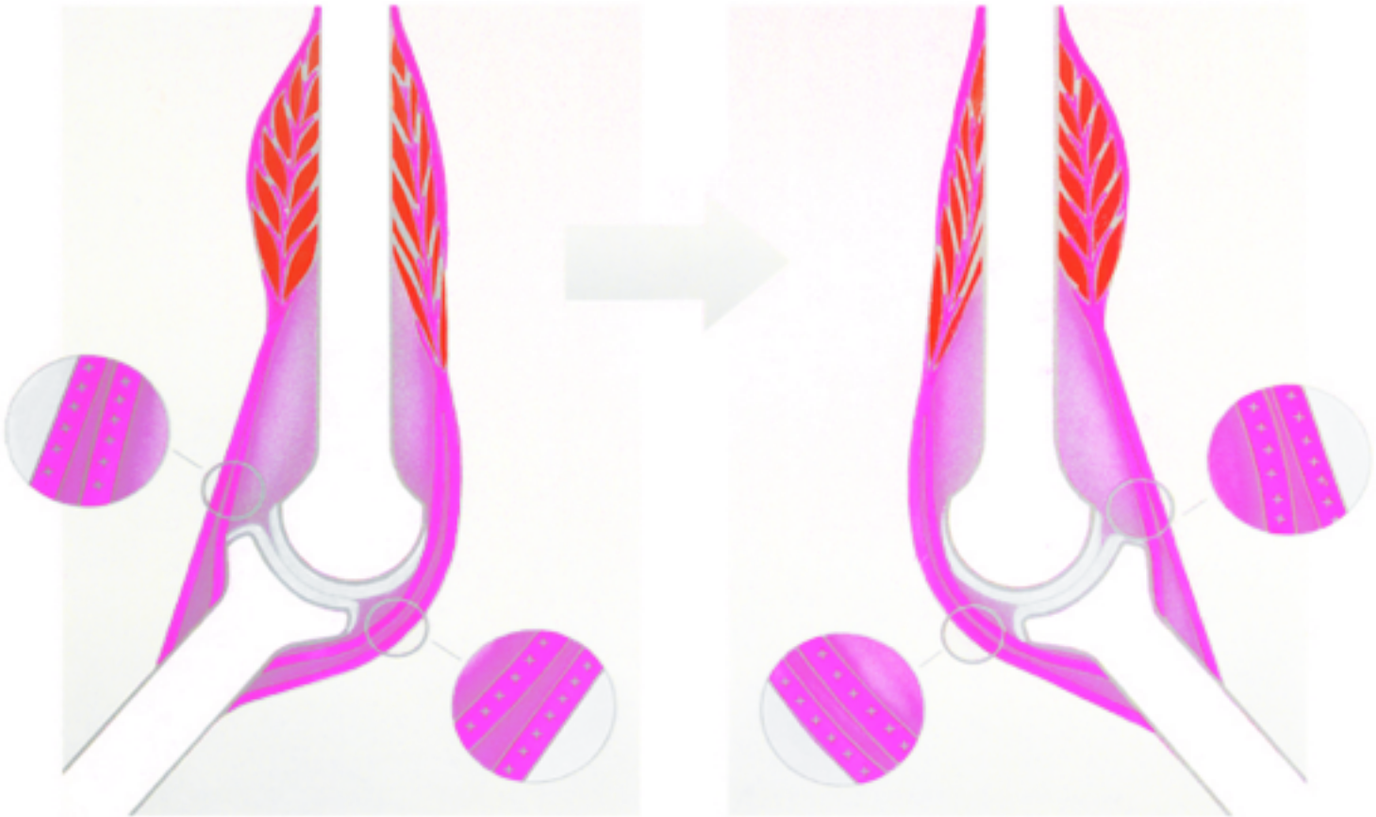
ISOLATION VS. INTEGRATION

- THE EFFECT MUSCLE CONTRACTION HAS ON LOCAL LIGAMENTS (Van der Wal - Ligaments in series with Muscle)

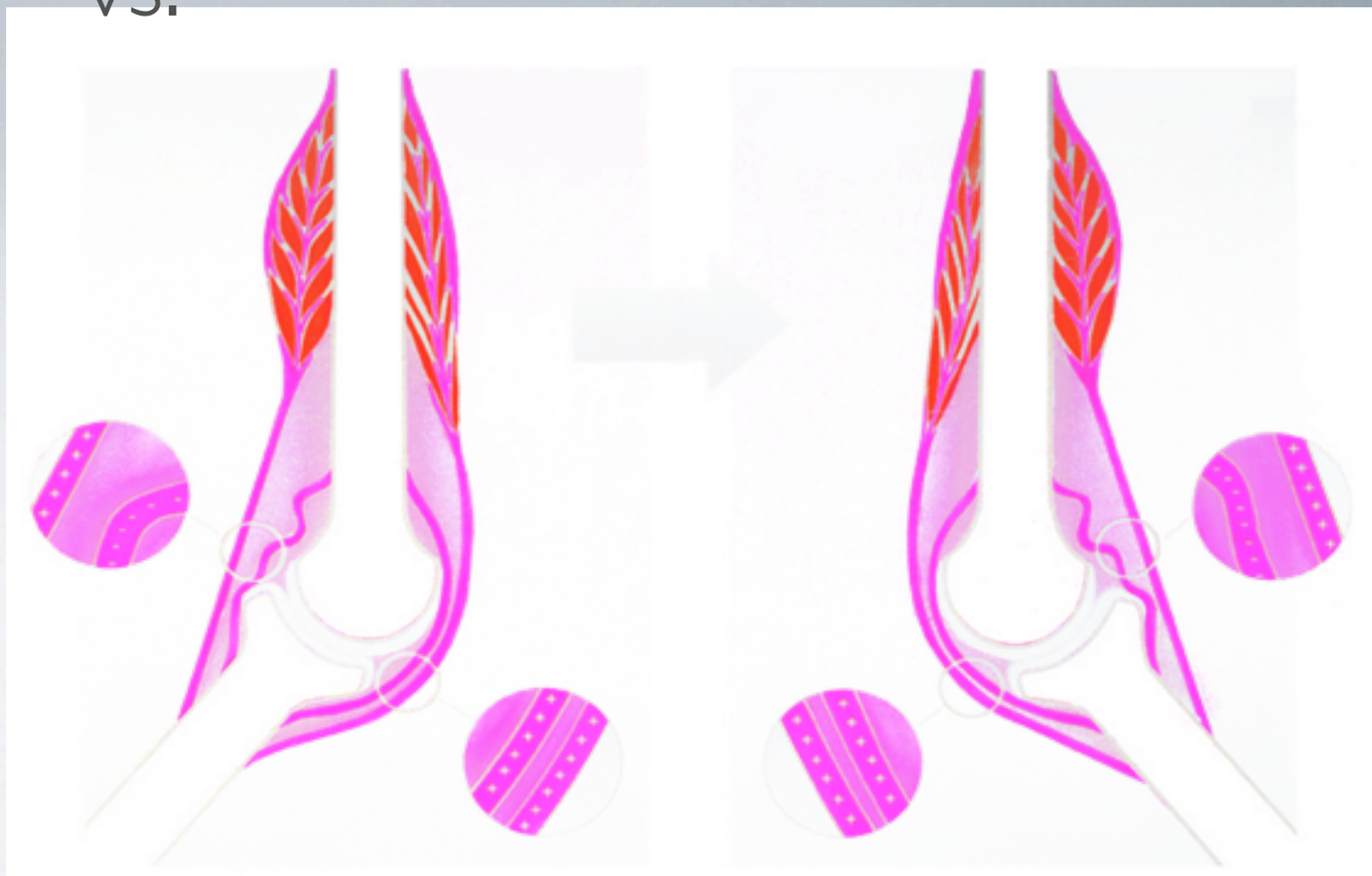


VS.





VS.



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In vivo mechanical properties of the human Achilles tendon during one-legged hopping

G. A. Lichtwark[1,*] and A. M. Wilson[1,2]

[1]*Structure and Motion Laboratory, Institute of Orthopaedics and Musculoskeletal Sciences, University College London, Royal National Orthopaedic Hospital, Brockley Hill, Stanmore, Middlesex, HA7 4LP, UK* and [2]*Structure and Motion Laboratory, The Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Herts, AL9 7TA, UK*

*Author for correspondence (e-mail: g.lichtwark@ucl.ac.uk)

Accepted 25 October 2005

Summary

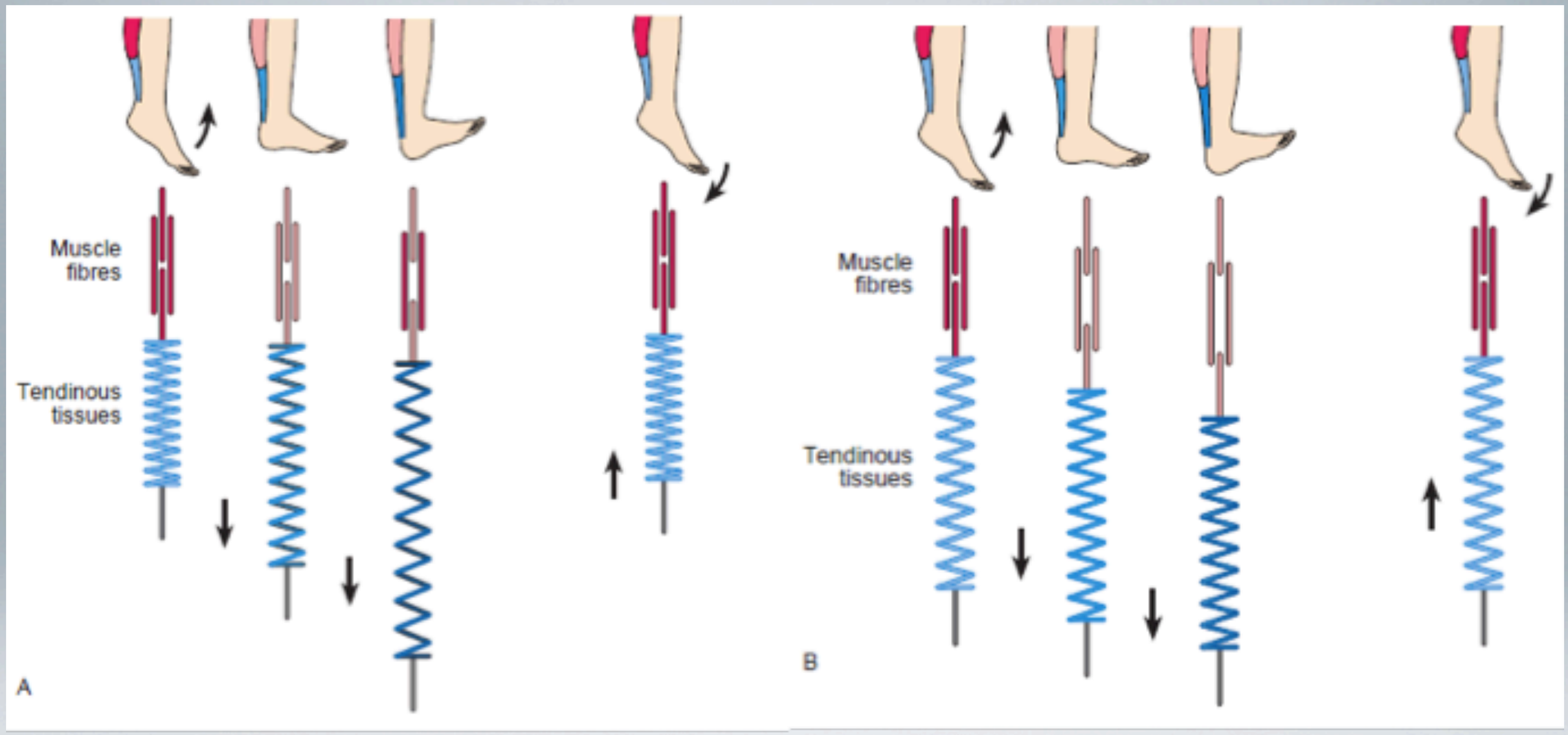
Compliant tendons act as energy stores, which benefit the energetics and power output of a muscle–tendon unit. However the compliance of tendon and the material properties may vary between individuals and hence alter the energy storing capacity of the tendon. We aimed to determine the *in vivo* Achilles tendon (AT) stress and strain during one-legged hopping and hence the contribution of elastic recoil to mechanical energy changes. We simultaneously measured the length of the Achilles tendon from the muscle–tendon junction to the insertion on the calcaneous and the approximate AT force in ten male participants. The position of the muscle–tendon junction was determined using ultrasound images that were projected into three-dimensional space. Achilles tendon force was measured using inverse dynamics. The results demonstrated that one-legged hopping elicited high tendon strains and that the force–length relationship of the whole tendon is relatively linear, particularly at high strains. The stiffness, elastic modulus and hysteresis varied across the population (inter-quartile range of 145–231 N mm^{-1}, 0.67–1.07 GPa and 17–35%, respectively). These values are within the reported biological range. An average of 38 J of energy was recovered from the elastic recoil of the tendon, which contributes 16% of the total average mechanical work of the hop (254 J). The high strains measured here (average peak strain was 8.3%) and in other studies may be possible due to the complex architecture of the Achilles tendon; however, prolonged hopping may well cause tendon damage. In conclusion, the properties of the elastic Achilles tendon can contribute significantly to the total mechanical work of the body during one-legged hopping; however, individual variation in the properties of the tendon vary the energy storing capacity of this structure.

Supplementary material available online at
http://jeb.biologists.org/cgi/content/full/208/24/4715/DC1

Key words: elasticity, biomechanics, stress, strain, elastic modulus, human.

Catapult Mechanism

Kawakami (2002)



Elastic Recoil of Fascial Tissue

A - Less Length Change in Muscular Units (i.e. less eccentric muscle load)
VS.
B - More Length Change in Muscular Units (i.e. more eccentric muscle load)

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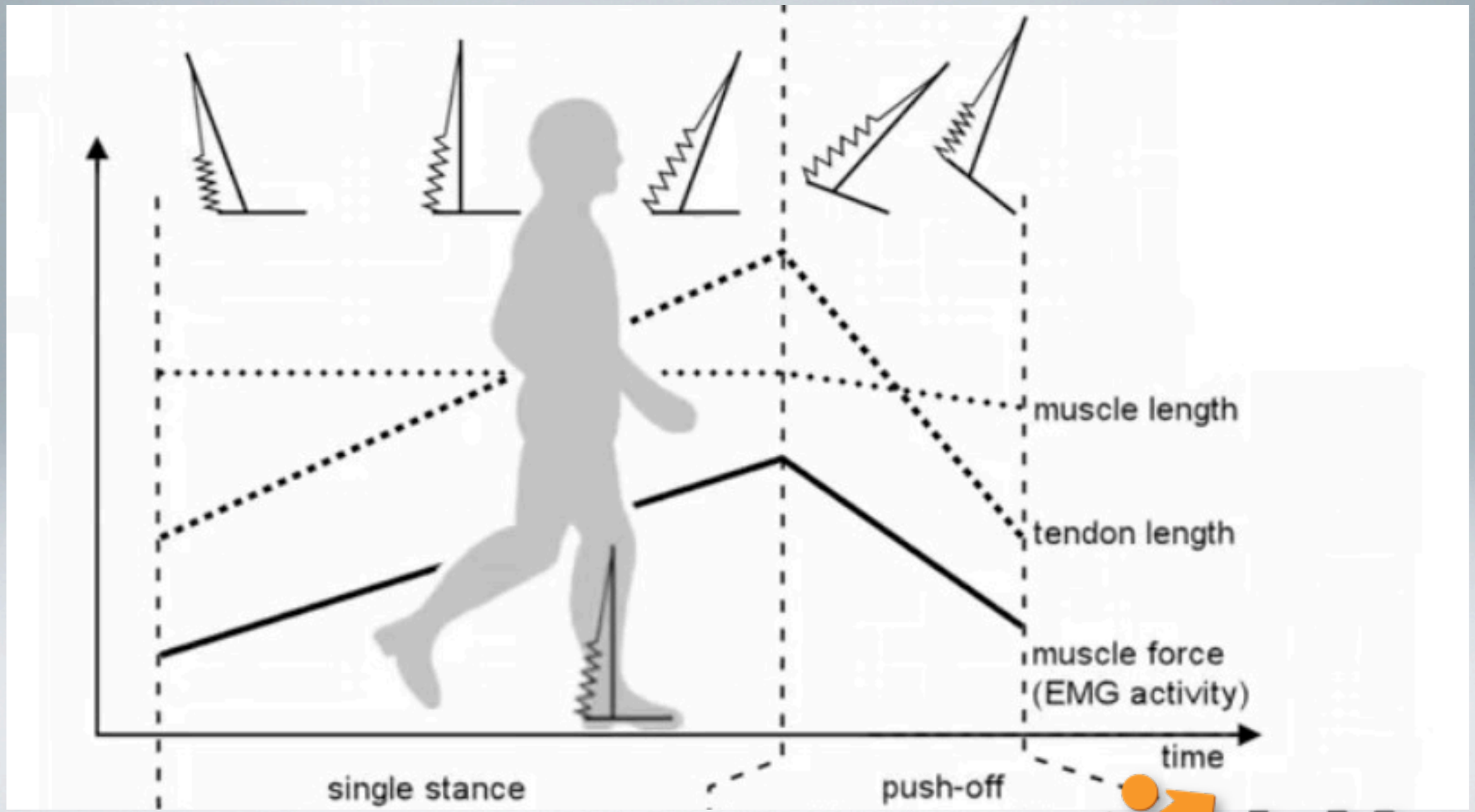
Adjo Zorn – Fascial Elasticity



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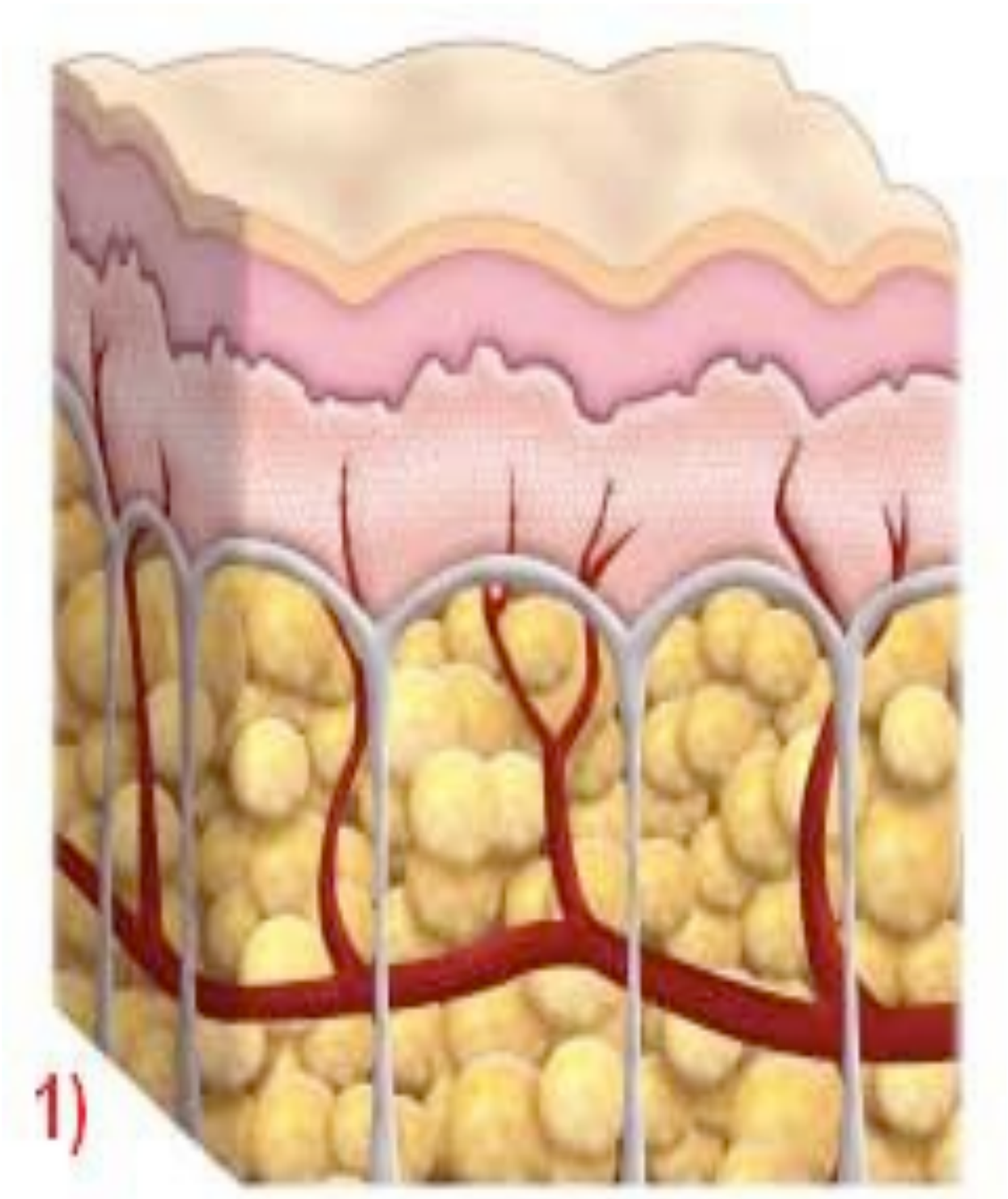
Any tendency to think of a local dysfunction, as existing in isolation needs to be discouraged as we try to visualize a complex, interrelated, symbiotically functioning assortment of tissues, comprising skin, muscles, ligaments, tendons and bone, as well as the neural structures, blood and lymph channels, and vessels that bisect and invest these tissues – all given shape, form and functional ability by the fascia.

(Schleip 2006, Ingber 2008, Solomonow 2009)

Our skin is very much the skin "of" the superficial fascia, and they are thoroughly mechanically related

Gil Hedley – PhD Anatomist

Retinacula Cutis

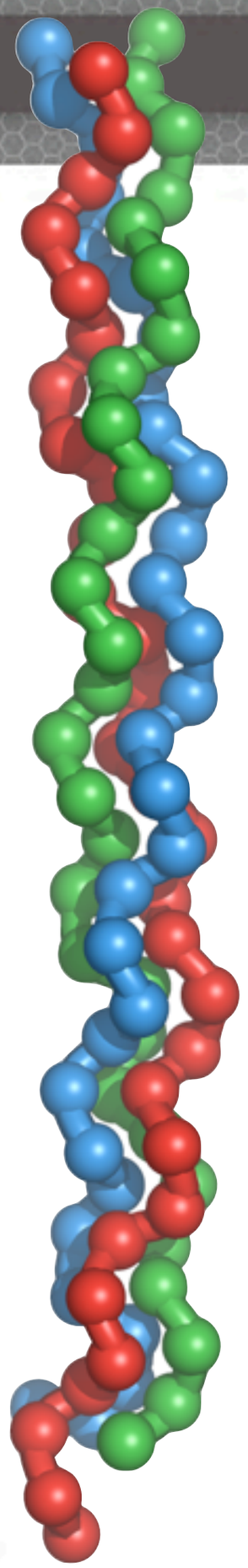


Bundles of collagen fibers, known as Cutaneous Ligaments extend from the dermis to the intermediate layer of the superficial fascia

Shearing of the skin will create a gliding effect on the superficial fascia.

Superficial Fascia

Collagen



Characteristics:

- Chains of amino acids coiled around each other in a triple helix format

- The longer they are, the more strength they give

- The longest/strongest collagens are the hardest to make (require the right diet and the right movement)

- All Collagen carry a special molecule called *Glycoaminoglycans*

- Once manufactured, collagen molecules get anchored to the exterior of the cell and unfurl throughout the extra-cellular matrix where molecules from adjacent cells can intertwine

- Wrinkles, arthritis, circulatory problems involve lesser quality collagen that cannot prevent the tissue from pulling apart and separating - this makes us look and function 'older' as stability begins to be affected

Fascial Nutrition:

Collagen Health for Life

- Foods that are rich in glycosaminoglycans help collagen production ... and attract A LOT of water with them (up to 1000 times their own weight)

- Glycosaminoglycans will naturally adhere to collagen everywhere in your body, moistening dry skin, helping your tendons and ligaments stay supple, and make you look and function younger

- Water in the connective system will coat joints and tissues in tiny, electrically charged clouds, which creates a protective layer of super-lubricating fluid

Fascial Nutrition:

Collagen Health for Life

- Collagen is the most prevalent kind of protein we have (about 15% of our dry weight)

- Research indicates that individuals with weak collagen experience more injuries throughout their lives

- When our body is making collagen, it's performing a physiological high-wire act, a feat of extraordinary timing and mechanical precision. This level of complexity makes collagen more dependent on good nutrition and more vulnerable to the effects of pro-inflammatory foods than other tissue types.

Fascial Nutrition:

Collagen Health for Life

- Inflammation is a culprit (under acute inflammation, the bodies response is to elevate white blood cell count, which attack free radicals and release collagen-chewing enzymes called *COLLAGENASES*)

- Under chronic inflammation / congestion (poor diet and environmental exposure) the exact same mechanism happens - but over a long period of time - and the fascial system suffers - leading to injuries, instability and poor motor control (due to the fact that nerves need fascial sensitivity)

- The number of children with food allergies has risen 100% in the past 5 yrs

- Sugar and Vegetable oil combined with nutrient-deficient foods make up the perfect pro-inflammatory diet

- Poor diet will negatively affect collagen in the skin and fascia, negatively affecting aging, joint stability and function

- Collagen is made from raw materials we must eat. Unlike other tissues, collagen is uniquely sensitive to metabolic imbalances

- One of the best ways to help collagen heal is to eat some (C. Shanahan, MD)

Fascial Nutrition:

Top PRO-Inflammatory foods to avoid:

1- Sugar
2 - Vegetable Oils
3 - Trans Fats
4 - Pasteurized Dairy
5 - Feedlot Raised Meats
6 - Processed Meats
7 - Alcohol
8 - Refined Grains
9 - Artificial Food Additives (processed foods)

Fascial Nutrition:

Top ANTI-Inflammatory foods to consider:

1- Kelp
2 - Herbs (including Tumeric, Ginger)
3 - Wild Caught Salmon
4 - Green Tea
5 - Good fats
6 - Cruciferous Vegetables
7 - Berries

Supplemental Resources:

- ‘Deep Nutrition’ (Shanahan/Shanahan)
- ‘Fascia’ (Mark Lindsay)

KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

- USE WHOLE BODY MOVEMENT
- USE 'COUNTER-MOVEMENT' TO CREATE PRE-STRETCH (OPTIMIZES TISSUE LOADING)
- VARY FORCES AND DIRECTION OF LOAD (TRIANGULATE EXERCISES - ALLOW ENHANCED TISSUE MOBILITY AND REGENERATION)
- TRAIN IN INTERVALS (REST INTERVALS ALLOW THE TISSUE TO REHYDRATE)
- MAKE USE OF ENVIRONMENTAL DRIVERS (GRAVITY / GRF) TO CREATE ELASTIC REBOUND
- RHYTHMICAL MOVEMENT (ALLOWS TISSUE AND JOINT DYNAMICS TO SYNCHRONIZE)
- ONLY MOVE TO YOUR OWN THRESHOLD (ALWAYS BEGIN WITH A SMALLER ROM)

KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

USE WHOLE BODY
MOVEMENTS

KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

USE 'COUNTER-MOVEMENT' TO
CREATE PRE-STETCH

KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

VARY FORCES AND DIRECTION OF LOAD

Evidence suggests that tissue (fascia) is better trained by a wide variety of vectors; in angle, tempo and load.

- Huijing 2007

TRAIN IN INTERVALS

TRAINING IN INTERVALS WILL HELP RESTORE WATER BALANCE IN TISSUE (EXERCISE SQUEEZES OUT WATER FROM FASCIA - 5 MINS OF RECOVERY EVERY 30 MINS WILL HELP HYDRATE 'DRY' TISSUE)

KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

MAKE USE OF ENVIRONMENTAL DRIVERS (GRAVITY / GRF) TO CREATE ELASTIC REBOUND

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KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

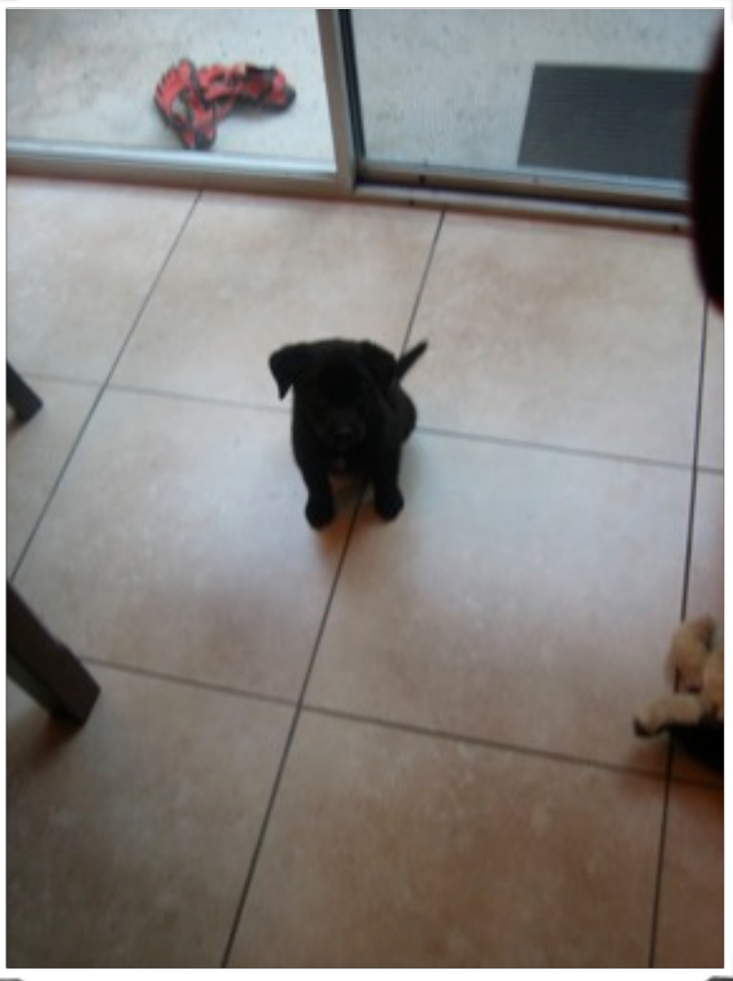
RHYTHMICAL MOVEMENT

KEYS TO TRAINING AND OPTIMIZING FASCIAL ADAPTATION

ONLY MOVE TO YOUR OWN THRESHOLD (ALWAYS BEGIN WITH A SMALLER ROM)

Threshold 1 - 3

- Instituteofmotion@gmail.com
- www.instituteofmotion.com
- Videos and workshops available



Thank you!