

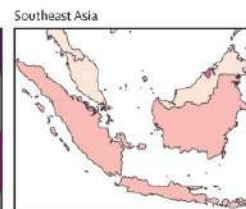
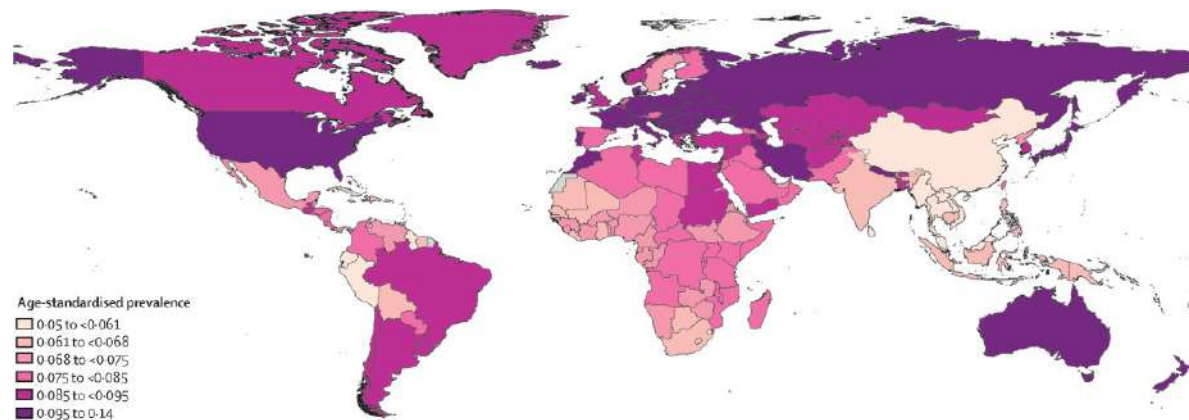
Sitting Ergonomy II.

Medical



Dr. Peter HANTZ
EcoBlue Ltd.
Fibervar Ltd.

Raw prevalence of low back pain by 204 countries worldwide in 2019



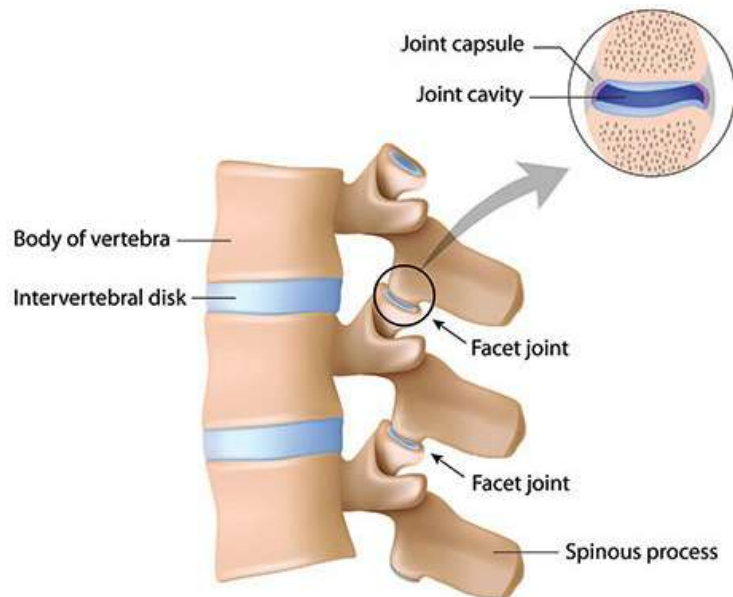
<https://www.thelancet.com/journals/lanrhe/article/PIIS2665-9913%2823%2900098-X/fulltext>

<https://www.medrxiv.org/content/10.1101/2022.09.16.22280040v2.full.pdf>

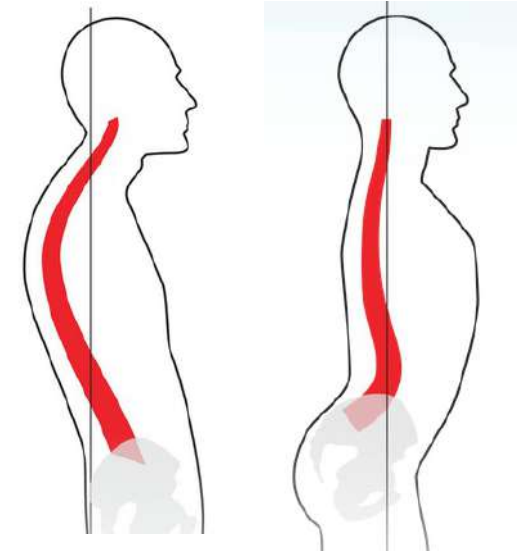
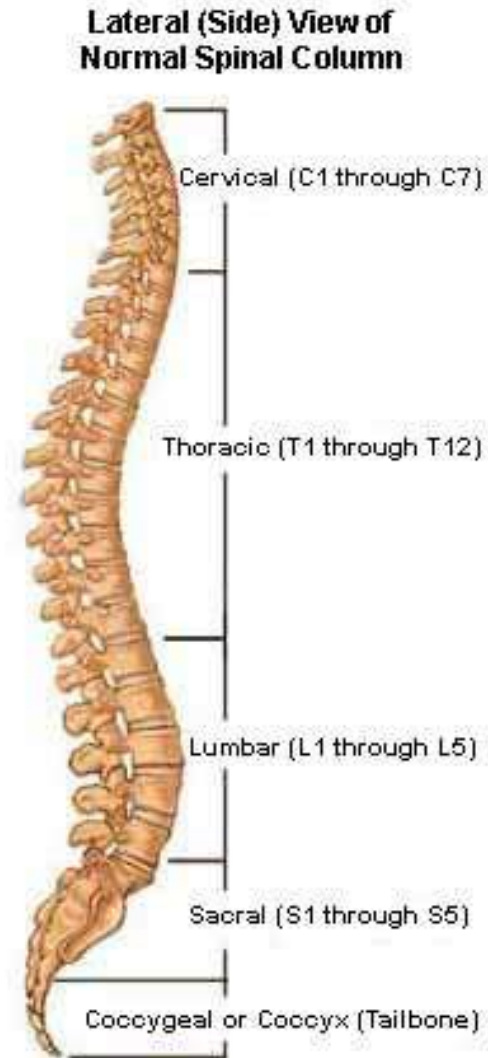
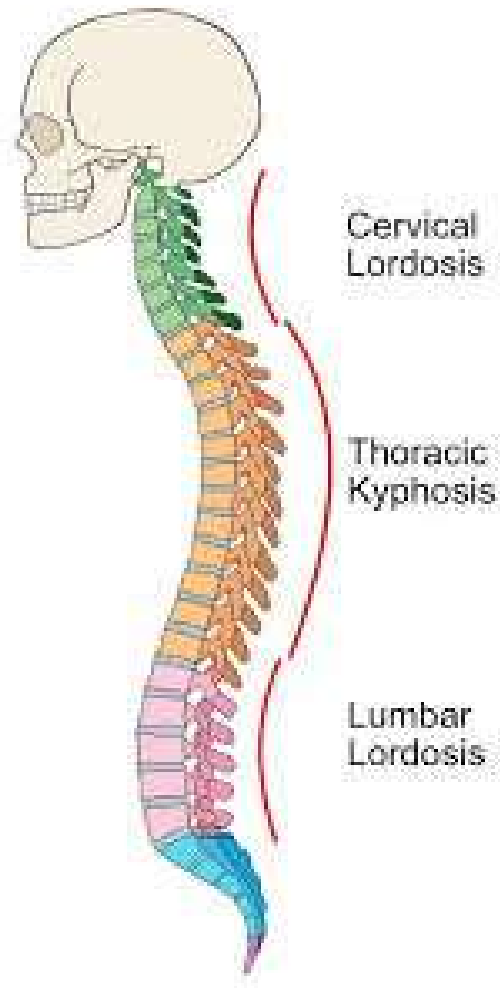
Spinal cord

Natural S-shape

Spine – 33 vertebrae
24 movable



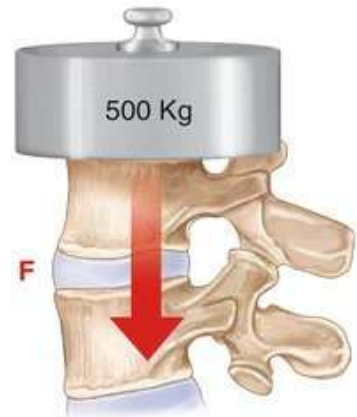
Discus and Facet joints



hypo / hyperlordosis
<=>
bad pelvic angle

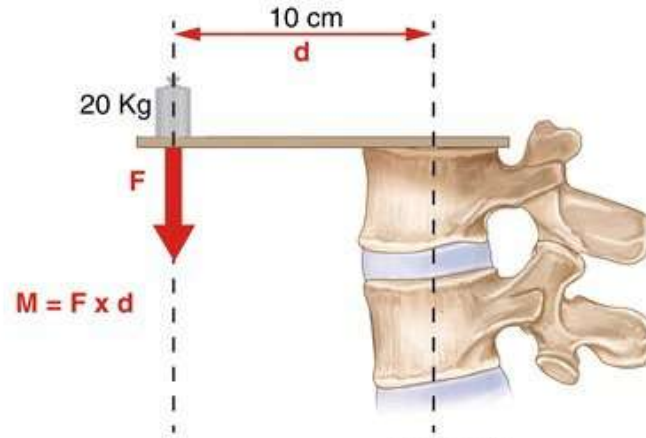
Spinal cord, Compressive & Tensegrity models

Admissible Physiological Loads on Intact Young Functional Spinal Unit.



COMPRESSION

Force $F = 3000 - 5000 \text{ N}$



FLEXION

Moment $M = 10 - 20 \text{ Nm}$

compression elements (rigids) never touch each other directly
@ floating network of tension elements (cables)

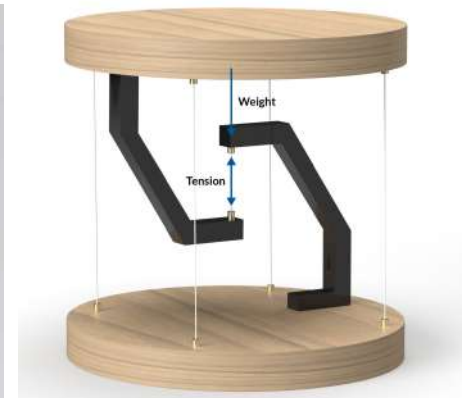
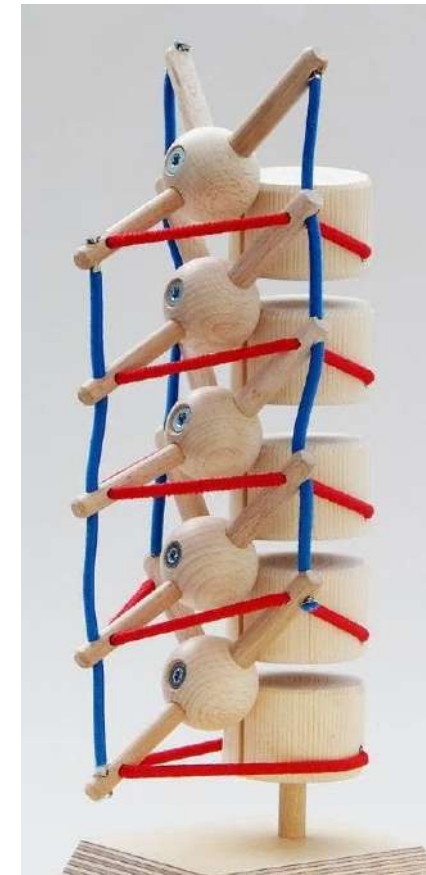
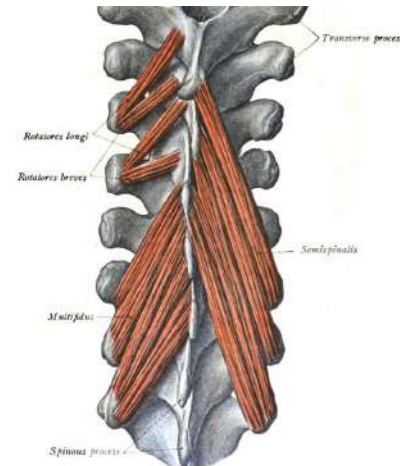
Spine: hybrid structure

tensegrity principles:

Transversospinal muscles

hydraulic pressure and

direct mechanical support



Wolff's law: osteoporosis

Wolff, 1892: Bone remodels itself in response to the mechanical loads placed on it
Decreased load - weakening

Sitting: site-specific lost
Hip
Femur

Frequent standing/walking breaks (every 30–60 min)
more protective than one long walk
(sitting time: same)

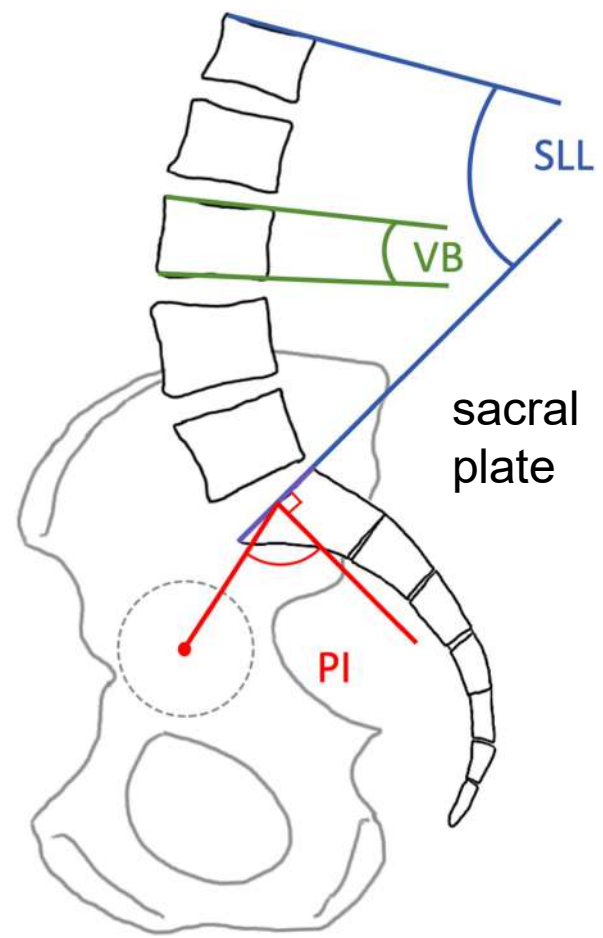
Contradictory results

<https://www.sciencedirect.com/science/article/abs/pii/S8756328214001446>

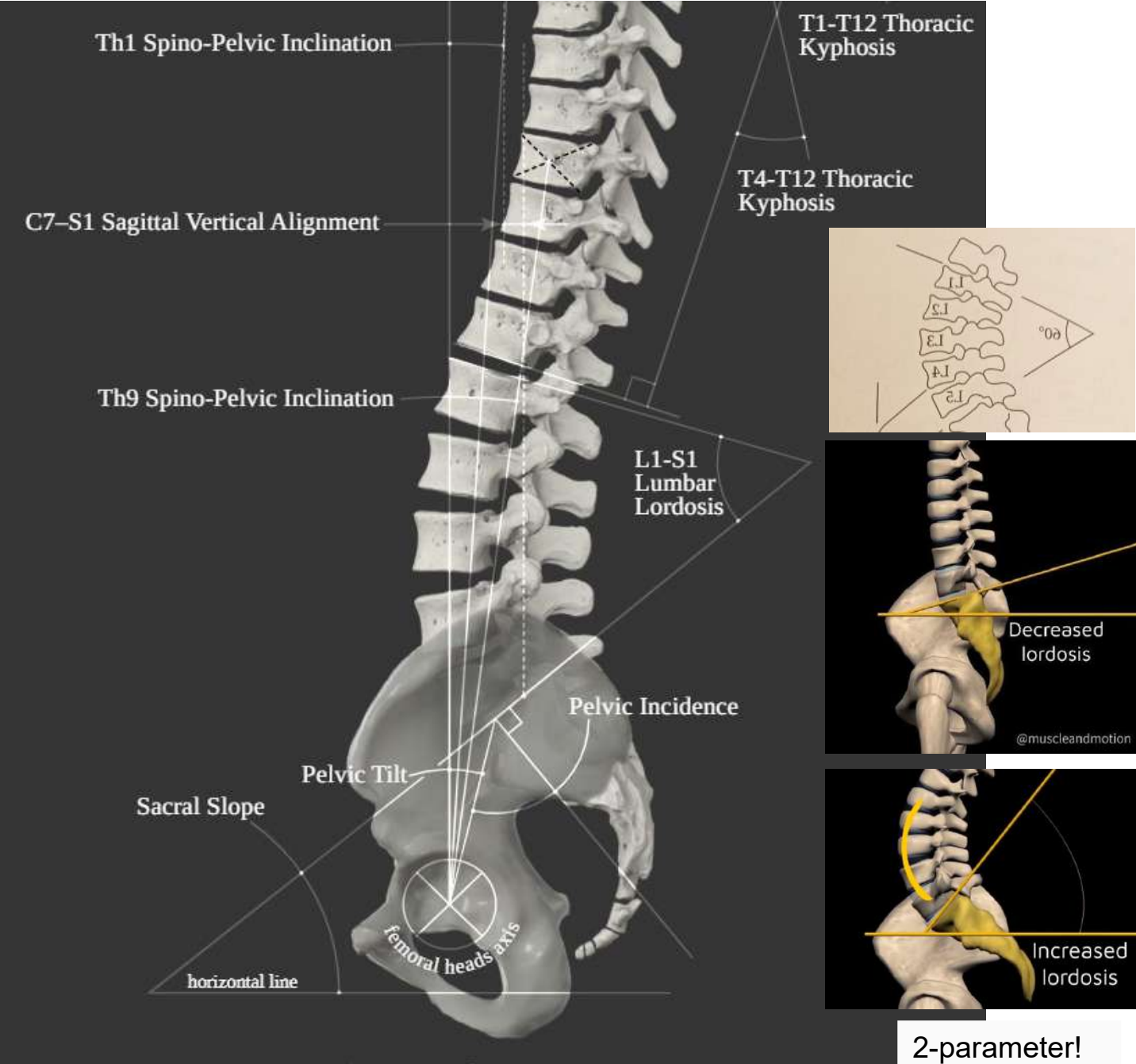
<https://pubmed.ncbi.nlm.nih.gov/40815408/>

<https://cemcor.ubc.ca/resources/sedentary-behavior-does-not-predict-low-bone-density-bmd-nor-fracture-camos-study-2024/>

Lordosis

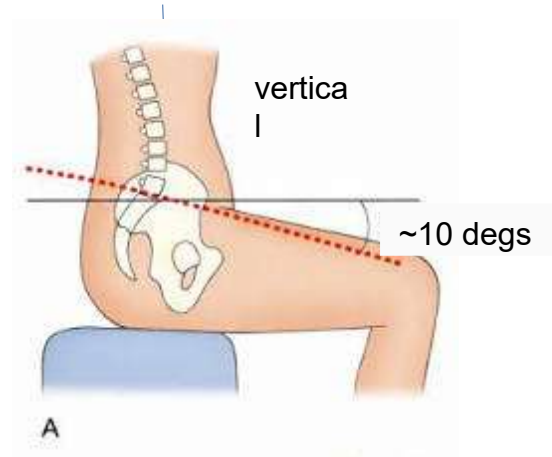
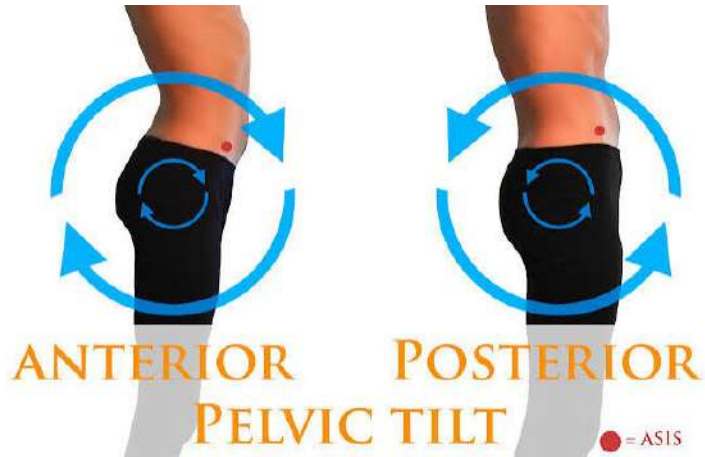


SLL = L1-S1 Segmental Lumbar Lordosis



2-parameter!

Pelvic tilt/rotation PT – relative to something



Pelvic Tilt/Rotation: several definitions
ASIS-PSIS line Relative to horizontal

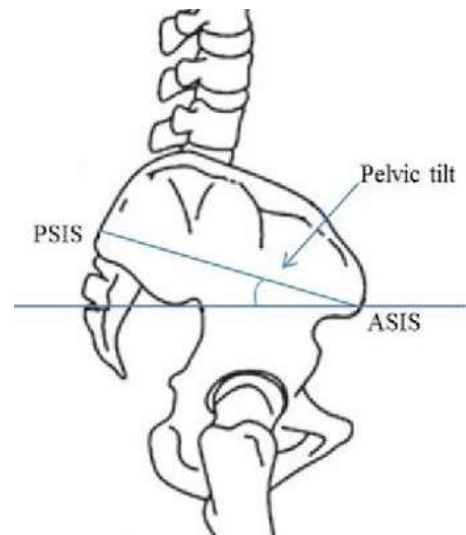
Mainstream “normal”:: 15°

Alternatives:

Relative to neutral posture

“normal”:: 0°

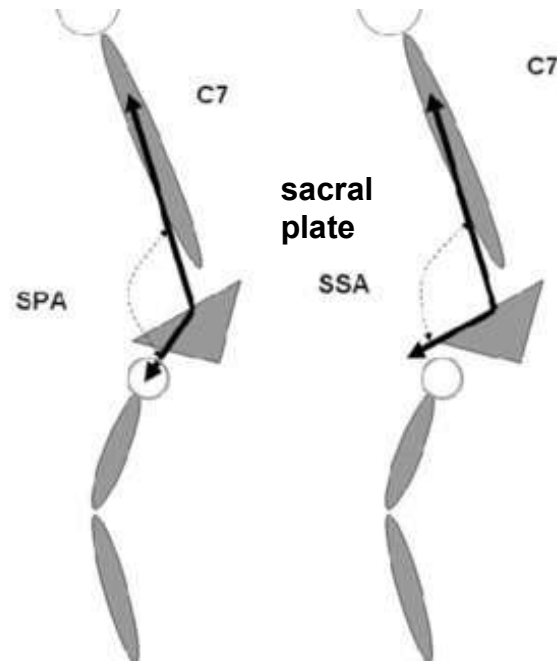
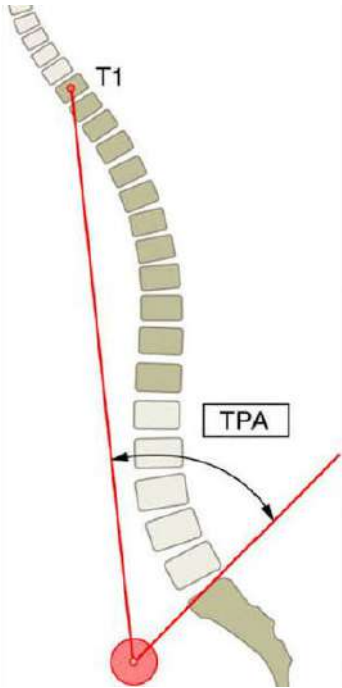
Relative to vertical



ASIS = Anterior Superior Iliac Spine
(elülső felső csípőtővis)

Kinematics chaos: trunk-hip

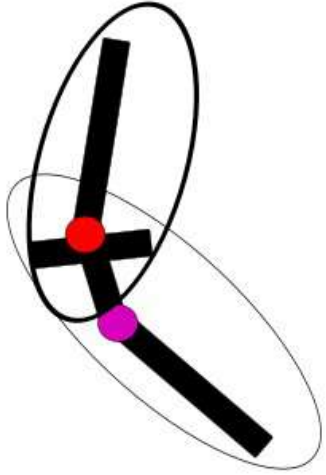
SPA = Spino-pelvic Angle
SSA = Spino-Sacral Angle
T1PA = T1 pelvic angle



Absolute ...

Patient on a table:
trunk :=
horizontal
Patient in a chair:
trunk := the back

Kinematics chaos



Trunk ... Pelvis... Femur

usually

[Trunk + Pelvis] ... Femur

- Lumbosacral/Lumbopelvic joint (L5–S1)
- Spherical Hip/Coxofemoral joint

Trunk–thigh angle = $180^\circ - (\text{Lumbo-sacral} + \text{Coxo-femoral})$ angle

Lumbo-sacral = ?? sacralplate-C7 ?? = “hip-trunk”

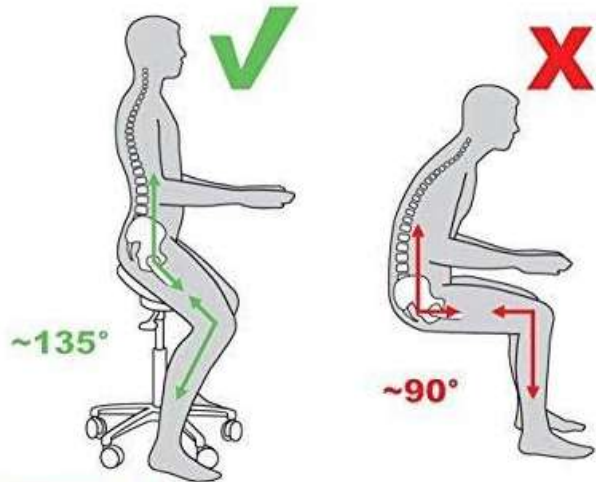
Coxo-femoral = pelvis ↔ femur = “hip–thigh”

If pelvic tilt cca 10° : lumbo-sacral cca 0° & Coxo-femoral all

Schoberth (1962) max 60-deg Coxo @ stand → sit

130: 50 by Cox + 0 by Lumbo

90: 60 by Cox + UNFORTUNATELY 30 BY LUMBO



Trunk–Thigh angle
110-135° optimal
But whats that?

Kinematics chaos

Hip Flexion:

Femur and ASIS-PSIS line
@ saggital plane

Alternatives:

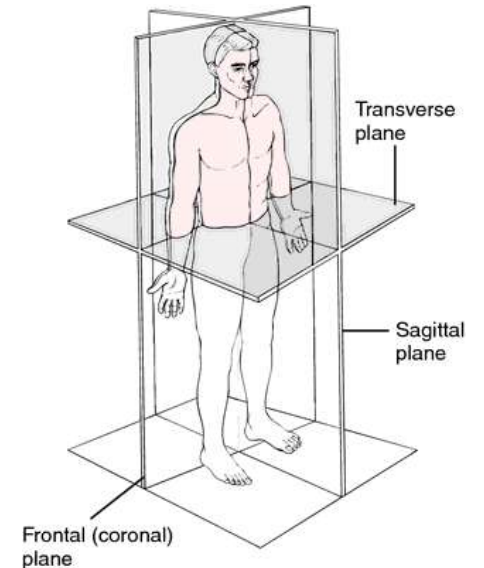
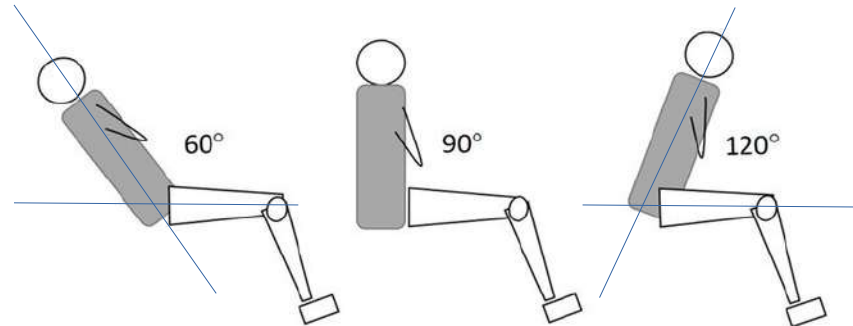
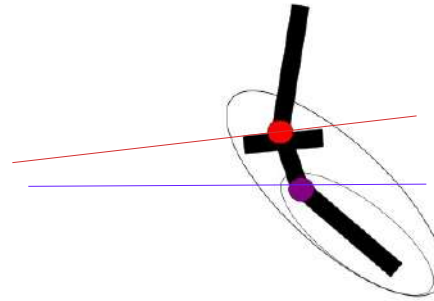
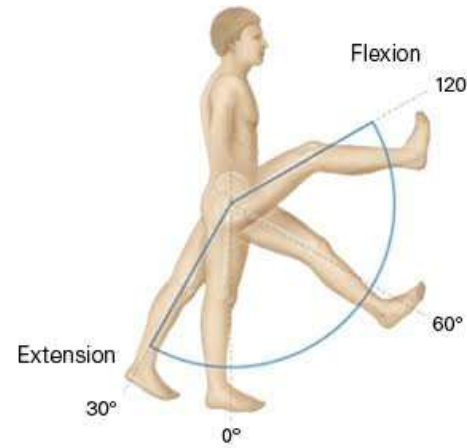
Standing/Laying "trunk"
may be reference-zero
may be not

Include?

Total angle:
femur $\Leftrightarrow$ outer reference

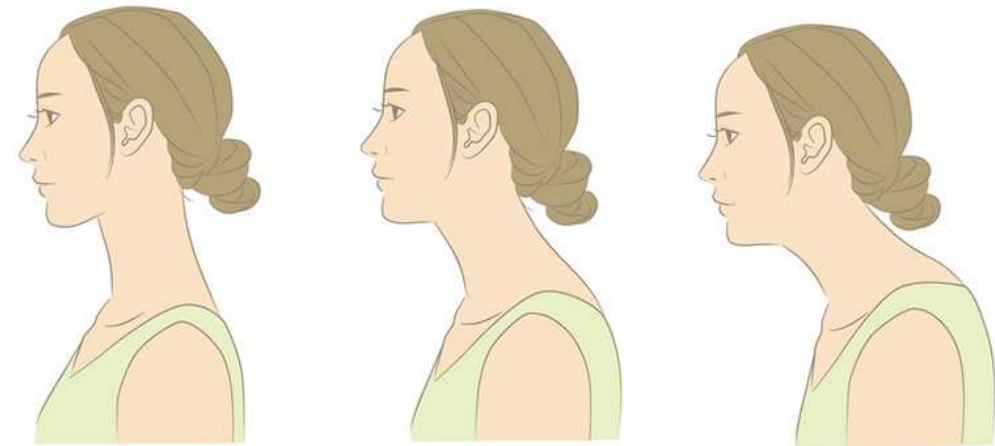
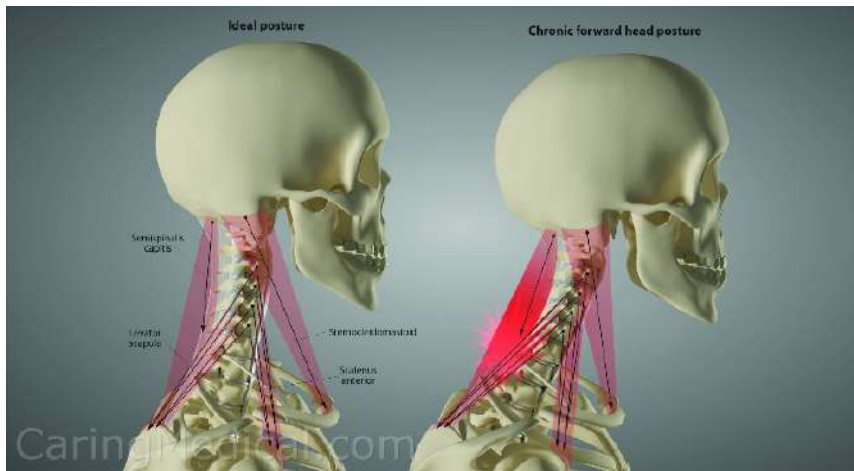
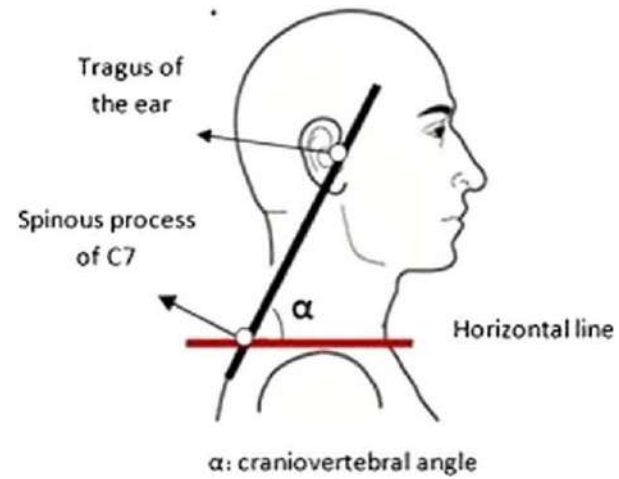
Corrected angle:
pelvic rotation "helped" inflate

Corrected angle = Total – pelvic rotation



Kinematics

Neck



loss of lordosis is associated with longer headache duration

<https://chiro-trust.org/neck-pain/loss-of-cervical-lordosis-its-connection-to-headaches/>

Methods: Motion capture (MoCap)

Inertial Measurement Systems (IMU):

suits @ sensors (**accelerometers, gyroscopes**)
without needing external cameras

Body segments = model

Markers/IMUs = noisy sensors

=> Kalman filters = best weighted estimate

(Predict, then correct

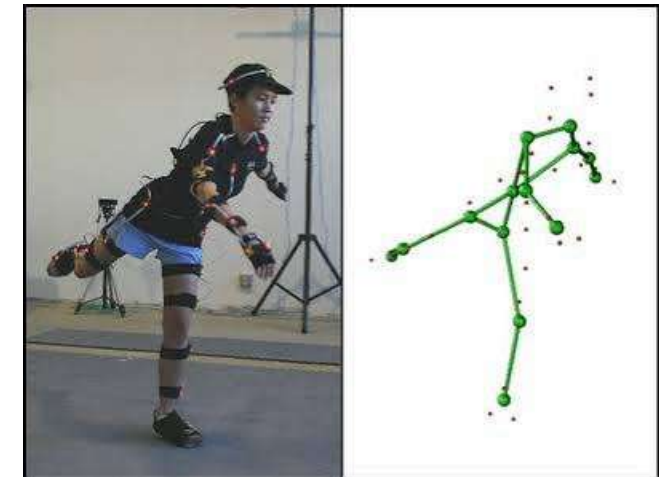
— trusting which source is currently more reliable.)

Inaccuracy: exponential growth

Angles: $\pm 2-5^\circ$

Absolute: (ten) minutes

Relative: arbitrary long



Methods: Motion capture (MoCap)

Video systems:

With Markers

passive: reflection

active: LEDs w timing/color

Precise: <1 mm, $<0.5^\circ$

Problems:

occlusion

soft tissue artifact

Markerless – with deep learning

Google MediaPipe – mobile!



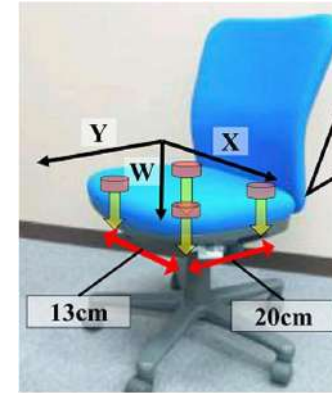
Methods: Sitting Pressure

Force plate: usually 4-6 units

Piezoelectric

Strain gauge

$F_x, F_y, F_z, M_x, M_y, M_z$



Contact area analysis - "pressure mapping" > 1000

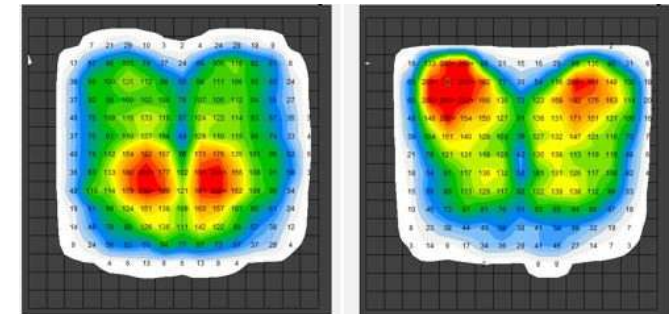
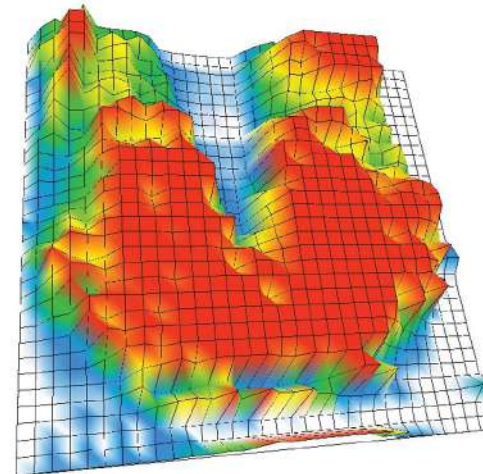
Capacitive

Plate distance

Resistive (cheap)

Conductive foam shape

No shear!



Novel: novel.de

Novel Pliance

Tekscan: tekscan.com

CONFORMat

Sitting Pressure and Center of Pressure COP

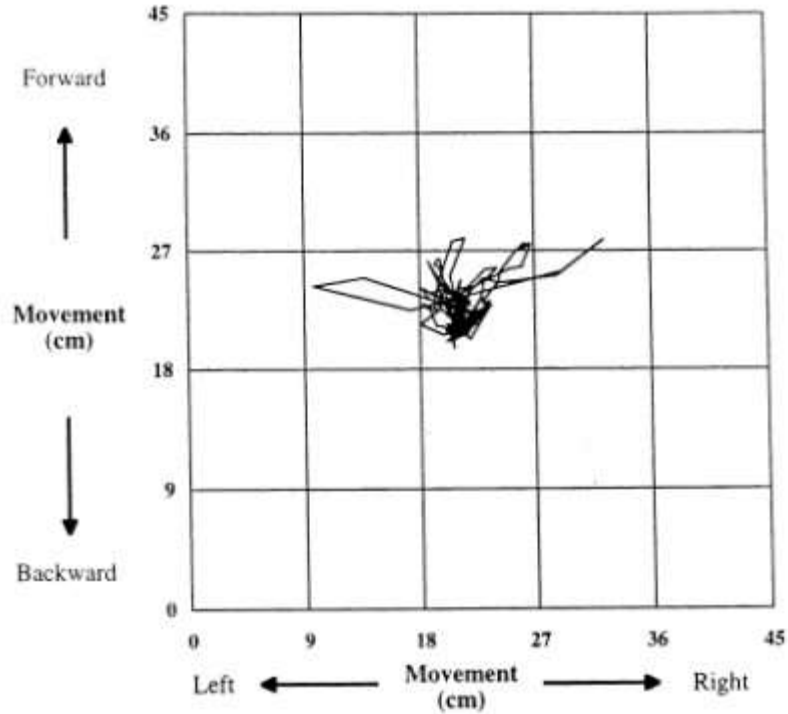


Fig. 2. Sample of a seated subject's center of pressure path recorded by the 45 cm square VERG mat from min 5 to min 10 of a 2 h trial.

Fenety et al.: small sways vs. big shifts

Methods: Disk pressure

Nachemson, 1964 (SE): needle, invasive

Adams, 1992 (UK): refined – spatial inhomogeneity

Wilke, 1999 (DE): only nucleus pulposus

Niche, rather custom-assembled:

Millar, Abbott, Fiso, Intrasure, (Gaeltec discontinued)

<https://www.millar.com/our-expertise/sensor-solutions/pressure-sensors>

<https://www.millar.com/medical-applications/pre-clinical/preclinical-pressure-catheters>

<https://www.adinstruments.com/blog/pressure-catheter-unique-applications>

<https://www.cardiovascular.abbott/us/en/hcp/products/percutaneous-coronary-intervention/pressurewireX-guidewires-physiology/about.html>

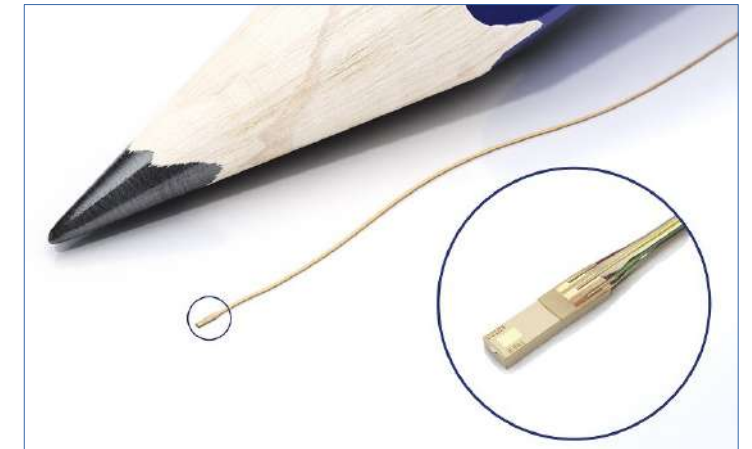
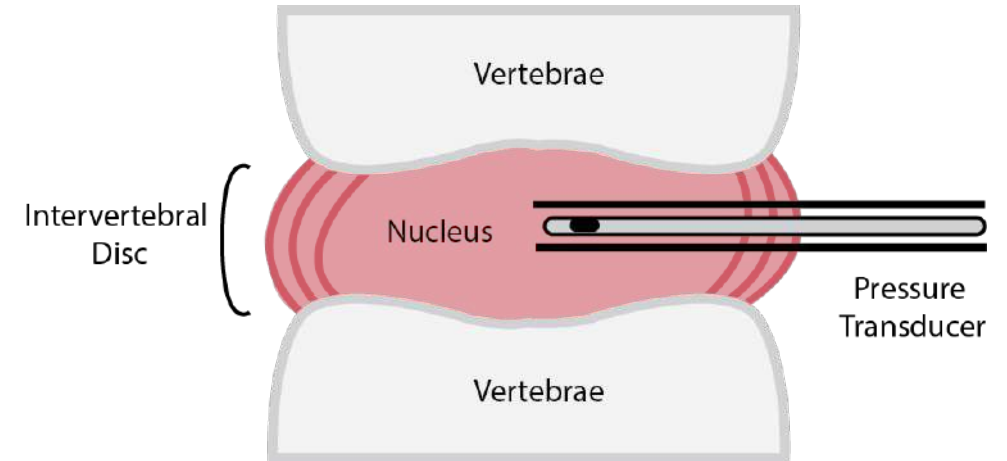
<https://fiso.com/en/communique-de-presse/fiso-technologies-launches-the-fop-m200-the-smallest-commercially-available-pressure-transducer/>

<https://www.amsys-sensor.com/products/pressure-sensor/intrasense-in-vivo-pressure-sensor-for-medical-catheters/>

Piezoresistive silicon pressure (membrane + piezo-resistors)

Fiber-optic Fabry–Pérot sensor (deformed optical cavity)

Computer simulations: finite element methods



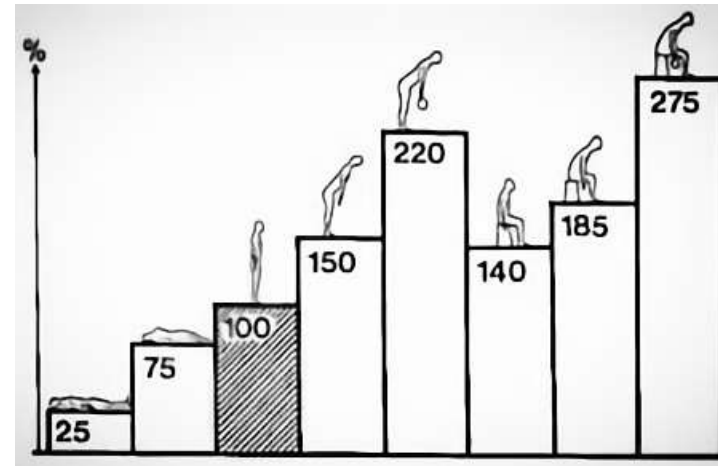
Disk pressure

Posture/Activity	Pressure (MPa)
Lying prone	0.10
Relaxed standing	0.50
Sitting, unsupported	0.45-0.7
Sitting, slumped	0.83
Lifting 20 kg, round back, straight legs	2.30

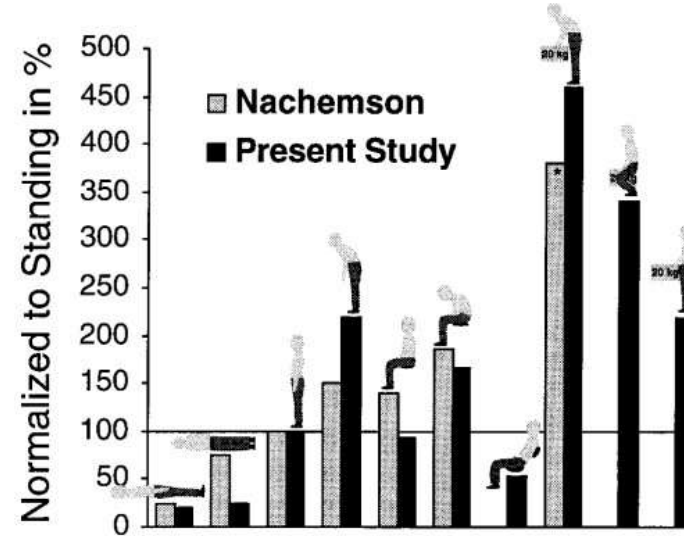
Atm: 10x MPa value (~100.000Pa)

Car tyre: 2 Atm

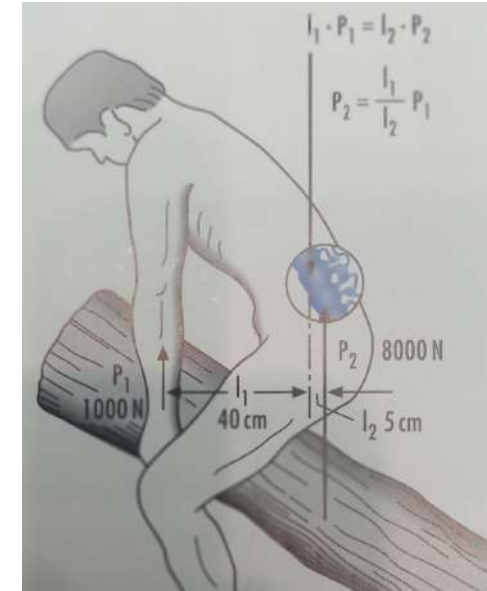
ASYMETRIC load problem



Nachemson,
1975

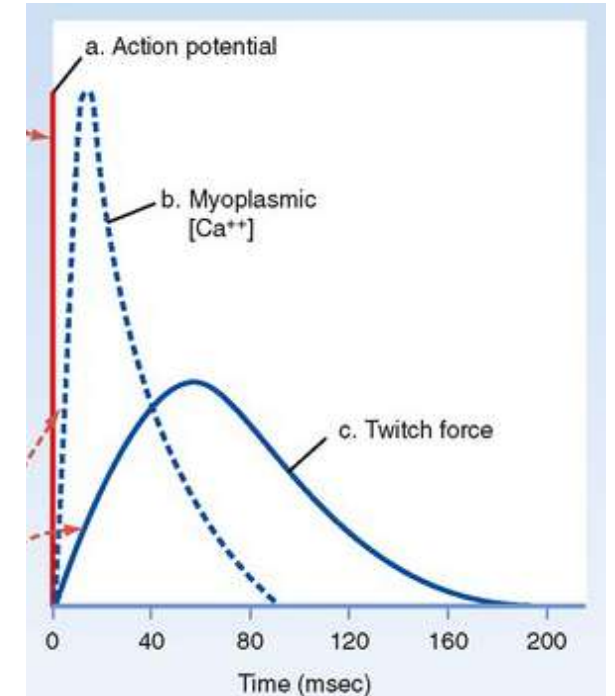
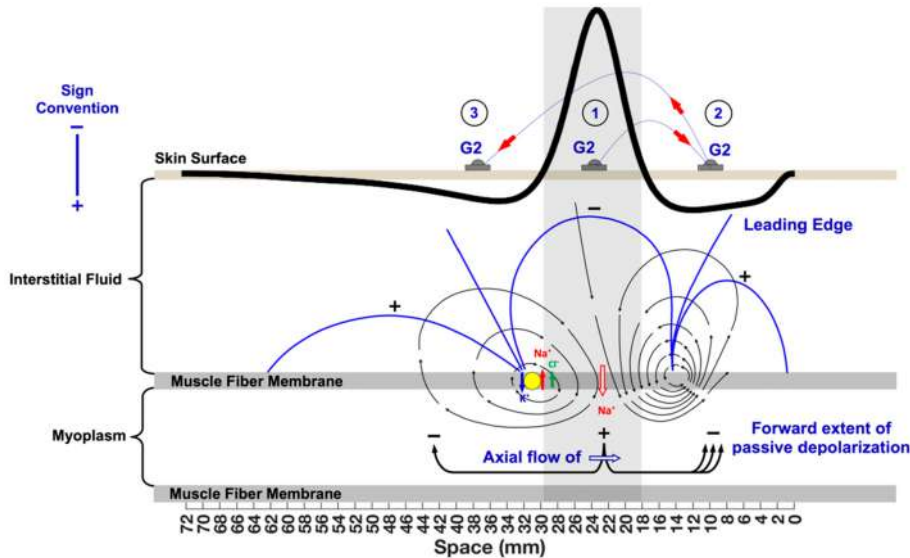


Wilke,
1999



Methods: Surface Electromyography

Nerve → Ach : Receptors → Na^+ in & muscle cell action potential
→ Ca^{2+} release (does not affect) → Actin-Myosin contraction



Σ thousands of units

opening Na^+ channels @ sarcolemma (muscle fiber membrane)
⇒ transmembrane ionic currents

Ionic currents → electric potential field → measured voltage (EMG)

NOT voltage → current
BUT “forced current” (“current dipole”) → voltage

Skeletal muscle (striated)

A-band — birefringent
dark @ polarized microscopy
myosin

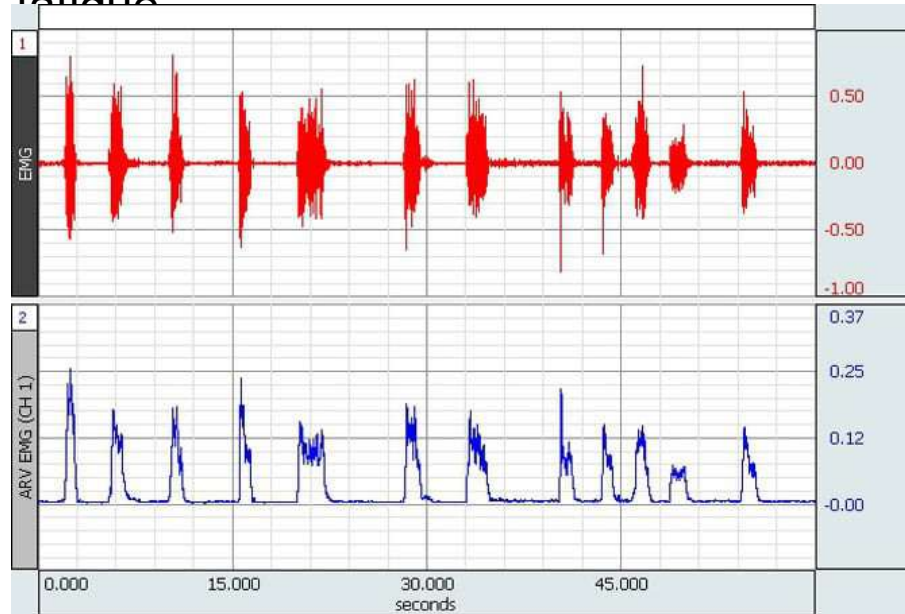
I-band — non-birefringent
actin

Surface Electromyography

Electrical signal @ contracting muscles

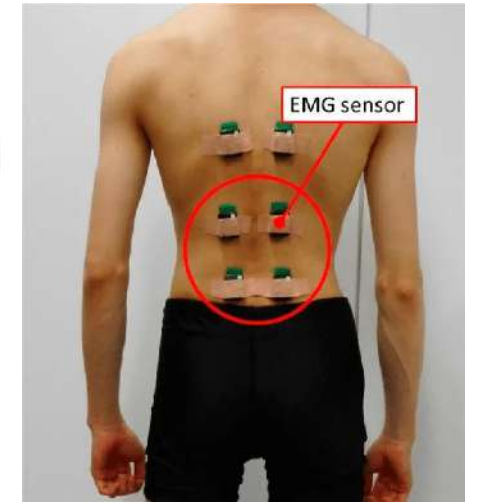
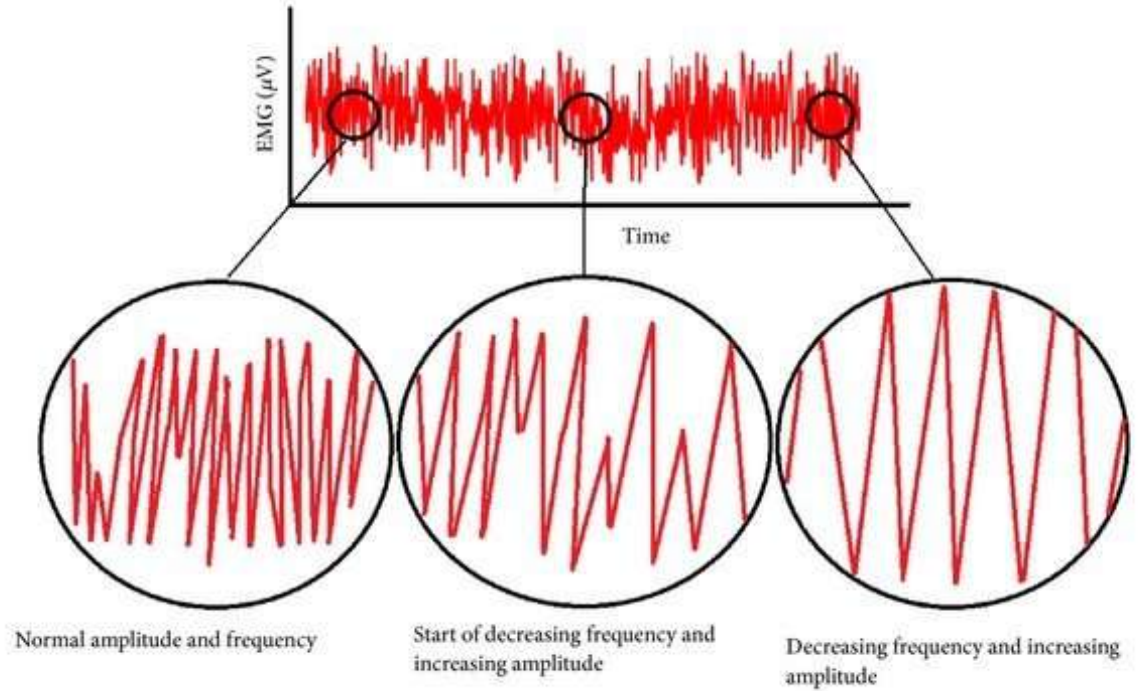
Amplitude → increase @ fatigue

Median frequency → decreases @ fatigue



raw EMG signal — contraction bursts

ARV (Average Rectified Value)



Methods: Hemodynamics

PPG (photo-plethysmography)

< 0.5 cm @ reflection mode

Light @ toe, foot, ankle, knee, calf

single λ : only intensity

pulsatile change (AC)

:: blood volume @ heartbeat

dual λ : spO₂ (saturation-peripheral)

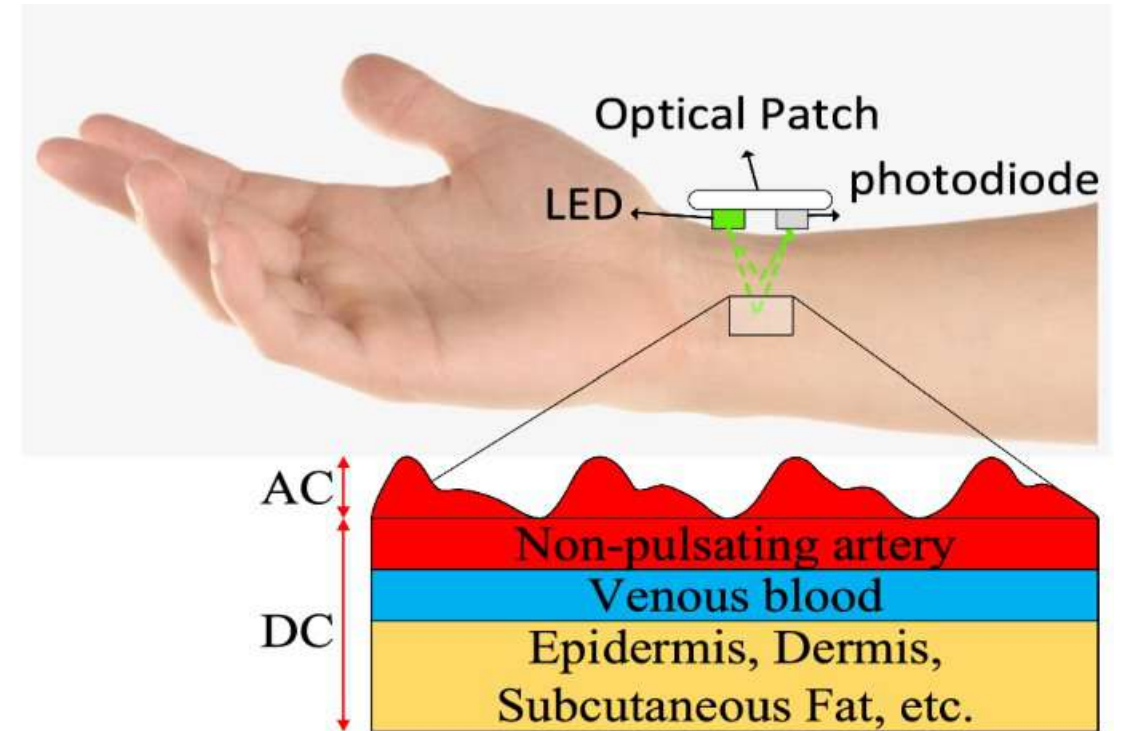
s=saturation p=peripheral

:: not really for leg

pulsatile: mostly arterial

SGP (Strain Gauge Plethysmography)

Circumference measurements



TRICK: AC/DC
separation

Hemodynamics

< 2.5 cm

fNIRS (functional near-infrared spectroscopy)

smO₂ m=muscle

Light @ "banana-shaped" pathES

– multiple scattering

two λ (e.g., ~760nm ; ~850nm)

HbO₂ and HHb :: distinct absorption spectra

Spatially Resolved: "subtracts two banana"

→ have the deeper one

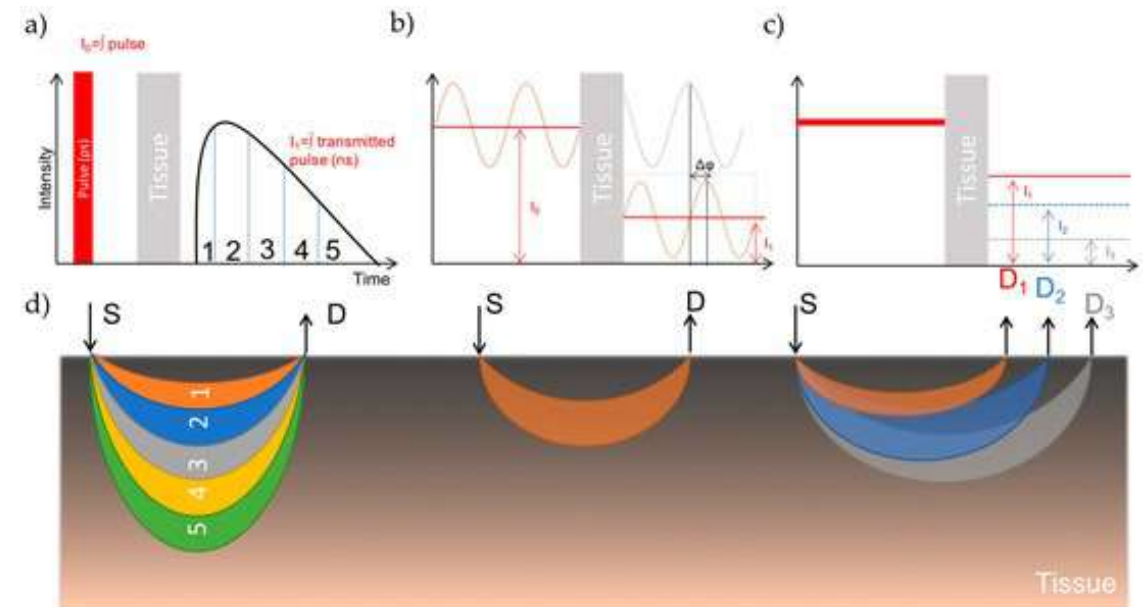
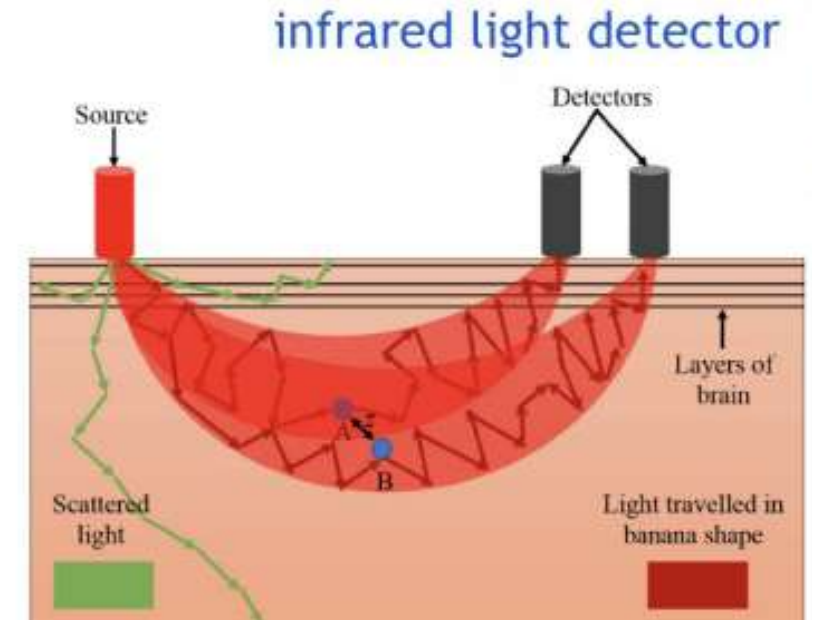
Statistical physics: path
shape

a.) an ultra-short light impulse delay = f(banana)

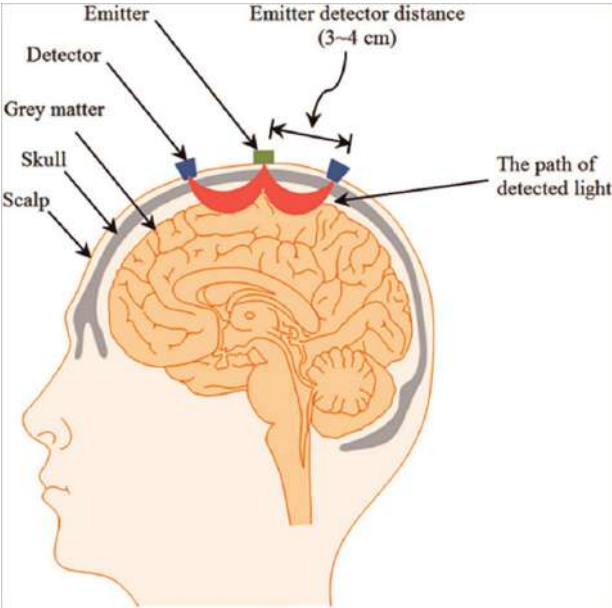
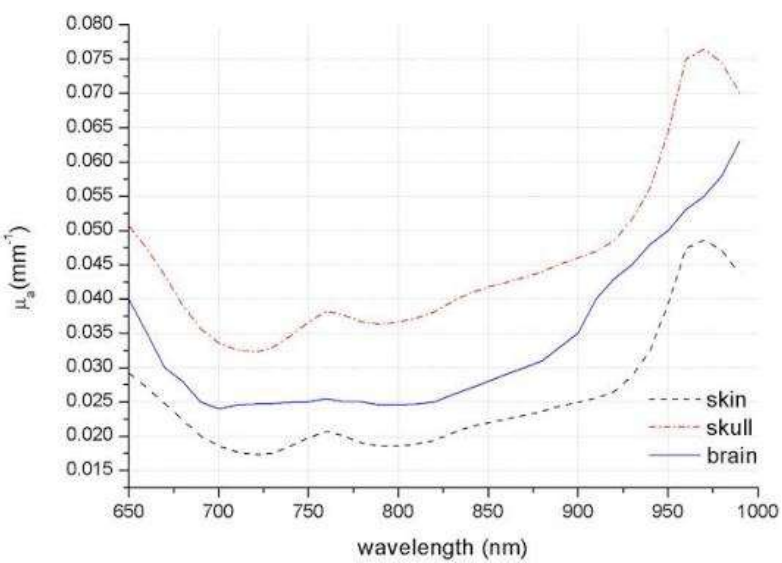
"time resolved"

b.) modulated, phase shift = f(banana)

c.) distances



Hemodynamics-fNIRS



> [Science](#). 1977 Dec 23;198(4323):1264-7. doi: 10.1126/science.929199.

Noninvasive, infrared monitoring of cerebral and myocardial oxygen sufficiency and circulatory parameters

F F Jöbsis



Metric	fNIRS	fMRI → T2*
Spatial resolution	~1 cm (CW) / ~1 cm achievable with TD	1-3 mm
Depth sensitivity	~1.5 cm, imaging limited to ~2-3 cm	Whole brain
Sampling rate (hardware)	1-250 Hz depending on device/channels	~0.5 Hz (TR ~2s)
Real limiting factor	Hemodynamic response (~seconds) same as fMRI	Same hemodynamic response, plus scan speed

Healthy men sat for 8 hours (airplane-like seat, no leg movement)

compression garment
without

What was measured:

limb circumference (calf/malleolus)
extracellular water (BIA - Bioelectrical Impedance Analysis)
arterial blood flow + shear rate (Doppler ultrasound)
and muscle oxygenation (NIR-TRS / Time Resolved Spec)

Measure	Change	p-value
Calf circumference	+2.4% ± 0.7%	p<0.05
Malleolus (ankle) circumference	+2.7% ± 1.4%	p<0.05
Extracellular water (BIA)	+10.1% ± 1.78%	p<0.05
Arterial blood flow (Doppler)	↓ to 61.4% ± 16.2% of baseline	p<0.05
Shear rate (artery wall)	significantly decreased	p<0.05
Oxygenated hemoglobin [oxy-Hb] (NIRS)	~ -10 to -15% by 8h (estimated from graph, not stated as exact number in text)	p<0.05
Total hemoglobin [total-Hb] (NIRS)	~ -10% by 8h (estimated from graph)	p<0.05
Deoxygenated hemoglobin [deoxy-Hb] (NIRS)	no significant difference vs. garment leg	n.s.

compression stockings
help @ 10-20 Hgmm

Z

Multi-frequency Bioelectrical Impedance Analysis mf-BIA

$$I_{in} = \frac{V}{Z_1} + \frac{V}{Z_f}$$

$$V = I_{in} \cdot \frac{Z_1 Z_f}{Z_1 + Z_f} = I_{in} \cdot Z_{total}$$

$$Z_f = R_i + \frac{1}{j\omega C} \text{ (resistor + capacitor)}$$

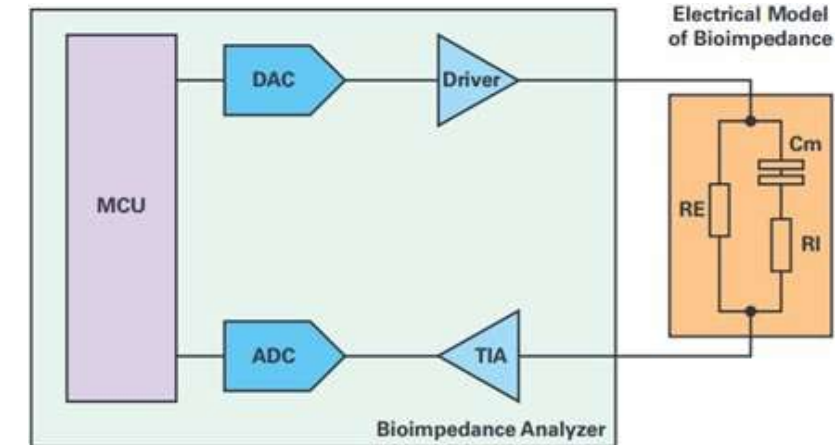
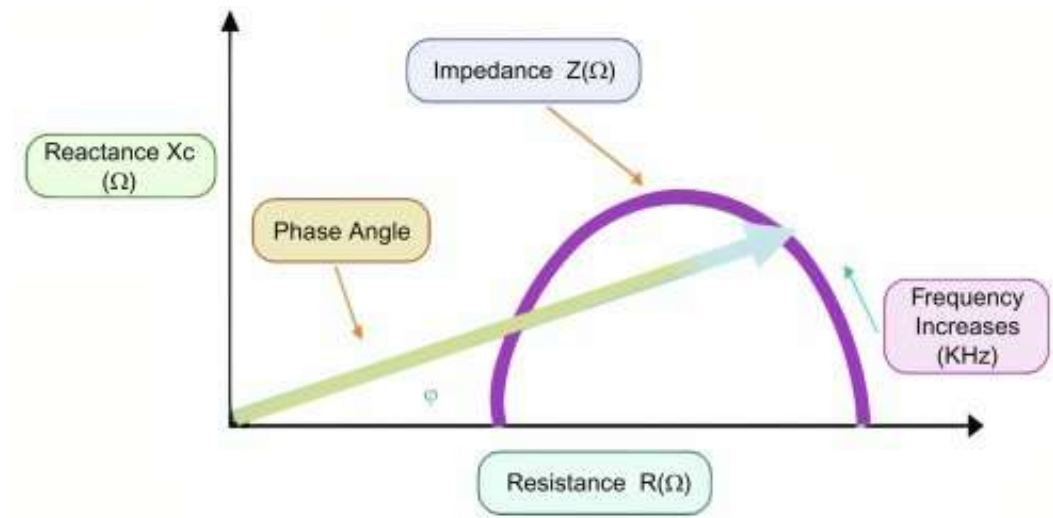
$$Z_{total} = \frac{R_e \left(R_i + \frac{1}{j\omega C} \right)}{R_e + R_i + \frac{1}{j\omega C}} = R_e \cdot \frac{1 + j\omega R_i C}{1 + j\omega (R_e + R_i) C}$$

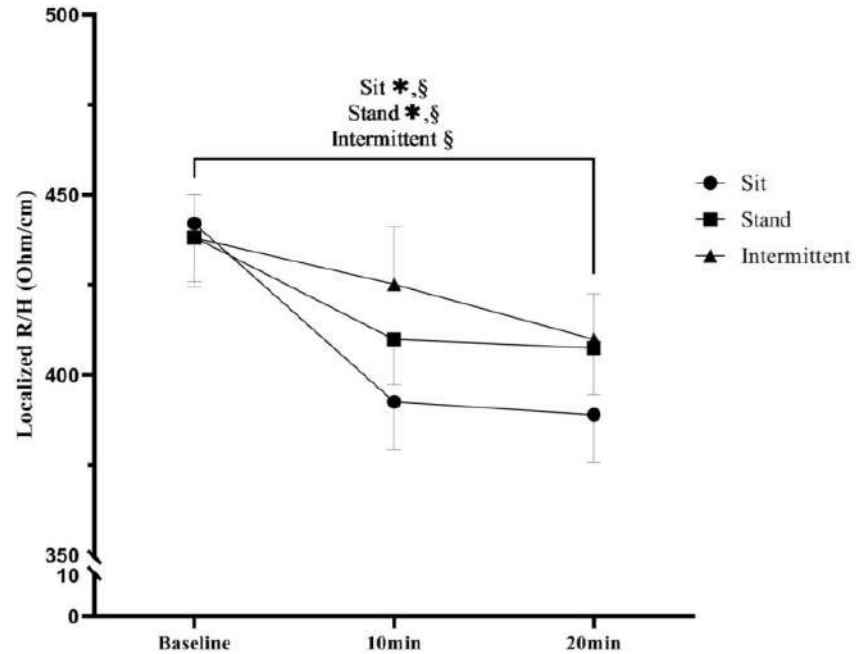
Split into Re and Im

$$R(\omega) = R_i + \frac{R_e - R_i}{1 + (\omega\tau)^2}, \quad X(\omega) = \frac{(R_e - R_i)\omega\tau}{1 + (\omega\tau)^2}$$

Clinical:

R_0; R_max; angle at 50 kHz





* Differences between baseline and 10min, $p < 0.05$

§ Differences between baseline and 20min, $p < 0.05$

Ranking, best to worst:

1. **Sit-to-stand transitions** (1 min sitting + 1 min standing) — **least swelling**
2. **Continuous standing** — intermediate
3. **Continuous sitting** — **most swelling**, measurably worse than both

Myotonometry

Impulse-response / damped-oscillation

Brief mechanical impulse

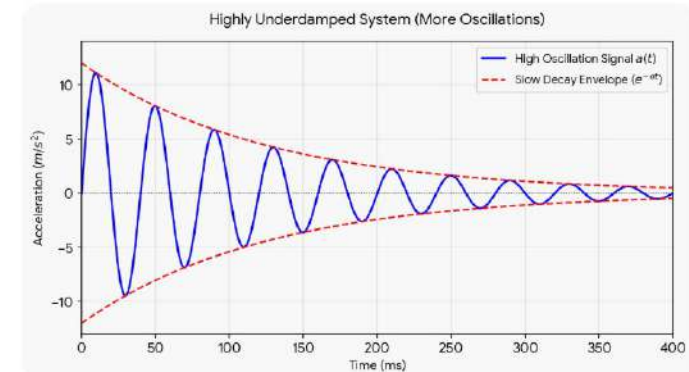
→ decaying micro-oscillation recorded

“hit + free oscillation/decay”



$$m\ddot{x} + b\dot{x} + kx = 0 \quad \Rightarrow \quad \ddot{x} + 2\alpha\dot{x} + \omega_n^2 x = 0$$

1. **Natural Frequency (ω_n)** → Calculates **Frequency (f)**
2. **Decay Constant (α)** → Calculates **Decrement (θ)** and **Relaxation Time (τ)**
3. **1st Amplitude (A_1) + Integral of Wave (Δz)** → Calculates **Stiffness (M)**



MyotonPRO <https://myoton.com/technology/>

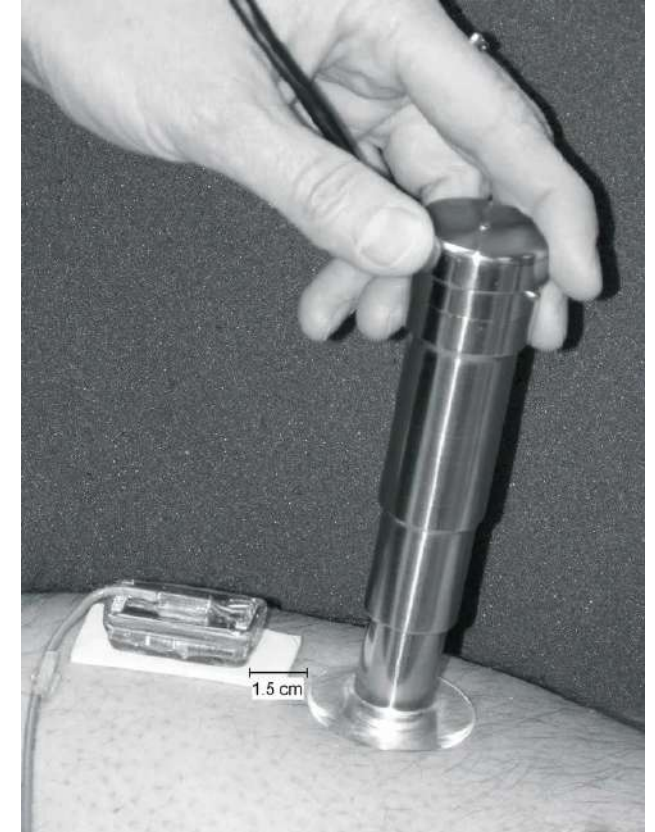
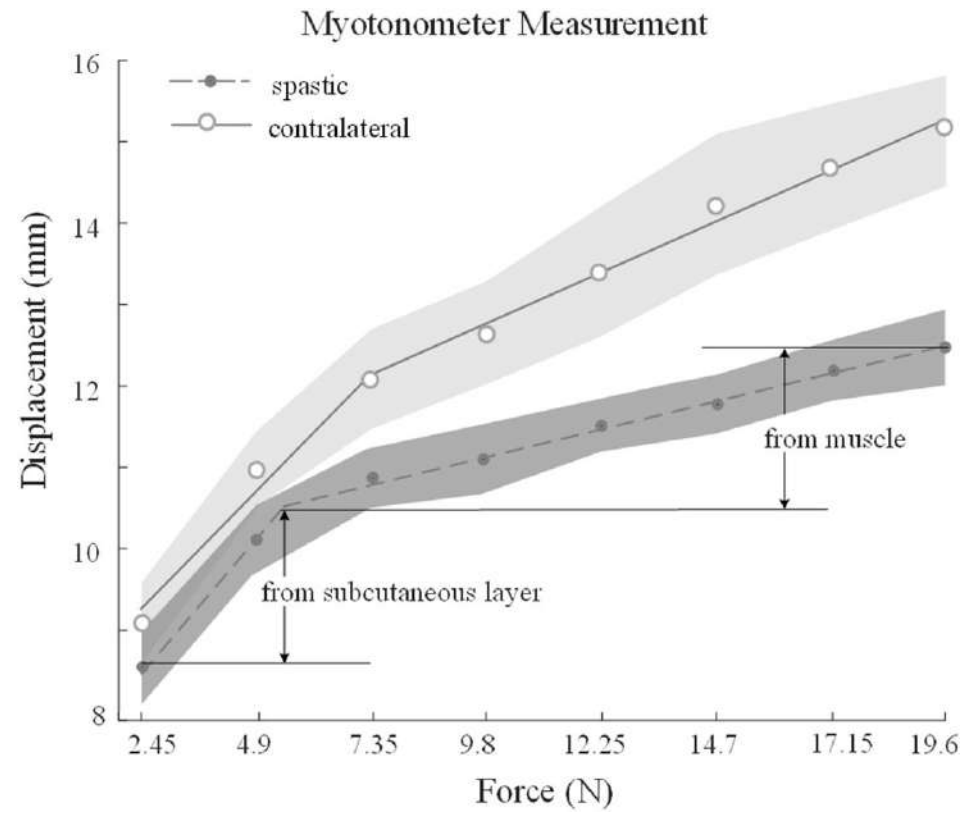
Increased stiffness @ erector spinae

Active: muscle contracting → fatigue over time

Passive: tissue compressed/stretched

Myotonometry

Force-deformation



sEMG and myotonometer
Neurogenic Technologies,
Inc.

Shear wave elastography (SWE)

Shear wave elastography (SWE)

Focused ultrasound pulse:

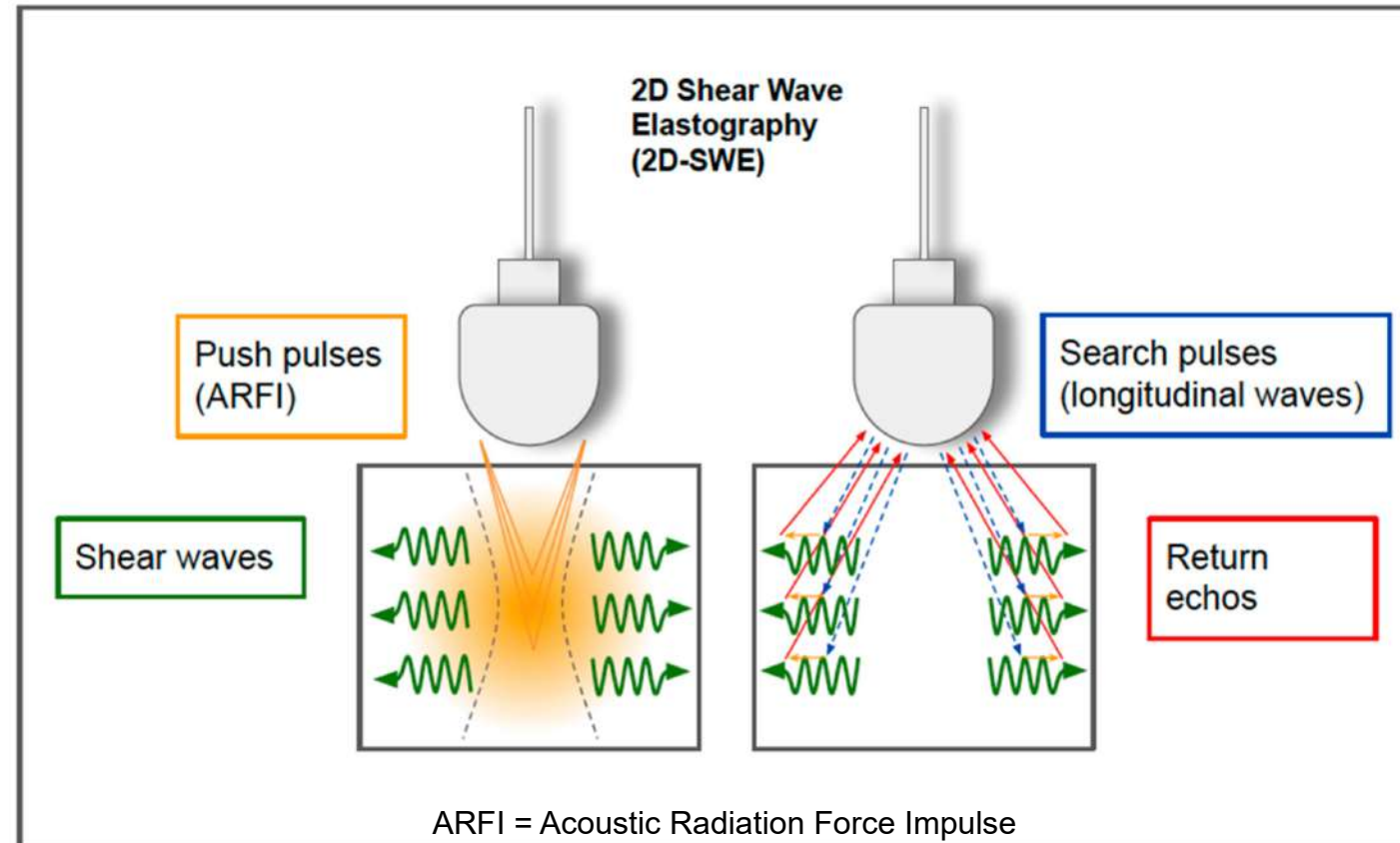
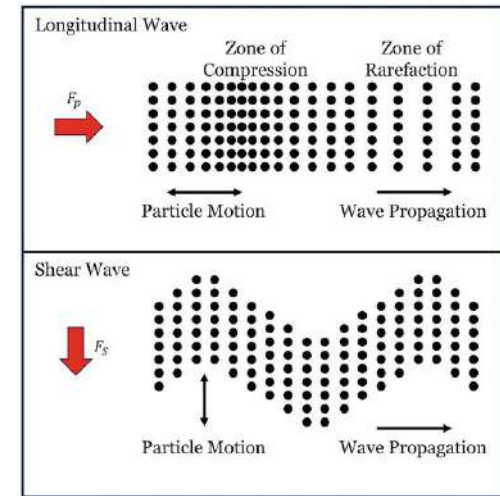
Compression wave speed $\propto \sqrt{(K/\rho)}$

- bulk modulus $K \sim 2.2$ GPa
in all soft tissue
- fast, 1500 m/s
- B-mode

Shear wave speed $\propto \sqrt{(\mu/\rho)}$

- shear modulus μ spans 1–100 kPa,
varies with pathology/tone
- propagates laterally
- only 1–10 m/s – “mechanical wave”

“Supersonic” : special moving
excitation

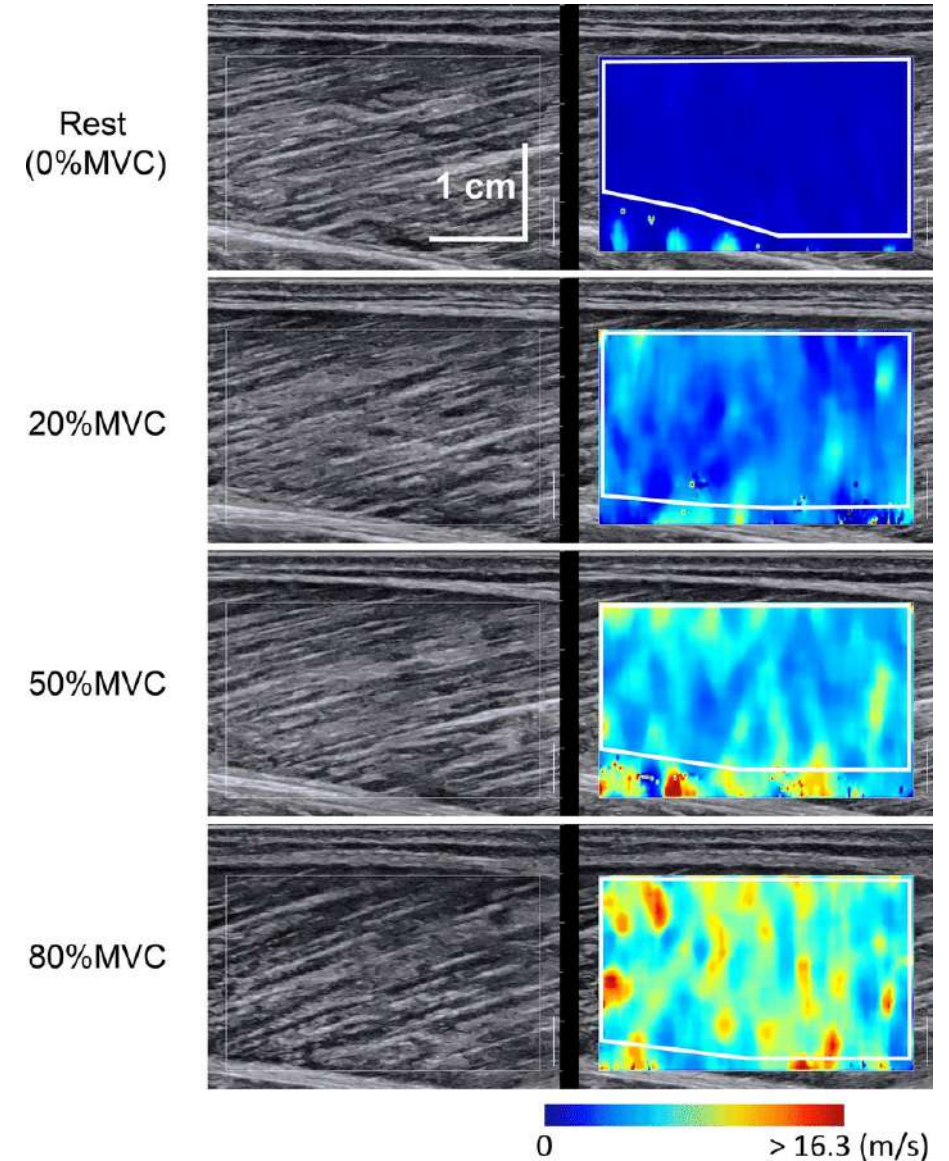


B(brightness)-mode vs. SWE: stiffness

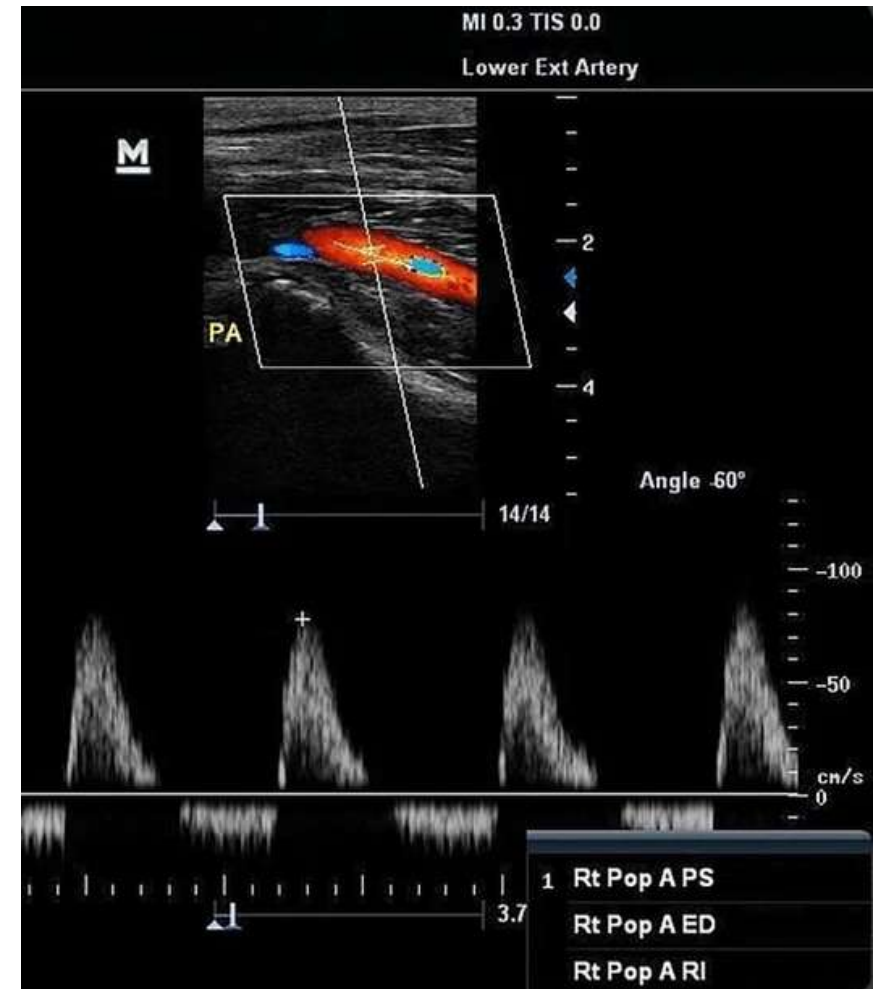
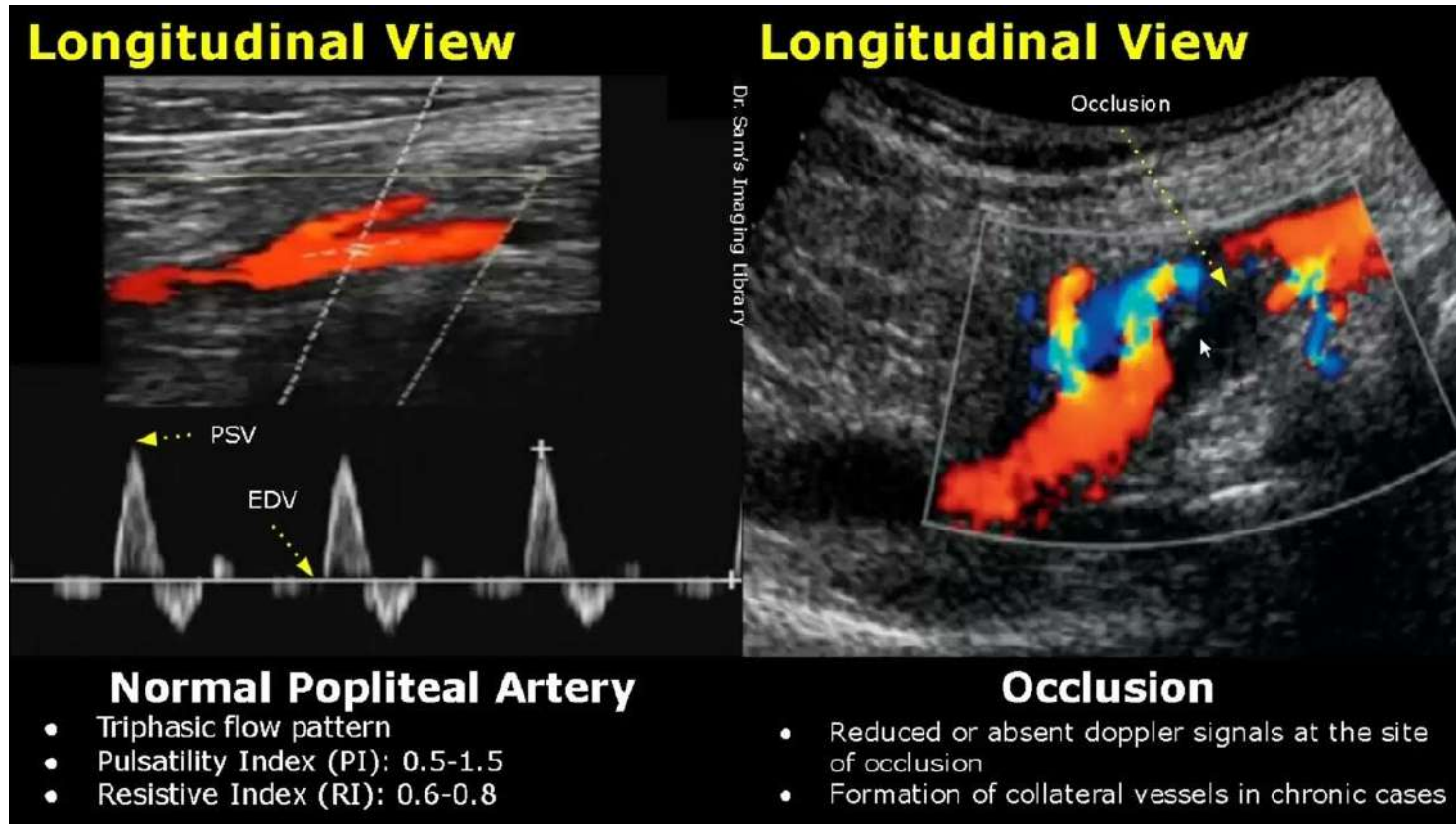
SWE —quantitative map of muscle mech parameters
@shear-wave speed

Increasing contraction
MVC = Maximum Voluntary Contraction

Yamazaki K. et al. (2022)
“Passive and active muscle elasticity of medial gastrocnemius
is related to performance in sprinters.”



Doppler ultrasound: blood flow



$$Q = v \times A$$

$$[v] = \text{cm/s}$$

Published in final edited form as: IEEE Trans Ultrason Ferroelectr Freq Control. 2024 Jul 9;71(7):713-729

Emerging Wearable Ultrasound Technology

[Hao Huang](#)^{1,*}, [Ray S Wu](#)^{2,*}, [Muyang Lint](#)^{3,*}, [Sheng Xu](#)⁴

Plethysmography: volume

Water-displacement

Air bag pressure

No-force Strain-gauge

Venous occlusion plethysmography (VOP):

veins are briefly occluded with an inflated cuff while arterial inflow continues



Air



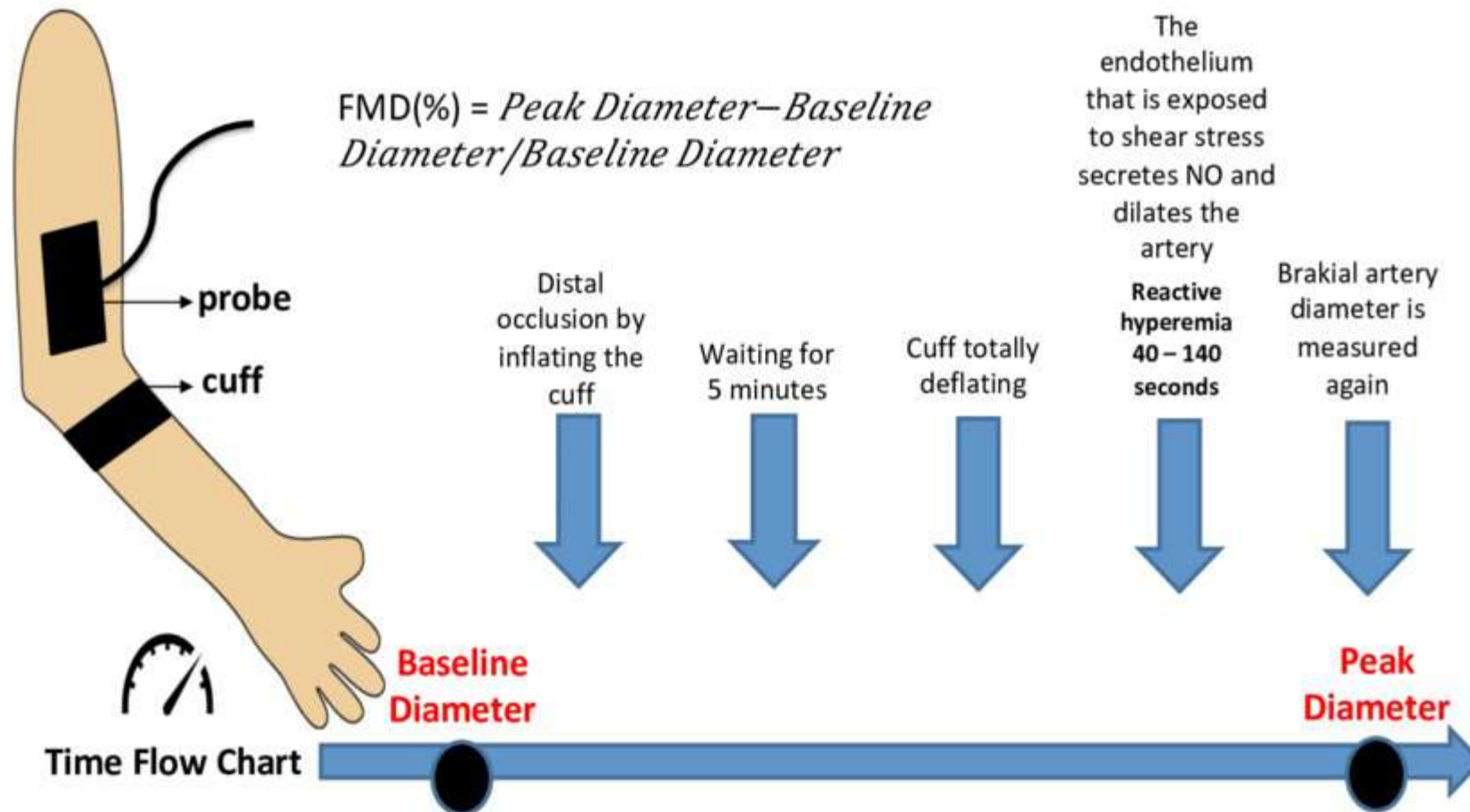
Circumferential strain

Flow-mediated dilation (FMD)

brief arterial occlusion => metabolic (I.) dilation

Release Shear => nitric oxide (NO)

NO => II. dilation (artery, meas. by ultrasound)



Muscles involved & ...

Muscle/Structure	What sitting does to it	Consequence
Erector spinae / Hátizmok Multifidus / Szegmentális	Inactive → atrophy	Load → discs :: disc / porckorong wear Excess shear :: facet / facettízület wear
Abdominals / Hasizmok	Inactive → atrophy	Loss of lateral/rotational control → increased disc shear stress
Pectoralis minor / Kis mellizom	Shortened position → shortening	Actively pulls shoulder forward
Hip flexors / Csípőhajlító	90° flexion → shortening	Anterior pelvic tilt → increased lumbar lordosis
Front: Longus colli / Nyakhajlítók Back: Upper trapezius / Csapóizom	Inactive → atrophy Overloaded holding head forward	Loses neck stabilization Neck/shoulder tension
Intervertebral discs / Porckorongok	High axial pressure, especially at bad postures	Dehydration/degeneration → herniation risk

Shoulders

Upper crossed syndrome

"Shoulder girdle", "Rounded shoulders", "Protracted shoulders"

Cause:

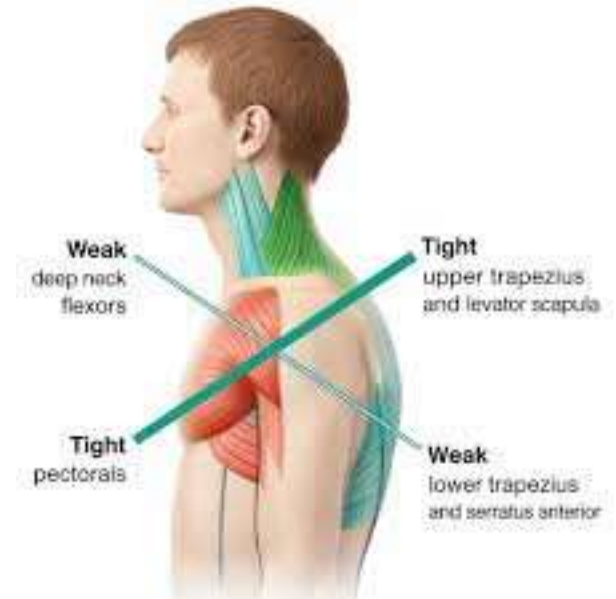
Writing/reading/typing :: arms in front
→ shoulder fixed in protraction

Mechanism:

Static for hours
→ SPECIFIC muscles chronically shortened & active
→ their antagonists unloaded

Adaptation:

Facilitated group (pecs, upper trap/levator) → shortens & strengthens
Inhibited group (lower trap/serratus, deep neck flexors) → weakness



Back pain

Bad Sitting Posture

- intradiscal pressure rises
- erector spinae/multifidus deactivate
- more load / wearing @ discs/ligaments
- :: disc degeneration
- :: disc protrusion

Static sitting

- reduced fluid exchange
- poor disc nutrition
- :: disc degeneration

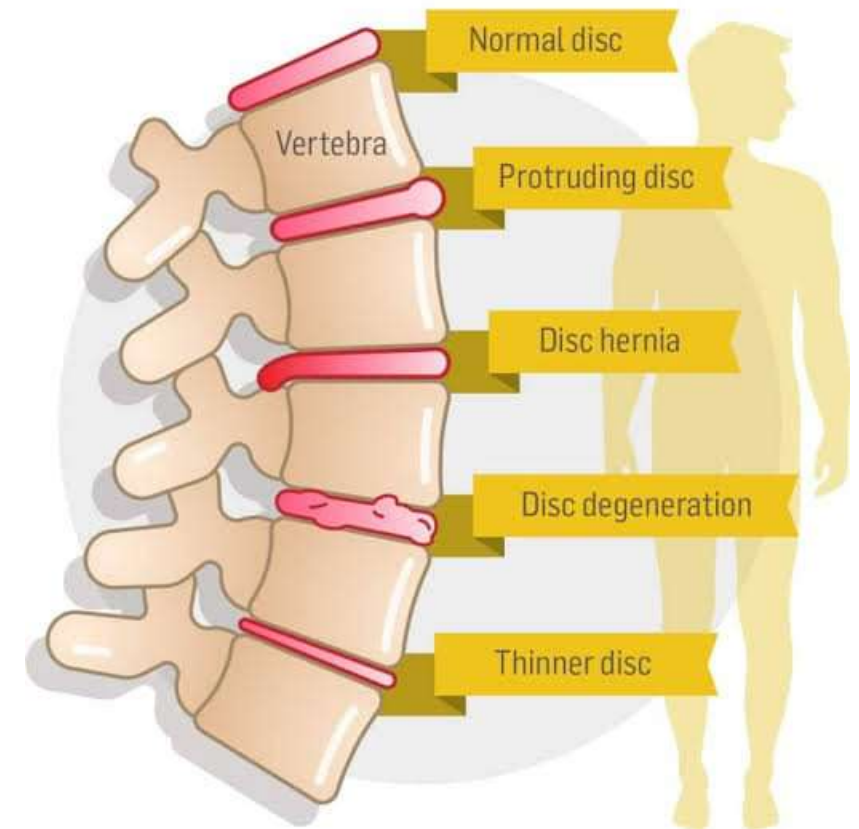
Stress and Psychosomatics

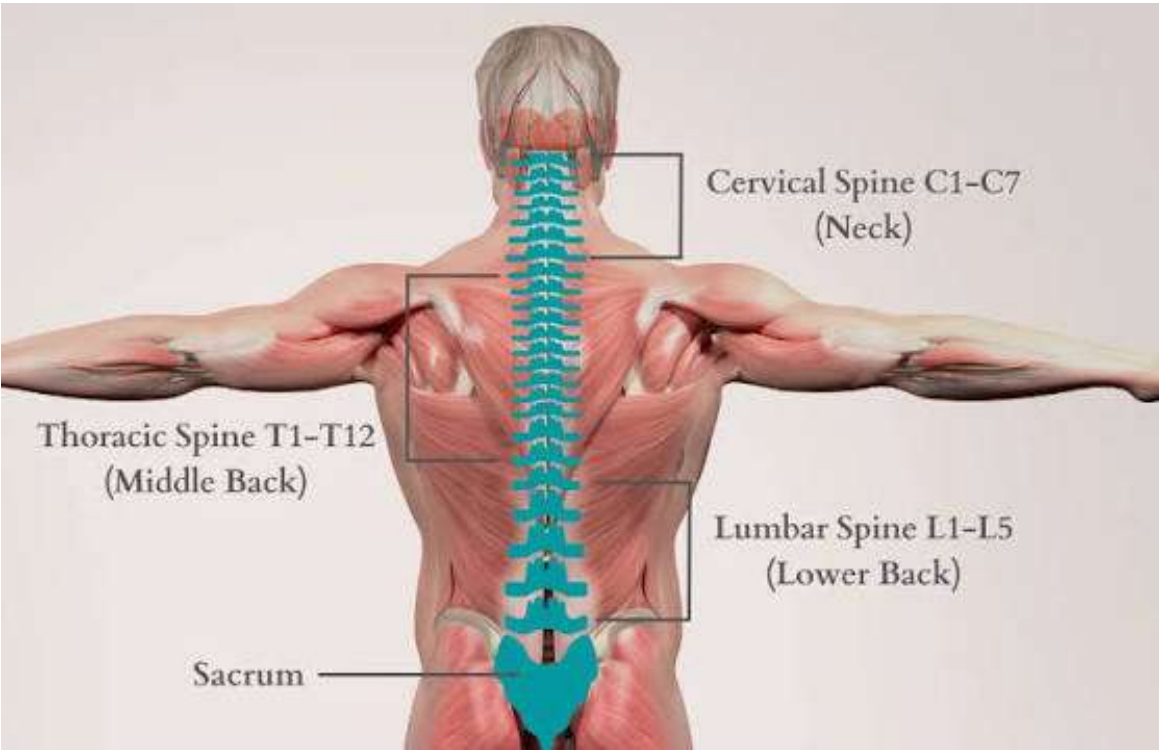
- ↑ muscle tension
- inflammation

PAIN:

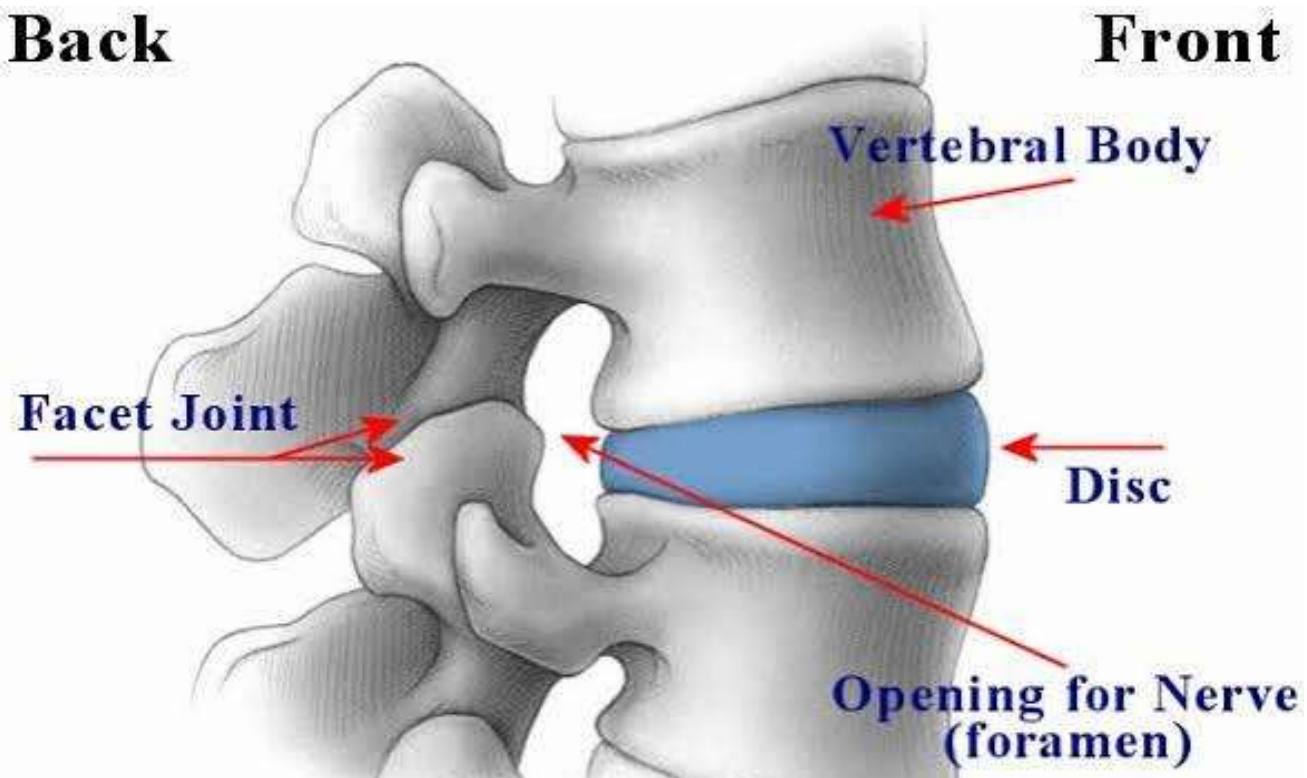
nerve compression
inflammation
pathological neural/vascular processes

Conditions intervertebral discs



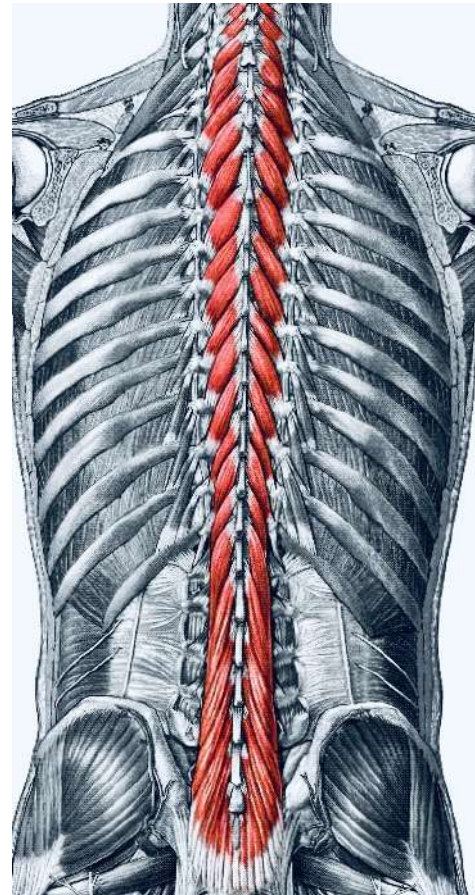
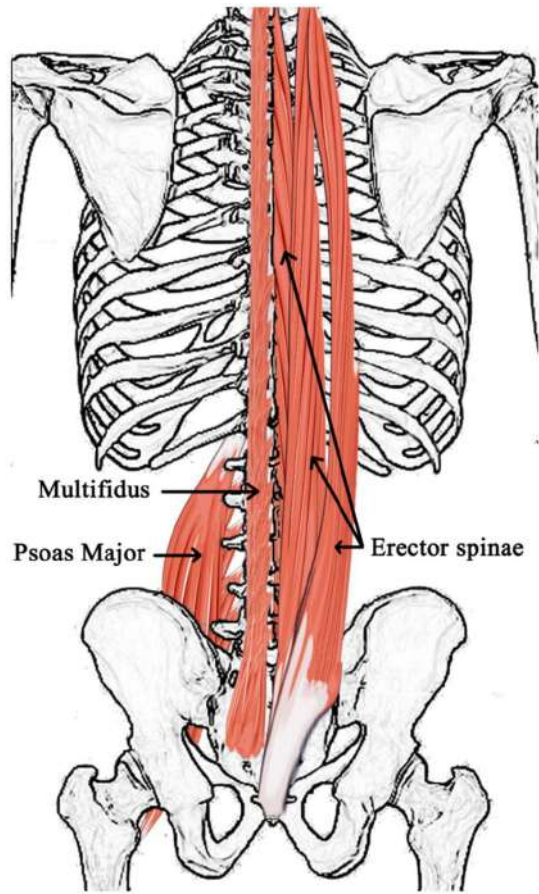


Back



Front

Multifidus



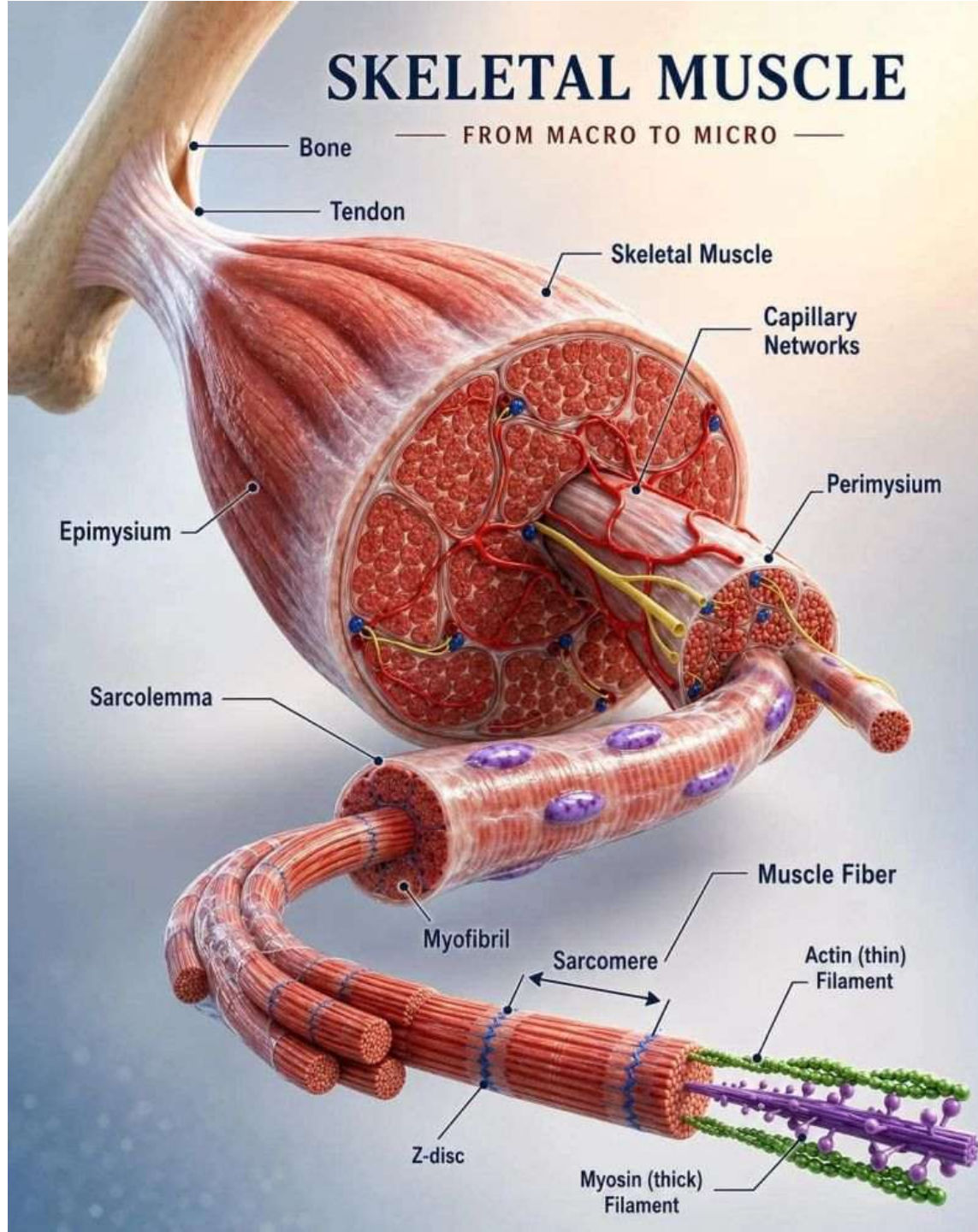
Erector spinae



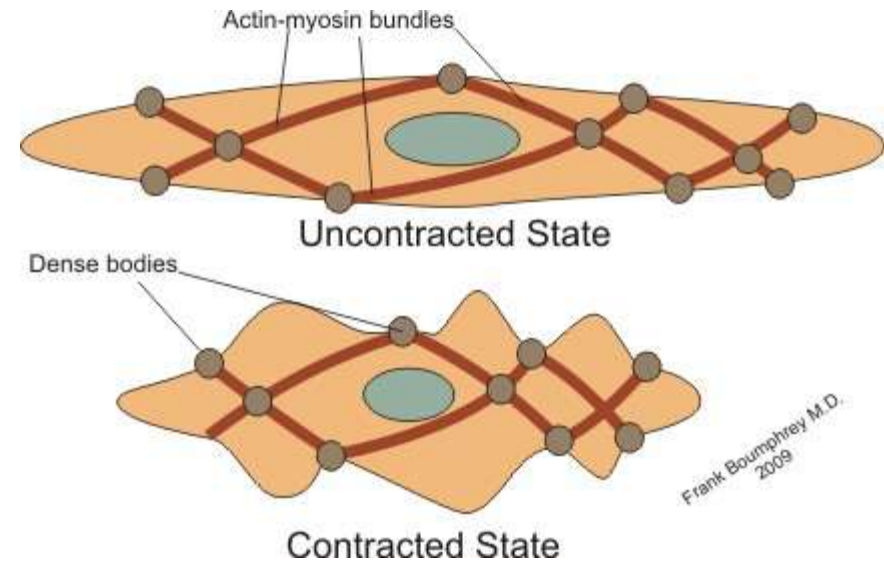
View from back

SKELETAL MUSCLE

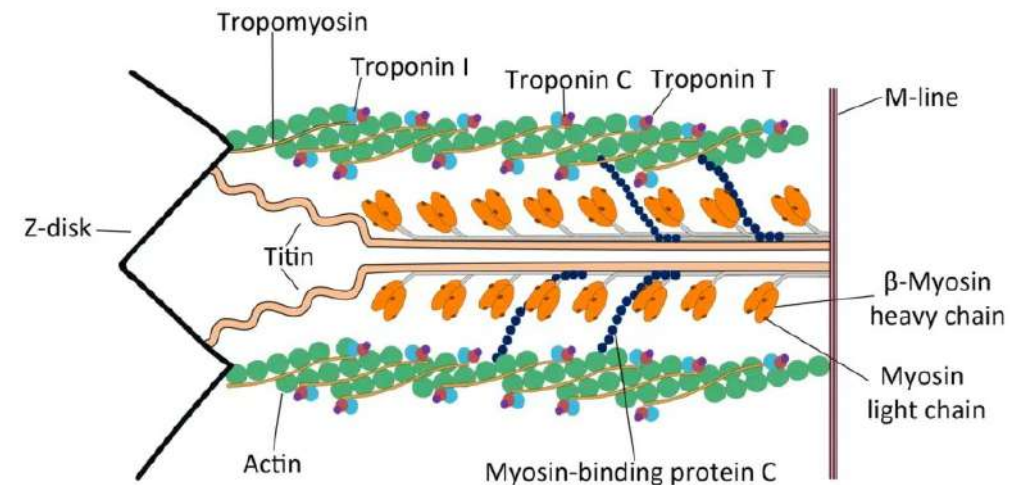
FROM MACRO TO MICRO



Smooth muscle

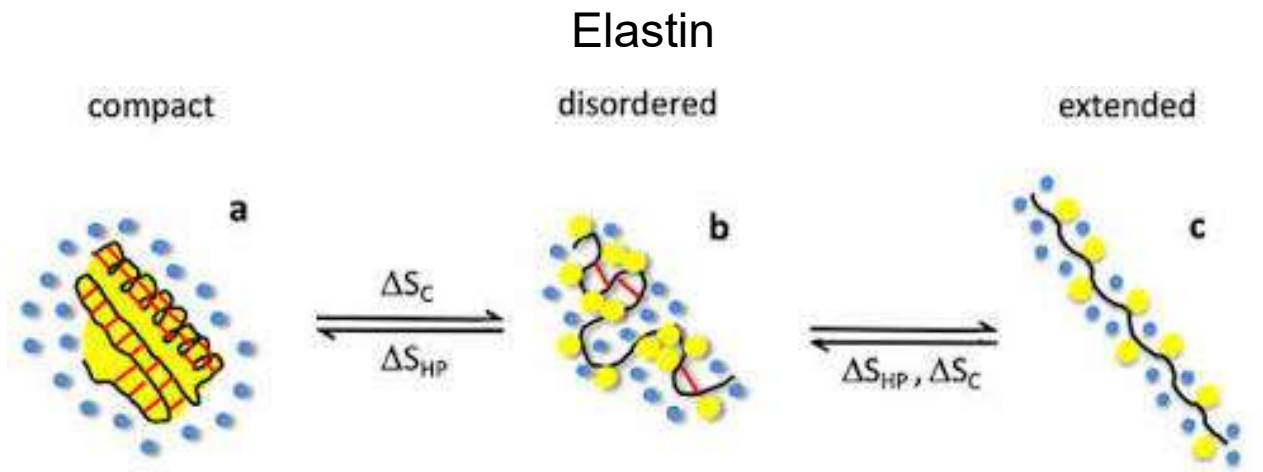
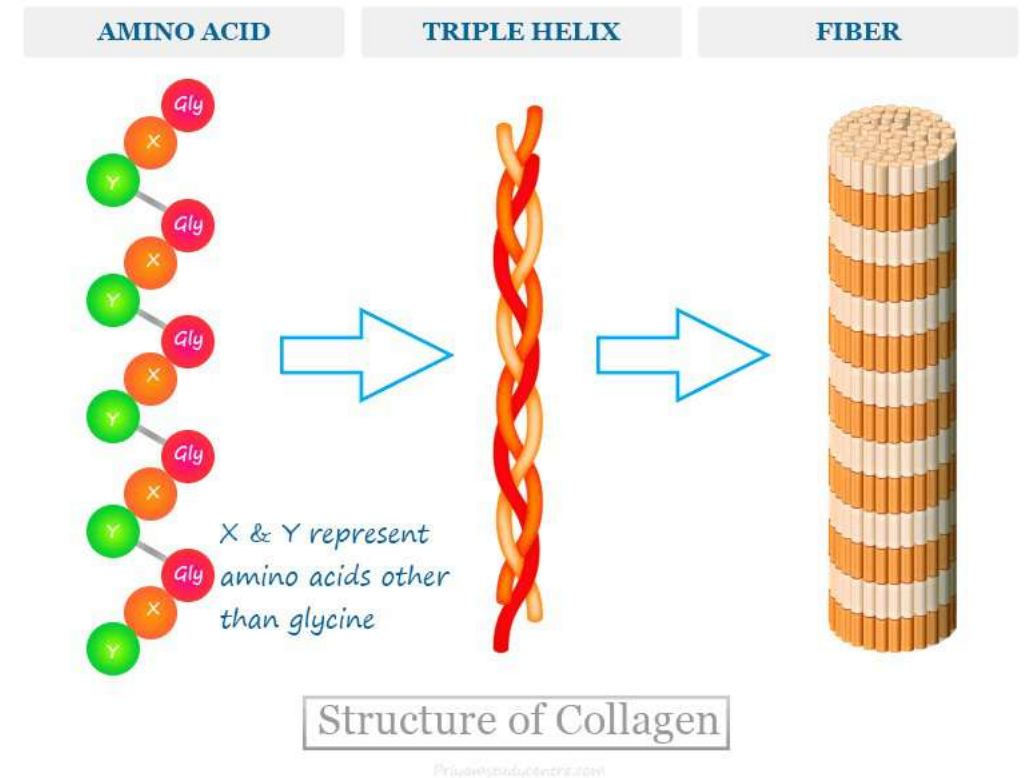
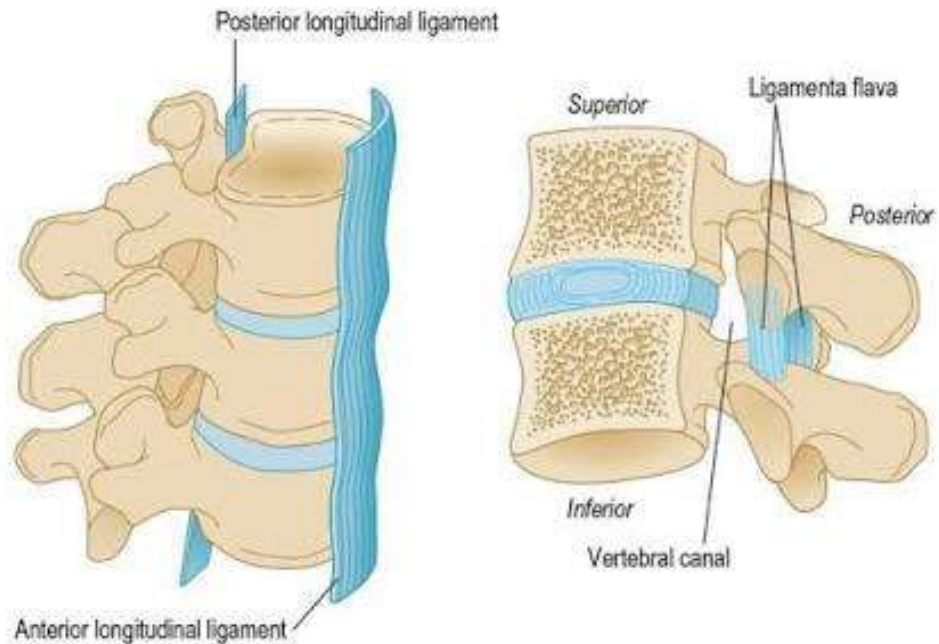


Titin :: elastic protein – inside sarcomers
 Tropomyosin covers / uncovers the BS



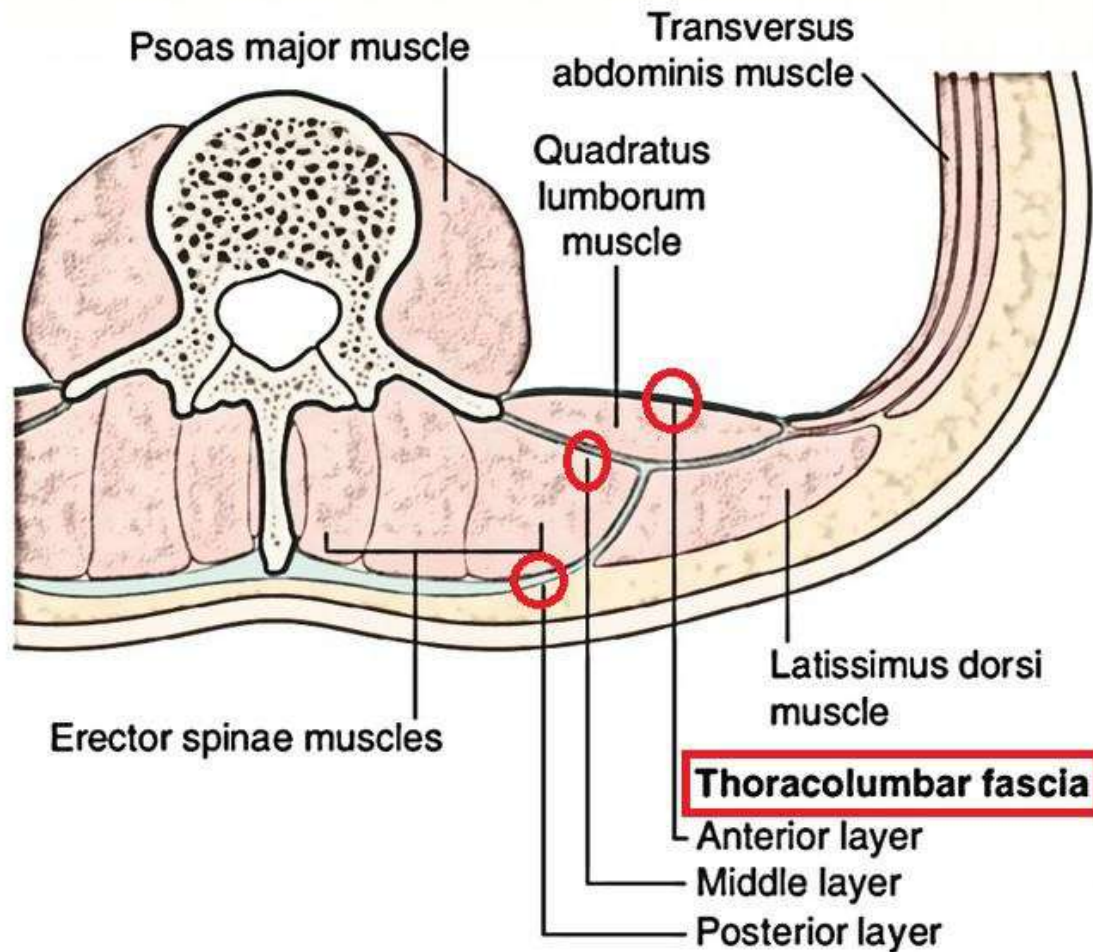
Elastin and Collagen

Structure	Main protein	Main function
Intervertebral disc	Collagen	Load distribution, resistance to tension
Longitudinal ligaments	Collagen	Spinal stability, limits excessive motion
Ligamentum flavum	Elastin	Elastic recoil, assists return from flexion



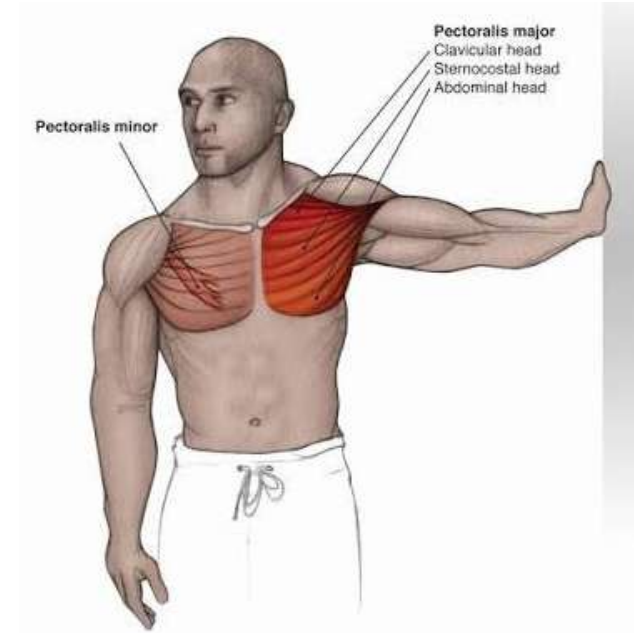
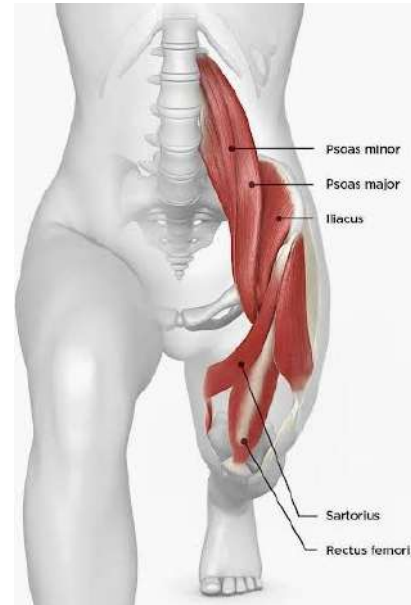
Fascia

Structure	Connects / surrounds	Main mechanical function
Ligament	Bone ↔ bone	Limits motion, stabilizes joints
Tendon	Muscle ↔ bone	Transmits muscle force
Fascia	Muscles and other tissues	Distributes and transmits force between structures

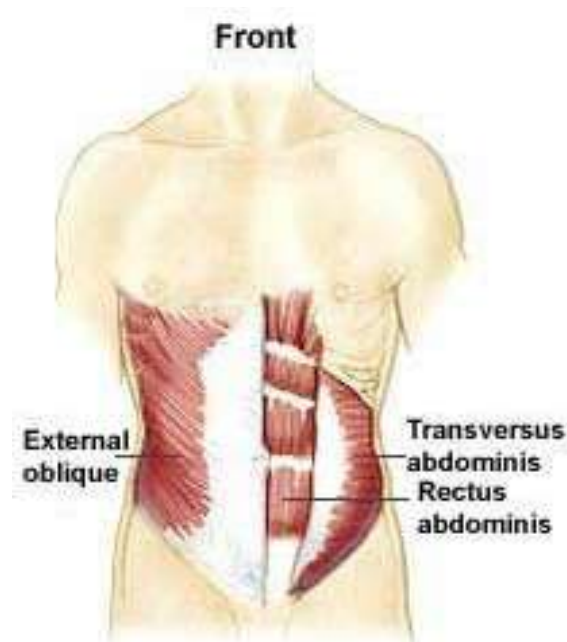




Hip
flexor



Pectoralis
minor



Core
muscles

Brain

Slouched

- diaphragm can't fully descend
 - ~30% less air intake
 - shallow chest breathing / no diaphragmic
- => brain oxygenation slightly drops

Possibly slightly less brain circulation

Less aerobic movement – less BDNF (Brain-Derived Neurotrophic Factor)

Unaltered long sitting = chronic physiologic stress → less BDNF

Less circulation = systemic micro-stress → IL-6 infl. cytokines → less BDNF

Divergent creativity: WALKING > SITTING

Convergent thinking: Walking ≈ Sitting

Sleep:

- less brain activity
- glymphatic cleaning
- low general metabolic needs

Regular walking breaks prevent the decline in cerebral blood flow associated with prolonged sitting

Authors: [Sophie E. Carter](#), [Richard Draijer](#), [Sophie M. Holder](#), [Louise Brown](#), [Dick H. J. Thijssen](#), and [Nicola D. Hopkins](#) | [AUTHORS INFO & AFFILIATIONS](#)

Prolonged sitting reduces cerebral oxygenation in physically active young adults

 Brett D. Baker ¹  ... and some contradictions Darla M. Castelli ^{2*}

Int J Behav Nutr Phys Act

<https://doi.org/10.1186/s12966-026-01953-6>

Article in Press

Acute cognitive effects of interruptions to prolonged sitting with brief standing or physical activity breaks: a systematic review and three-level meta-analysis

Received: 23 March 2026

Mingnan Zhuang, Mingyue Yin, Zongnan Liu, Ningkun Xiao, Qing Yi, Zhiwei Fan,

Circulatory system

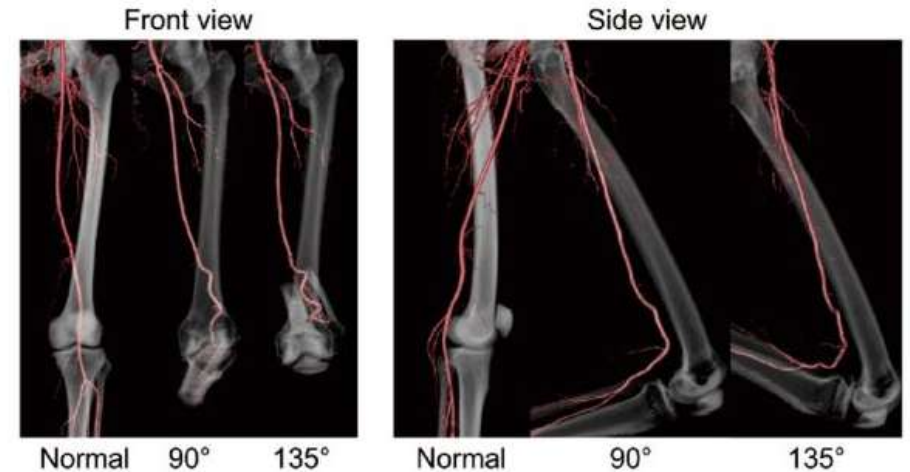
Worst for veins

Vena/Arteria poplitea (térdhajlati): @ knee

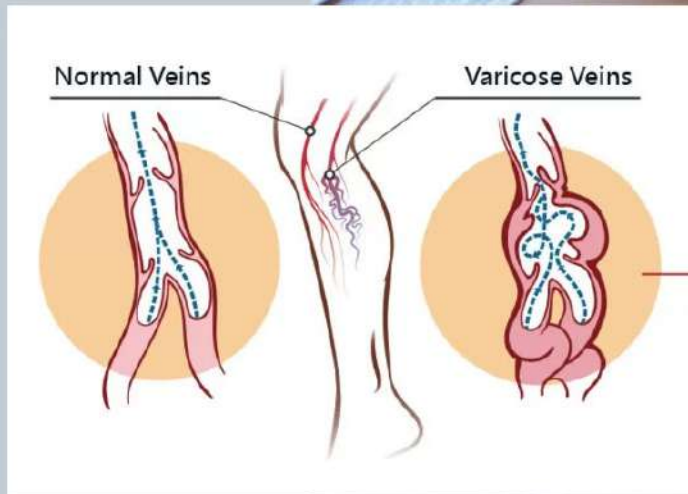
Vena/Arteria femoralis (comb): thigh

Lymphatic fluid buildup

WORST: Knee-over-knee position



This **bad posture** will cause your pelvis to skew over time and cause the following diseases:
1. Varicose veins (aka Spider Veins) or thromboembolism in the legs



10.1253/circj.CJ-23-0672

Night:

Parasympathetic dominance
— promoting

vasodilation

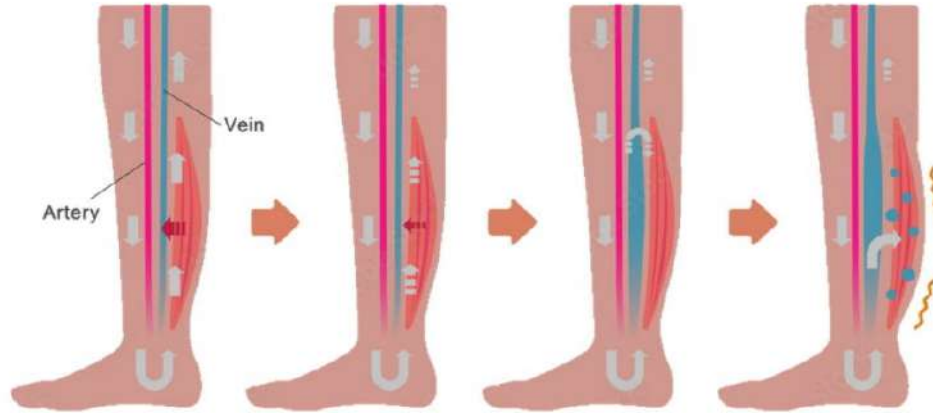
Horizontal

Micromovements

Lymphatic system

Lymphatic system helps drain excess fluid

Causes of swelling of the legs



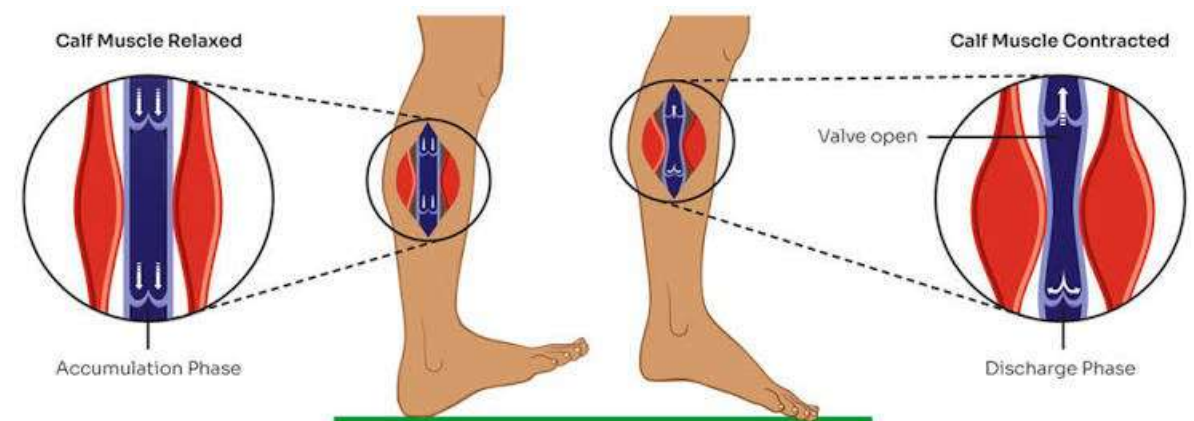
Keeping the same posture, tiredness and weakness in the leg muscles reduces the ability to return blood to the heart.

Water in the blood stagnates and venous pressure rises.

Water leaks from the veins and swelling occurs.

Lymphatic effects of prolonged sitting

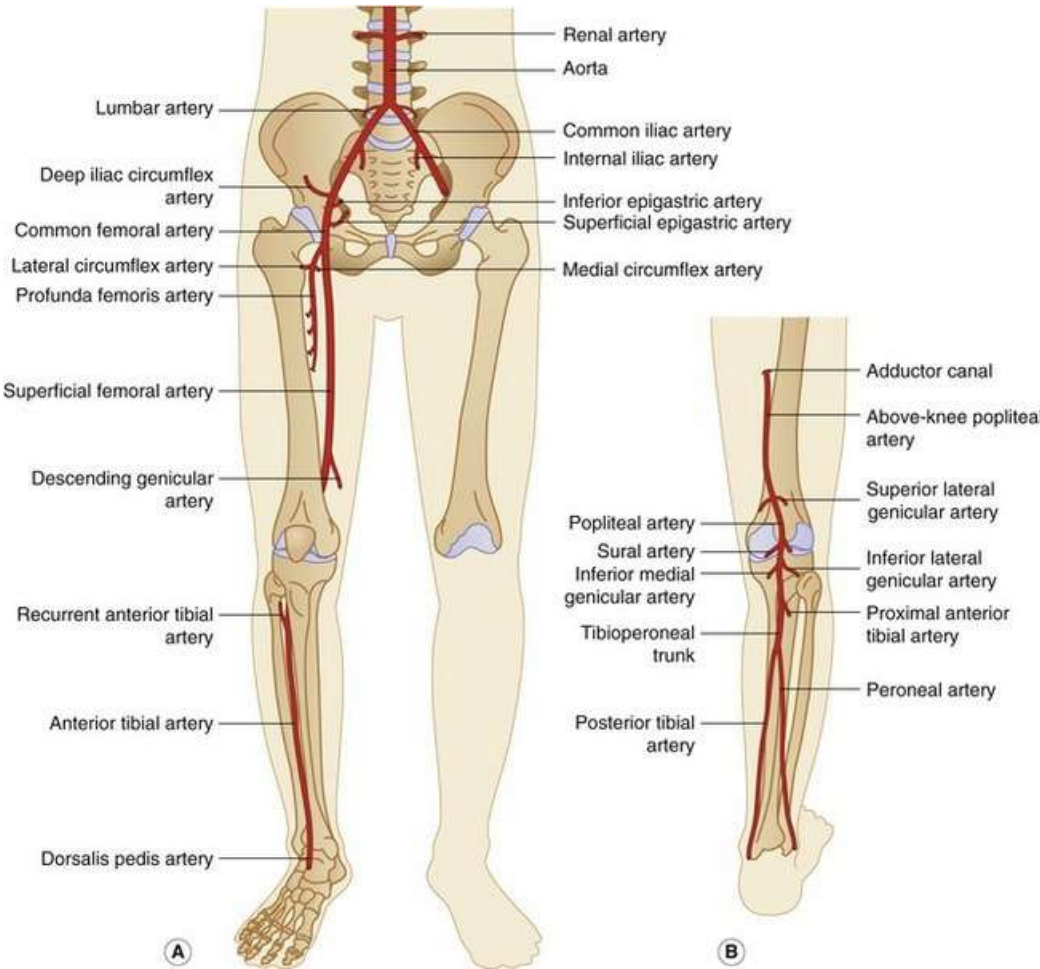
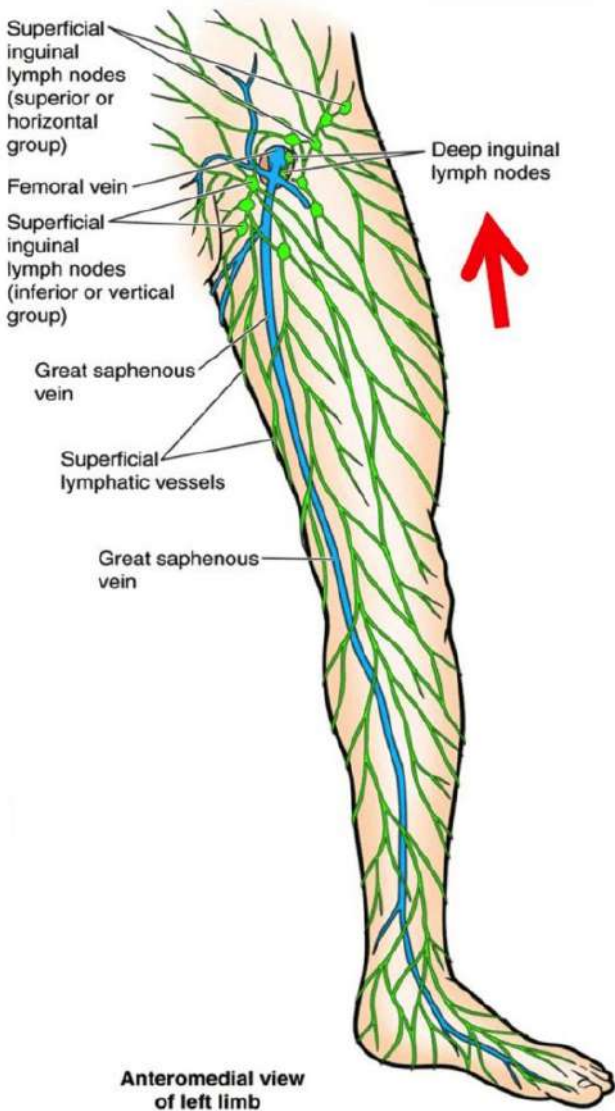
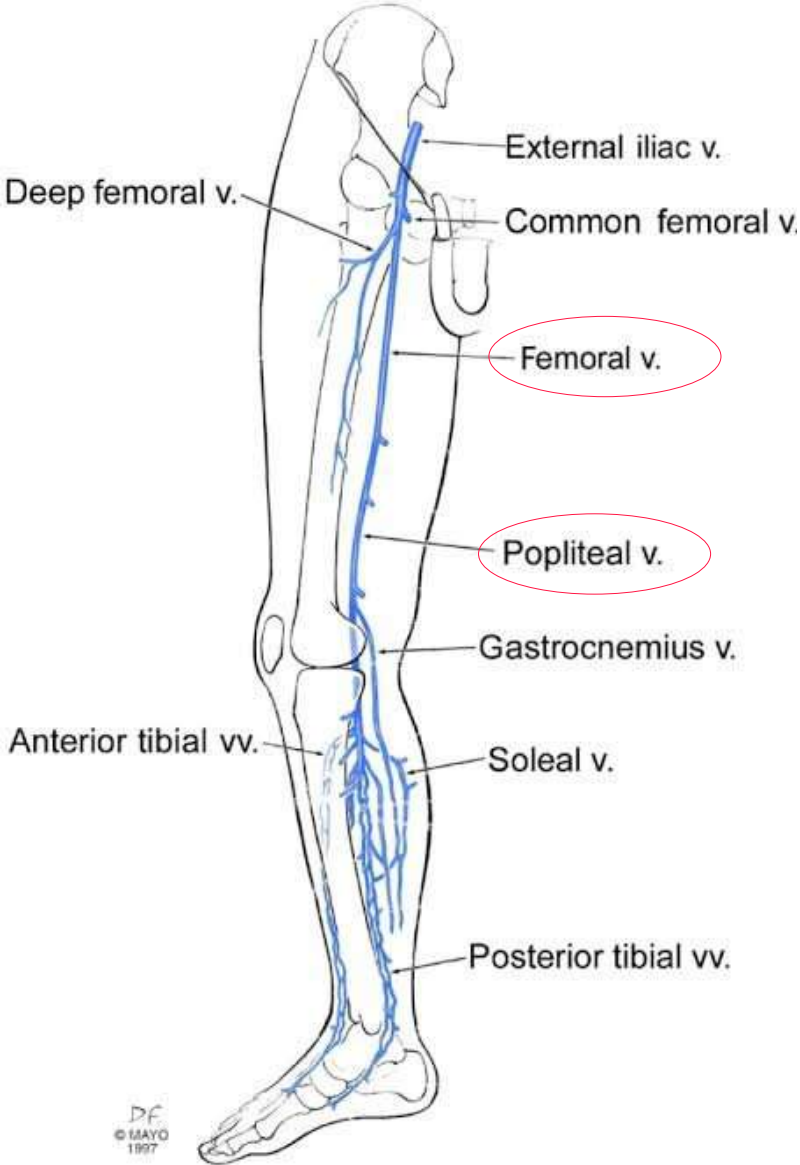
- ↓ Skeletal muscle pump activity
- ↓ Lymph flow
- ↑ Interstitial fluid accumulation
- ↑ Lower-limb edema
- ↓ Clearance of tissue fluid and proteins



Sleep:

Lymphatic system is highly active @ night
Horizontal
Micromovements

Veins and lymph vessels



Blood vessels

Low shear stress on the inner wall of blood vessels (the endothelium)

→ less NO

→ stiffening → endothelial dysfunction

Metabolism

1 MET several defs:

=> 3.5 mL O₂ / kg minute :: 1 kcal / kg hour

=> the amount of energy @ sitting quietly 1h = cca. 300 kJ/h = cca. 70 kcal/hour

Fat:

900 kcal = 3700 kJ / 100g

cca 13 hours of sitting

Slow walking 2-3 MET

Jogging 5+ MET

3-5 min break @ 30 min IMOPROVE for metabolism, blood pressure

3-5 min break @ 1 hours Less improvement

Metabolism

Metabolic effects of prolonged sitting

↓ Skeletal muscle contraction

↓ AMPK activation (AMP:ATP ratio) — energy-sensing switch (@ Metformin!)

anti: mTOR (anabolism)

↓ GLUT4-mediated glucose uptake

↓ Lipoprotein lipase (LPL) activity

↓ Fatty acid oxidation

Fats in cells: ↓ Insulin sensitivity

↑ Blood glucose and triglycerides

→ **Metabolic syndrome and type 2 diabetes — the long-term endpoint**

Normal sleeping:

→ little movements

→ fasted = better

↑ autophagy,

↑ growth hormones: ↓ fats

Metabolism

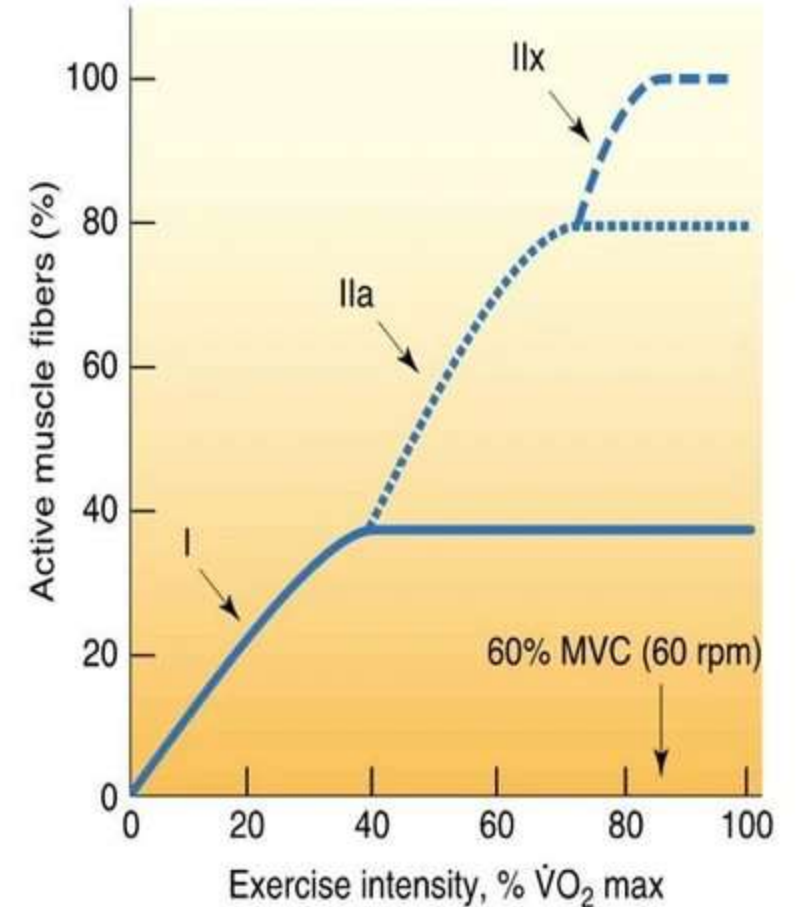
Muscles:

Type I — slow oxidative

Type IIa — fast oxidative-glycolytic

Type IIx — fast anaerobic-glycolytic

Postural control → low-force, sustained contraction
→ predominantly Type I motor units



Metabolism

Aerobic: fat, glycogen/glucose

Anaerobic: CP, glycogen/glucose

Sedentarism: shift @ muscles:

oxidative ("red") => glycolytic ("white")

↓ mitochondria, ↓ oxidative enzymes, ↓ capillarization

Exercise: "5-min rule"

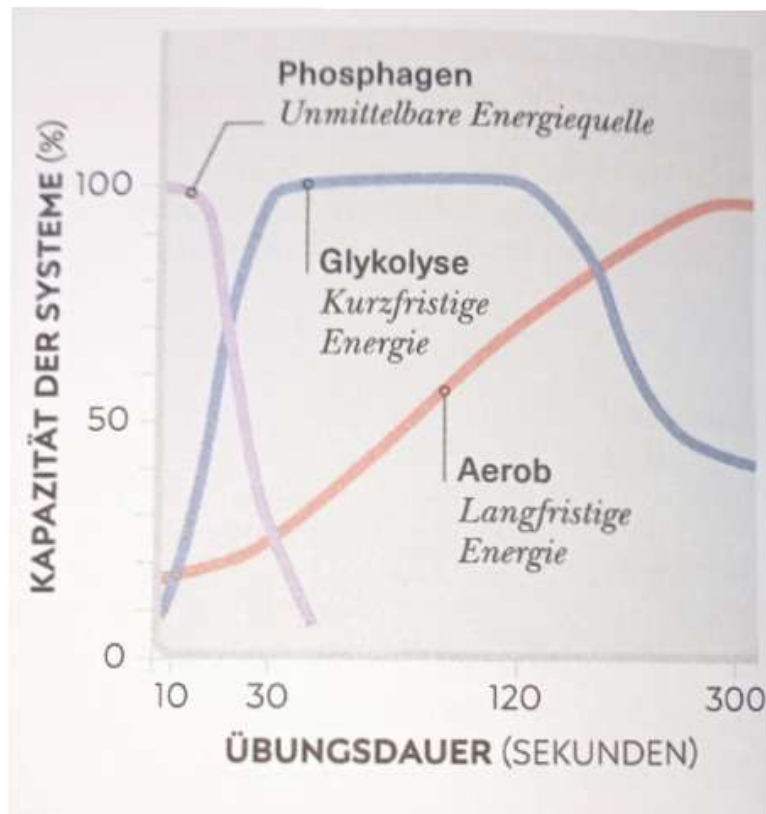
Note:

glycogen: esp. @ skeletal muscles

blood glucose: liver glycogen / food

kidney from lactate, Gln

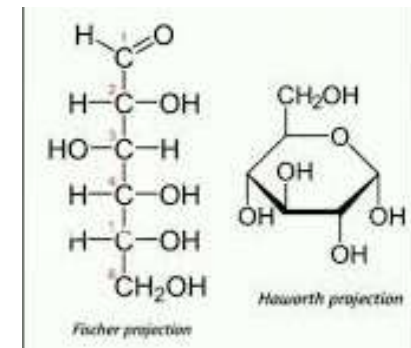
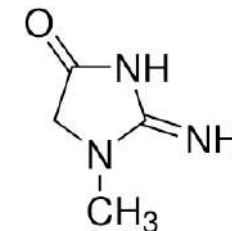
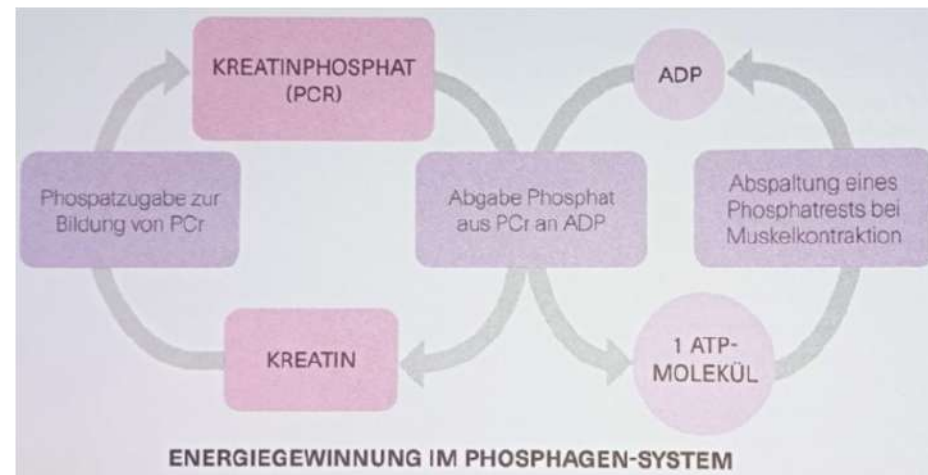
slaughter: carbs in hours → lactate



"Stiffness" @ hours of monotonic use:

Cyndrella effect: metabo exhaust, blood supply "pressed"

Thixotropic Effect: no movement cross-bridges



Abdominals

Pudendal artery compression
Impaired microcirculation
→ reduced blood flow

Testicular temperature rise
→ impaired sperm production

Multifactorial Chronic Pelvic Pain Syndrome (CPPS)

- pelvic floor muscle tension
- mech. pressure, stress: chronic, unconscious clenching

Male Chronic Pelvic Pain Syndrome

Signs and symptoms

- Pelvic floor pain
- Abdominal pain
- Frequent urination
- Genital pain
- Lower back pain
- Pain during or after sex
- Post-ejaculatory pain
- Pain while sitting
- Erectile difficulty
- Sexual dysfunction
- Unexplained fatigue

PHYSIO
DOWN UNDER



TIGHT/HYPERTONIC PELVIC FLOOR SYMPTOMS IN FEMALES

- ✓ Painful sex (dyspareunia)
- ✓ Discomfort when inserting tampon or during pelvic exams
- ✓ Vaginal or rectal pain without a clear cause
- ✓ Difficulty relaxing the pelvic area
- ✓ A constant feeling of "tightness" or internal bracing

The pelvic floor matters.

When the nervous system stays in protection mode, the pelvic floor may stay tense. That tension can reinforce the **pain cycle**.

So in chronic pelvic pain, pelvic floor is often not weak.

More commonly, it may be:

- **Overactive**
- **Guarded**
- **Unable to fully relax**

General

20-8-2 rule @ Hedge

SIT 20

STAND 8

WALK 2

cca 8h => cca 10h sedentary time

+ 13% risk of hypertension,

+ 18% risk of diabetes

+ 14% risk of chronic kidney disease

Sports do not compensate

JACC: Advances (2026; 5(5): 102718)

Sittings

Conventional office sitting

Short-term comfort

Minimal postural muscle effort

Muscle atrophy → disk wear

Venous stasis

Elevated disk pressure

Standing

Eliminates femoral and perineal compression

Improvement glucose metabolism

Venous stasis

Fatigue

Elevated Turkish / Cross-legged

Preserves hip mobility

Popliteal compression risk

No lumbar support

Saddle sitting (2-piece)

Restores lumbar lordosis

Lower intradiscal pressure

Trunk muscle activation

Excessive: pressure on thighs

Kneeling chair

Restores lumbar lordosis

Reduces lumbar flexion

Knee/patellar compressive load

Ischial sitting

Minimizes femoral and perineal compression

Promotes physiological pelvic orientation

Postural muscle activation

Venous stasis

Fatigue

Cowboy (straddle) sitting

Promotes lumbar lordosis

No stooping

Excessive: soft-tissue stress

Dynamic posture alternation

Restores cerebral blood flow

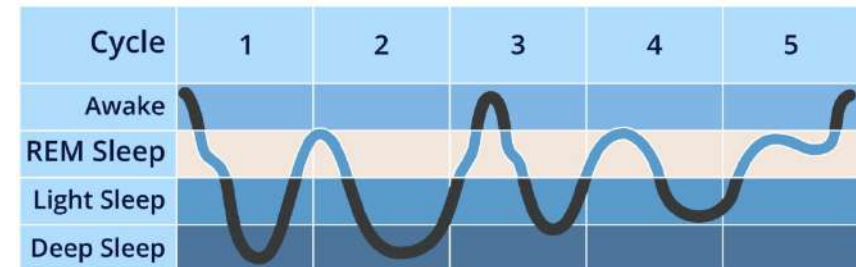
Improves postprandial glucose regulation

Reduces musculoskeletal discomfort

Why sleeping isn't bad?

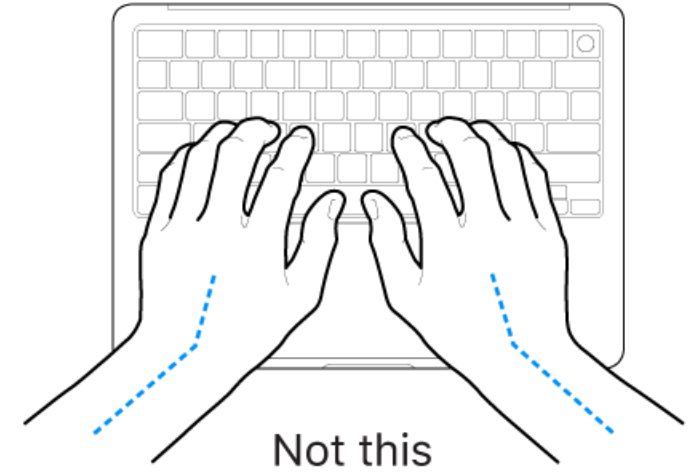
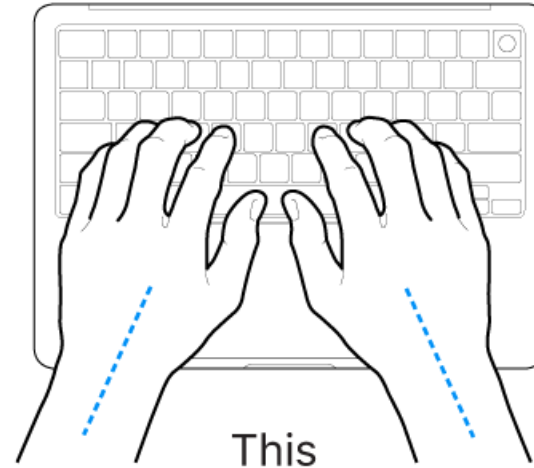
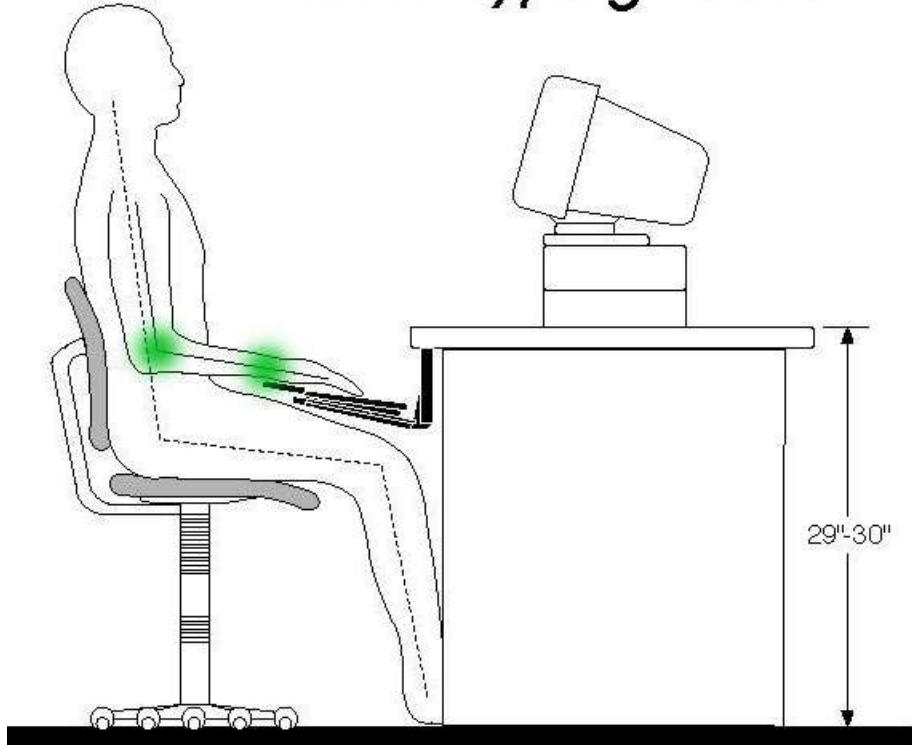


- Posture change in cca every 30 min
- Fasting (ideally +3h before)
- Growth hormone anabolism – energy
- metabolism:
 - Brain (glymphatic), Maintenance-Synthesis, Immune system



Hands

Ideal Typing Position



Elbow flexion: 100–110° relative to the upper arm

Abduction: 5-20°

Wrist: neutral (straight)

Keyboard: -6°

<https://ergo.human.cornell.edu/AHTutorials/typingposture.html>

<https://epublications.marquette.edu/cgi/viewcontent.cgi>

<https://pubmed.ncbi.nlm.nih.gov/39376320/>

Digression: sitting and Cigarettes

Microlife: 30 min
less

Using speed of ageing and “microlives” to communicate the effects of lifetime habits and environment

Public communication of chronic lifestyle risks is generally opaque and potentially misleading. **David Spiegelhalter** suggests using the concept of ageing faster or slower, by expressing the daily effect of lifestyle factors as changes in “microlives” (half hours of life expectancy)

Smoking:

1 microlife / 2 cigarettes
A pack-a-day 5 hours/day

Passive Sitting:

WITH SOME CAUTION

- chronic?
- breaks?
- above a limit ?

1 microlife / 2 hours of passive sitting
A workday: 4 hours/day

Mortality in relation to smoking: 50 years' observations on male British doctors

Richard Doll, Richard Peto, Jillian Boreham, Isabelle Sutherland

Downloaded from <http://bjsm.bmj.com/> on March 10, 2015 - Published by group.bmj.com

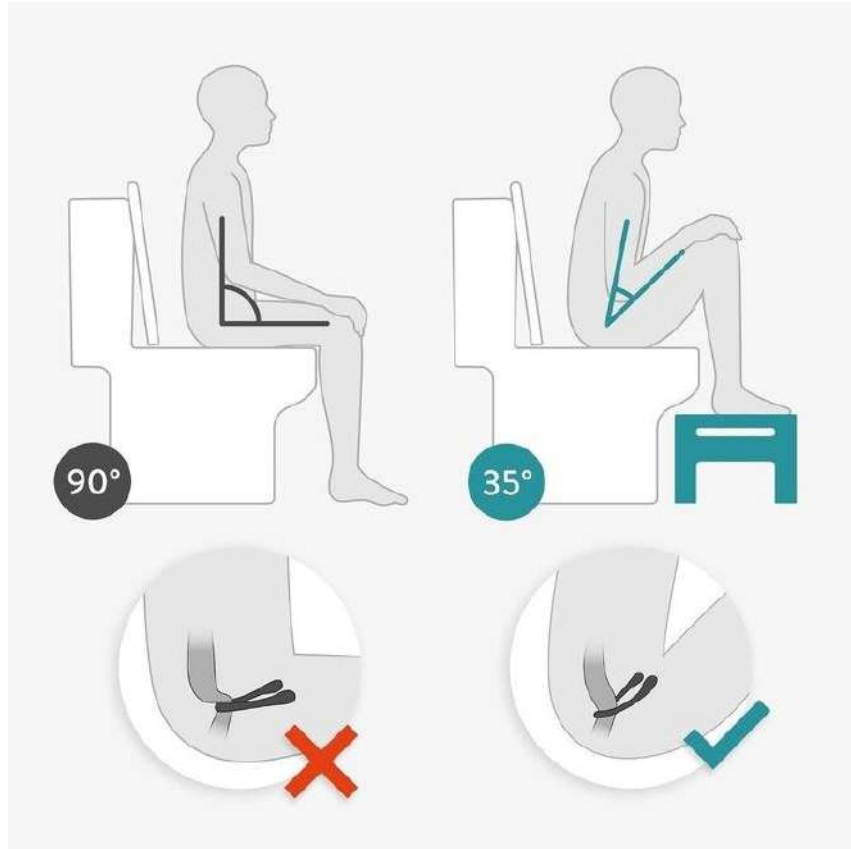
Original article



Television viewing time and reduced life expectancy: a life table analysis

J Lennert Veerman,¹ Genevieve N Healy,^{2,3} Linda J Cobiac,¹ Theo Vos,¹ Elisabeth A H Winkler,² Neville Owen,^{2,3} David W Dunstan³

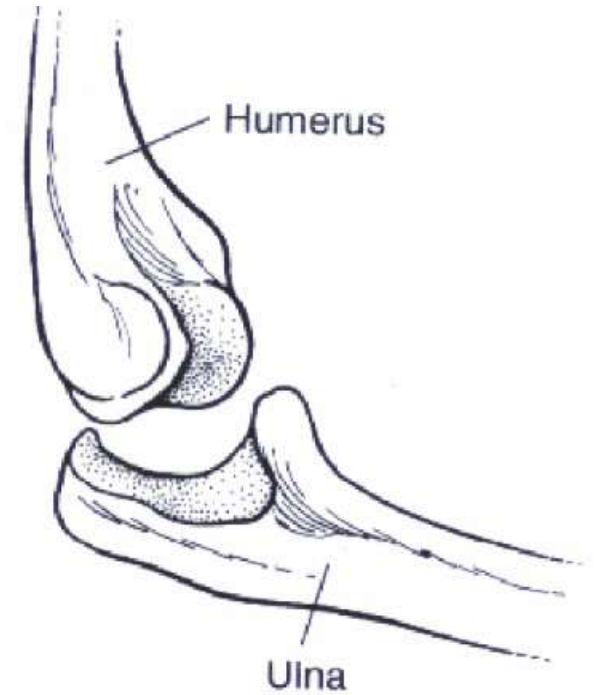
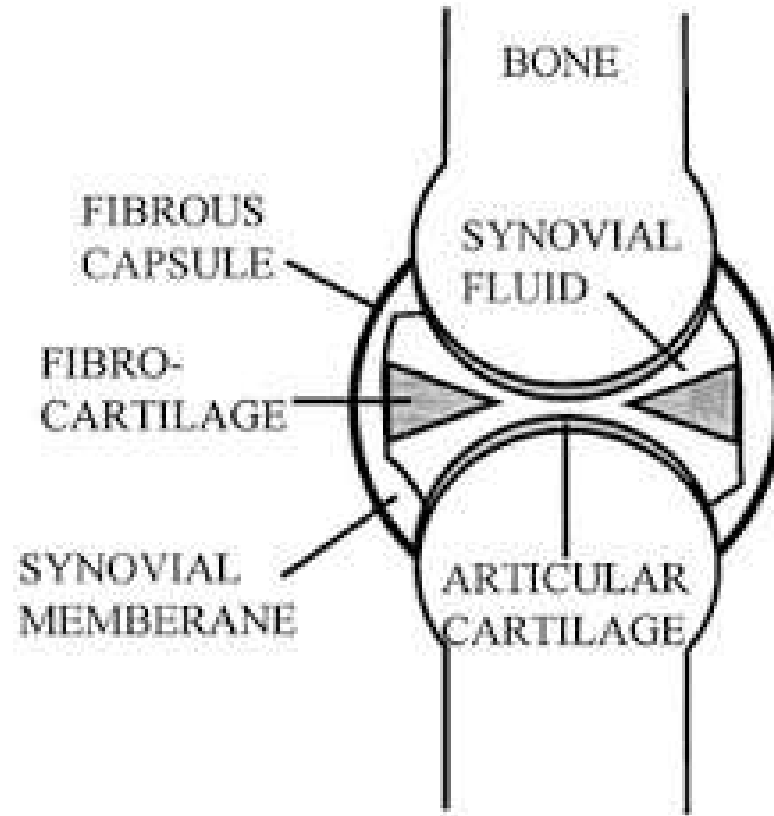
Digression: toilet



m.
puborectalis

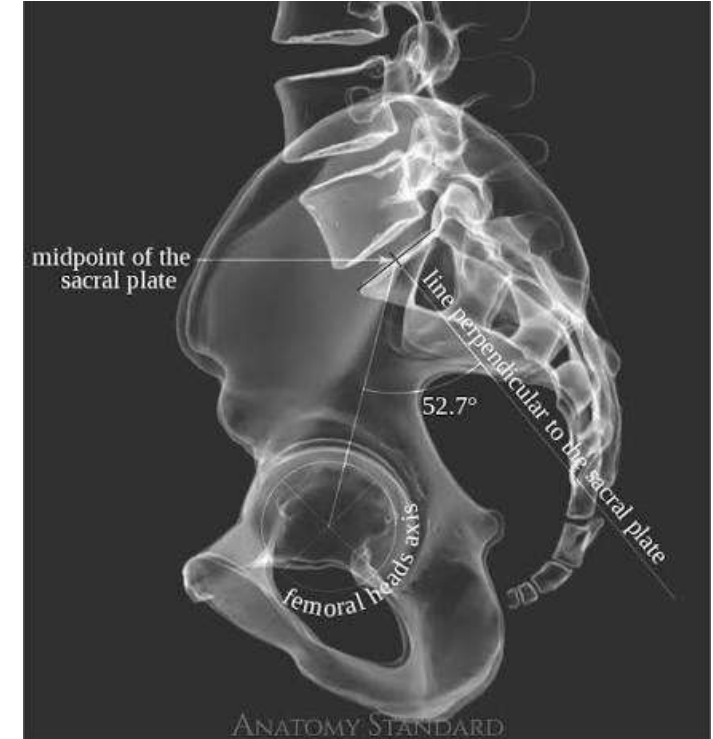
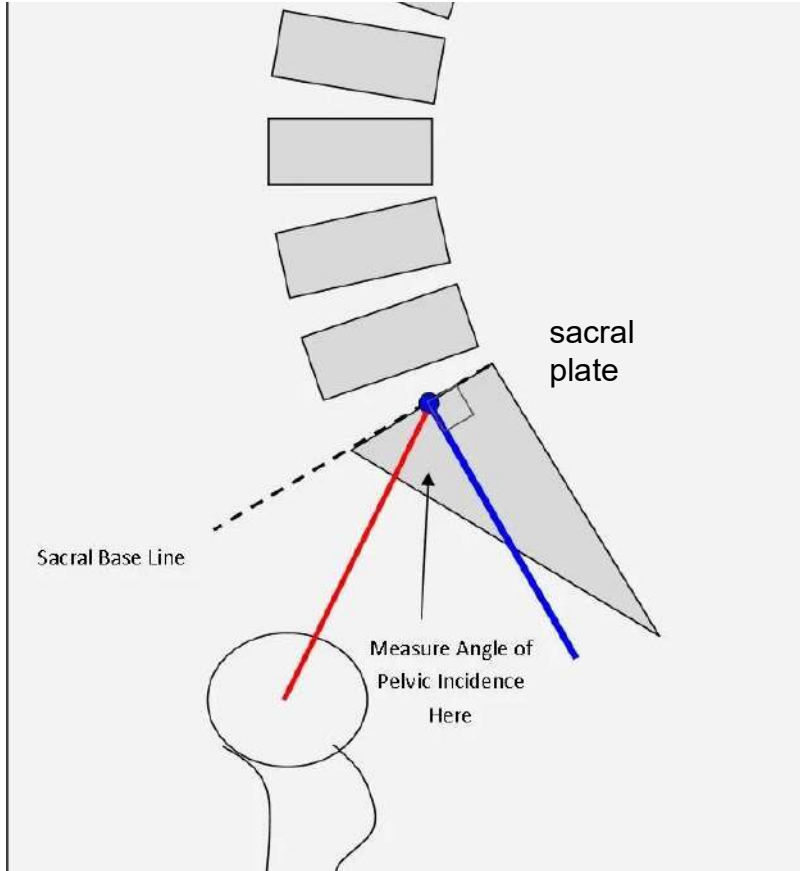


Joints



**NOT pure rotation
BUT rotation +
translation**

Kinematics: FIX pelvic incidence PI



PI = Pelvic Incidence
FIX for person/age

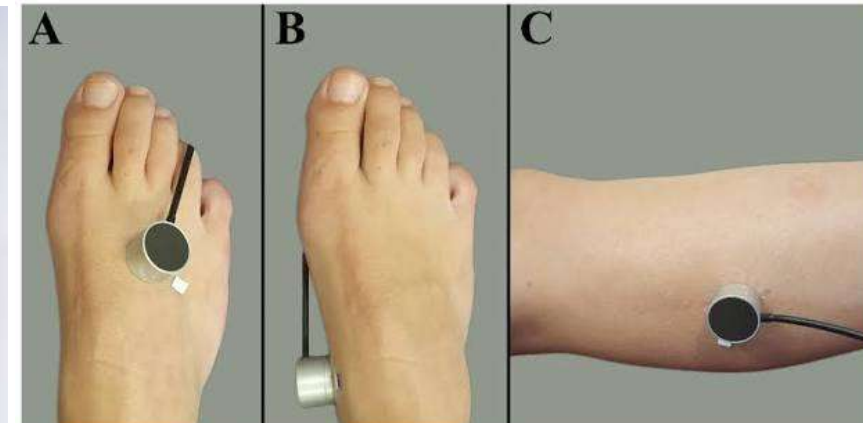
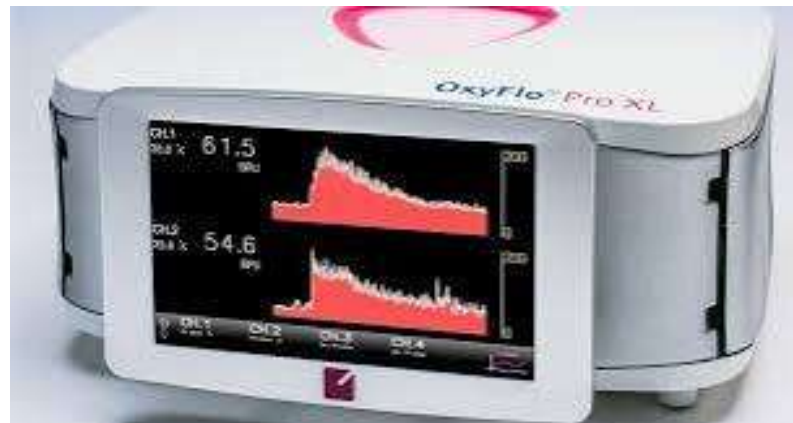
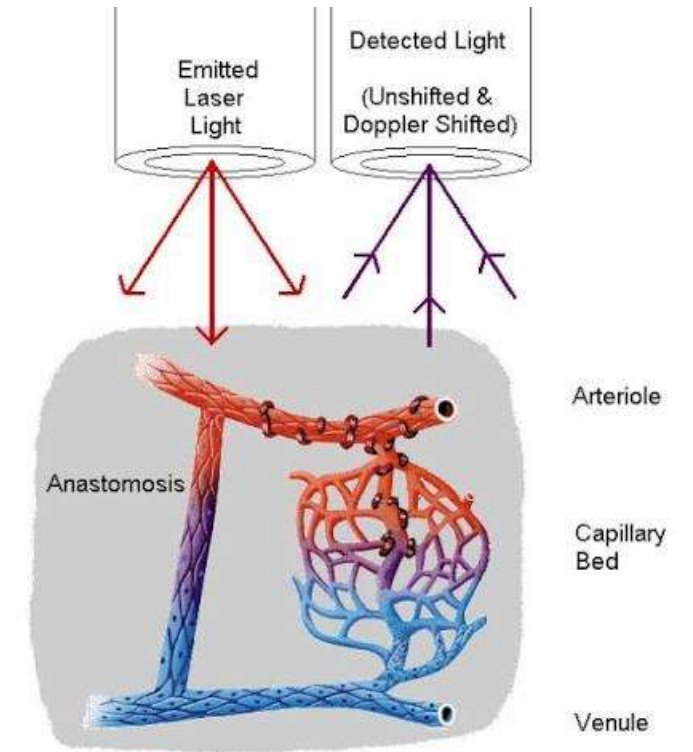
Hemodynamics

Laser Doppler MicroFlowmetry (LDF) < 3mm, accurate

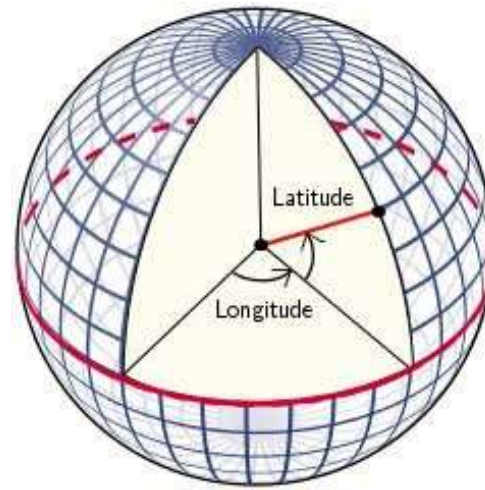
Blood Perfusion Unit: BPU – relative

NO MOTION – motion artefacts

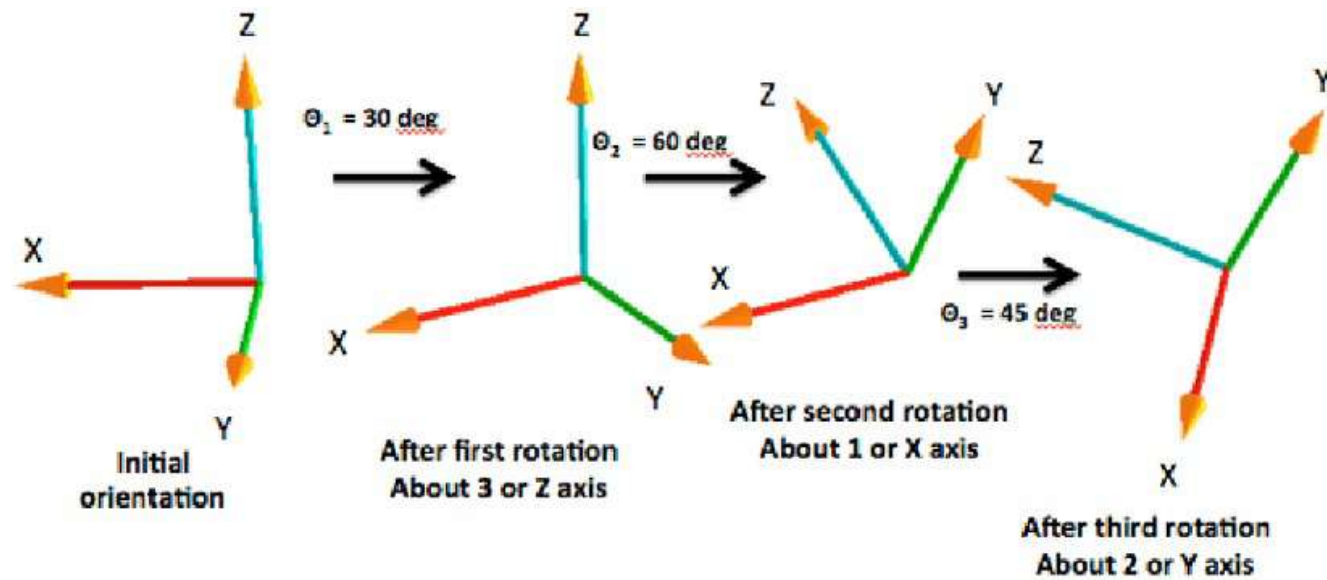
Use: mostly dermatology



Polar angles



Euler angle conventions: Z-X-Z, ... Z-X-Y



Viscoelasticity

Vibrating a needle at certain frequencies to insert it into skin

Needle insertion force model (Okamura & Simone, 2004)

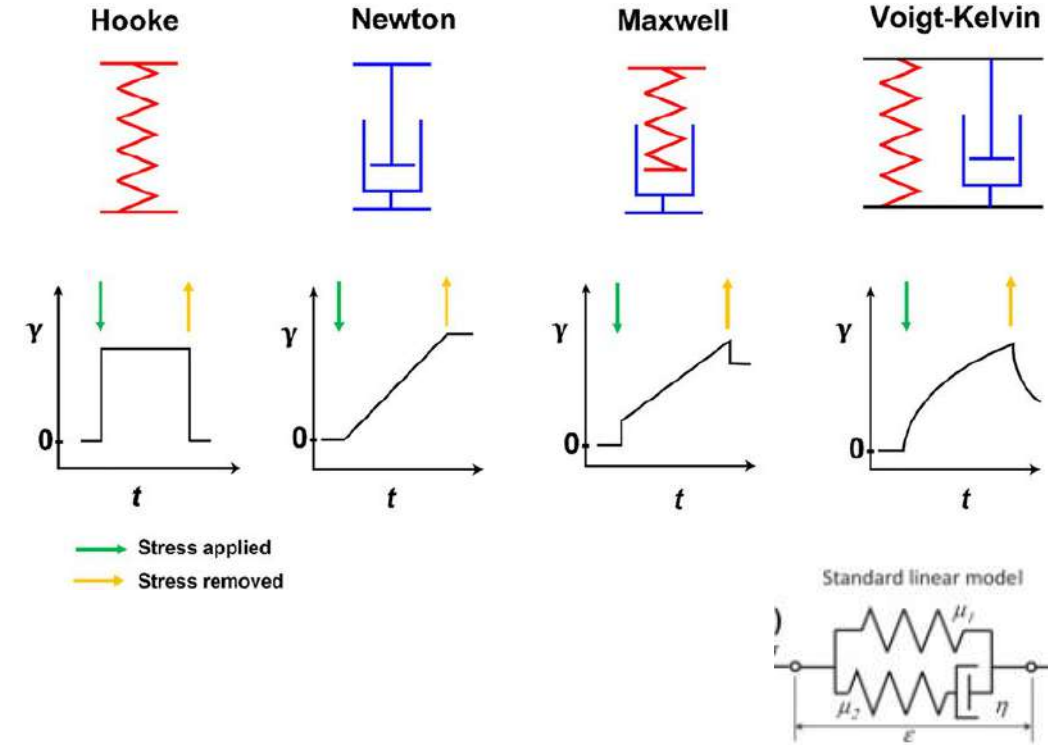
$$F(t) = F_{\text{stiffness}}(x) + F_{\text{friction}}(x') + F_{\text{cutting}}$$

=> optimal frequency

No mass
case:

$$p_1 \dot{\sigma} + p_0 \sigma = q_1 \dot{\epsilon} + q_0 \epsilon$$

γ = strain deformation



Model	p_0	p_1	q_0	q_1	Equation
Hooke (purely elastic)	1	0	E	0	$\sigma = E\epsilon$
Newton (purely viscous)	1	0	0	η	$\sigma = \eta\dot{\epsilon}$
Kelvin-Voigt	1	0	E	η	$\sigma = E\epsilon + \eta\dot{\epsilon}$
Maxwell	E/η	1	0	E	$\dot{\sigma} + \frac{E}{\eta}\sigma = E\dot{\epsilon}$
SLS	E_1	η	E_0E_1	$(E_0 + E_1)\eta$	$\eta\dot{\sigma} + E_1\sigma = (E_0 + E_1)\eta\dot{\epsilon} + E_0E_1\epsilon$

Hooke — ideal spring. Instant response, no memory.

Newton — ideal piston. Resists speed only, no memory of shape.

Kelvin-Voigt — spring + piston in **parallel**. Delayed elastic, always returns.

Maxwell — spring + piston in **series**. Instant jump, then flows forever.

SLS — spring + Maxwell arm in parallel. Instant jump, partial relax, settles at new shape.