Negative adaptive strategies of the human locomotor apparatus in children on their intensive sedentary lifestyle

On the threat on Healthcare systems by sitting and the importance of Milan Roth's work to understand it

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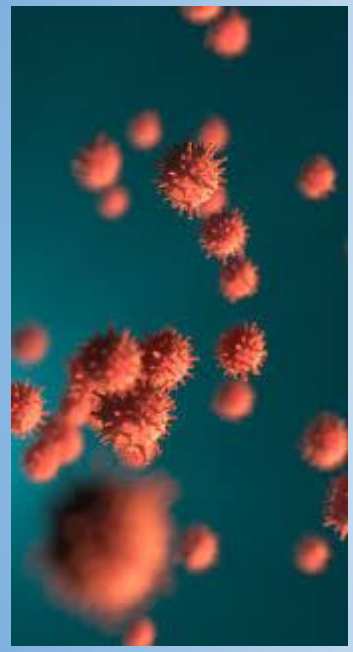
Lessons from COVID-19



- A pandemic caused by an external factor: **a virus**
- worldwide **socio-economic detoriaton**
- Morbidity and mortality are dependant of **prexexisting chronic lifestyle diseases**

(obesity, smoking, bad posture , stiff spines, diabetes, COPD etc.etc.)

The only answer till now:

HYGIENICS!

- Distancing
- Facemasks
- Washing hands etc.
- Being outside
- Quarantaine etc

What about the other pandemics?

The greatest socio-economic burdens of societies:

"**Musculoskeletal Conditions**"

- Back pain
- Neck pain
- Arthrosis
- Injuries chronic and acute
- etc

- Also no other solution

than HYGIENICS or PREVENTION ?

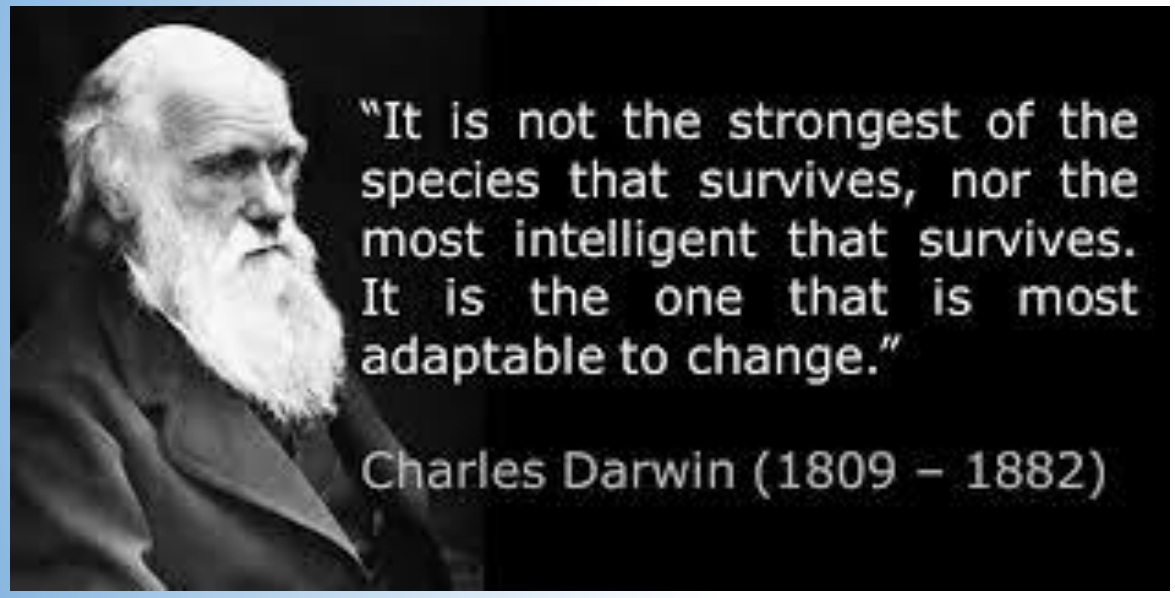
Indeed, but not easy!!:

You need the whole period of growth!

- Starting statement of Orthopaedics(1741): Sitting leads to unhealthy postures

Adaptation, the base for survival!

Phylogenetic, but also ontogenetic



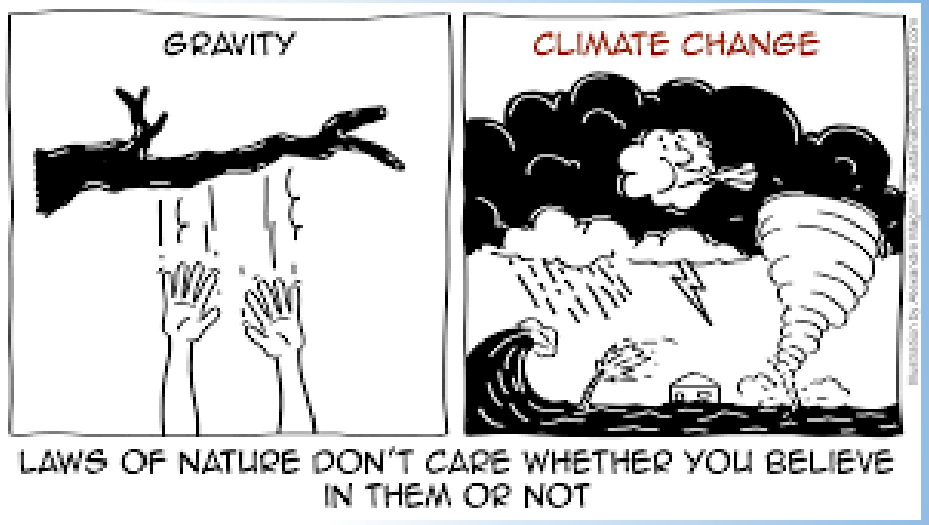
Change on environment:

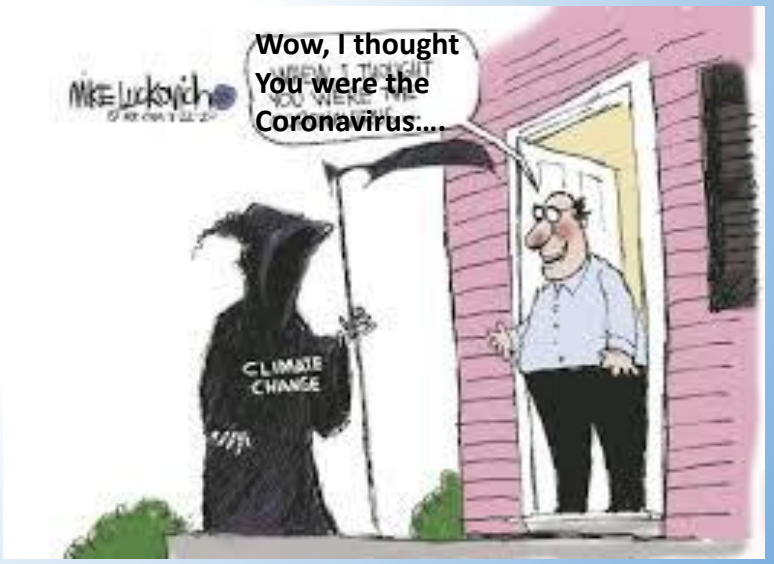
Nature on earth can be changed by earthquakes and floodings, but the greatest once came from outside: meteorites!

Same is true for the individual!

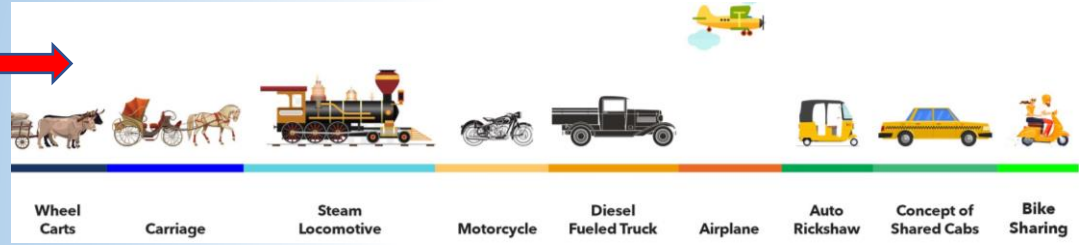
Morphogenesis, only a matter of adaptation?

- Normal growth also dependant of direct and indirect external factors (Roth)
- Homo Sapiens is the only species that can change its own environment……..
- from the Industrial Revolution on Homo Sapiens looks determined to change it in such a rapid way that we can destroy the complete living world……..





It is **civilization** in all its aspects that changes external factors on our genotype (unchanged!!)



In only 100 years !!

Thousands and thousand of years…….

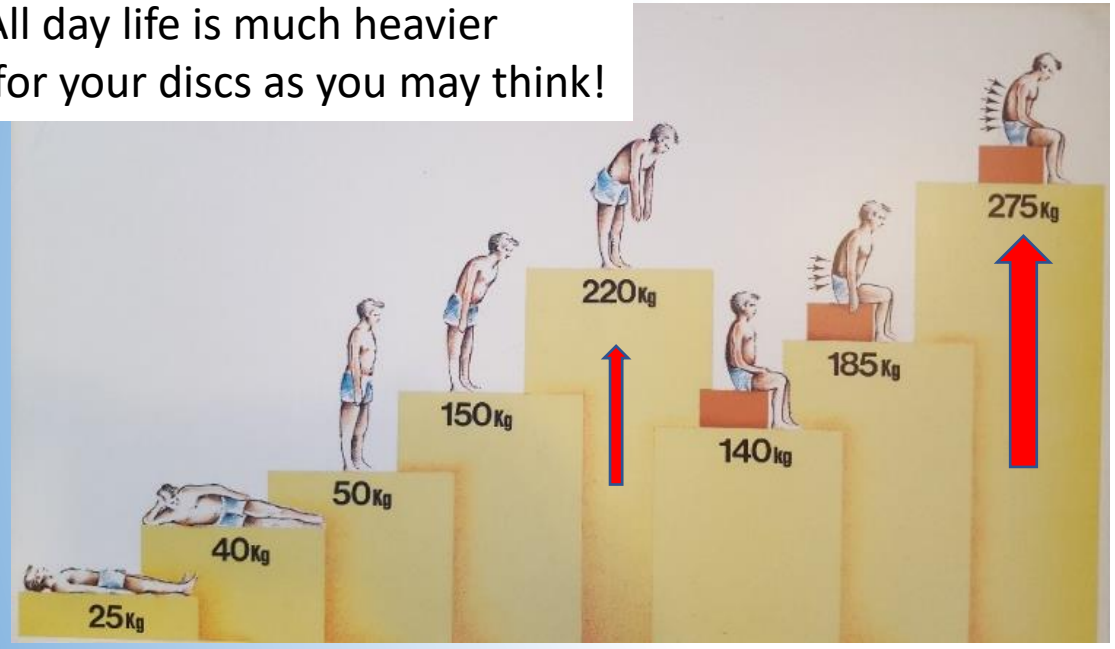
Sedentary lifestyle, sitting on chairs

- Sitting on chairs is the greatest change in the evolution of external factors in the direct environment .
- It started in Europe : the throne of the mighty evolved in a “throne for everybody”

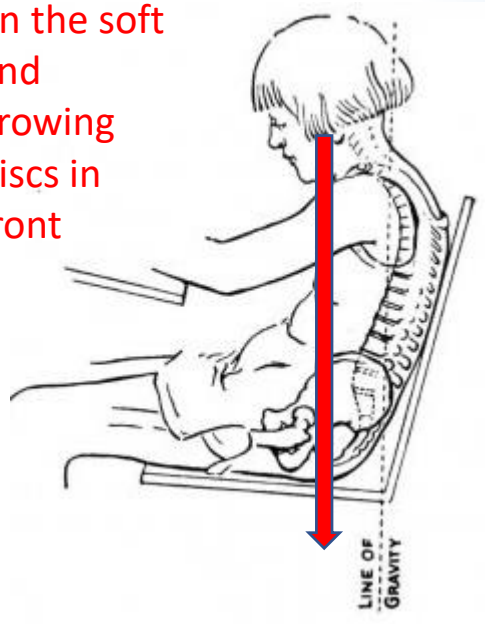
From Andry (1741) on we know: sitting changes a childs posture!!

What is the pathway?

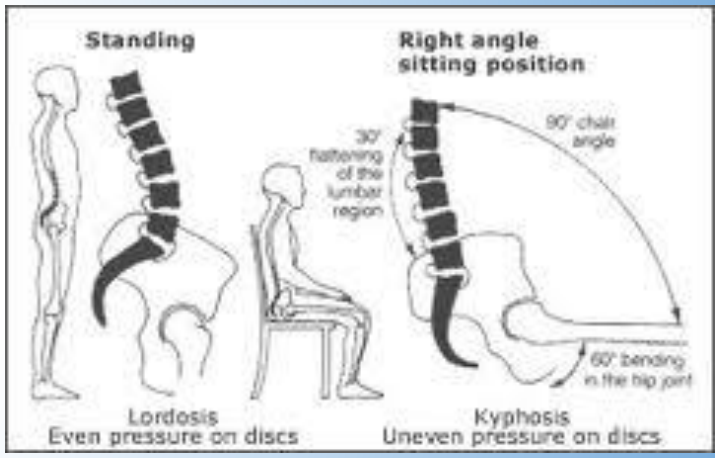
All day life is much heavier
for your discs as you may think!



All loading on the soft and growing discs in front

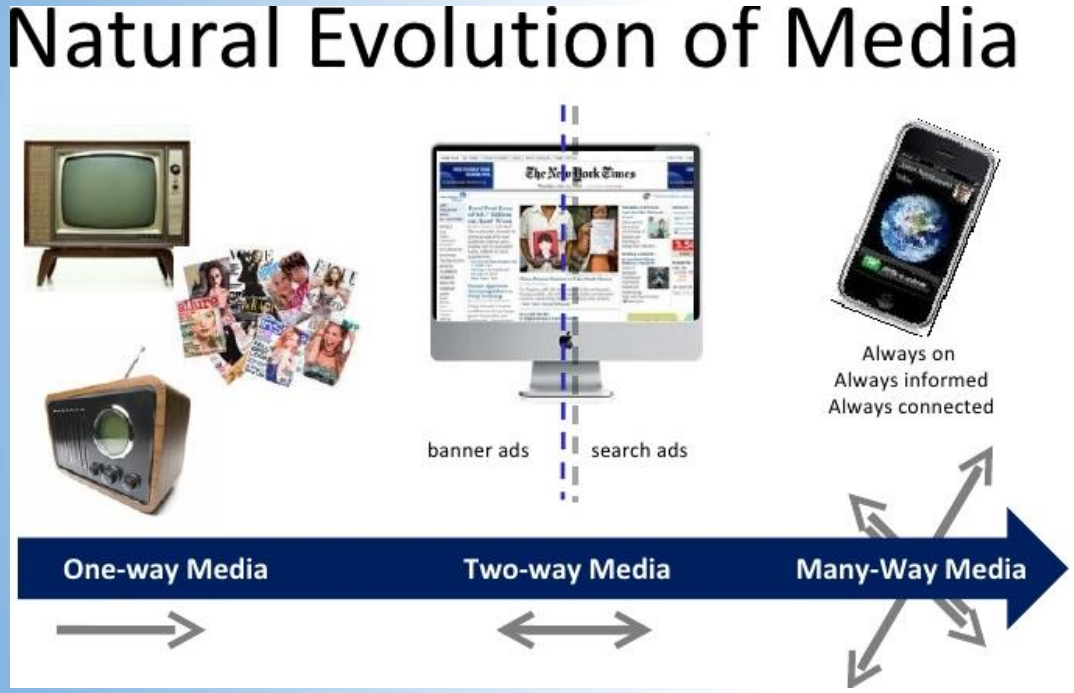


Sitting on chairs give unhealthy loading and stresses



Evidence by intradiscal pressure measurements
Prof. Alf Nachemson Sweden

New technologies . They are great!
But how do they influence a child's growth?



They used to play (outside) but became Puer Sedens!

They sit mainly slumped and sloughed

Adaptation processes needed in all tissues!

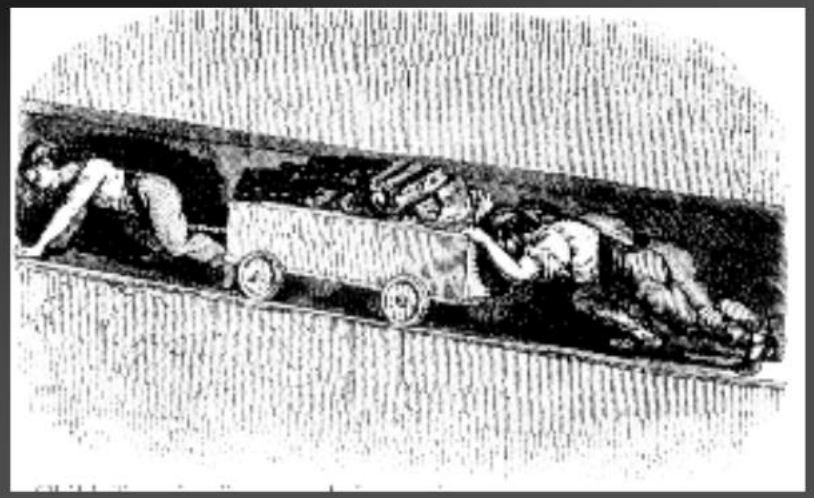
Sitting and deformation a wellknown relation!

was very common in Europe until the early 20th century !

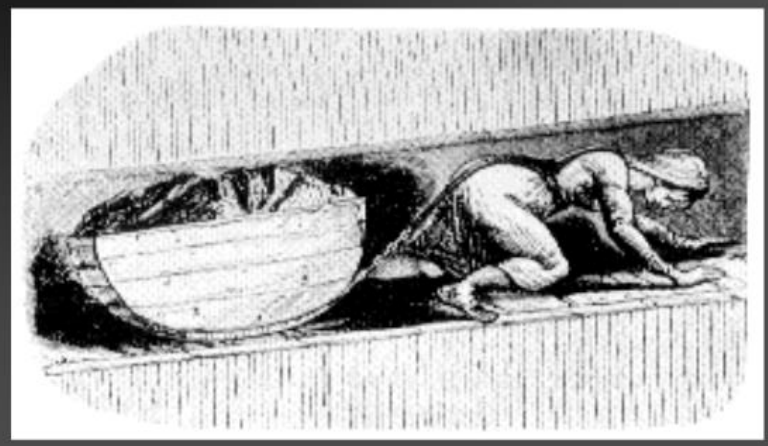
Childhood labour

Misadaptation in growing childs: still a social and political issue

Child "hurriers" working in mines. From official report of the parliamentary commission



Girl pulling a coal tub in mine. From official report of the parliamentary commission.



Crooked spines, lung diseases, severe injuries, early death

USA abandonded childlabour only in 1938!

"breaker boys" in a Pennsylvania
80 hours a week

From the book ***The Bitter Cry of the Children*** by labour reformer John Spargo:

Adaptation = Form follows Function

- All mechanical (static and dynamic) stimuli on the integrated 3-D structure of a living animal from the fertilised eggcell to adulthood add to the endresult of morphogenesis

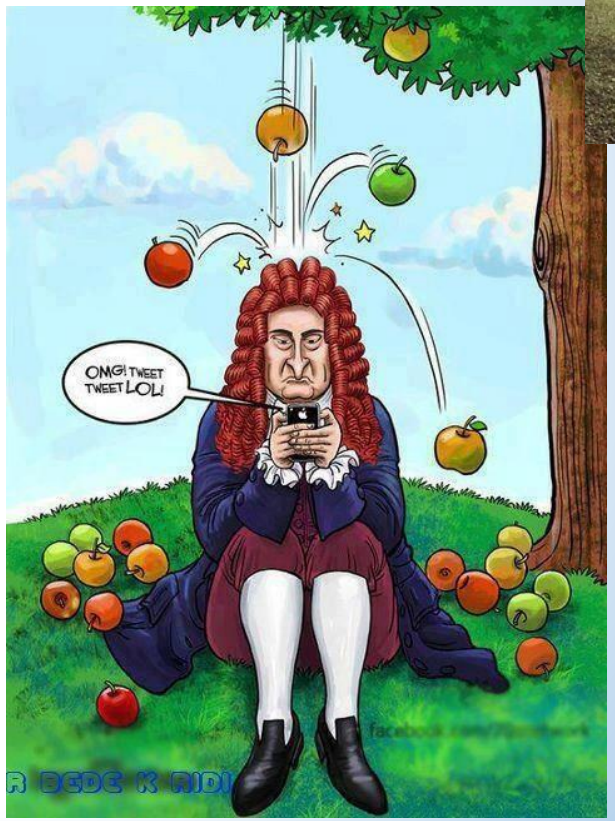
- Andry and classic Orthopaedics: **bone react as wood on mechanical forces**: in trees you can prevent deformity by wind

Frontspiece of *Orthopédie* by Nicolas Andry, 1741

Andry's allegory on adaptation (1741)

Ontogenesis ≈ Phylogenesis

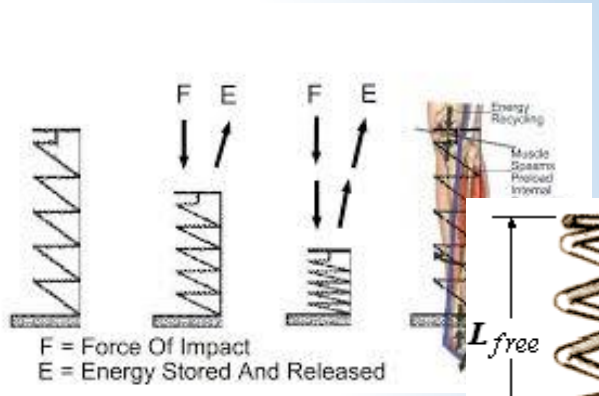
- Life on earth is all about dealing with gravity (Natural Laws)
- Every single cell has to obey all Natural Laws from the first bacteria to the complete integrated system of the vertebrate
- The human body differs in no way in reacting on mechanical forces as any other living structure



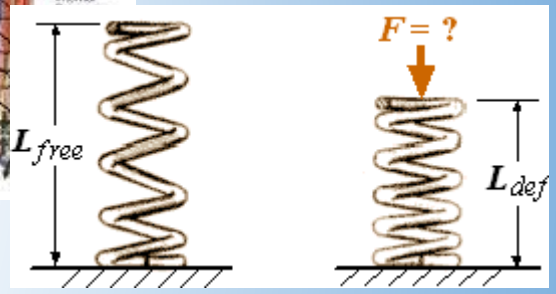
Adaptation in a growing structure; It is all about **tension**!

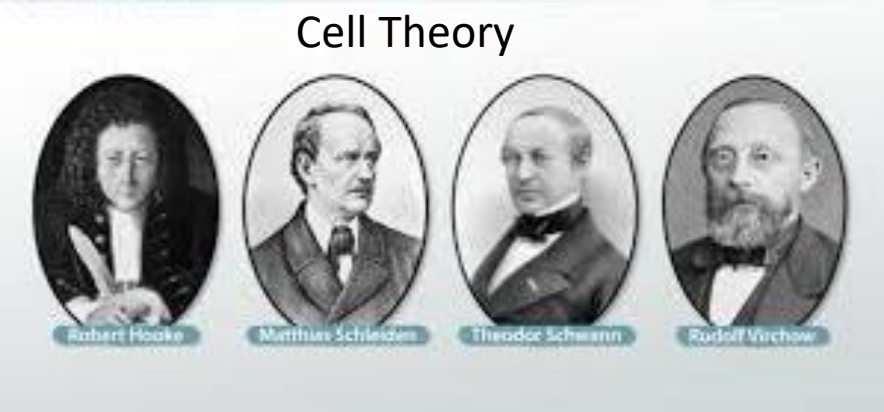
- Direct deformation by overload in compression or stretching by too much tension. It is the quality of the single cell that counts for the whole structure

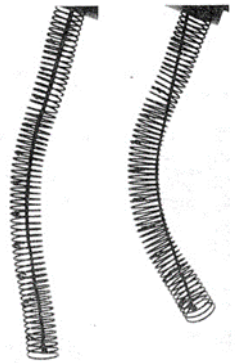
Robert Hooke



Dynamic Laws



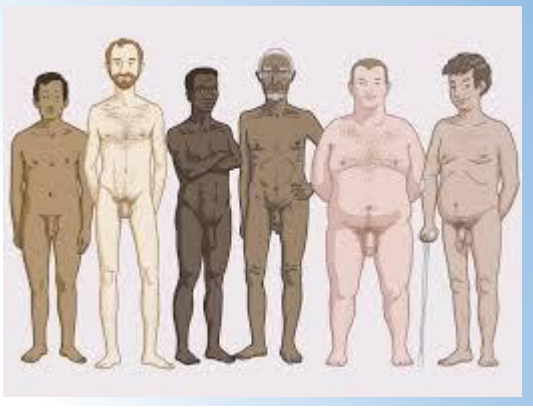




Laws on preservation of energy

Some little facts to think about

- Osteo-neural **growth is a tension driven system** of reciprocal influence between these two tissues with the muscle-fascie ligament systems as intermediate
- Homeostasis combines *static* (anatomical and functional posture) and *dynamic muscle action* (movement) and the *spring-like functions of joints and discs* (=energy preservation) in stance and voluntary locomotion.



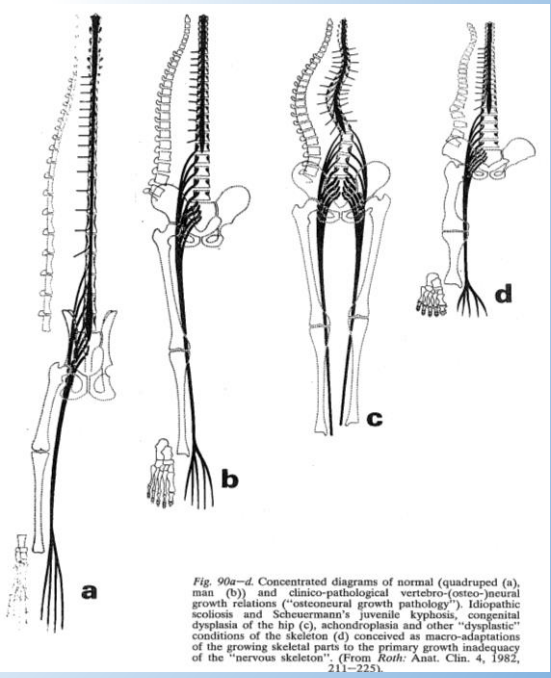
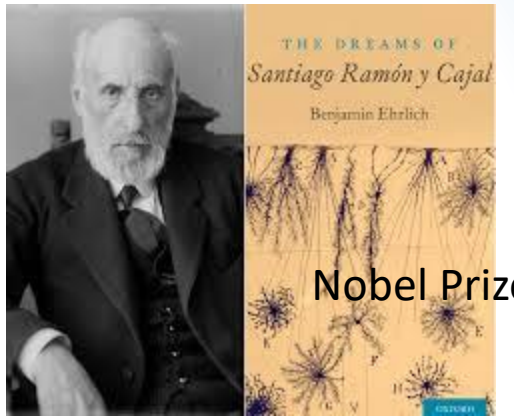


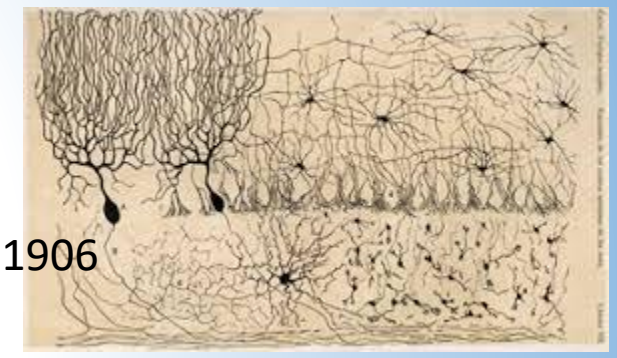
Fig. 90a–d. Concentrated diagrams of normal (quadruped (a), man (b)) and clinico-pathological vertebro-(osteo-)neural growth relations ("osteoneural growth pathology"). Idiopathic scoliosis and Scheuermann's juvenile kyphosis, congenital dysplasia of the hip (c), achondroplasia and other "dysplastic" conditions of the skeleton (d) conceived as macro-adaptations of the growing skeletal parts to the primary growth inadequacy of the "nervous skeleton". (From *Roth:* Anat. Clin. 4, 1982, 211–225).

Locomotion is creating forces , but growth by itself is creating forces too (Roth)

- The nervous tissue is responsible for sensoring all external and internal forces
- The nervous tissue is responsible for creating muscular reactions (autonomic /reflectory or somatic nervous system)
- But what happens in a growing body ??
- It is the **synaps** that gives the clue to processes af adaptation!



Nobel Prize 1906



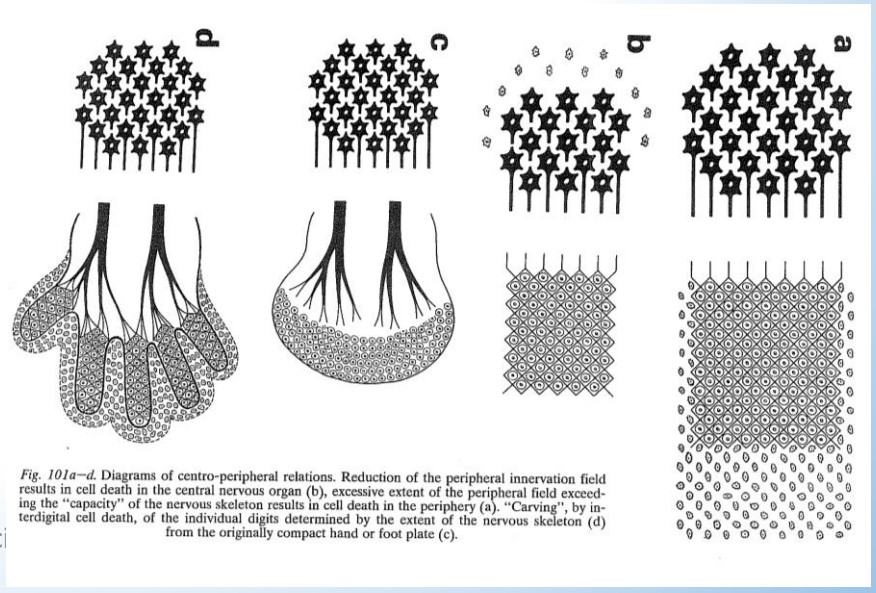
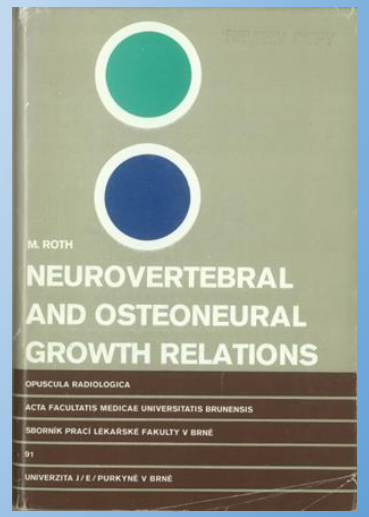
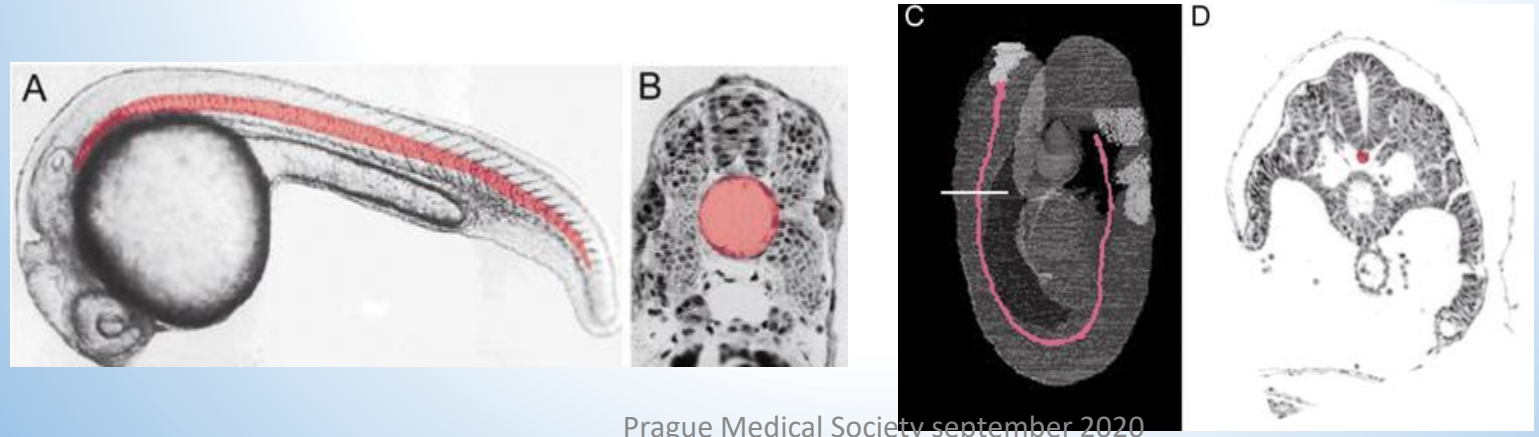


Fig. 101a–d. Diagrams of centro-peripheral relations. Reduction of the peripheral innervation field results in cell death in the central nervous organ (b), excessive extent of the peripheral field exceeding the "capacity" of the nervous skeleton results in cell death in the periphery (a). "Carving", by interdigital cell death, of the individual digits determined by the extent of the nervous skeleton (d) from the originally compact hand or foot plate (c).



Some little facts to think about

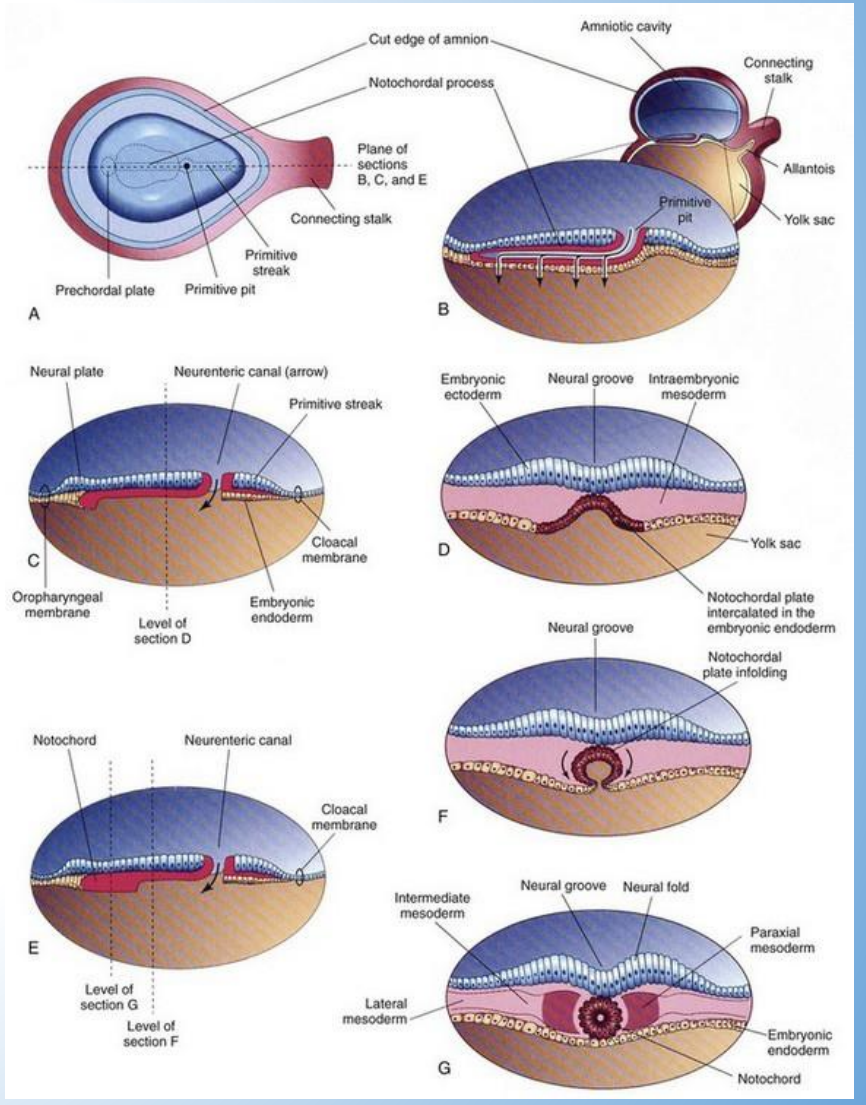
- One of the first cellular differentations in the embryo is the formation of neural stem cells in the notochord which will remain their controlling and regulating role in growth.
- They have to contact all new somatic cells into the tip of finger and toe!



Roth: Some little facts to think about

- Somatic tissues grow in volume and mass by mitosis
- Neural tissue, however, grows by stretching
- (not in number of cells, all billion neural cells present 3 months after gestation)

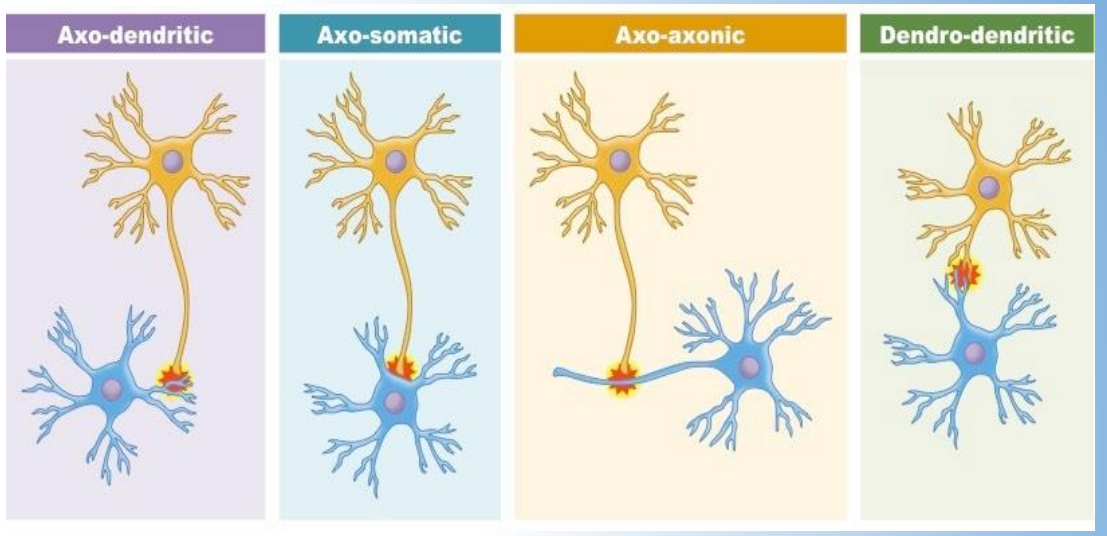
But what is the total amount of synapses all neurons need to give you an optimalised and durable form and function??

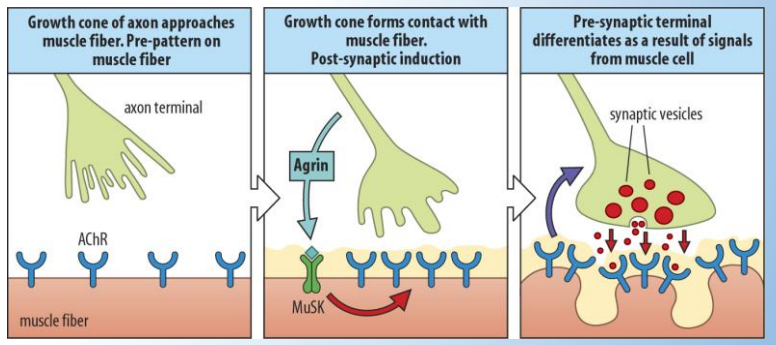


Adaptation: its all about signaling and tension(Roth)

Unanswered questions:

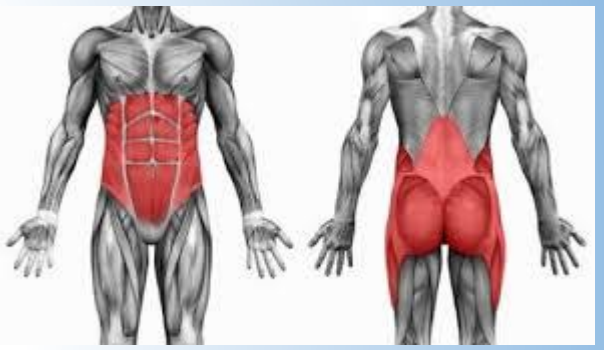
- How are synapses produced?
- What are the triggers for this proces? All mechanic and dynamic forces?
- What is the most optimal amount of synapses per neuron to add to health? 1000? Some millions per cell???
- Do modern children have less synapses than in the old days?





The central pivot for posture and locomotion: the Thoracolumbar Joint

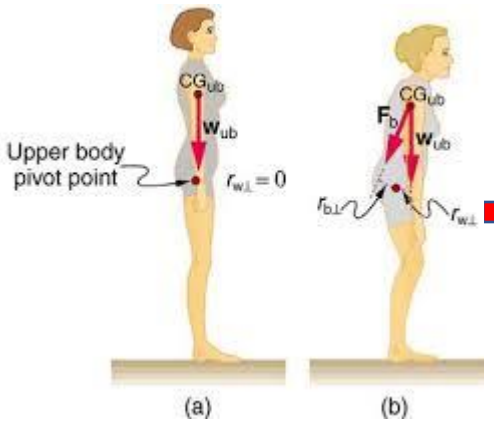
- In all vertebrate species, the spine acts as the chassis and “core muscles” as primary engine in locomotion.
- The main change in function of the spine between quadrupeds and bipedals is that the coupling mechanism at the thoraco-lumbar junction changed.

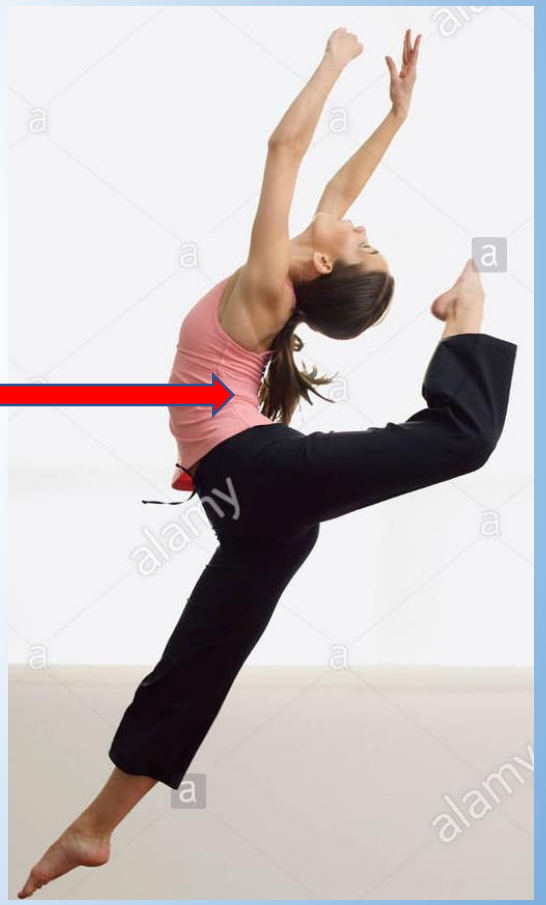


Some little facts to think about

- The pivot point of this inverted pendulum is at the thoraco-lumbar junction!

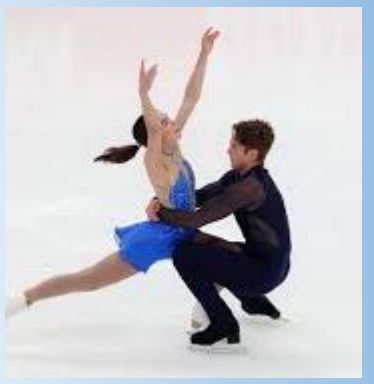
- *Roth: Homo erectus* is the only species with a conus-cauda at the thoraco-lumbar level.

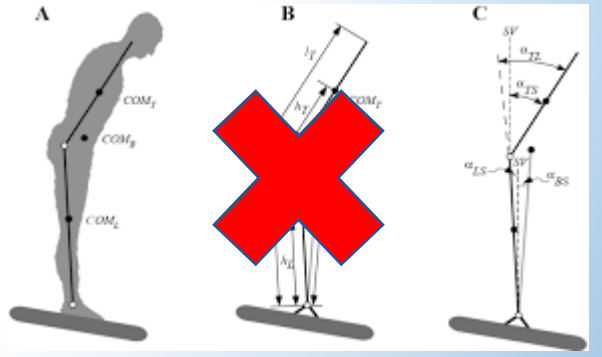




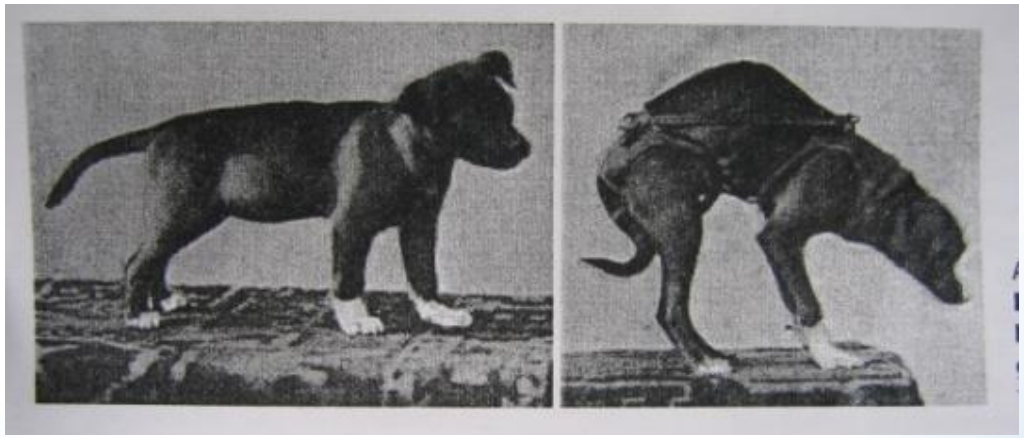
TL- joint (Th10-L2)

- Walking is characterised by an "inverted pendulum" movement in which the **center of gravity** vaults over a stiff leg with each step.
- Balancing the weight of the skull connected on top of the spring-like spine plays an important role in optimal anatomy.
- Centre of gravity = centre of locomotion = referencepoint of all proprioscepsis





And now present life: what is the fate of the TL joint , posture and locomotion in children??



Wullstein 1903: Animal experiment
Destruction spine in 6-12 weeks forced flexion

It’s the (American?) lifestyle taken over by adults that hinders health of their children

Children are excellent copyists of adult behaviour ! TL joint and CNS are frustrated by this lifestyle

Effect sitting (slumped and sloughed) on a growing spine: ADAPTATION with secundary ADVERSE RESULT

- Discs under much too much compression TL anterior, lumbosacral posterior: herniated discs
- Cartilage under shearstresses: early degeneration
- Bone/ vertebrae will deform gradually (Wolff's Law): kyphosis, scoliosis.
- Motion units spine will stiffen up (contactures, ankylosis)
- Ribs and diaphragm in unphysiologic position: hindering ventilation
- The CNS becomes confused and "unhappy"

CNS involved? Posture and attitude are coupled

- In German and in Dutch we do have only one word for posture and attitude: Haltung (D) and Houding (NL)
- In English two: posture and attitude
- In Czech??
- BODY (Skeleton) and BRAIN (CNS) will show adaptations to the new lifestyle

Autism , ADHD and at the end Alzheimer and Parkinson as consequences??

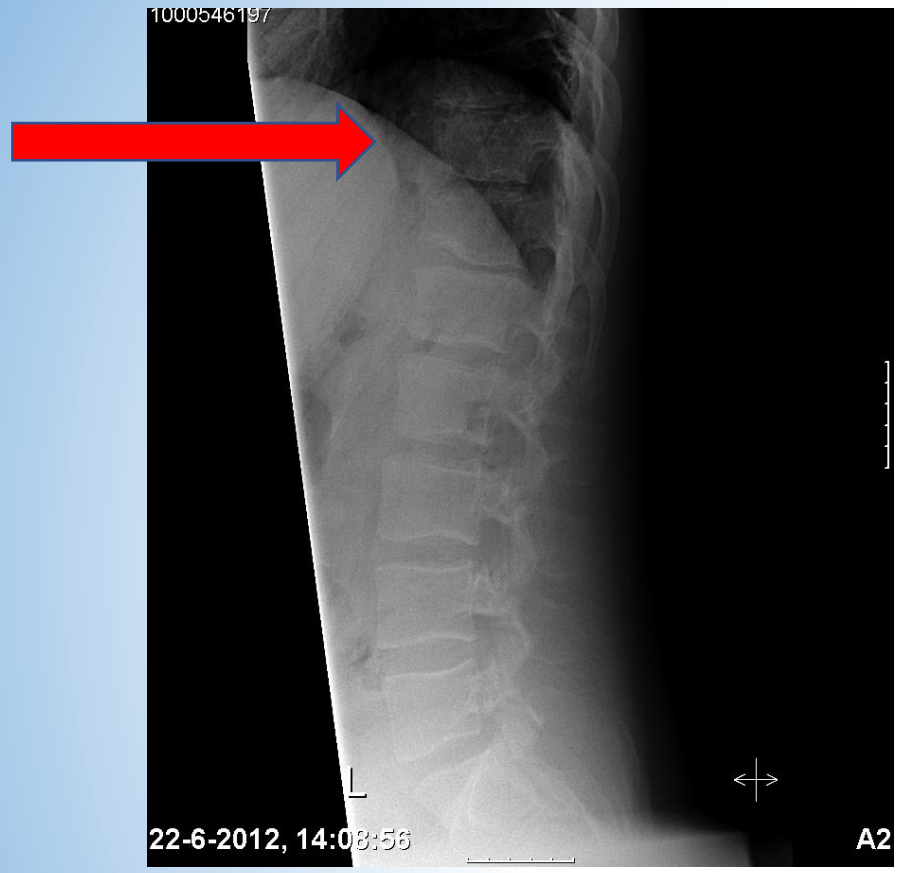
Increased tension tested

"Pop-up" test

"Pump handle" test

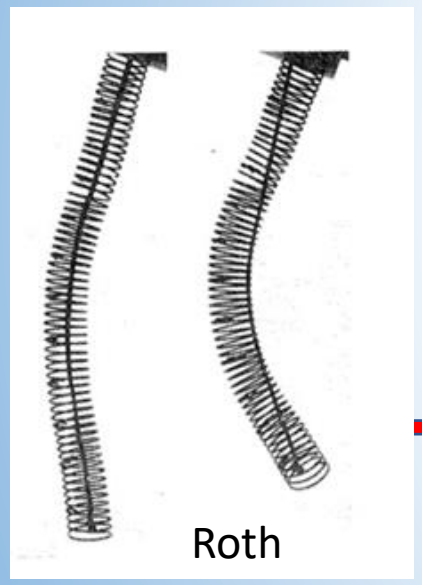
Example

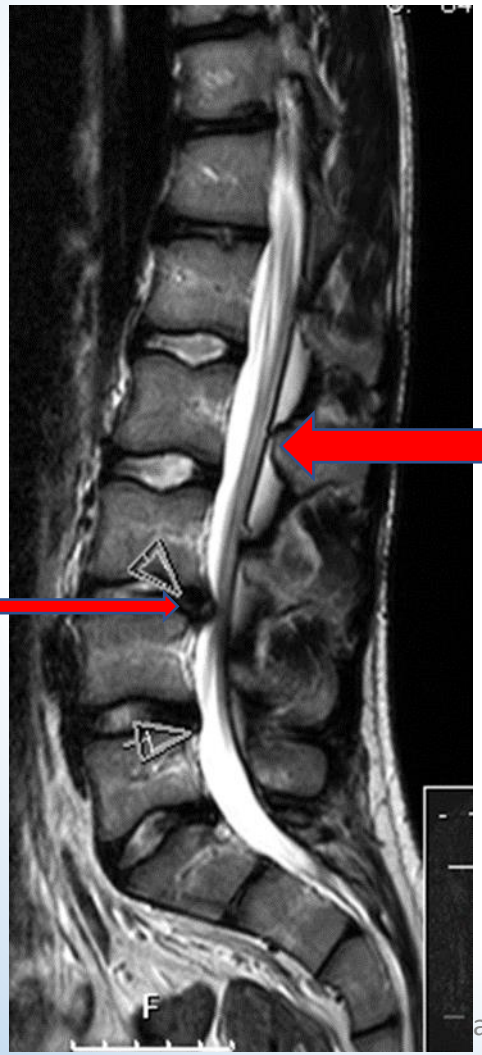
Boy 9 years old. Backpain.

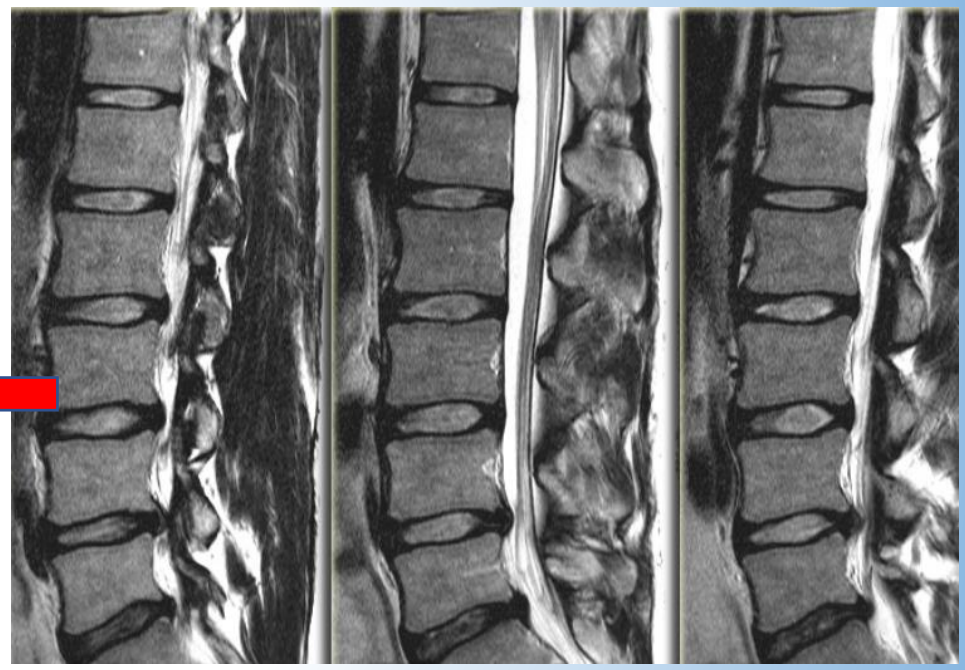


4 years later. Progressive backpain. Schmorl++ Wedging++ Bad posture. Gameboyspine while sitting and thight hamstrings++

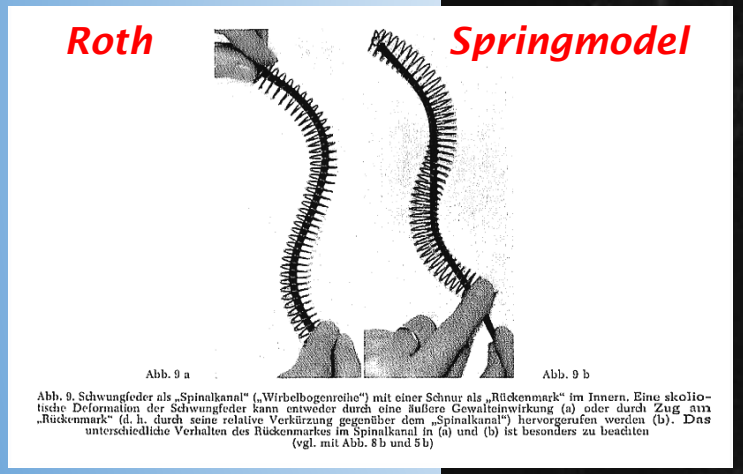
On MRI all features Roth found in pneumomyelography

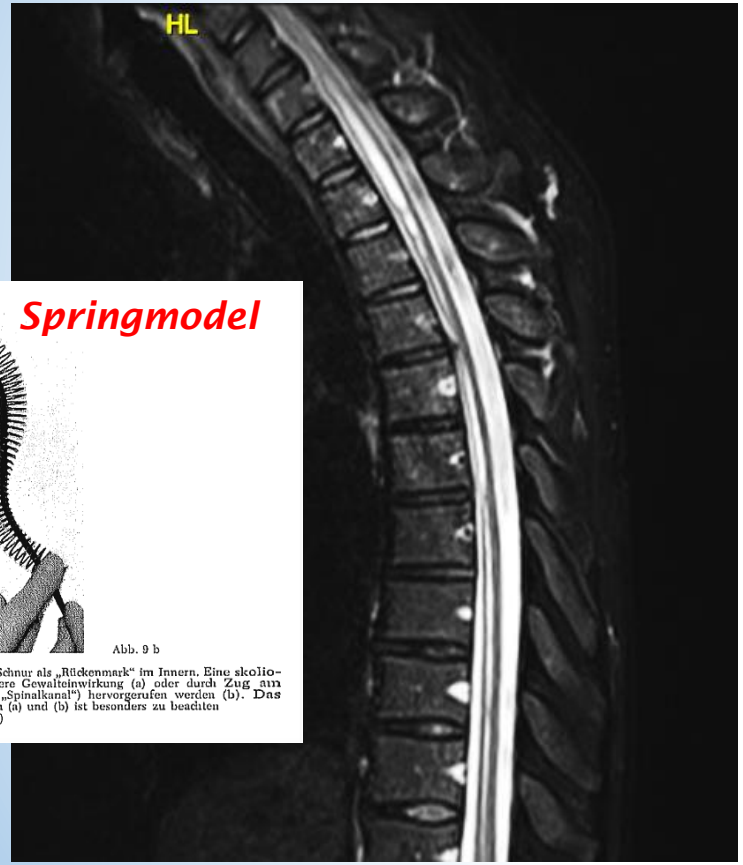






Roth postulated mechano-dynamic etiology of syringomyelie





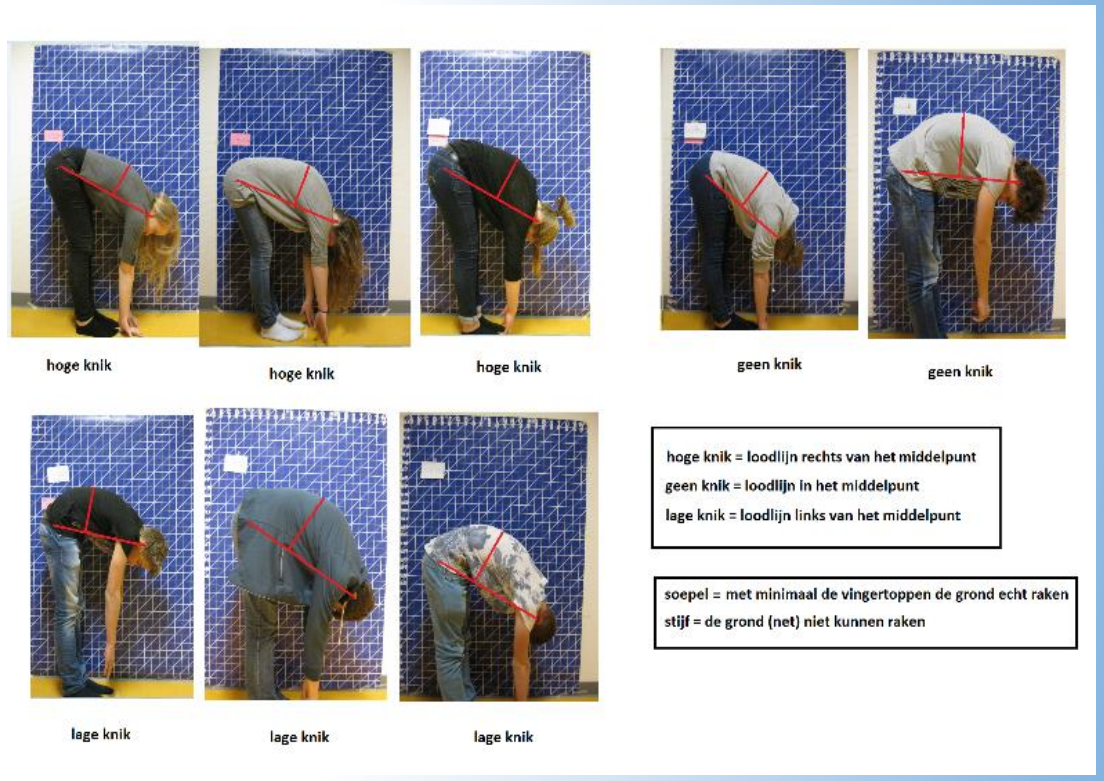
Always kyphotic
Always stretched cord
Always rubbing on ventral bony canal
Visco-elastic mismatch

Distorted venous plexus

syrinx

Own pilot: evidence in a schoolcohort : 248 children 14-18 yr.

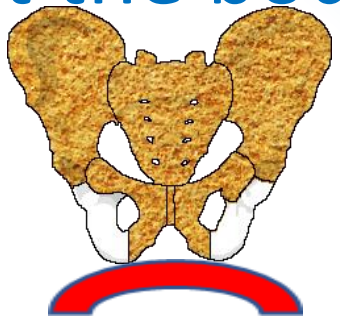
- Hamstring tightness in both legs was present in 62.1%.
- Unilateral tightness in 18.2%.
- Achilles tendon tightness in both legs was present 59.3%.
- Unilateral short calf muscle-tendon thightness in 19, 4%.
- The correlation of the Finger Floor Test with tight hamstring is 73.2%.
- So there is a link between the hamstring and the lack of flexibility at bending



Humpolec 2019

A fundamental other approach to “sitting” is needed in order to let the body adept

- Sit as less as possible: stand up, walk, lay down
- Sit as less as possible in 90º with both legs
- Facilitate good posture of the torso
- Variation in all positions of hips, knees and ankles
- Go for active sitting
- Facilitates the torso into the same postures the standing person has (as Leonarda da Vinci draw)



Leonardo: one leg bowed!

The solution for society: **prevention** targeted on youth

- Awareness nationwide
- Education parents
- Education
  - children
  - teachers
  - physicians
  - physiotherapists
- Less sitting hours
- Active sitting
- Active sitting solutions
- Extension+++
- Gymnastics / dancing

- Active bracing protocols (TLI)

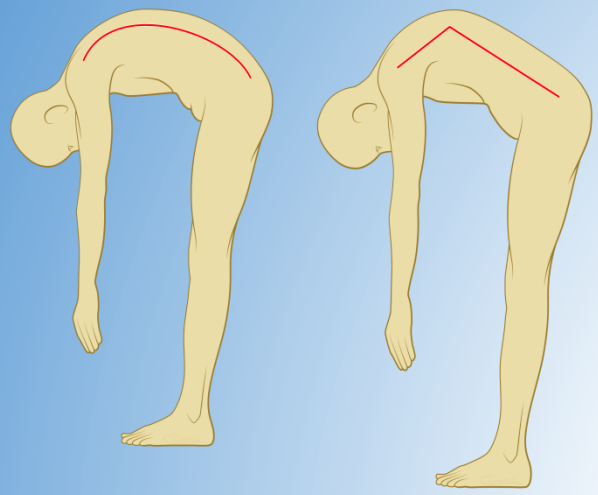
Zami , active sitting

Houding Netwerk Nederland

But a big task for the scientific society too!

Start research on Growth and Posture!

- Growth, number and fate of synapses
- Relation posture and neuromusculaur thightness on macrosopic cellular level
- Compare Roth's findings on MRI
- Effects of active sitting on posture
- Effects of Thorocolumbar Lordotic intervention in excersises and bracing



Thank you!

Change habits and posture !