HEALTH LIVING: BACK PAIN

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My Background/disclosure

Work:

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Education

- Msc. Physiotherapy, specialist in sports injuries (University of the Western Cape, South Africa)
- Ph.D Exercise Science (University of Cape Town, South Africa).
- **Promoter of Exercise is Medicine slogan**

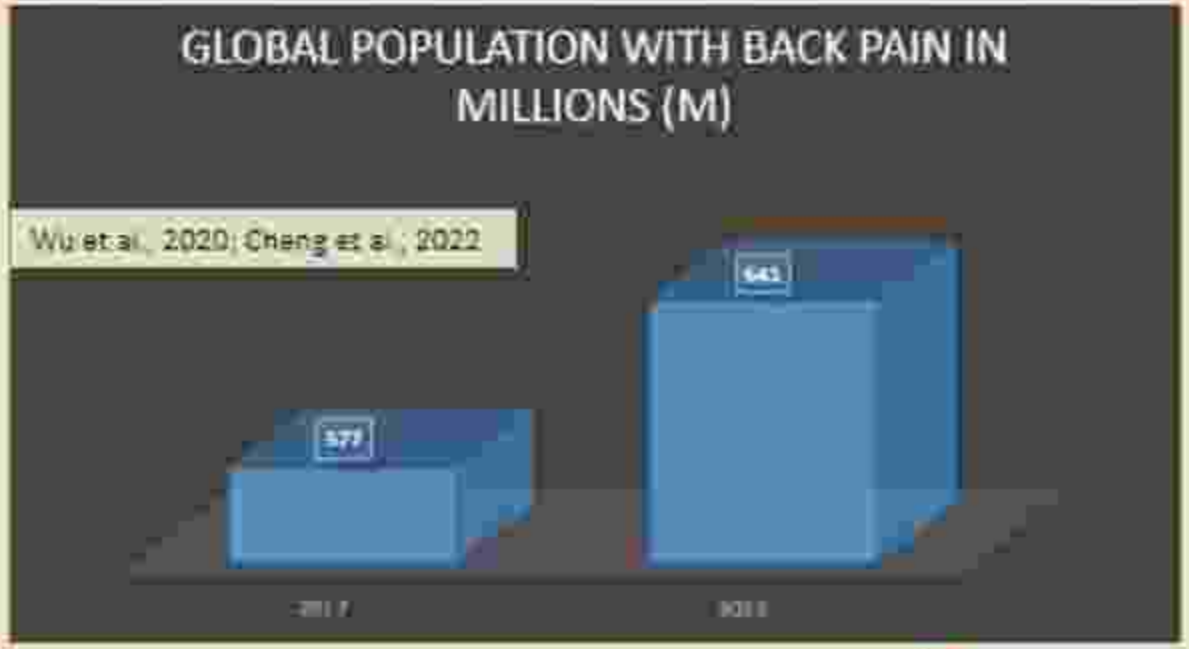
Members

- South African Sports Medicine Association SASMA **(Membership No. WC 1044)**
- UAPC (Uganda Allied Health Professional Council **(Reg. No. 6322)**
- Health Professional Council of South Africa **(Reg. No. PT S 0115843)**
- Golden Key International **(Membership No. 9028311)**

TALK ABOUT

- ❑ Burden of Low Back Pain (LBP)
- ❑ Anatomy & Function of the spinal Units
- ❑ Back pain Pathologies
- ❑ Risks & Causes of the back to pain
- ❑ Preventive measures

The burden of Back pain: Back pain (LBP) has become a global pandemic, and it is now a public concern



Frequent medical consultations, and therefore, a huge medical burden and direct or indirect financial implications (Brady, 2022)

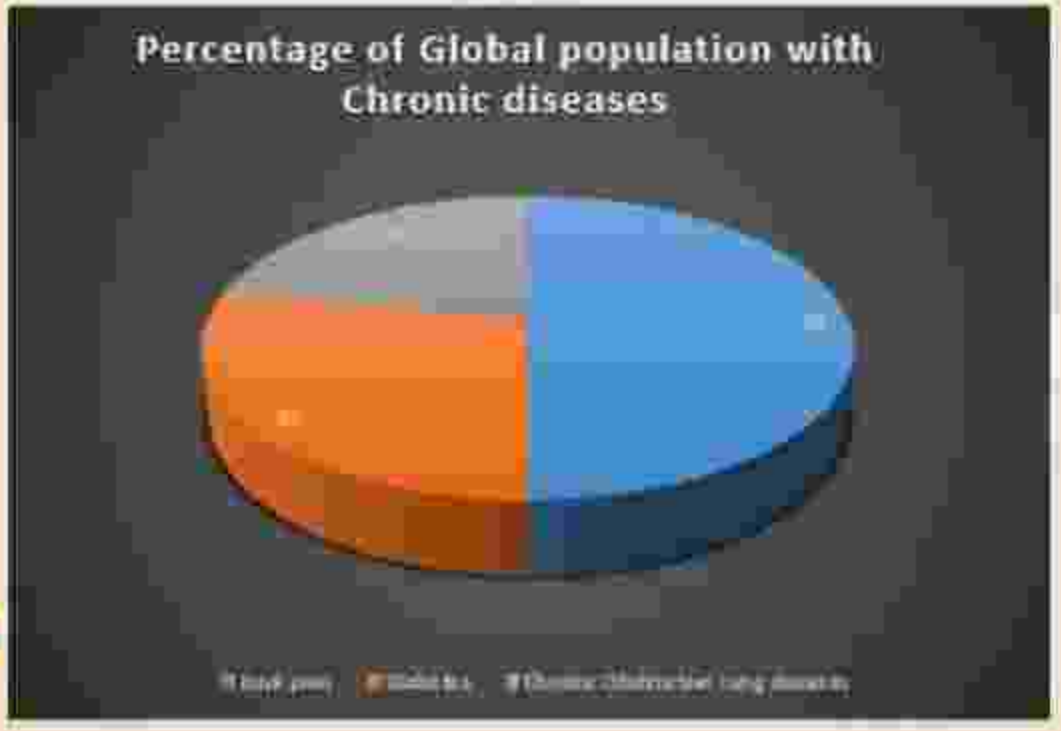
Quality of life & Disability: Significantly affect performance at work

Leading cause of activity limitation and absenteeism from work

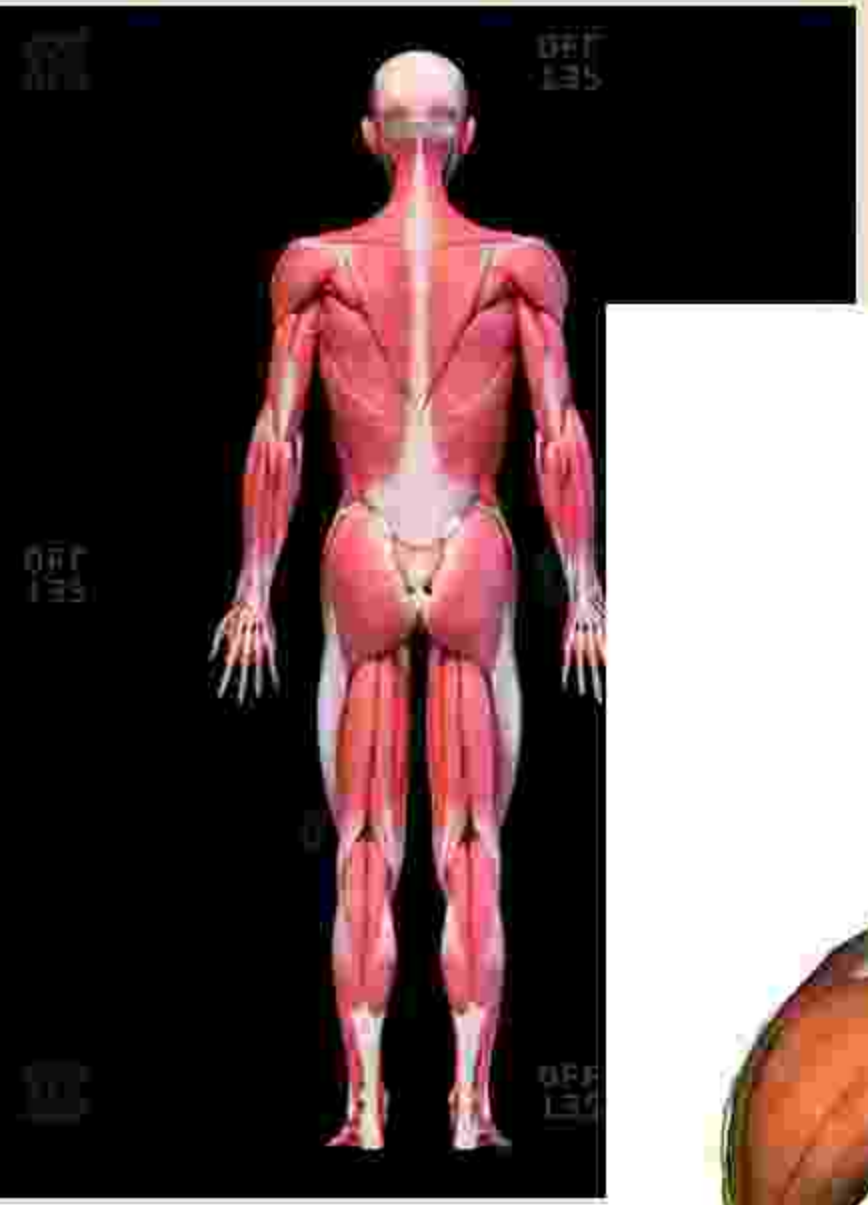
Wu et al., 2020

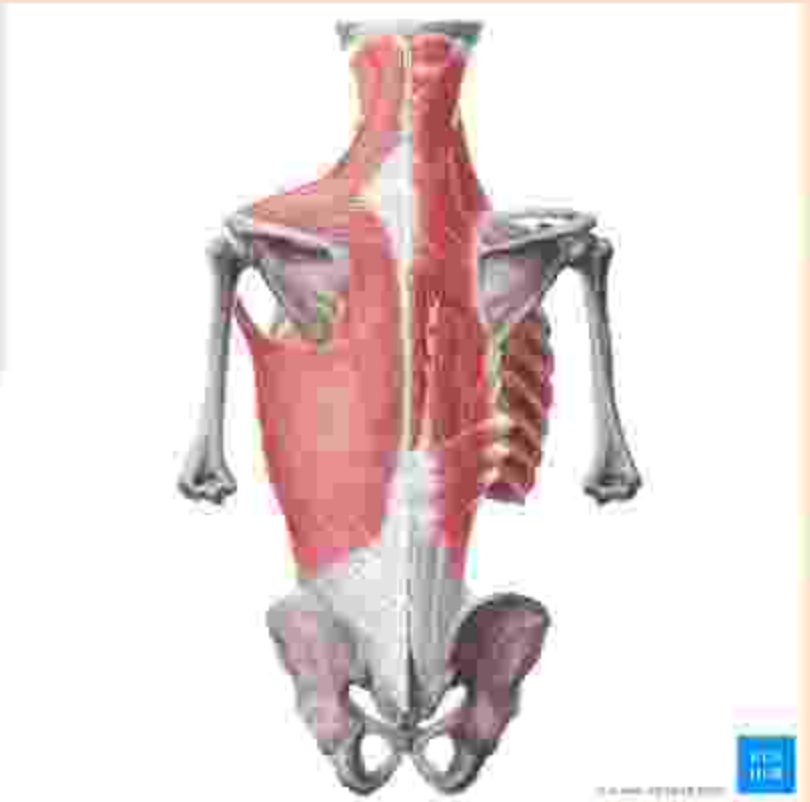
Women are more affected
Wu et al., 2020

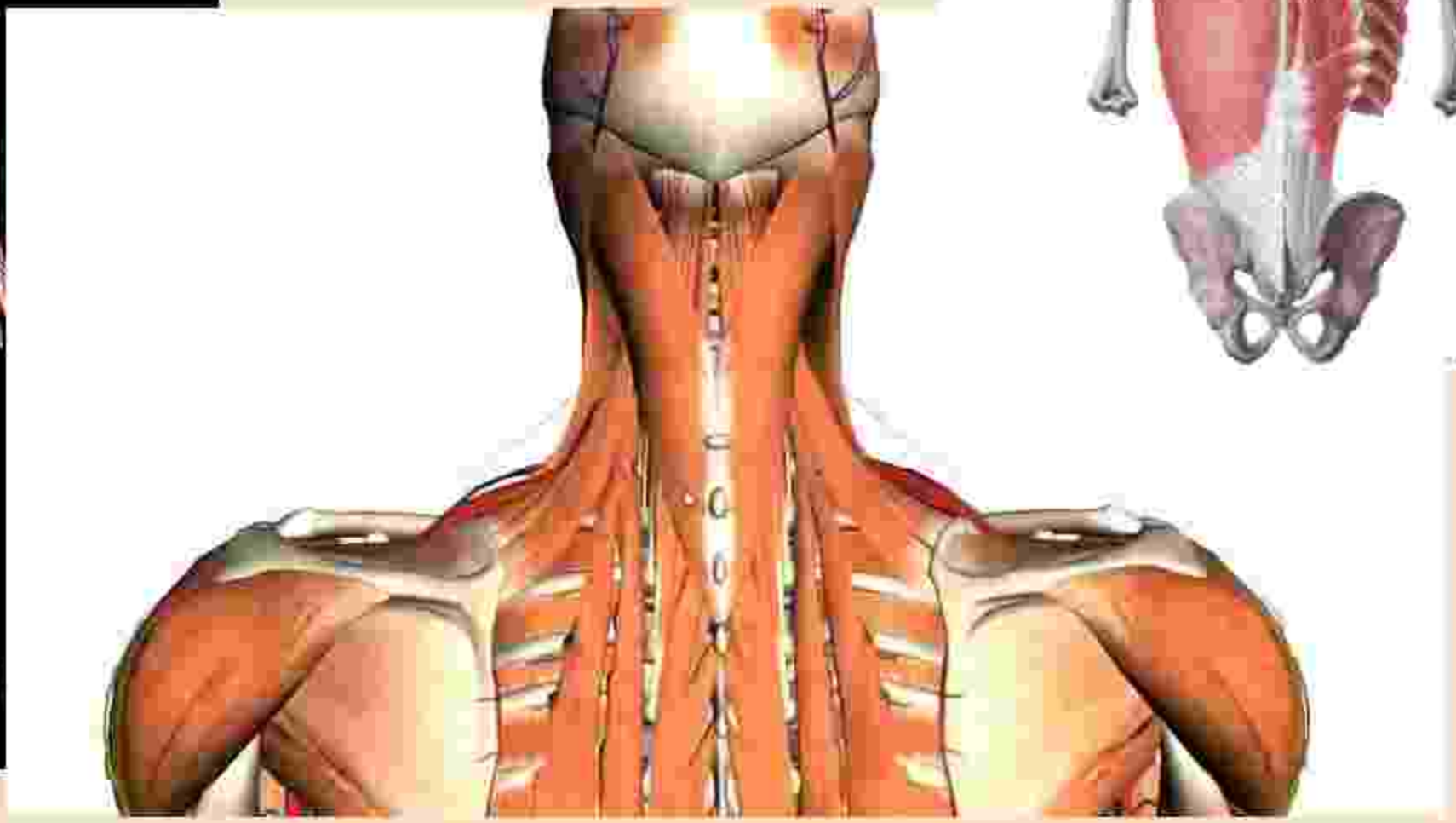
2010 report indicated LBP among the 10 global burden of diseases. Hoy, March, Brooks et al., 2014



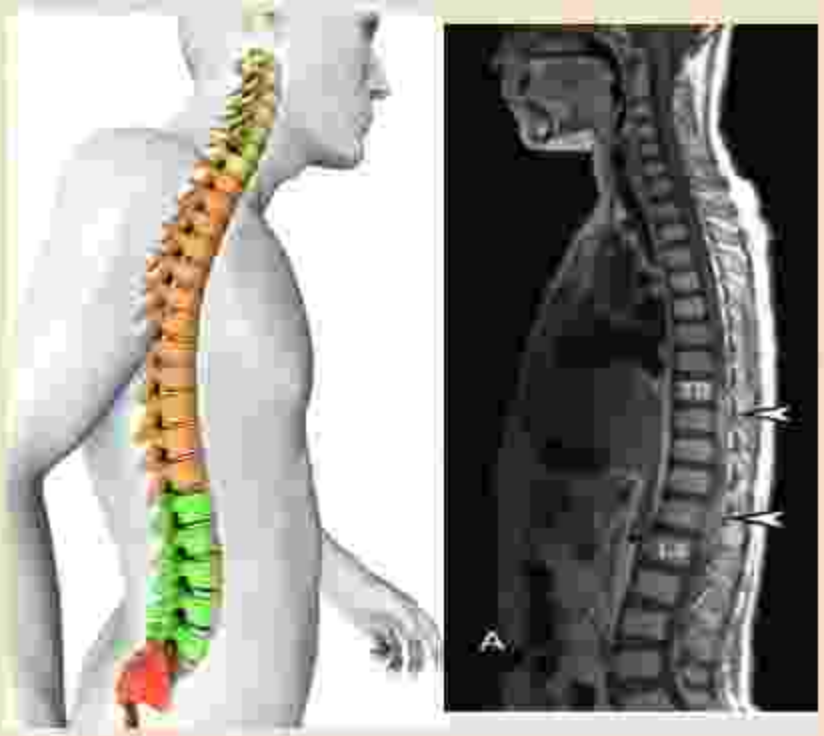
WHAT STRUCTURES ARE FOUND AT THE BACK







Basic Anatomy & Function of the spine



SPINE

- 33 Bones
- Cervical (neck=7); Thorax (chest=12); Lumbar (back=5);

  Sacrum (bottom=5); coccyx (tail =3)
- Bones separated by intervertebral disc
- Disc is a pad made of:
  - Annulus fribrosus (outer layer)
  - Nucleus pulposus (inner layer)

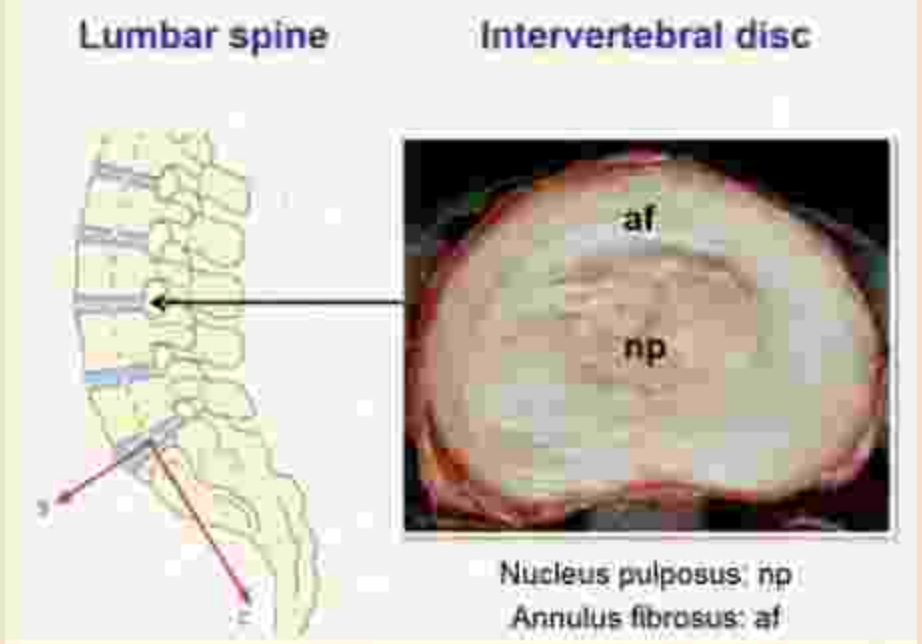
Spinal unit anatomy: Intervertebral disc/pad

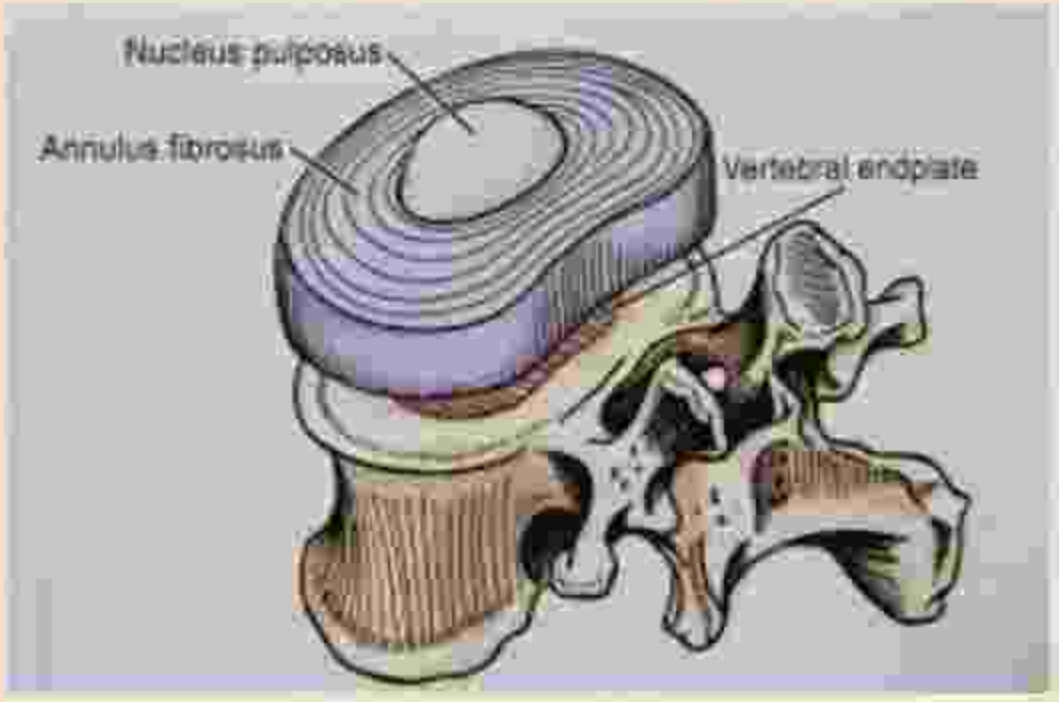
Annulus fibrosus

- The tough circular exterior of the disc
- A lot of collagen, glycosaminoglycan material for mechanical support
- Composed of a ring of ligament fibers

Nucleus pulposus

- A soft tissue
- High water content
- Loose network of collagen fibers
- Absorbs forces of compression

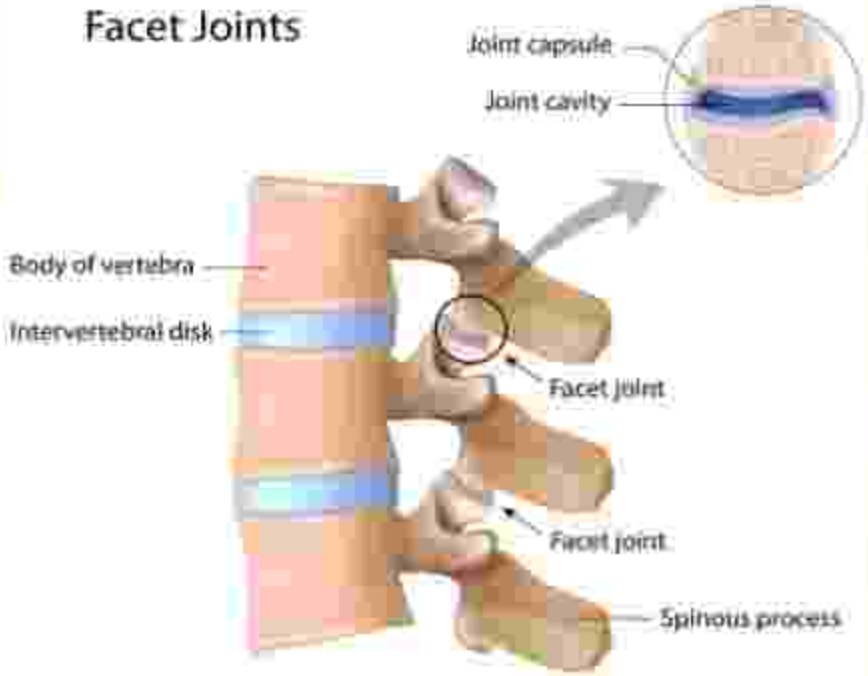


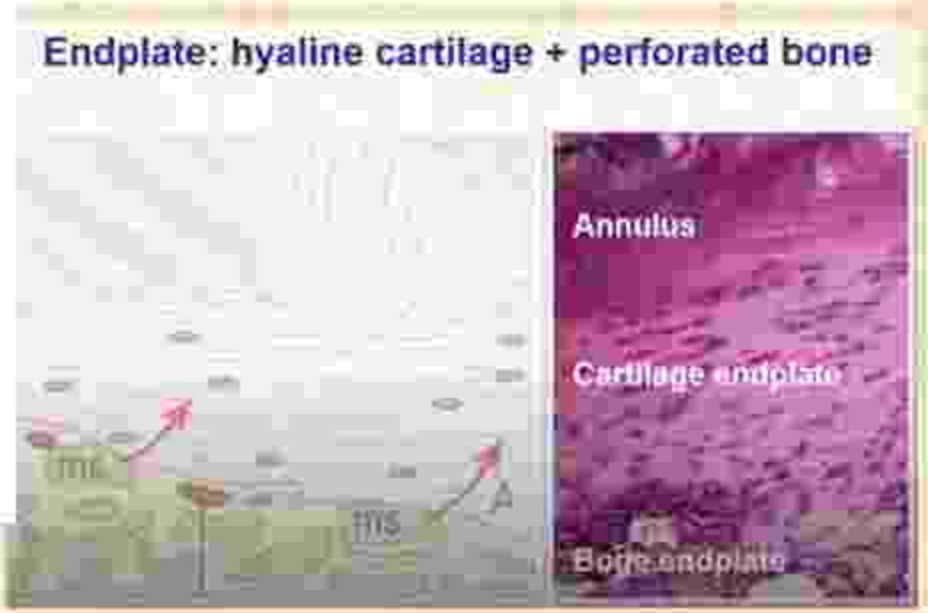


Spinal unit anatomy

End-plate structure

- Two tissue layers (hyaline cartilage and perforated bone).
- The cartilage is a very dense structure and does not swell up easily.
- Established in most apophyseal joints.
- The layer of cartilage is also weakly bonded to the bone to allow quick exchange of products.
- The histological photo shows the a clear picture of these layers.





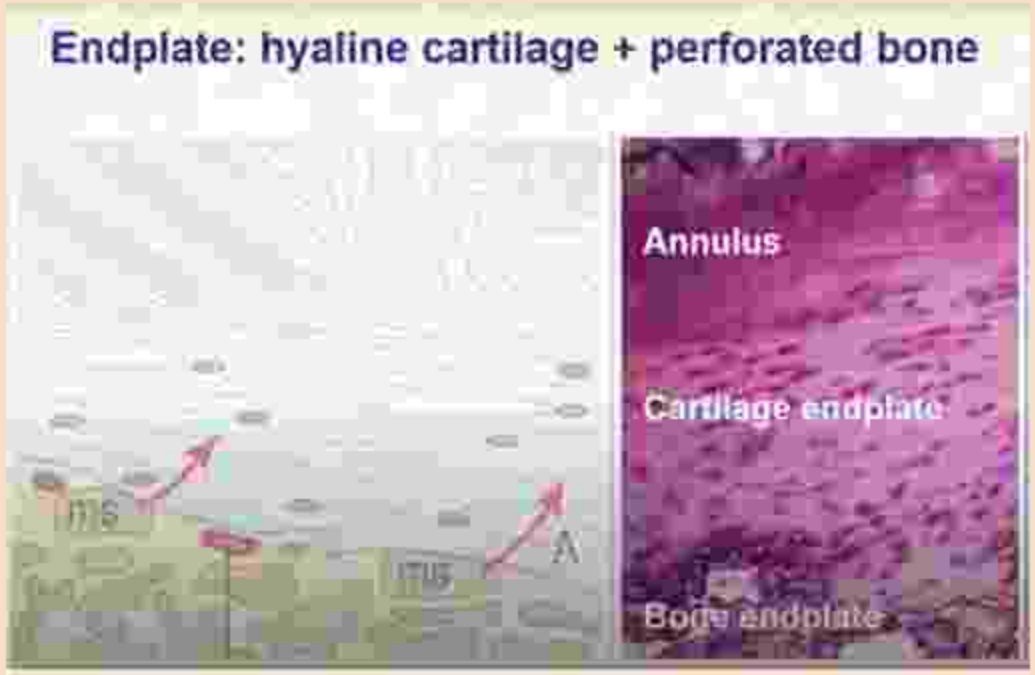
Spinal unit anatomy: Intervertebral disc/pad

Adult Human Disc highly innervated

- The nerve from its origin shown in picture arrow forms a plexus in the post Longitudinal Ligament.
- Further they penetrate the post. Annulus fibrosus structure (1-3mm).
- NERVE (Sinuvertebral nerve) report somatic and visceral problems.

Intervertebral disc/pad: End-plates

The vertebral End-plates described above are too highly innervated.



Back pain pathology or disease

Two categories

- Non-specific or un known cause
- Specific or known Cause

Origin of Non-specific back pain (BP)

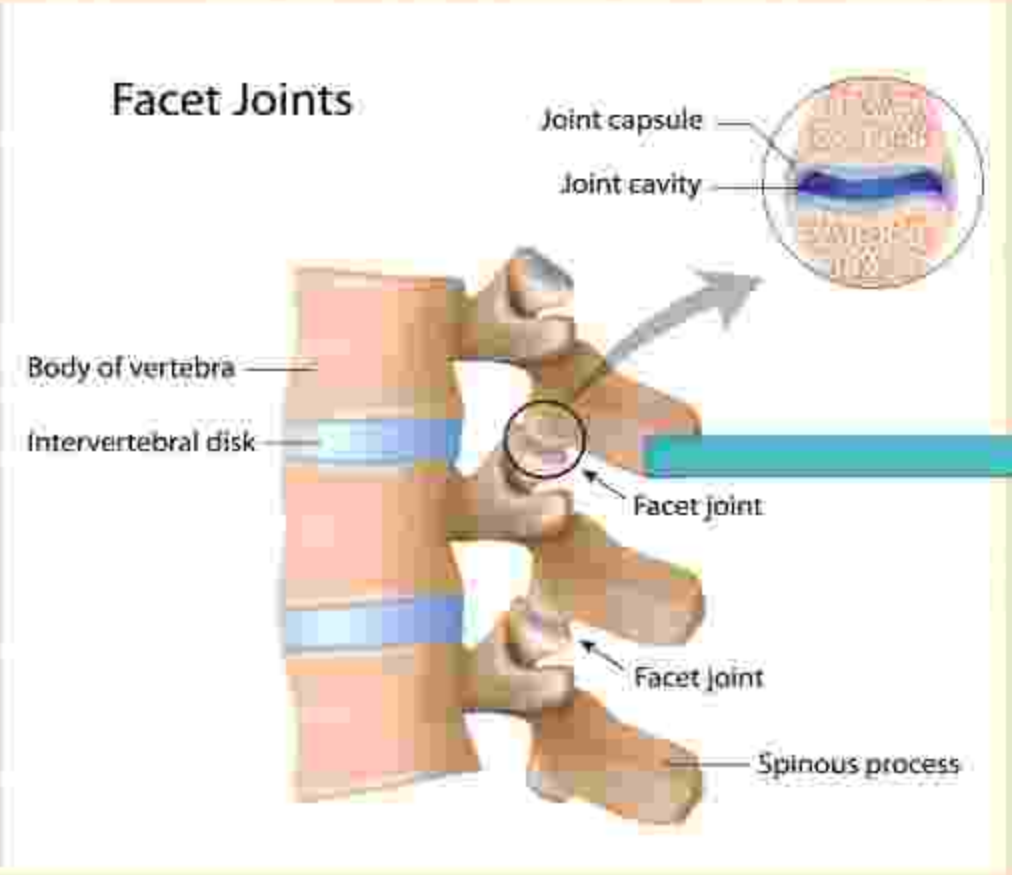
- Non-specific BP means:
  - The patient exhibit symptoms of back pain
  - The cause is unknown
  - We think its not serious, and likely to get better
- This is NOT a diagnosis
- One may explain it further using Bio-psych-social Model of BP
- One may also consider muscular origin because muscles heal fast

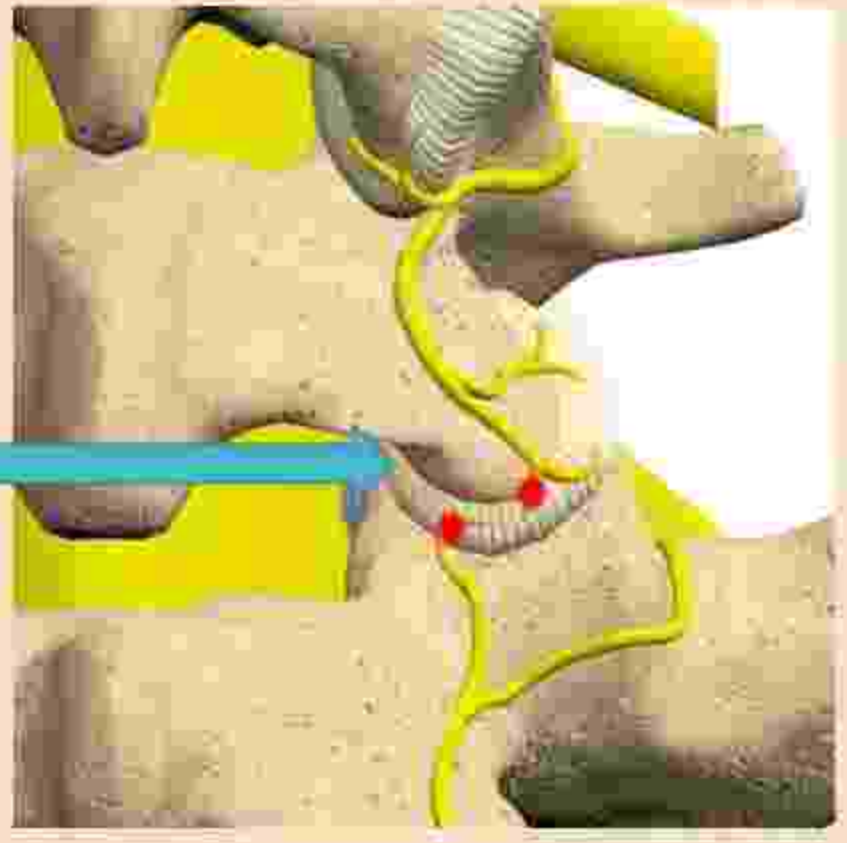
Origin of Back Pain/common causes

- Disc and Facet Joint (apophyseal joint) found in the spine.
- Nerve roots compression (eg sciatica).
- Muscles/tendon/ligament may explain localized and transient back pain
- Diseases (TB, Cancer and viruses)

Origin of Back Pain

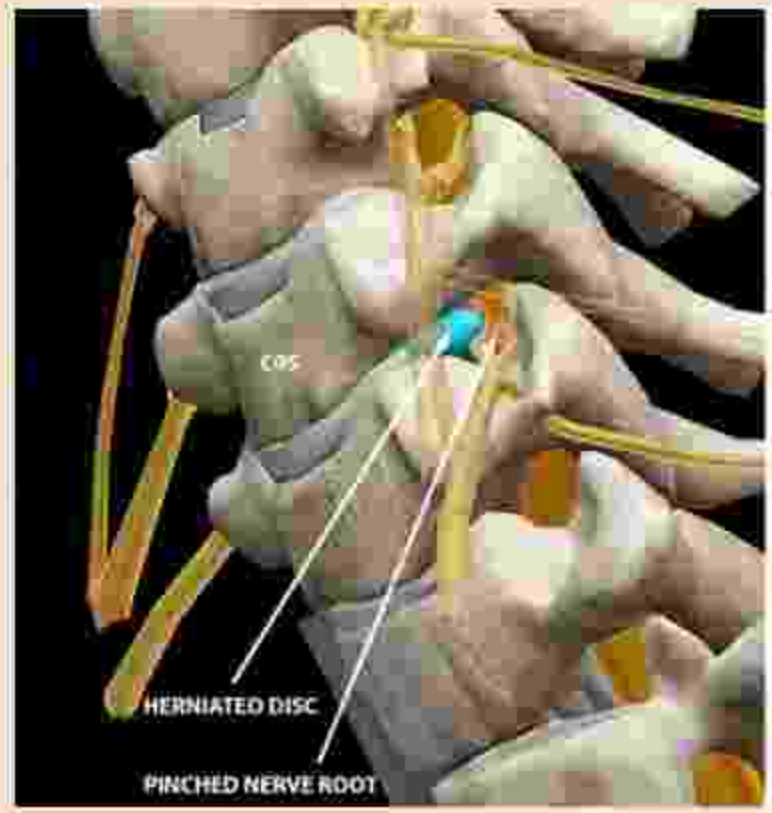
Disc and Facet Joint (apophyseal joint) found in the spine

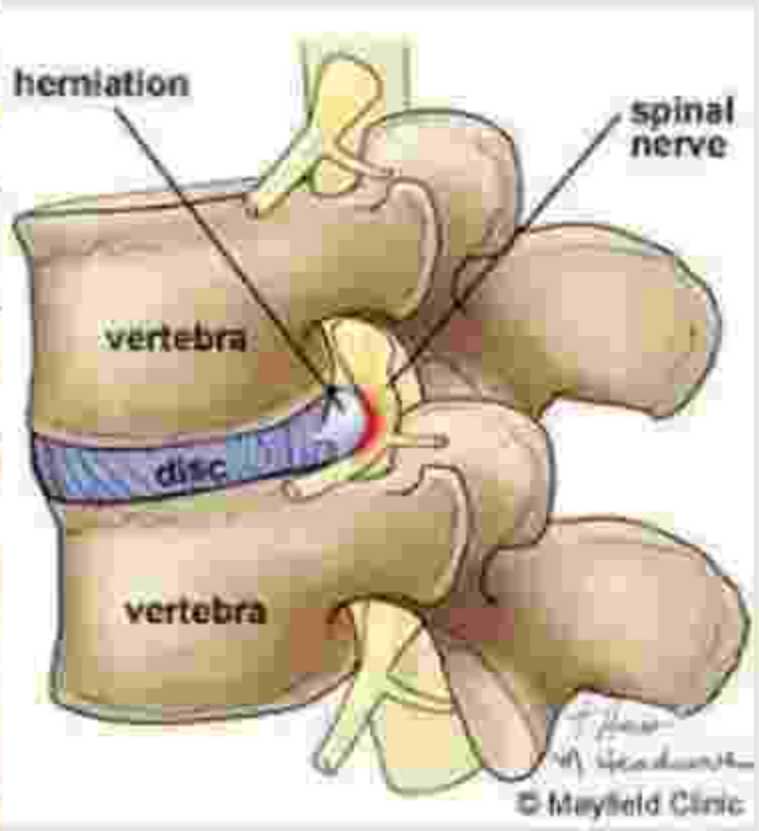


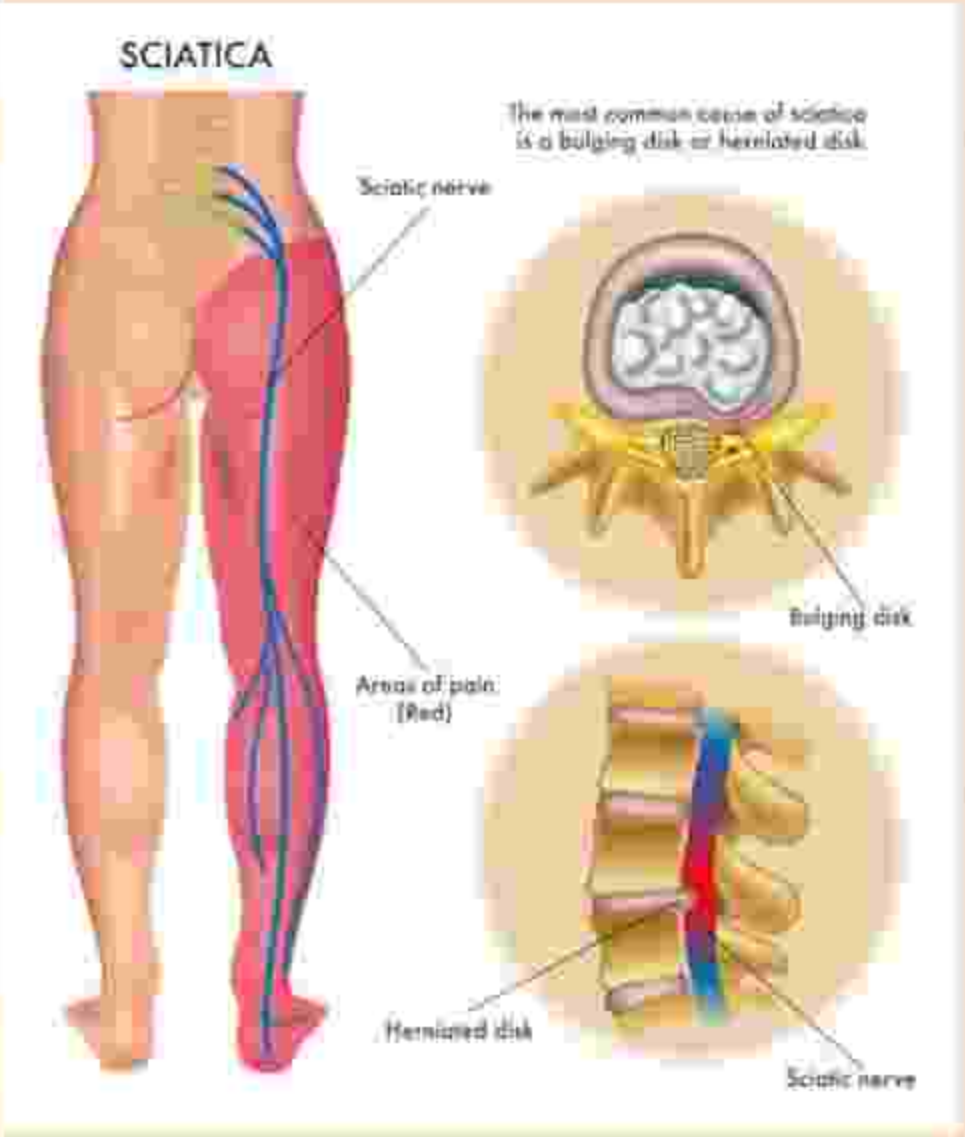


Origin of Back Pain

Nerve roots compression (sciatica)

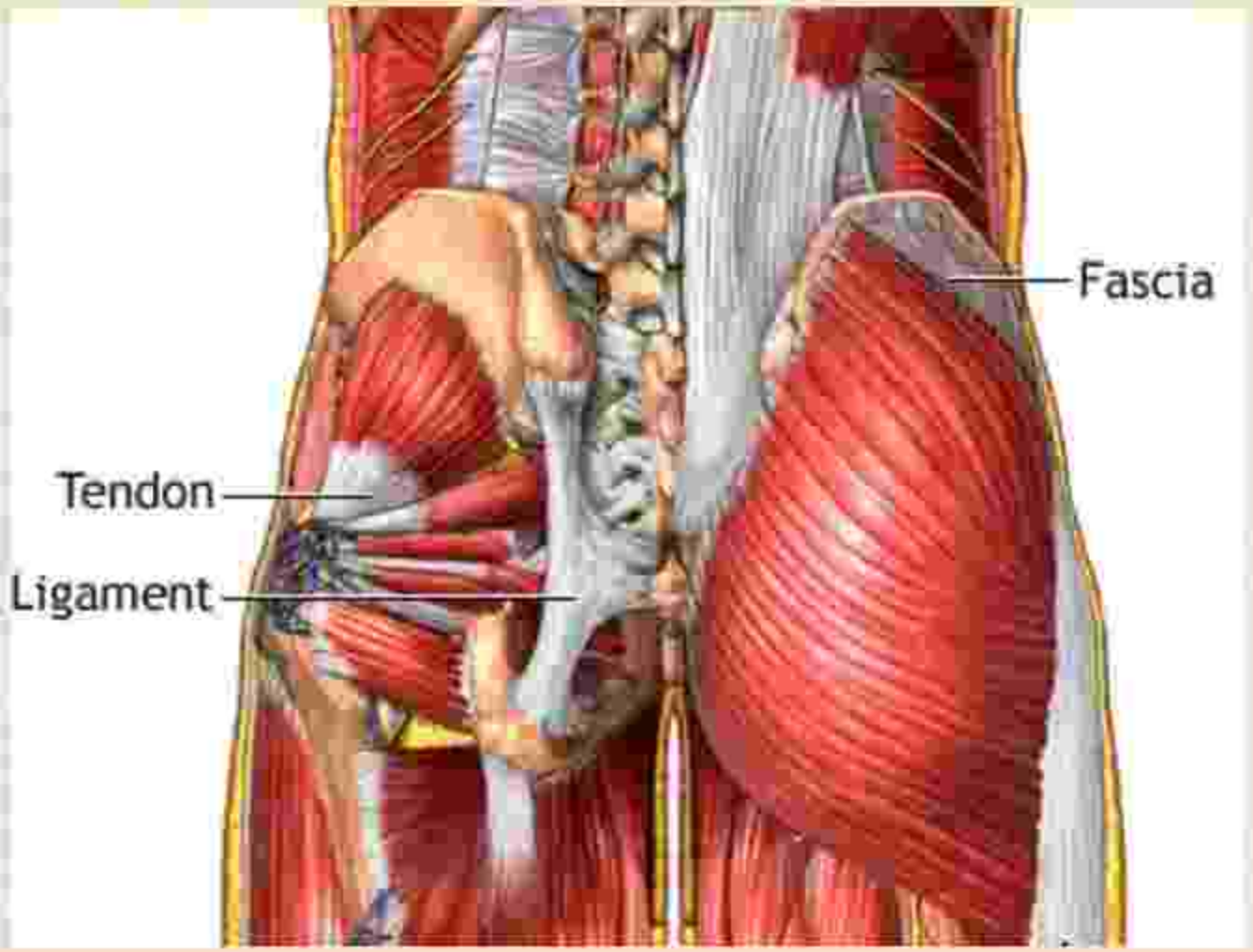






Origin of Low Back Pain

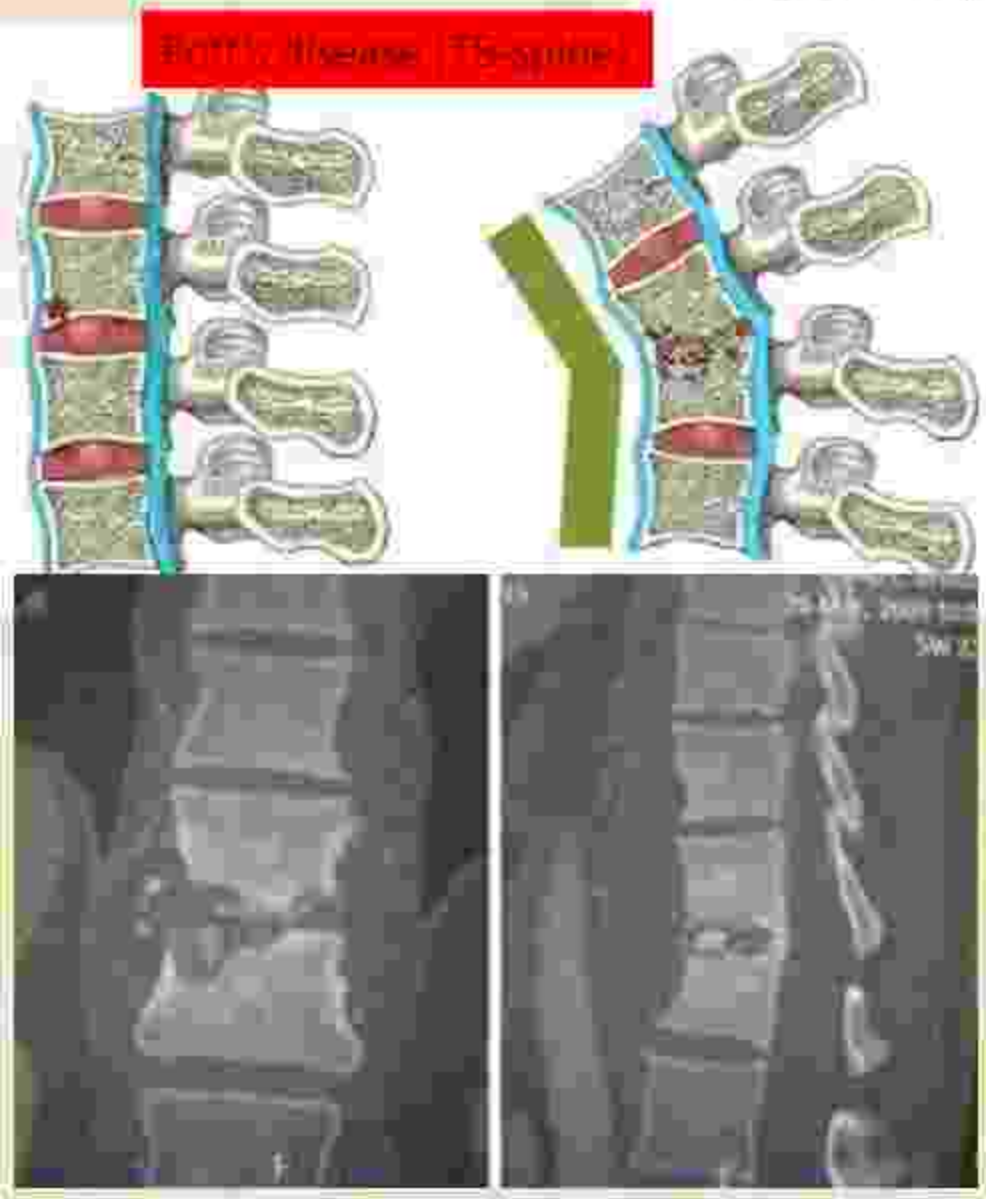
Troubles in Muscles/tendon/ligament may explain localized and transient pain

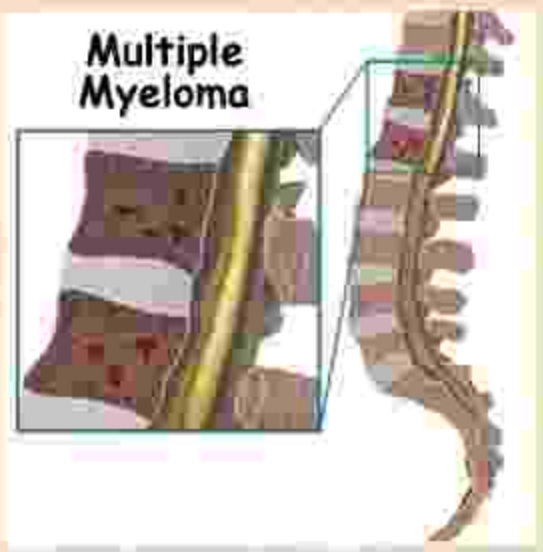


Damaged and Health muscle fibres

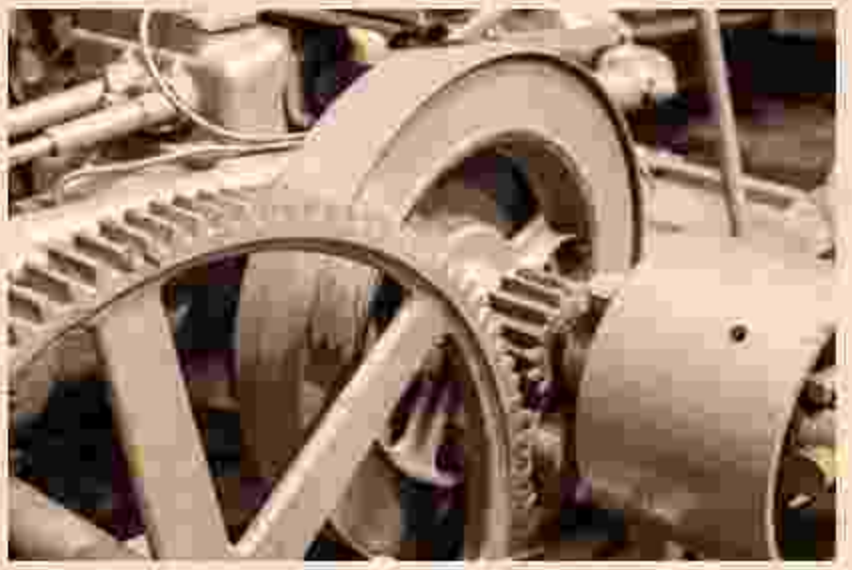
Origin of Low Back Pain

- Diseases (TB, Cancer and viruses)





Risks, vulnerability and mechanisms to mechanical Back pain

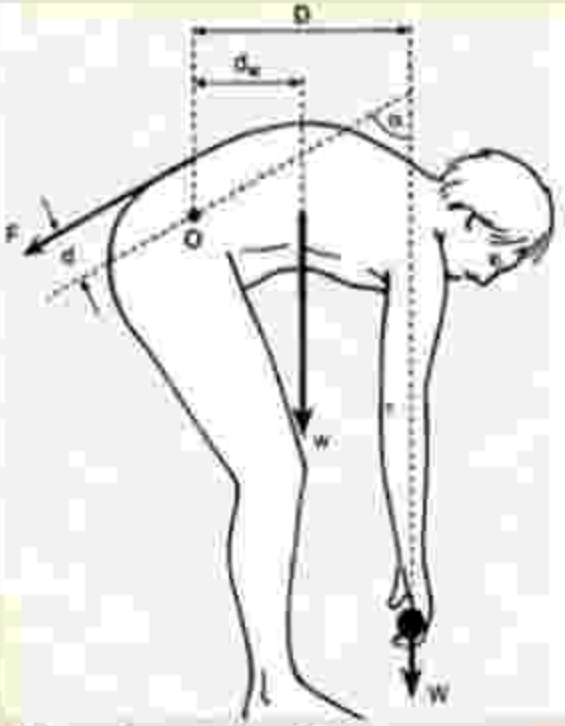


Mechanical mechanisms damaging the back

- Forces on the spine and History of Loading on the spine
- Disc degeneration
- Postural effects
- Stress (psycho-social factors)

Forces acting on the spine: Compressional force

- Back and Abdominal Muscles produce tensional Forces F.
- Therefore, Excessive manual activity increase the tensional Force on the spine.
- Force F enable you to lift the weight W, F creates a tensile force that compress the Lumbar spine.
- Dynamic forces produce more compressional force on the spine compared to the Static forces (F=MA), GYMNS goers PLEASE NOTE



Muscle tension F acts on a shorter lever arm (d) than the weight lifted (D), so F>W

$F*d = W*D + w*dw$

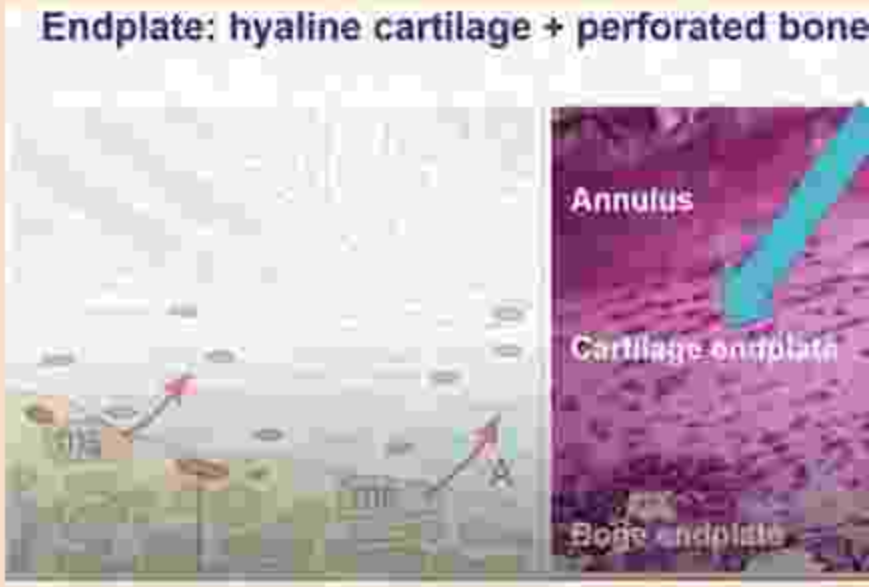
$C = F + (W + w)\cos\alpha$

Movements that produce a forces on the spinal structures:

- Bending activities
- Torsion & Shear (Rotational activities)

Mechanisms of injury to the Vertebral End-plates

- ✓ Compressive overload damage End-plates, and this decompress the disc and cause internal disruptions (Admas et al. (2000)



Mechanism of injury to the spinal structures: Backwards bending

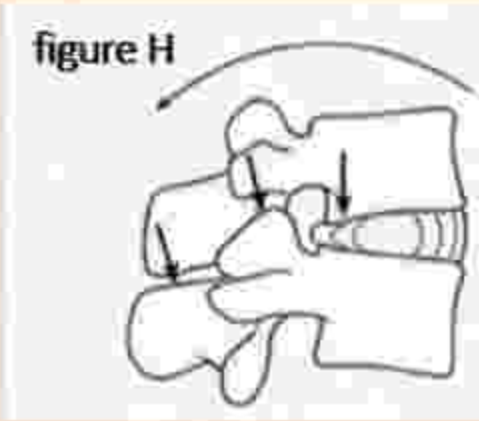
- Not a frequent move of the spine but when you reach out things above you, cause backward compression.

  ✓ This mov't is controlled by Spinous processes, apophyseal joints and Posterior Annulus (letter G in figure F) (Adams et al. (2000).

  ✓ Bending beyond the available limit, apophyseal joint capsule get damaged, and posterior disc protrusion is likely to happen (Figure. H)

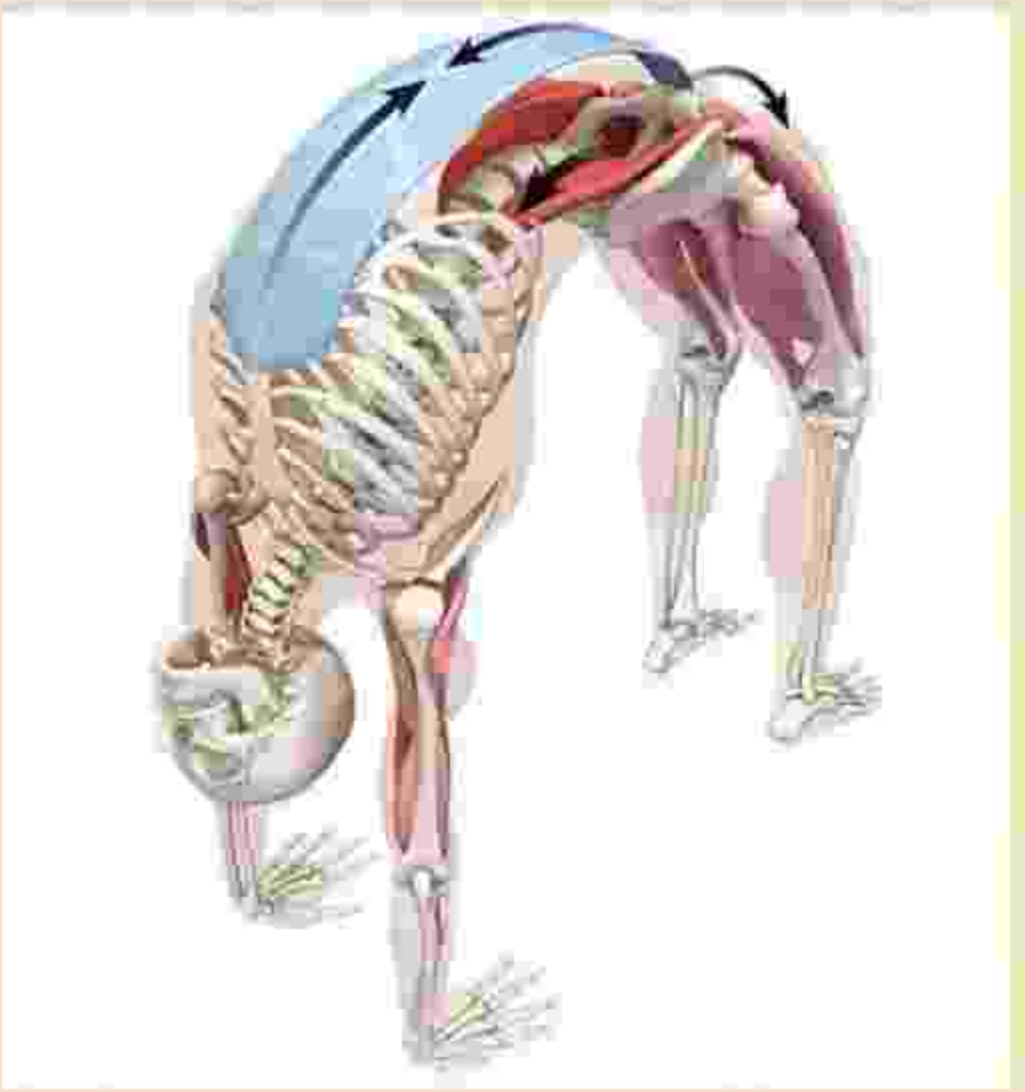
figure F

figure H

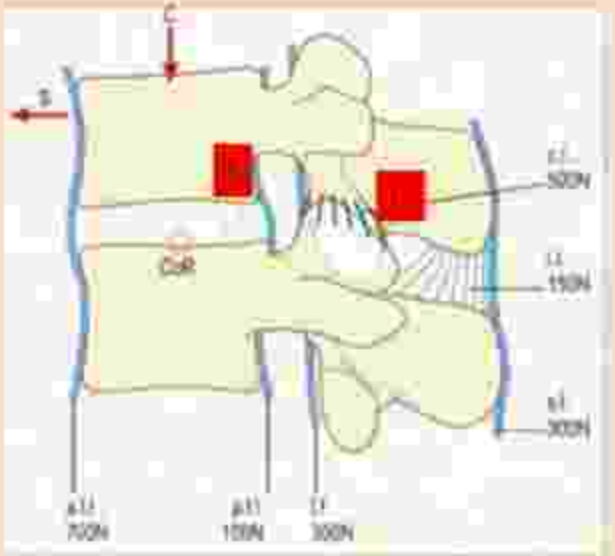


Bending produce compressional force

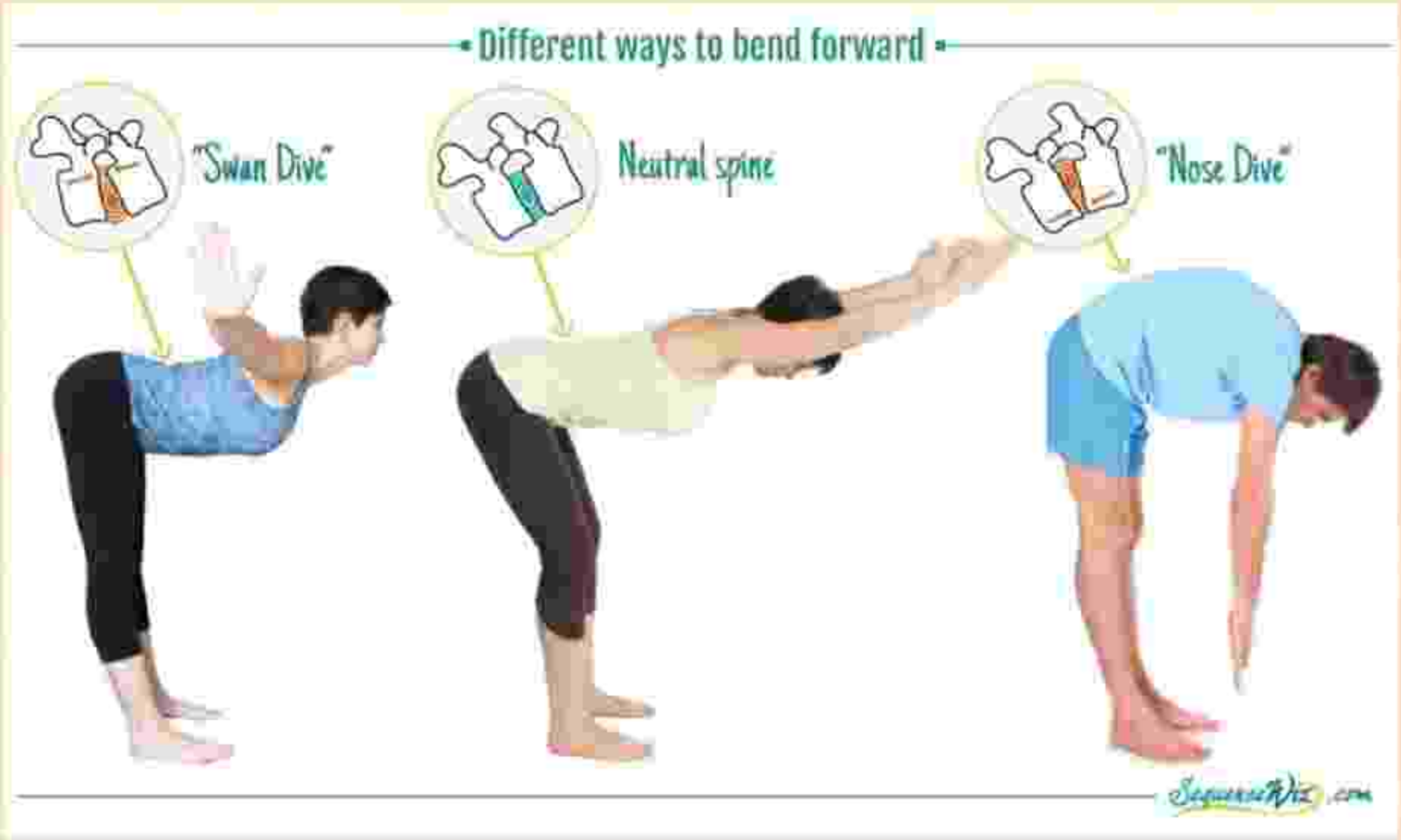
Backwards bending:



- **Forward bending:**
  - ✓ This mov't is controlled by posterior ligament of Lumbar spine (Lx) letter L and then after the Disc.
  - ✓ Bending too far, ligaments are damaged first, before the apophyseal joint capsule letter C.
  - ✓ However, the back muscles must detect over bending and by reflex mechanisms, may cause the muscles to contract back to protect the structures.
  - ✓ Situations where there is Creep or fatigue in these muscles, protection is not possible.



Sanchez-Zuniga et al. (2010)

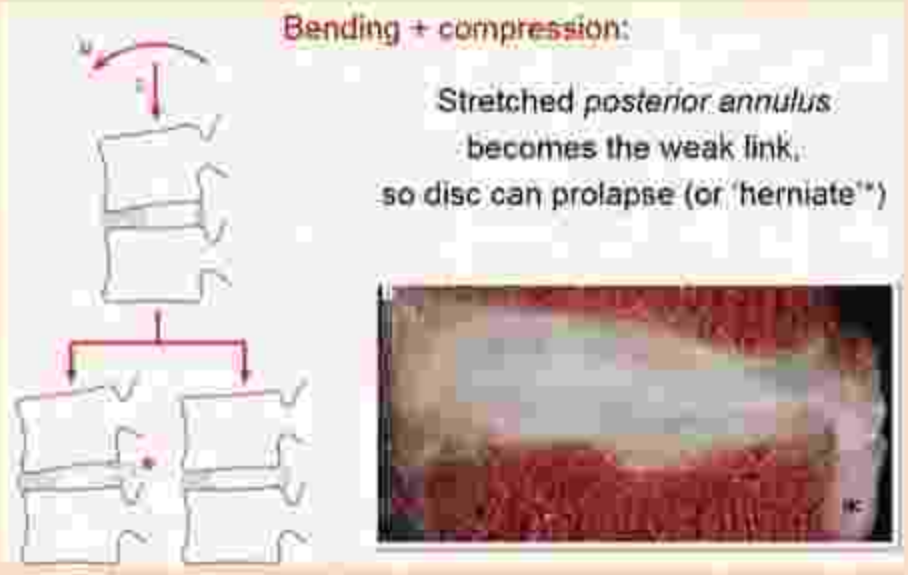

Different ways to bend forward
"Swan Dive"
Neutral spine
"Nose Dive"
SequenceWiz.com

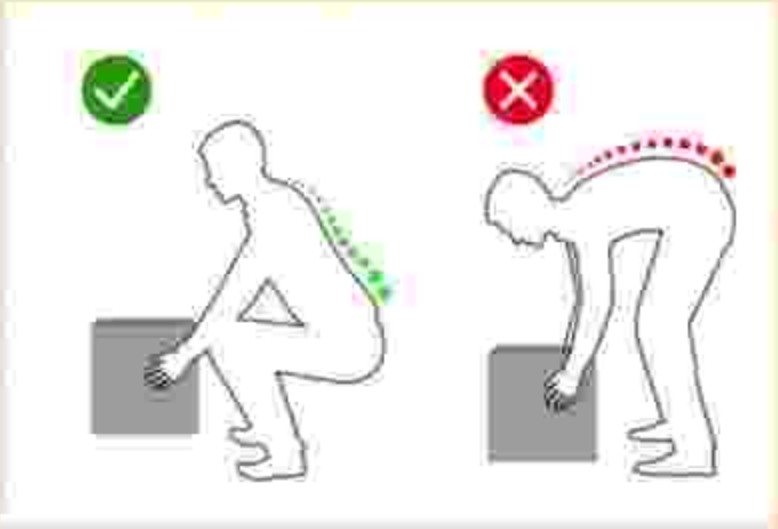
Mechanism to cause Back pain

Bending and lifting

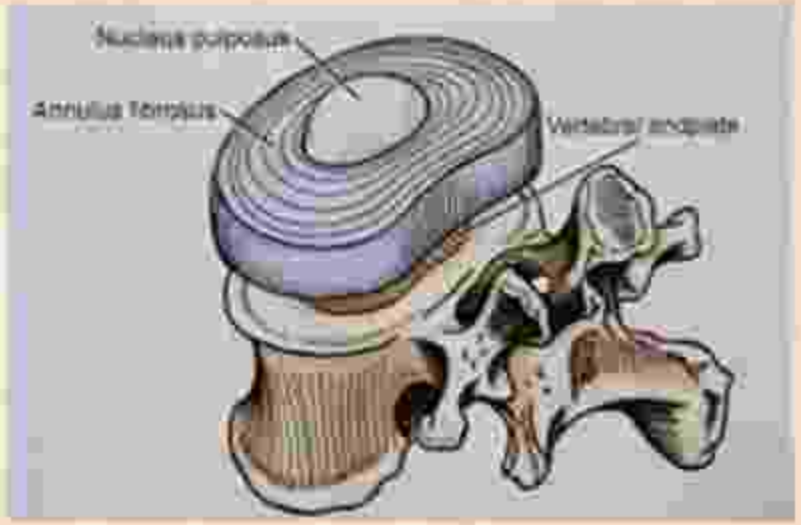
- This occur mainly when collecting item from the ground this stretches the posterior Annulus structure, and becomes weak, so the disc can prolapse (Herniates).

- As you lift up the items, the contraction of the muscles increase pressure on the nucleus pulposus, disc herniation is possible at this point (Adams et al., 2000)



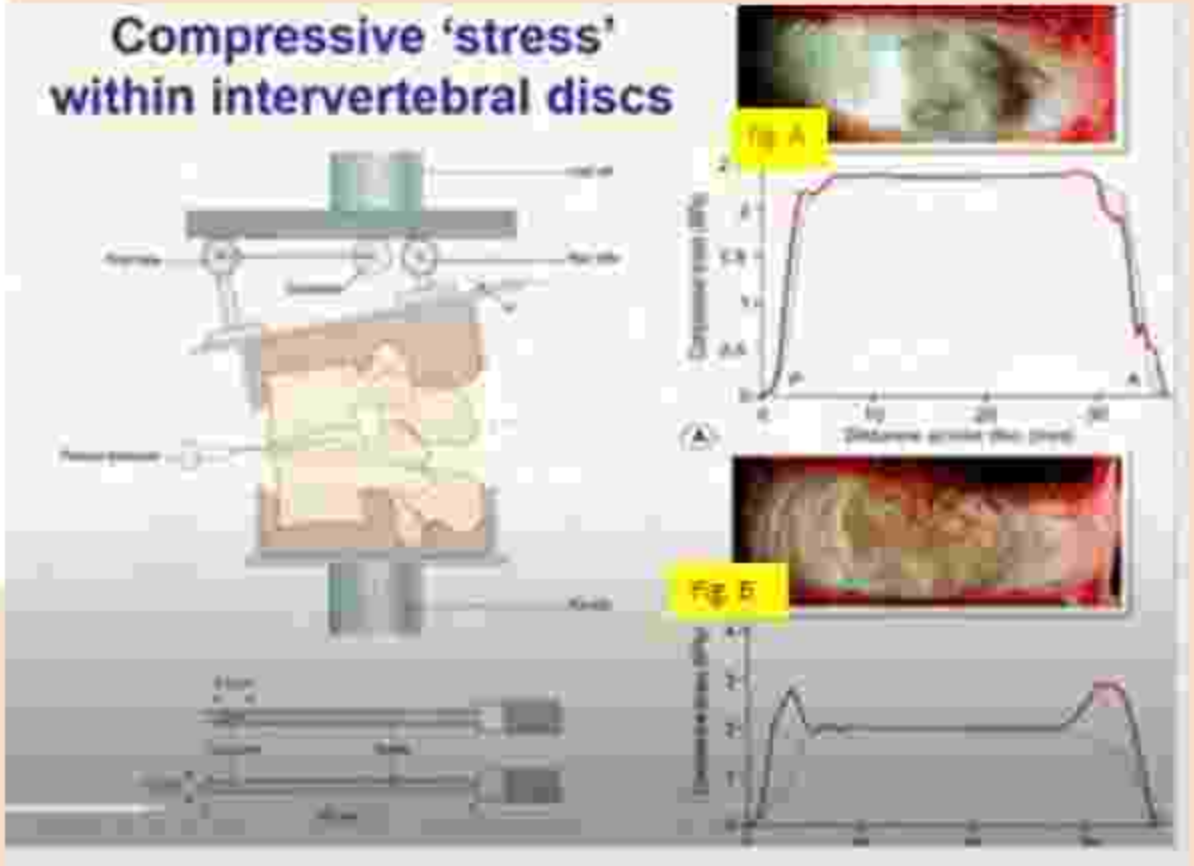


Compressional force on the PAD (DISC)



HOW DISCS WORK INTERNALLY

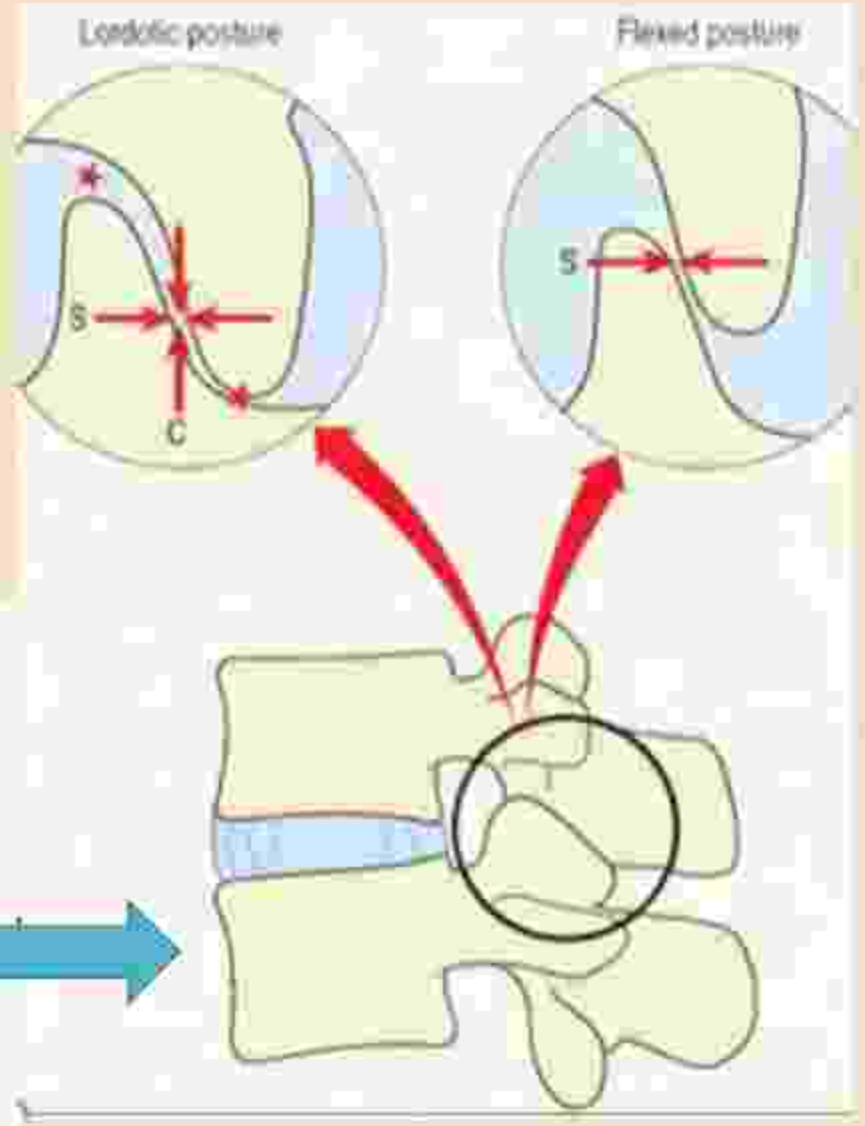
- McNally & Adams (1992) did an experiment on the cadaver.
- They subjected a disc from the cadaver to compression loading.
- In a health Disc Fig. A the distribution of forces both in Annulus and Nucleus is uniform as compared to un-health disc of 58 old female specimen in Fig B



Postures

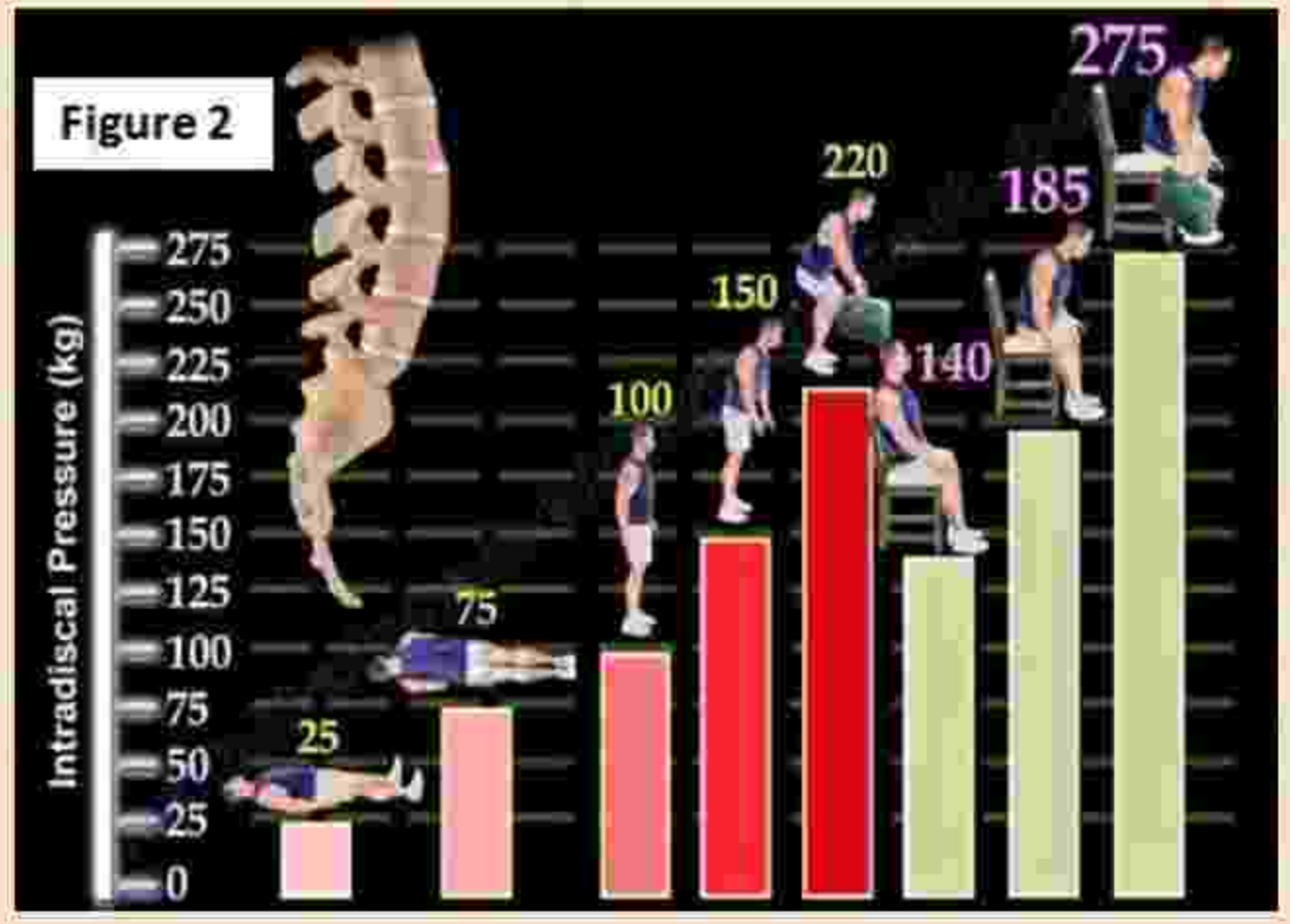
- Certain postural habits generate stress concentration within innervated tissues (discs and facet joints), give rise to pain
- This theory explains the cause of back pain during the day, and relieved at rest.

Exaggerated lumbar curve



Posture

- Standing, sitting while bending your neck increases compressional forces to the spine soft tissues including the disc (Sato et al.,1999)

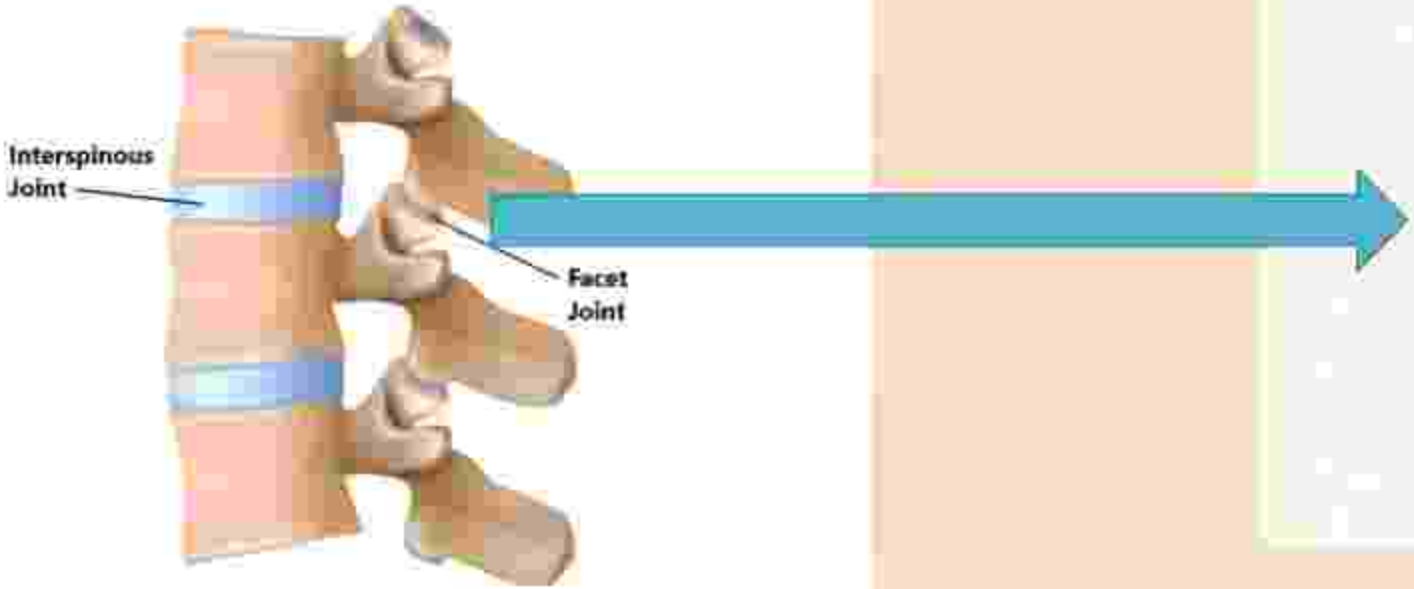


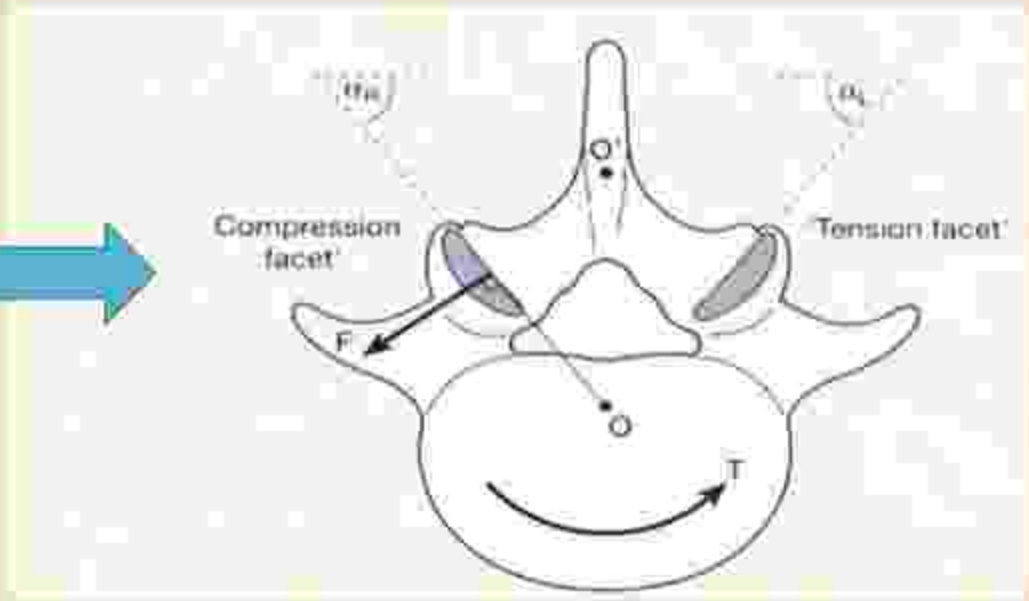
"You have Tech-neck."

Forces acting on the spine: Torsion

- Torsion: Rotation of the spine about its long axis.

  ✓ This should be controlled by Apophyseal joint (1-3^{0}) beyond these degrees, the structure under compression may be injured (Adams et al (2000)





Other mechanisms causing Back pain:

History of loading

✓ Repetitive over load may cause micro-damage to muscle or other soft tissues found in the spine leading to their fatigue.

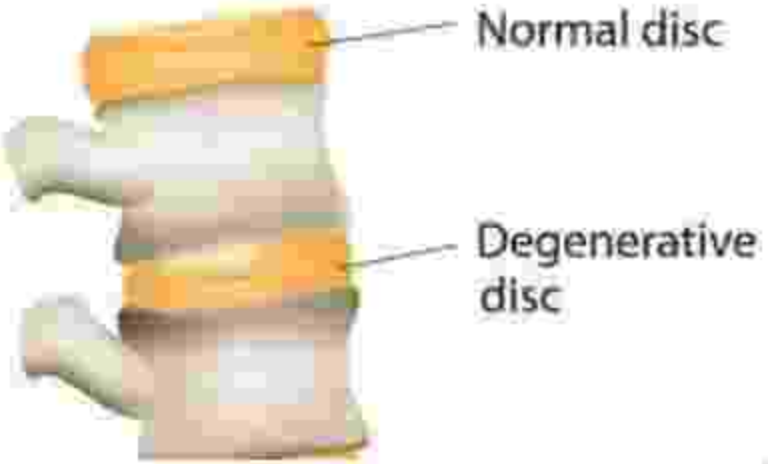
Physical activities

✓ Rapid increase in physical activities may lead to weakening of slowly-adapting tissues especially Discs.

Idleness

✓ Idleness (no-work), muscles and bones become weak so too the disc and acquire certain weak posture (DeGroot et al. (2004)

Mechanisms of Back to pain: Disc Degeneration



Disc degeneration is the structural failure of the disc as a result of *Mechanical loading*, or *idleness* that may affect the normal cell metabolism. (all seen above)

All the four pictures indicate disc damages: altered structure, cell biology (matrix degrading enzymes), and function.

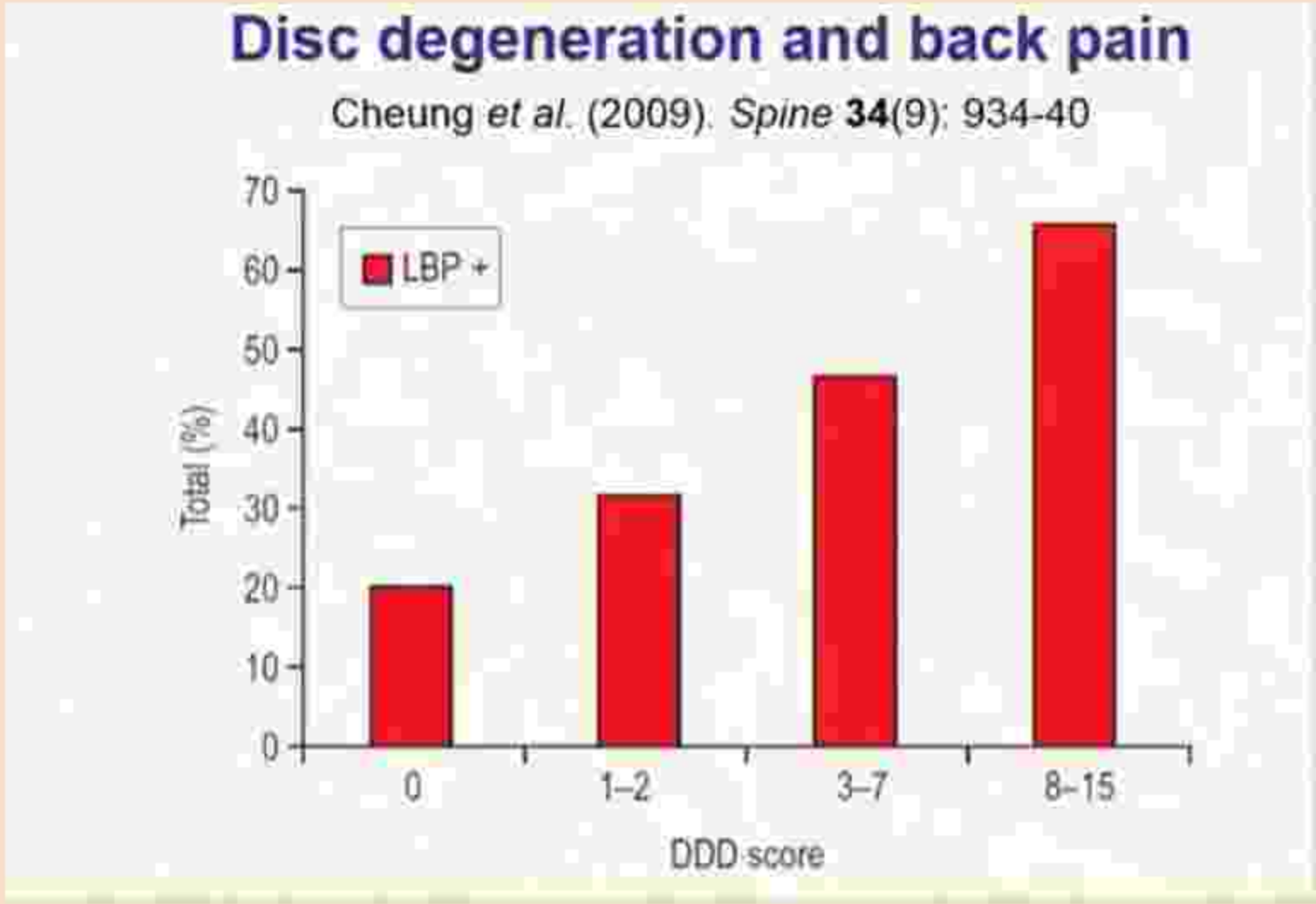
Note: Healing is frustrated in the disc

Disc degeneration

- **Altered structure:** radial fissures, disc prolapse, internal collapse, e/p fracture, disc narrowing
- **Altered function:** decompressed nucleus, stress peaks in annulus, reduced strength
- **Altered biology:** apoptosis, ↑ MMP's & cytokines

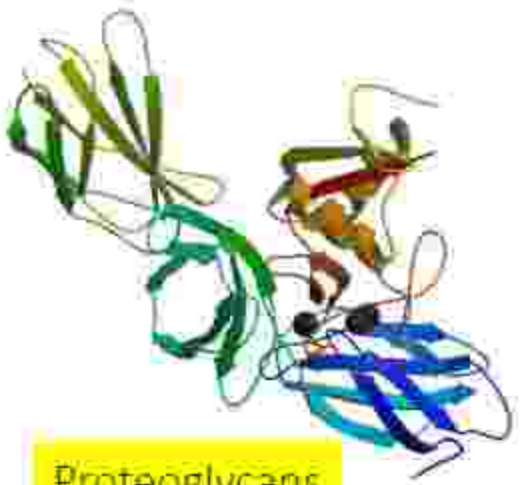
Compressional forces lead to Disc degeneration

Cheung et al. (2009) showed that the risk of BP increased with Disc degeneration

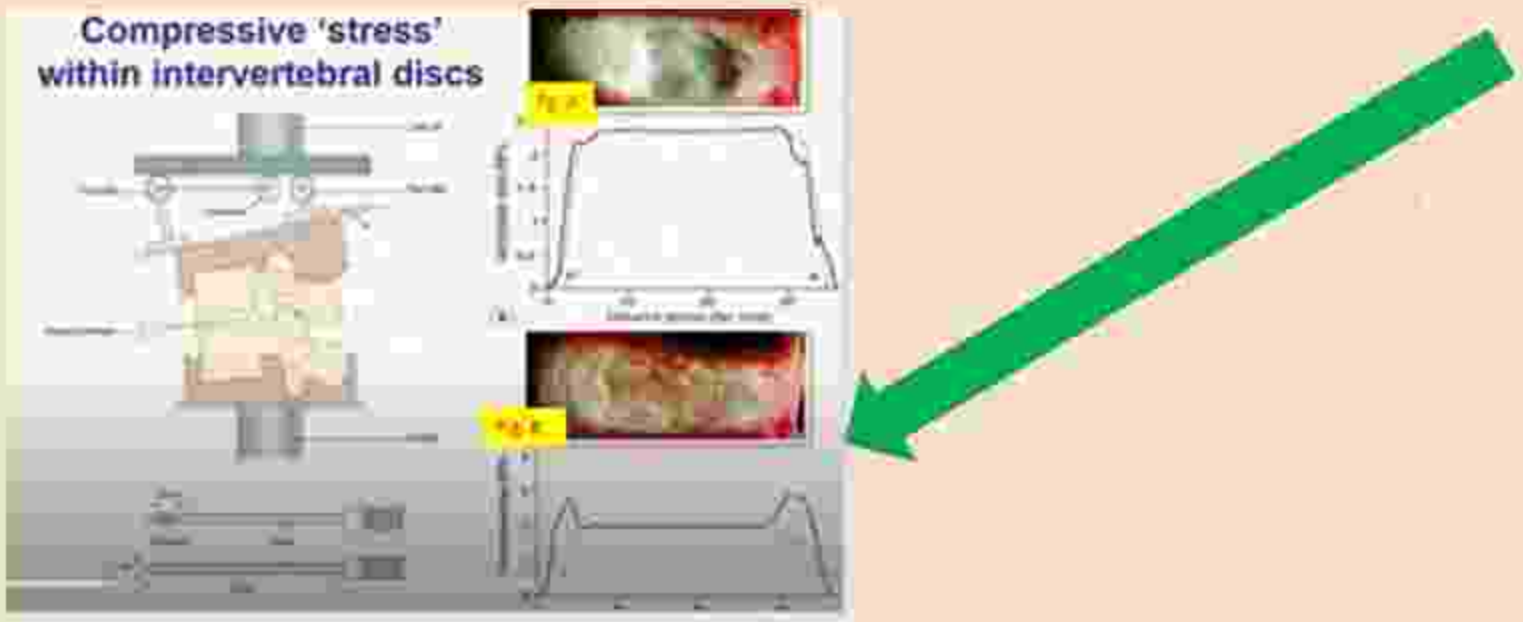


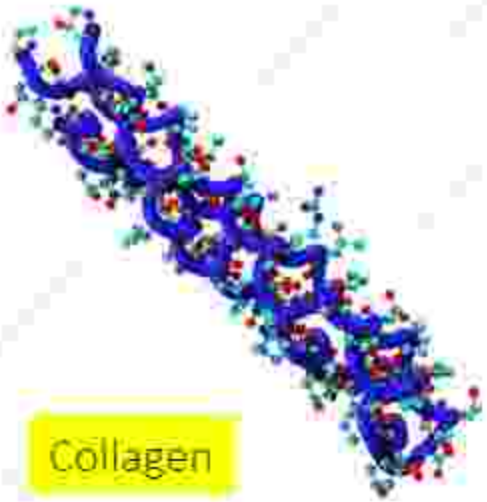
Mechanisms of disc damage: Age-related biochemical changes in the disc

- Age-related biochemical changes
  - ✓ Loss of proteoglycans leading to water concentrate stresses in the disc.
  - ✓ Dehydrated tissues do not equalize forces significantly.



Proteoglycans

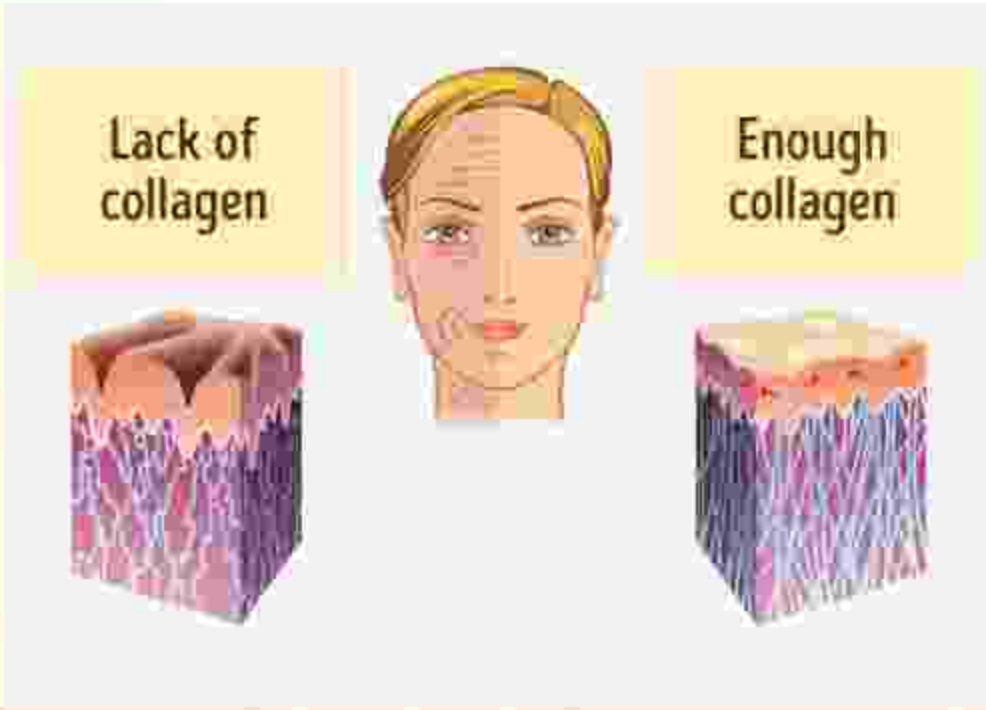


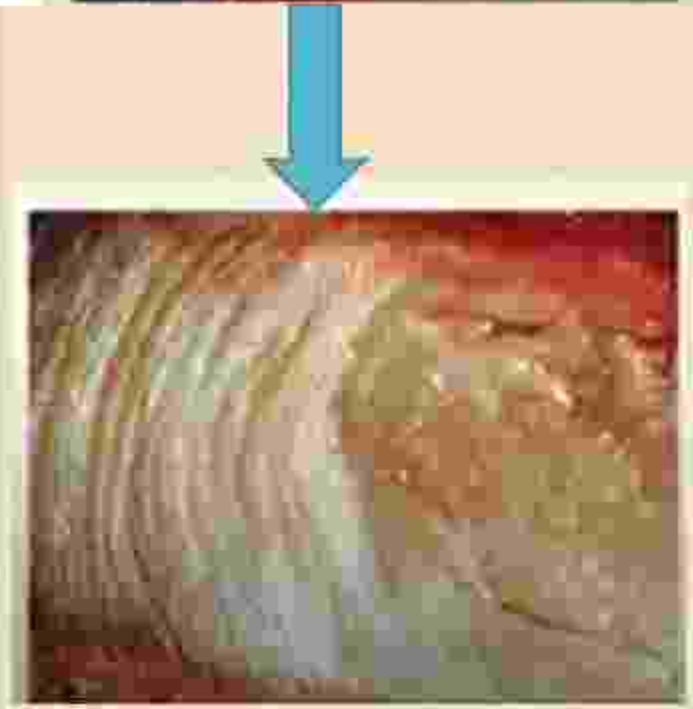


Collagen

Cont'n: Age-related biochemical changes

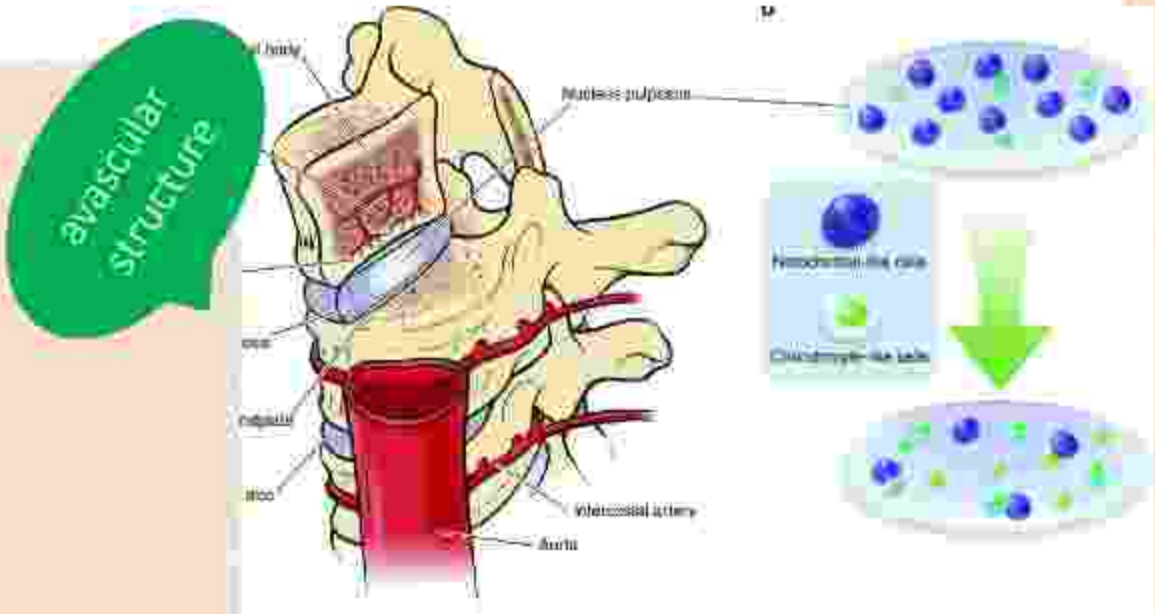
- ✓ Collagen is a large protein molecule that hold the body together.
- ✓ The cross-linking of the collagen fibre as you get older makes cartilage coarse, & stiffens (DeGroot et al. (2004).
- ✓ The changes can happen to any tissue of the body therefore Nutrition is very important here





Nutrition stress in disc

- ✓ NOTE: Discs are the largest avascular structure in the body
- ✓ Low cell density.
- ✓ Therefore, mechanisms of transporting nutrients are inadequate especially in disc Center..
- ✓ Low cell density frustrates repair processes, so disc injury leads to degeneration rather than healing. However, the peripheral region has high cell density and therefore heals



Mechanisms of Back pain: Features in a degenerated disc

Radial fissures:

- ✓ Mechanically and chemically conducive for regrowth of the blood vessels and nerves.

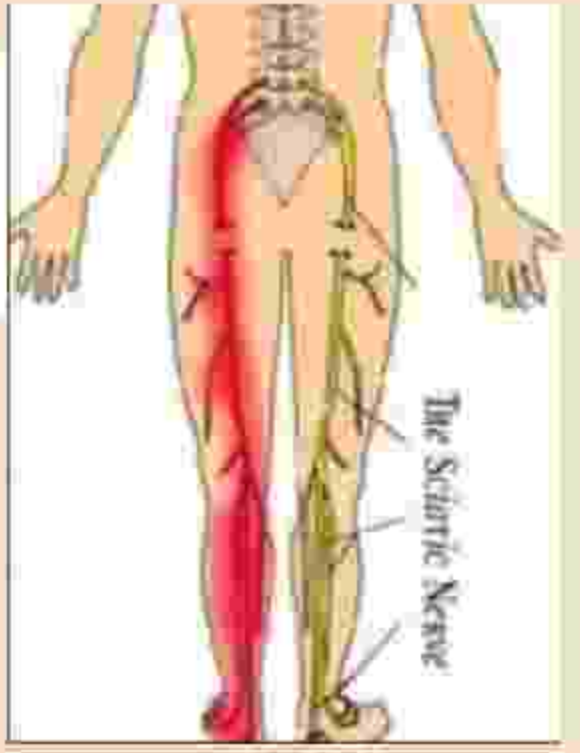
- ✓ Because there is low mechanical pressure, and depleted of proteoglycans that resist neural growth activity (albert et al. (2013)

Radial fissures allow blood vessel & nerve ingrowth

Nerves are then sensitised by inflammation, or infection[3]?

Mechanisms of Back pain: Disc Herniation

- ✓ Herniation generates radicular pain from nerve root



Mechanisms to the cause of Back pain: Genetic inheritance

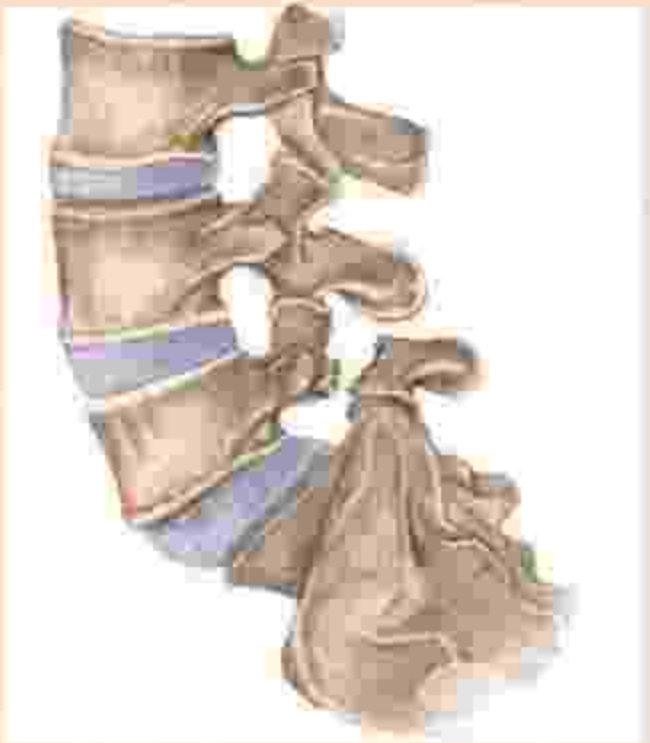
- ✓ With confidence 30-50% of Disc diseases (or BP) may be attributed to genetic inheritance.
- ✓ Example of these genes are: Vit D receptor, Collagen IX, and proteoglycans builders.
- ✓ Genetic predisposition is least L4-S1, and high at L1-2.
- ✓ The mechanical influence is high at L4-S1, and least at L1-2

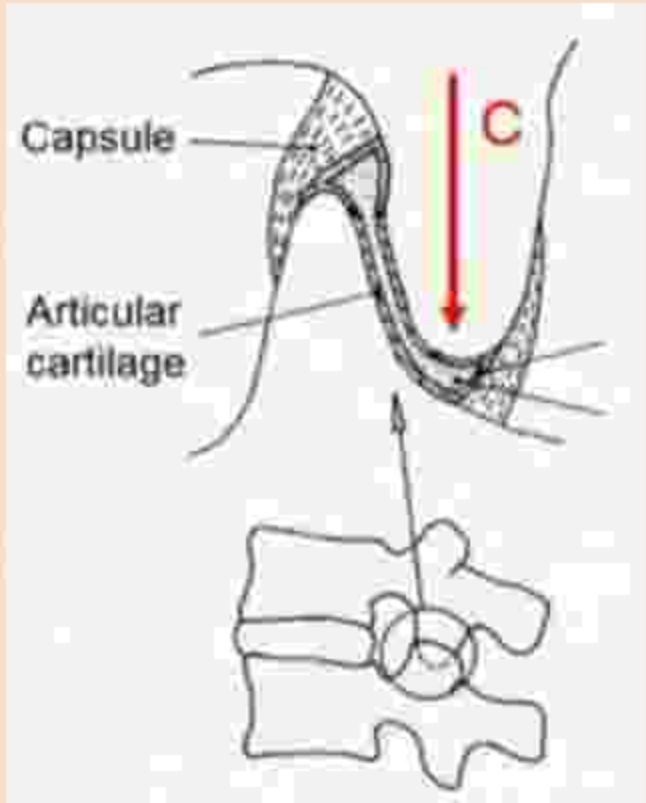
Mechanisms to the cause of Back pain: Osteoarthritis

Spinal degenerative cascade leading to osteoarthritis

- Disc degeneration & narrowing cause facet joints to face more compression.

- Slackening of ligaments responsible for spine stability can lead to segmental instability, osteophytosis, and stenosis (Robson Brown et al (2008)





Thanks for your attention!

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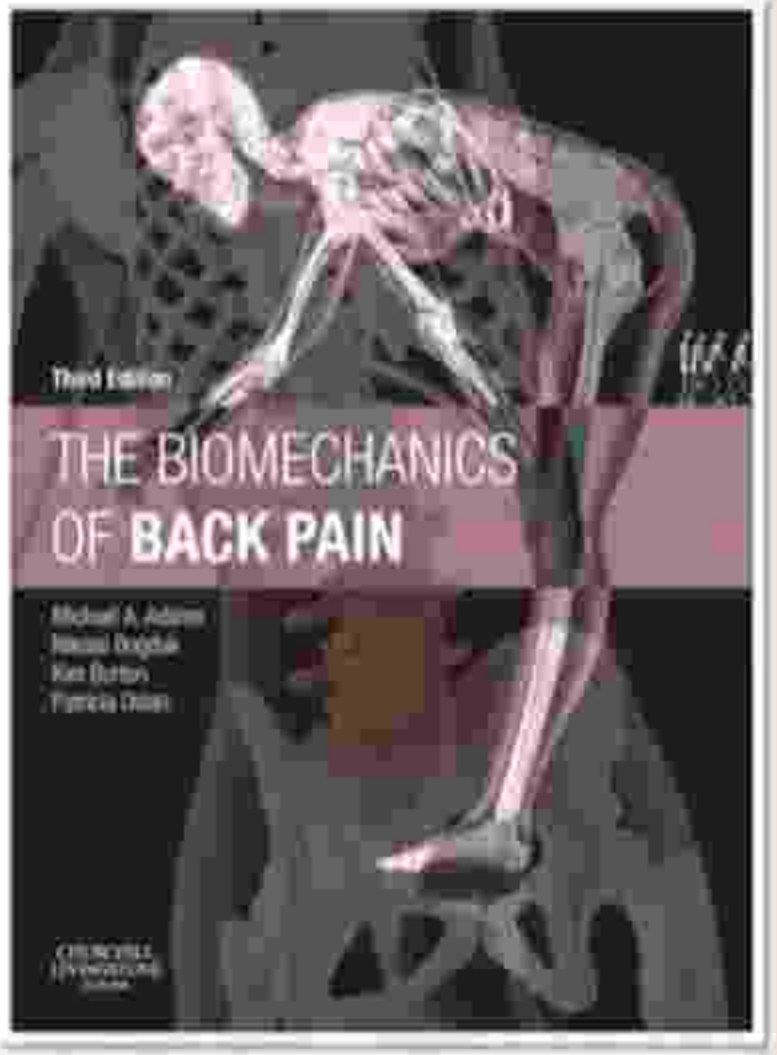

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