


FORM AND FUNCTION OF INTERVERTEBRAL DISK

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Bones and Spine



Outline

- 
- A large, ornate metal key is positioned vertically on the left side of the slide. The key has a circular bow at the top and a long, slender shaft with a notched bit at the bottom. It is set against a textured, golden-brown background that resembles sand or gravel. The left edge of the slide features a vertical gradient bar transitioning from yellow at the top to dark blue at the bottom.
- ◆ Introduction
 - ◆ Function of Disc
 - ◆ Anatomy
 - ◆ Vascular Supply
 - ◆ Innervation

Too much pain, Too little money

- ◆ \$86 Billion spent on back and neck pain (2005)

- ◆ More U.S. health care dollars are spent treating back and neck pain than any other medical condition.

Company	acquirer	Price(million)
Spinecore	Stryker	360
Link spine	JNJ	325
Spine solution	Synthes	350
Spinal dynamc	Medtronic	270
Total		1.3 billion

Why Disc?



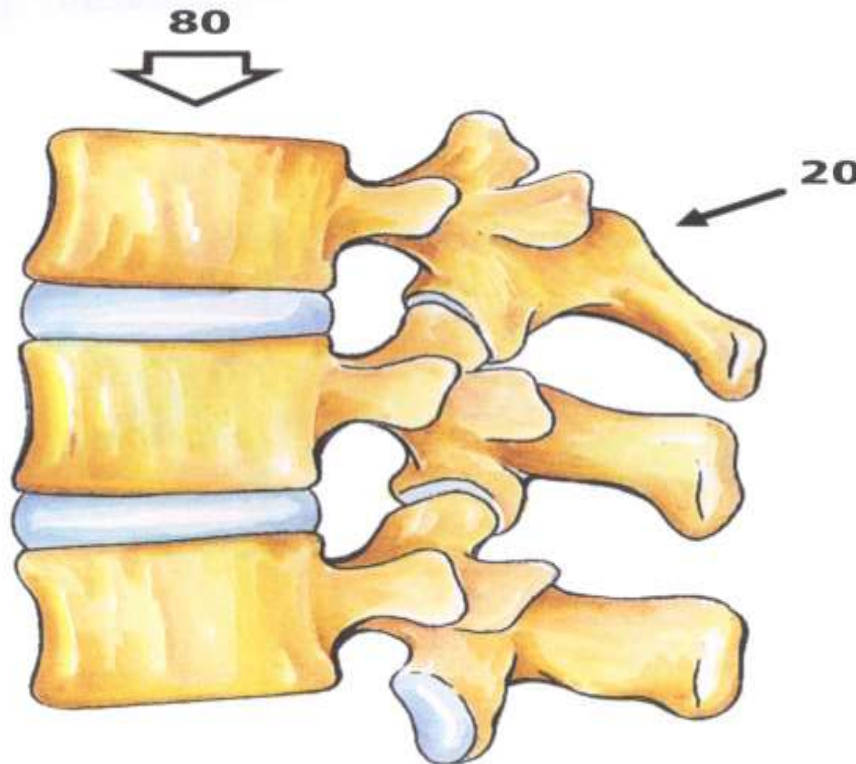
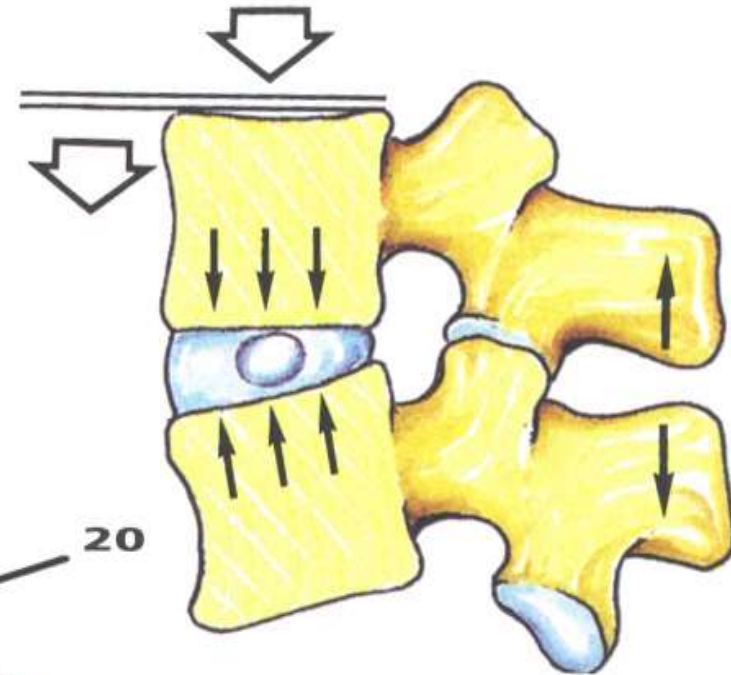
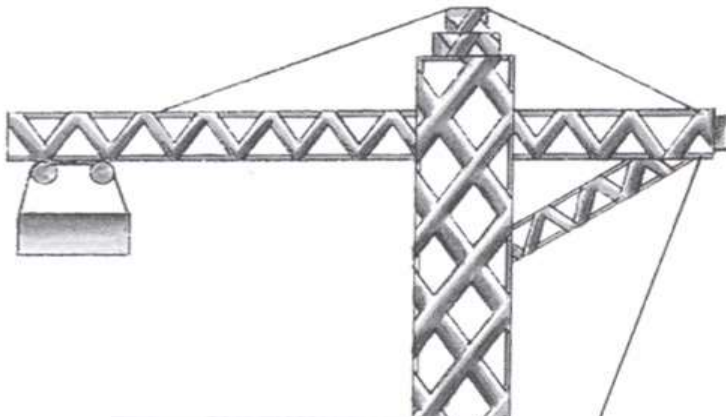
Function of Disc



Function

- ◆ Spine motion/flexibility
- ◆ Absorbs energy
- ◆ Distributes load

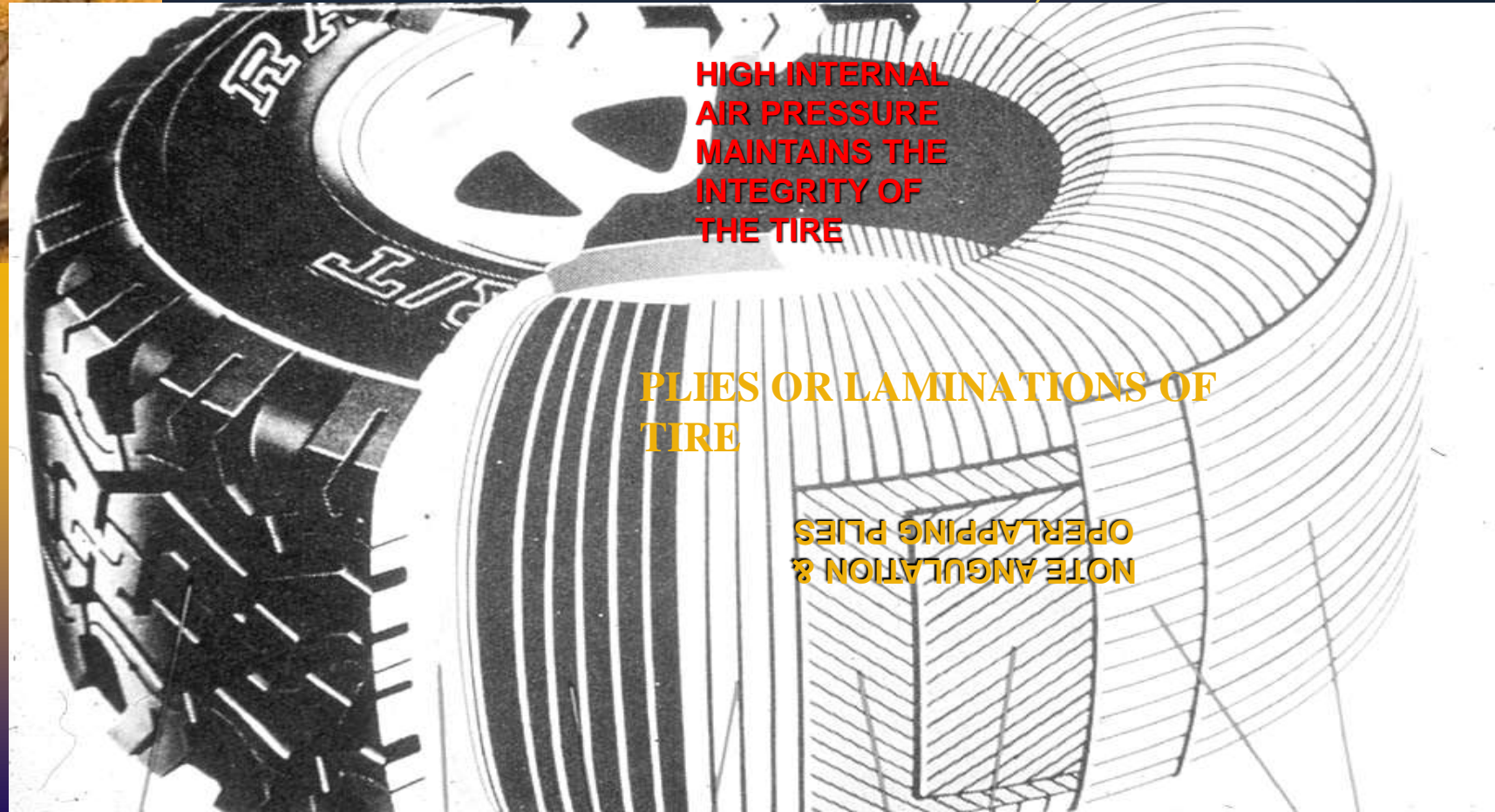
BIOMECHANIC - LOAD



A detailed cross-sectional diagram of an intervertebral disc. The central core is labeled "HIGH INTERNAL PRESSURE GEL" in red. Surrounding this core is the "Annulus fibrosus", which is composed of multiple layers labeled "LAMINATIONS OF ANNULUS, Angulated & Overlapping" in yellow. A yellow double-headed arrow points to these layers. The text "20-24 PLIES AT L5-S1" is written in red at the bottom left. The innermost part of the disc is the "Nucleus pulposus". The outer boundary of the disc is labeled "Vertebral body". The layers of the annulus are also labeled "Laminae of fibro-cartilage".

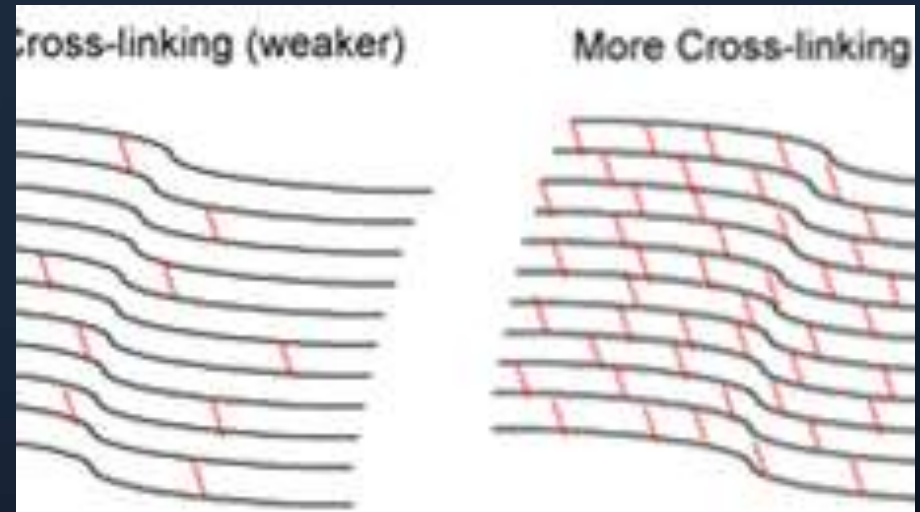
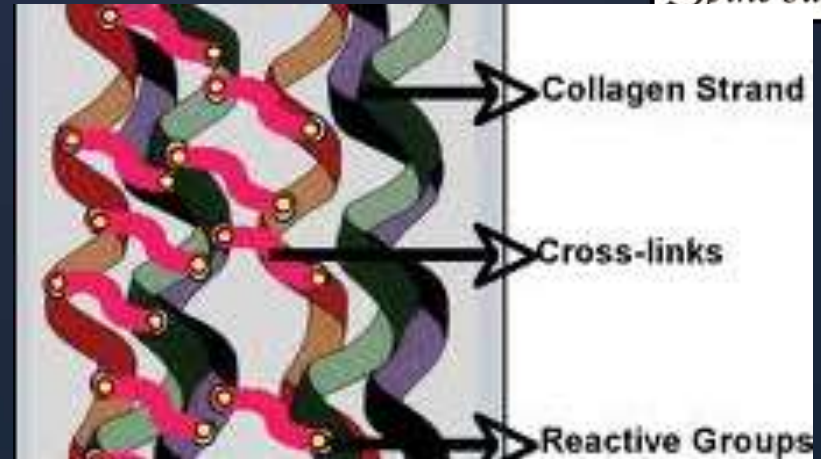
Part 2- ANULUS

LAMINATED CONSTRUCTION OF THE ANNULUS
RESISTS MECHANICAL FORCES YET PRESERVES
SEGMENTAL MOTION (THE AUTOMOBILE TIRE, WITH ITS
HIGH INTERNAL PRESSURE IS QUITE SIMILAR.)



Collagen

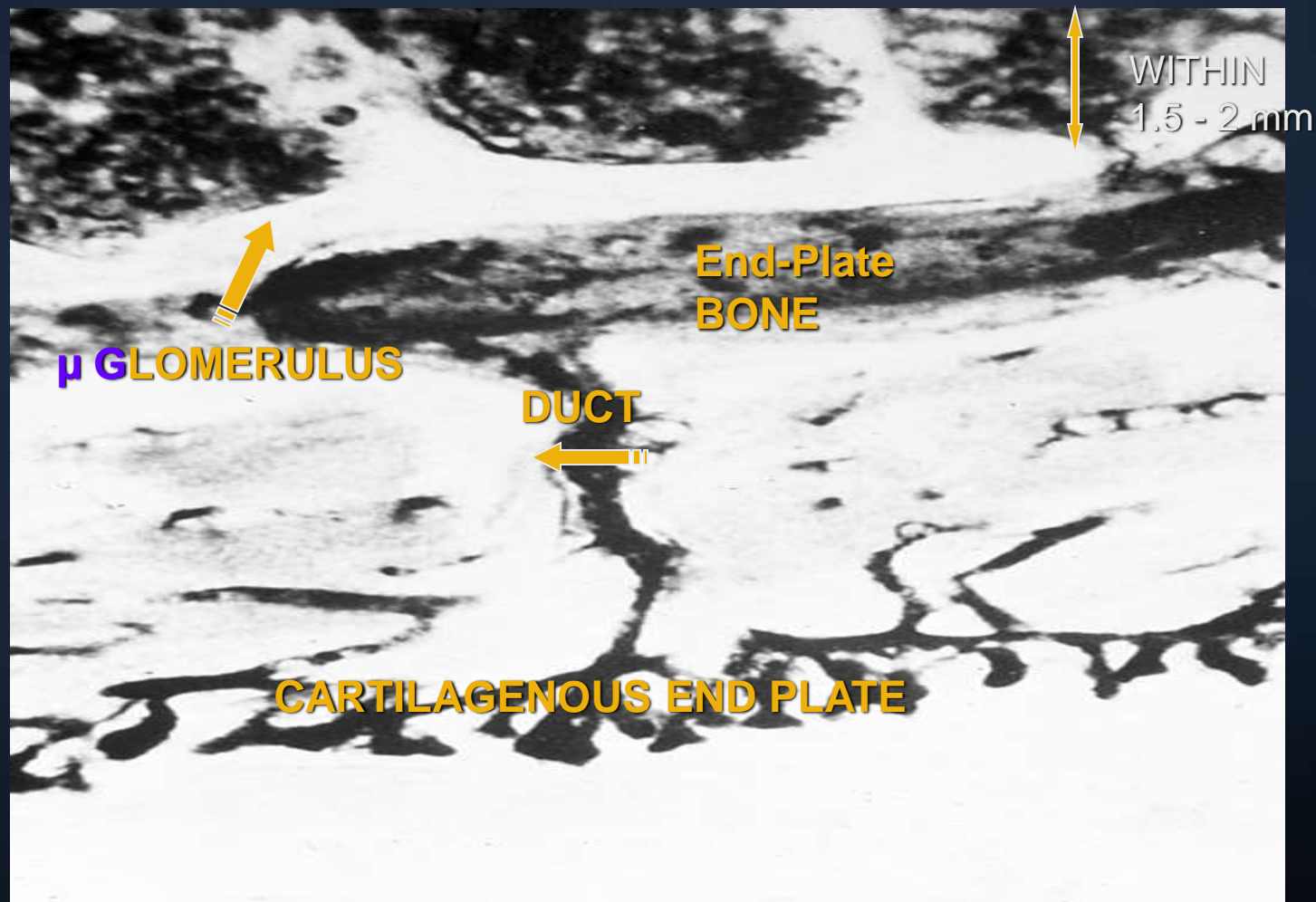
- ◆ I/II (xlink w pyridinline)
- ◆ VI
- ◆ III,V,IX,XI,XII



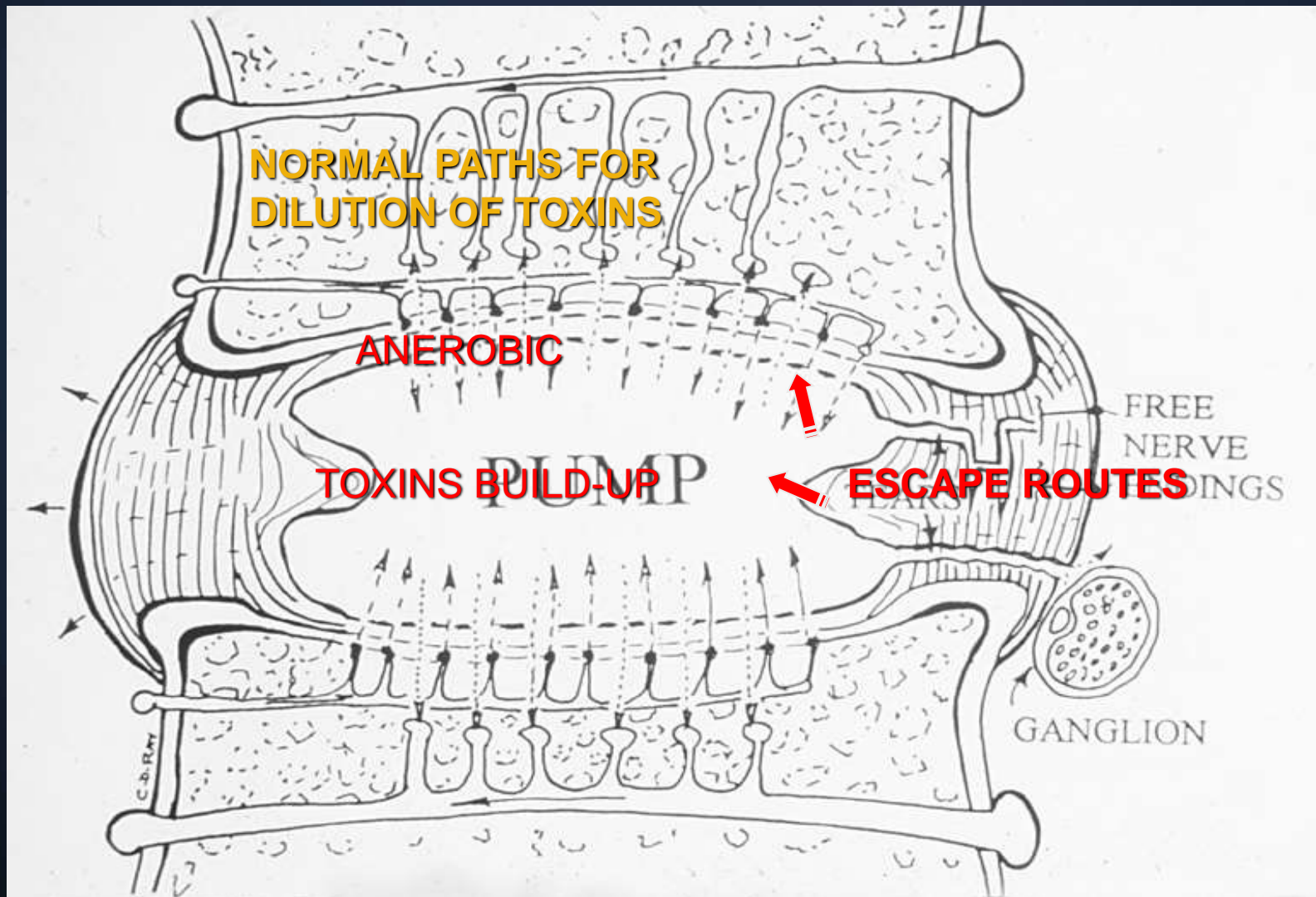
PART 3- ENDPLATE /VASCULAR: ENDPLATE FILTRATION SYSTEM

For Transfer of Nutrients and Waste Removal

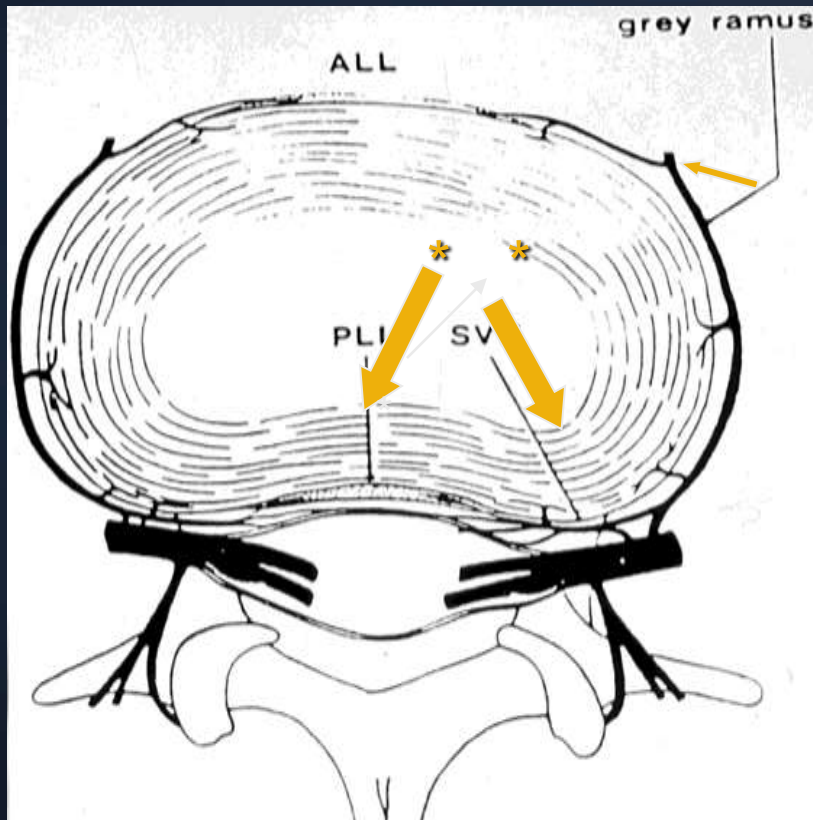
VERTEBRAL SPONGIOSA



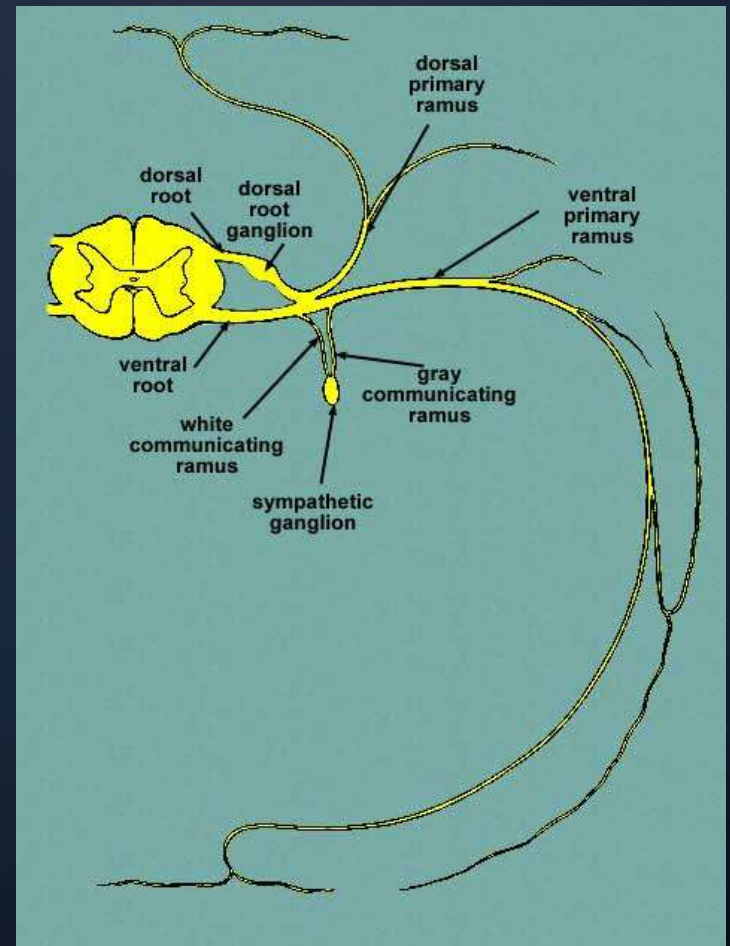
THE STRUCTURES OF THE ENDPLATE WITH THE NUCLEUS AS A METABOLIC PUMP



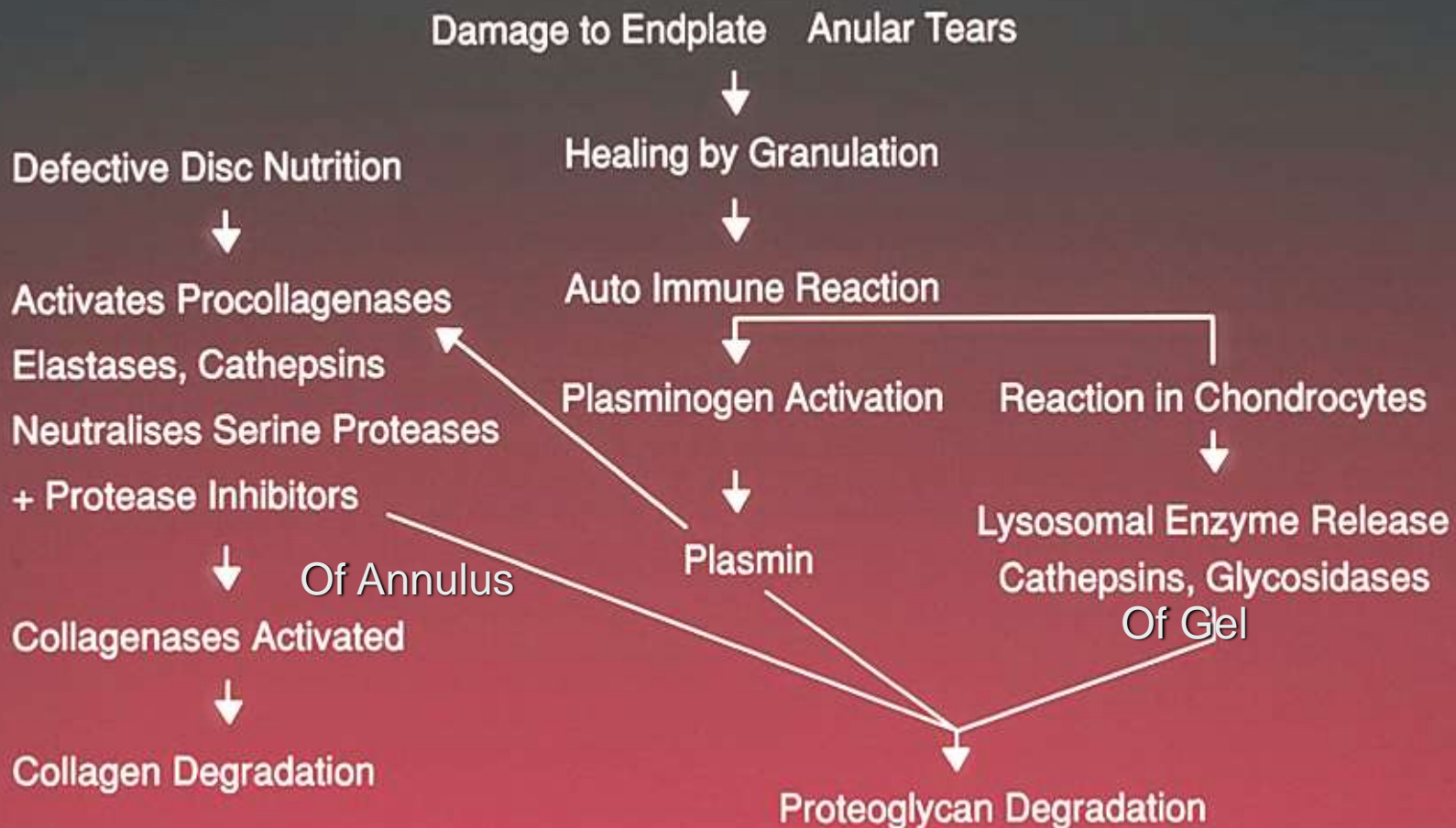
OUTER ANNULUS VESSEL & NERVE BELT



* AREAS OF HIGHEST NERVE & VESSEL CONCENTRATION, BUT ONLY IN THE OUTER 6 ANNULAR LAYERS



HOW THE DISC DEGENERATES

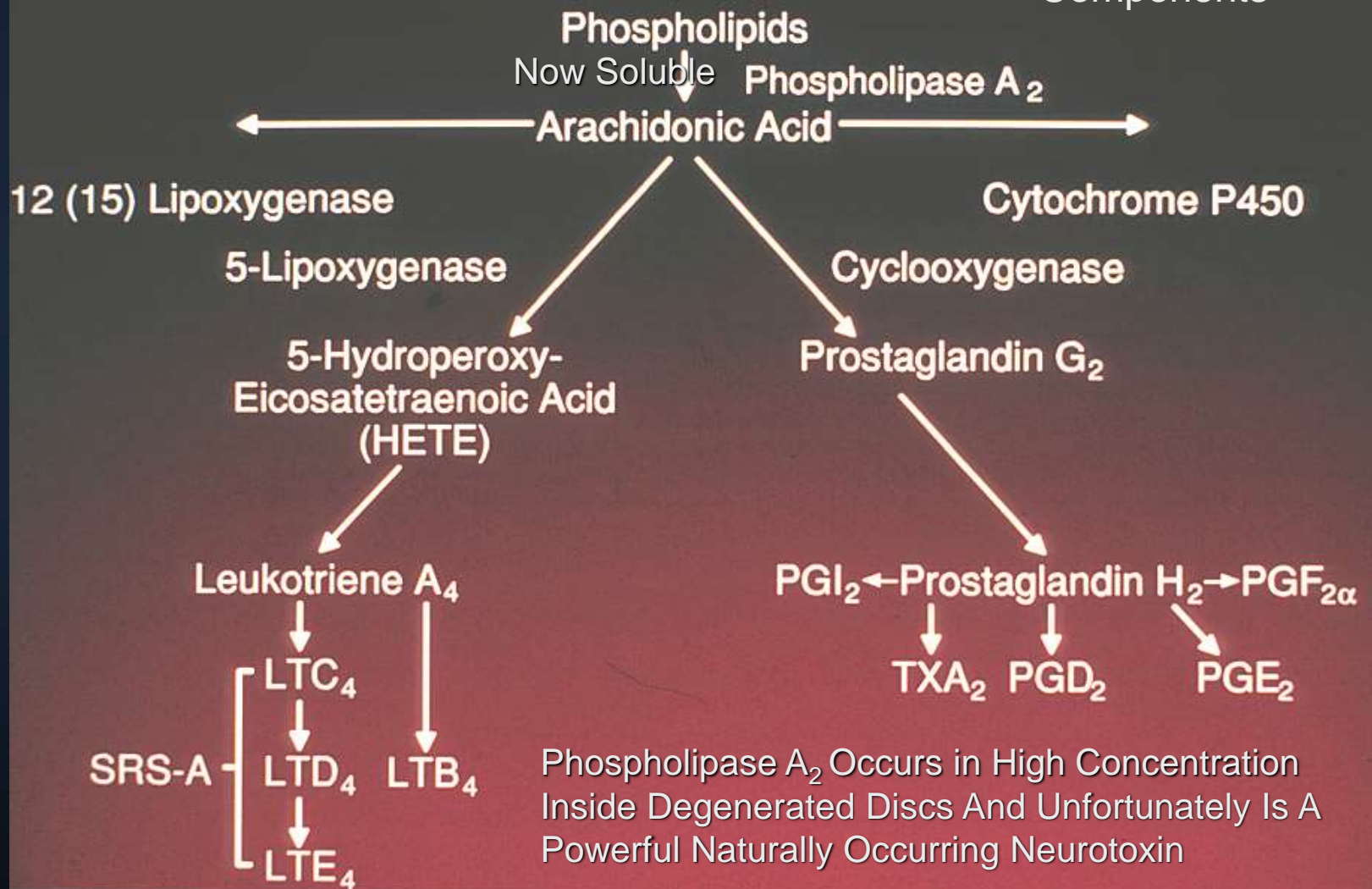


CHEMICAL CAUSES OF DISCOGENIC PAIN



Insoluble Portion of Cell
MEMBRANE=

One of The Key
Components



ANNULAR DEGENERATION, A PRECURSOR TO POTENTIAL INSTABILITY AND PAIN



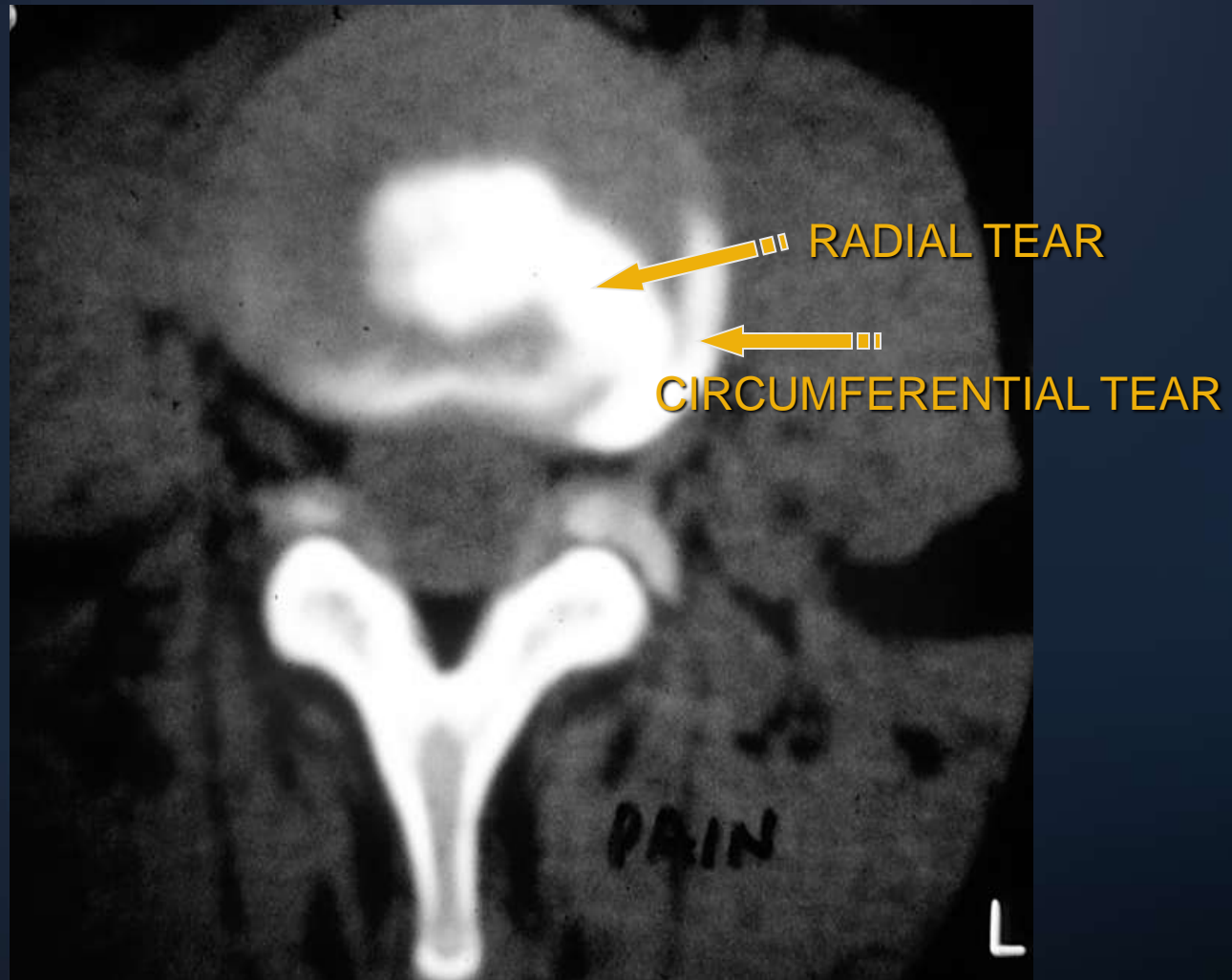
DEGENERATED,
FIBROTIC NUCLEUS

EDEMA OF GEL
LAYERS

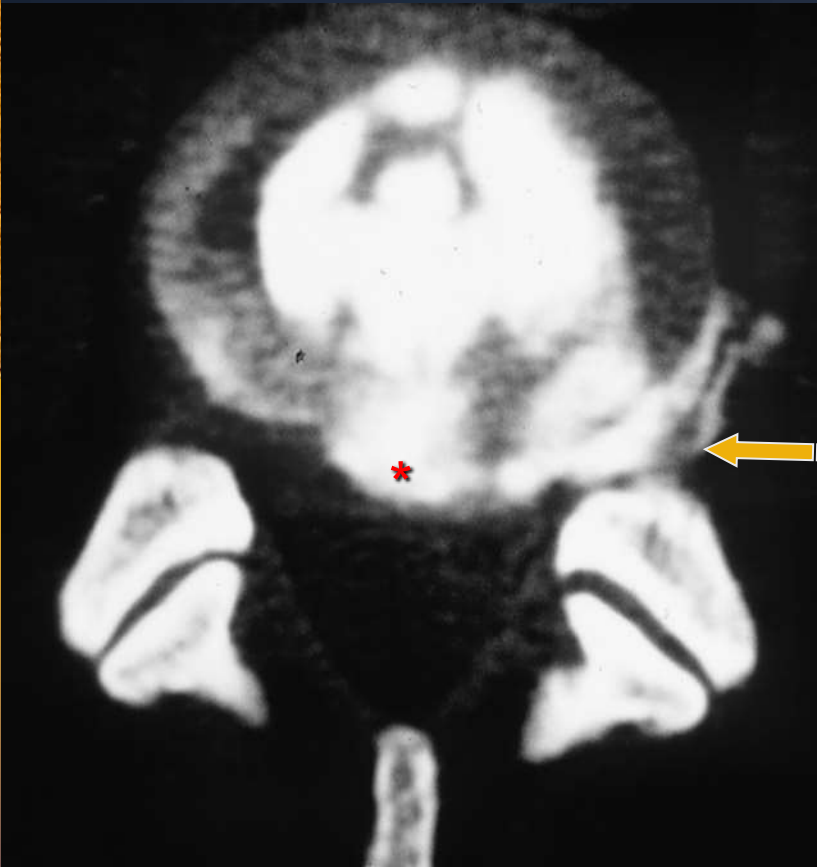
OUTER ANNULUS
TEARS

CIRCUMFERENTIAL
TEARS

TYPES OF ANNULAR TEARS

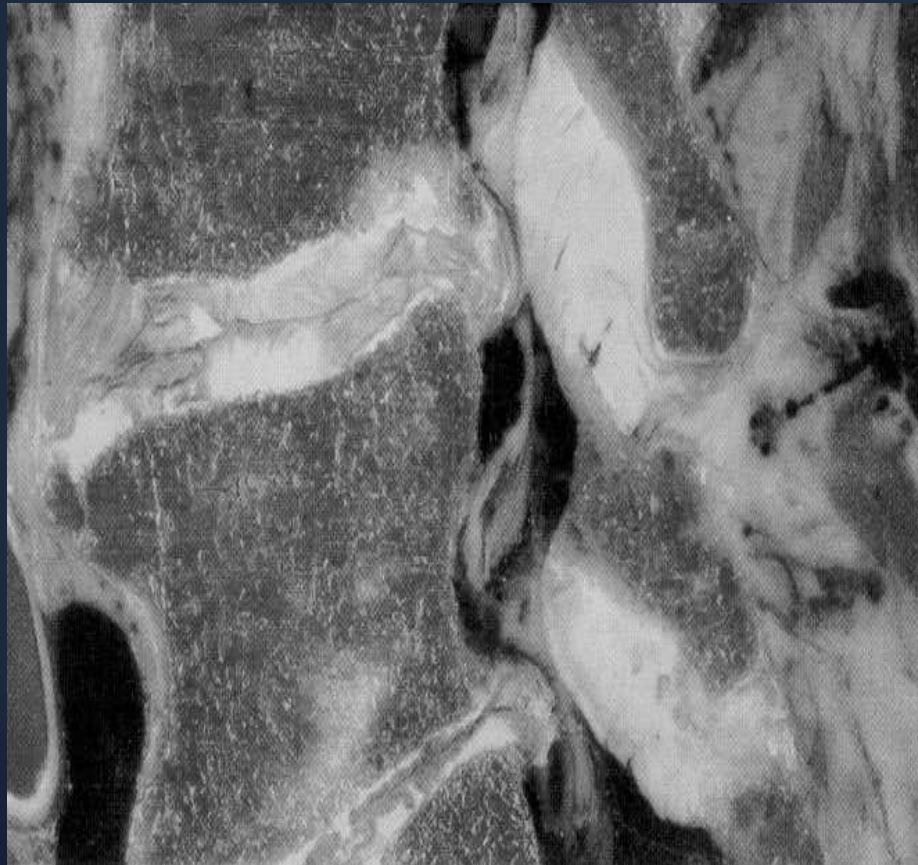


COMBINED DEGENERATION, LEAKAGE AND GANGLIONIC ATROPHY

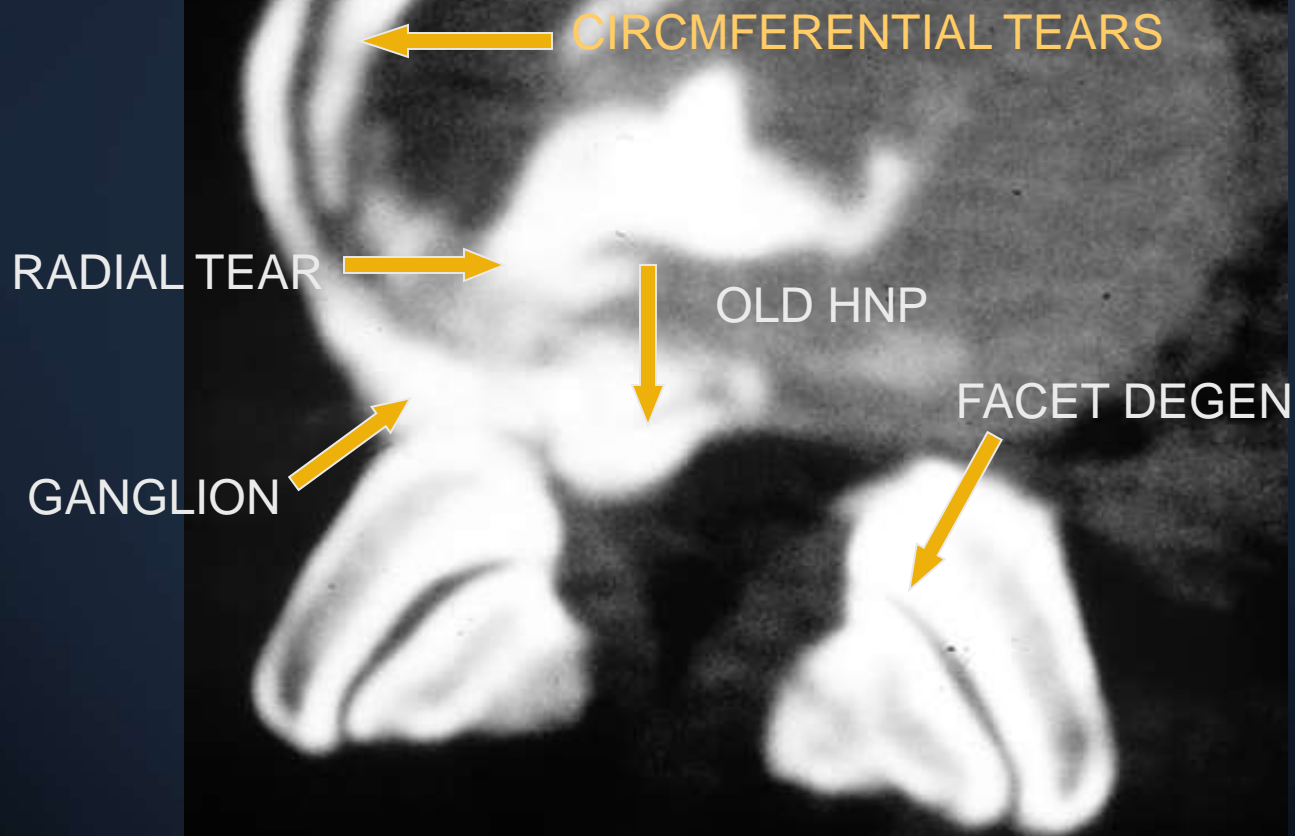


This Rare Case
of Long-Standing
Back and Leg
Pain Shows
Atrophy Of the
Ganglion And
Post-Ganglionic
Nerve. An Old
HNP is Also
Seen At the
Midline *

MECHANICAL FAILURE



MORE ADVANCED NUCLEUS DEGENERATION



MECHANICAL FAILURE



Disc Degeneration

- ◆ Controversial
- ◆ Young patients
- ◆ Mostly mechanical back pain worsen with any activities
- ◆ Sitting intolerance
- ◆ More pain with flexion than extension
- ◆ ?Abnormal psychological profile



Discogenic pain



Disc Degeneration

- ◆ Black disc
- ◆ HIZ



Treat patient not x-ray !

◆ 67 Asymptomatic volunteers:

- MRI + Herniated disc
 - <60 yo = 20%
 - >60 yo = 36%
 - >80 yo = 90%

(Boden JBJS 1990)

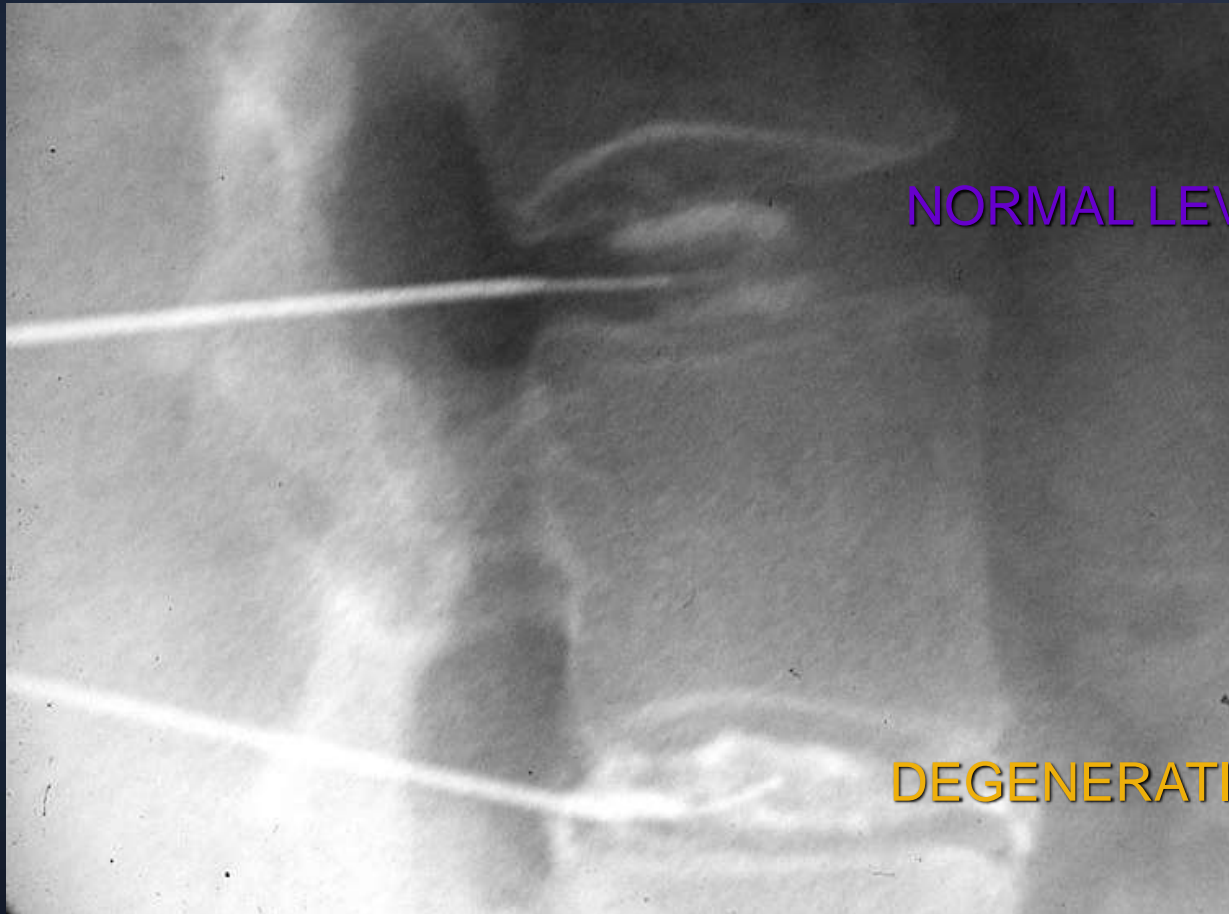
◆ 98 Asymptomatic vol.

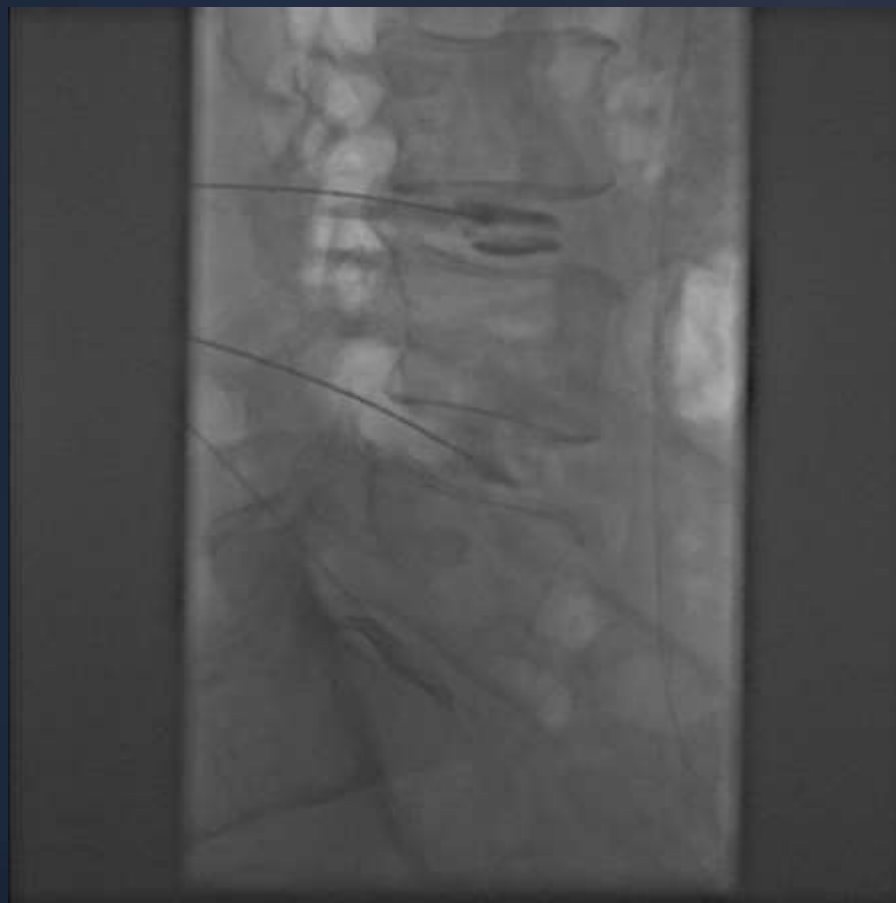
- 36% had normal disc at all levels

(Jensen NEJM 1994)




PROVOCATIVE DISCOGRAPHY





DISCOGRAM

- 
- A large, ornate metal key is positioned vertically on the left side of the slide. The key has a circular head with a small loop at the top and a long, slender shaft. The background of the slide is a dark blue gradient, and the key is set against a lighter, textured background that looks like sand or gravel.
- ◆ Carragee, E
 - ◆ Spine dec, 2000
 - ◆ Randomized
 - ◆ Symptomatic patients
 - 17/27 (63%) = +
 - ◆ Asymptomatic patients
 - 8/20 (40%) = -
 - ◆ April, C
 - ◆ Sine J 2005
 - ◆ Control
 - ◆ Asymptomatic, 55 disc, 58% Grade 3 tear, all had negative discogram result.

Non-Operative Treatment

- ◆ NSAID
- ◆ Physical therapy
- ◆ Epidural steroid injection
- ◆ Activity modification



Disc pressure & position

- ◆ Highest sitting with forwarded posture
- ◆ Lower with straight or relaxed with arm rest.
- ◆ Lowest with standing



OCCUPATIONAL PREVENTION

- ◆ Inclination of backrest to 110 deg, lumbar support, arm rest.
- ◆ Decrease vibration input.
- ◆ Keep object center of mass close to the body



Motion Preservation-Artificial Disc for Patients w Disc Degeneration



Charite' (depuy)



Prodisc (synthes)



Maverick (Medtronic)

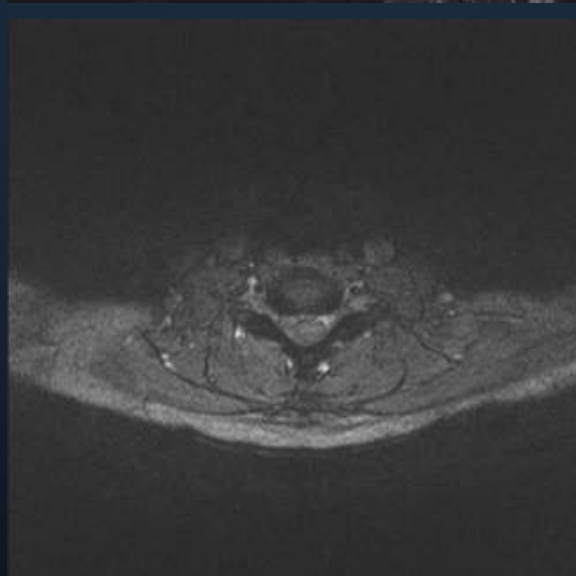


Flexicore (stryker)

Artificial Disc and Fusion



Cervical artificial disc



2 Level cervical artificial disc

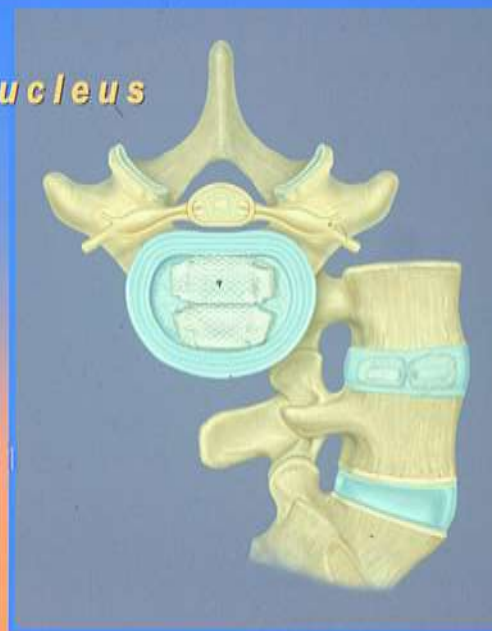
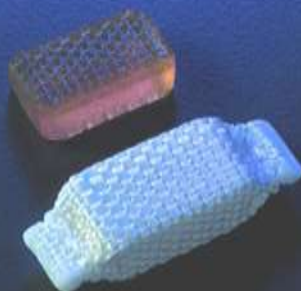


Posterior Dynamic Stabilization

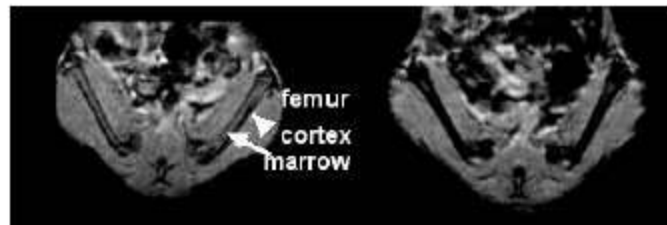




**RayMedica PDN®
Prosthetic Disc Nucleus**

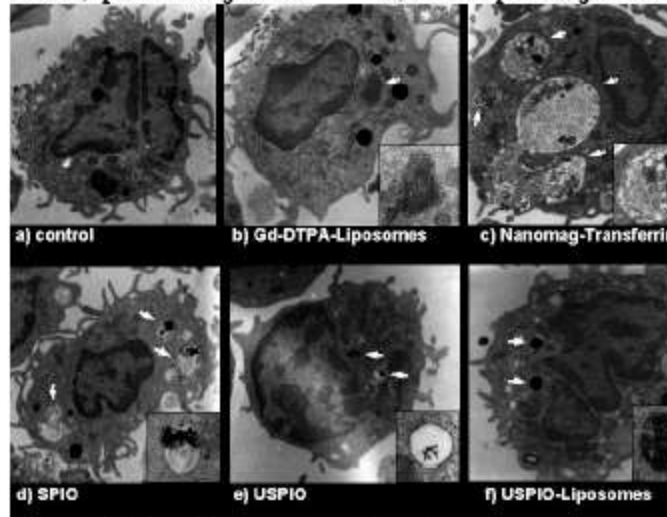


Progenitor Cells / BMP



C.24a) pre cell injection

b) 24 hr. post-injection



C.24e Histology showing incorporation of agents in human progenitor cells.

Thank You

