Beyond Slipped Discs and Degenerative Joints

A Progressive Look at Managing Low Back Pain

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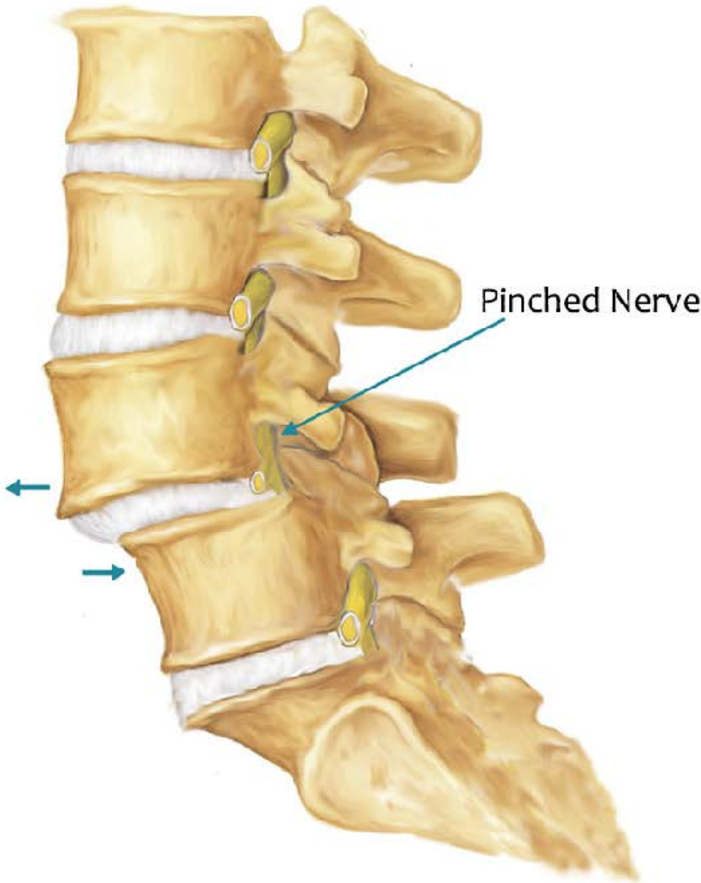


kintec

FOOTWEAR + ORTHOTIC

Does Smoking Cause Lower Back Pain

Learning Objectives

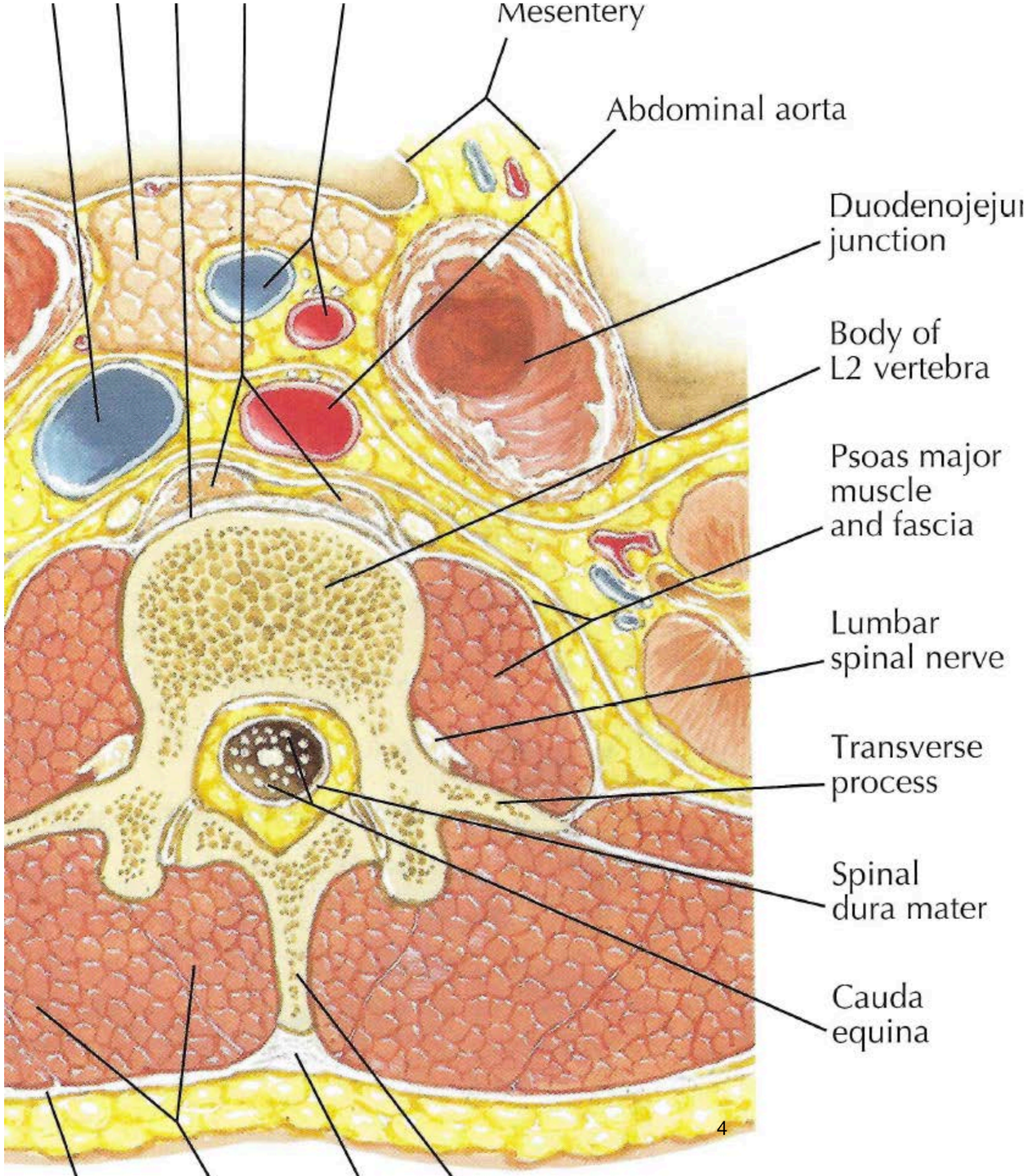
1. Appreciate early considerations in the genesis of the bio-psychosocial model of care for low-back pain;

2. Understand the disconnect between pain, structural change, and disability;

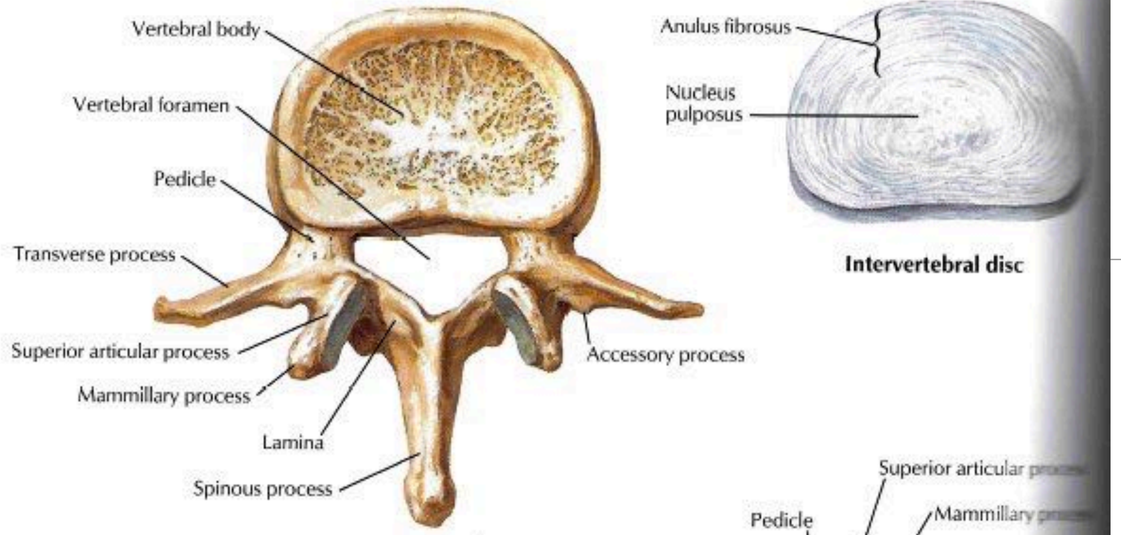
3. Review consensus guidelines on both diagnostic and management approaches to low-back pain;

4. Learn how recent research are favourable to using orthoses to manage low-back pain;

Background

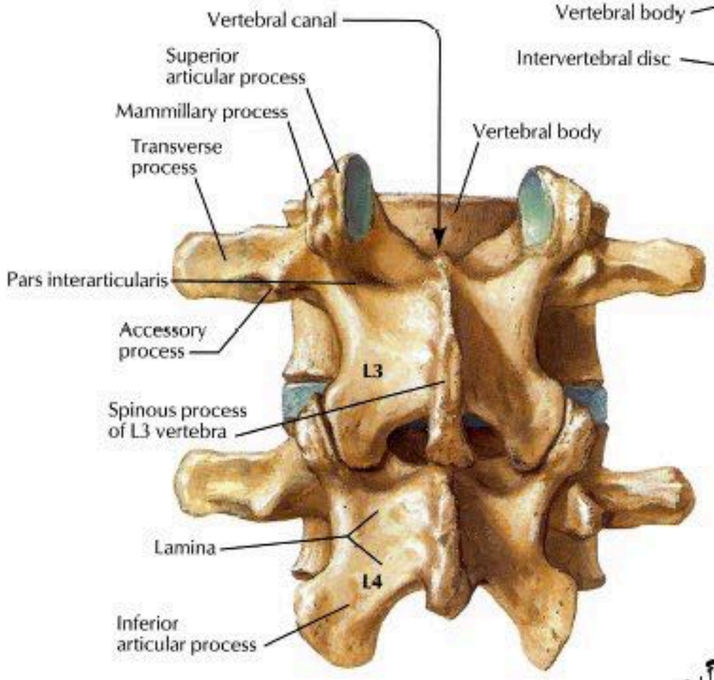

Mesentery
Abdominal aorta
Duodenojejuı
junction
Body of
L2 vertebra
Psoas major
muscle
and fascia
Lumbar
spinal nerve
Transverse
process
Spinal
dura mater
Cauda
equina

Back Anatomy

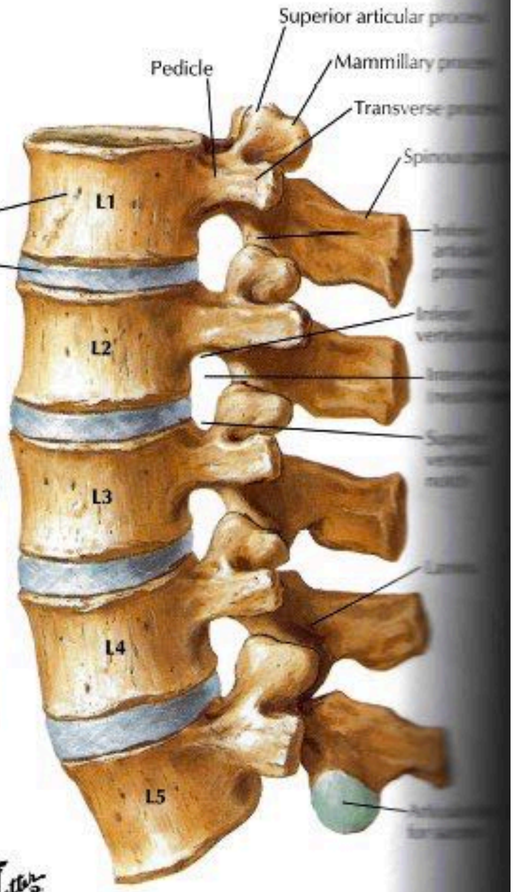


L2 vertebra: superior view

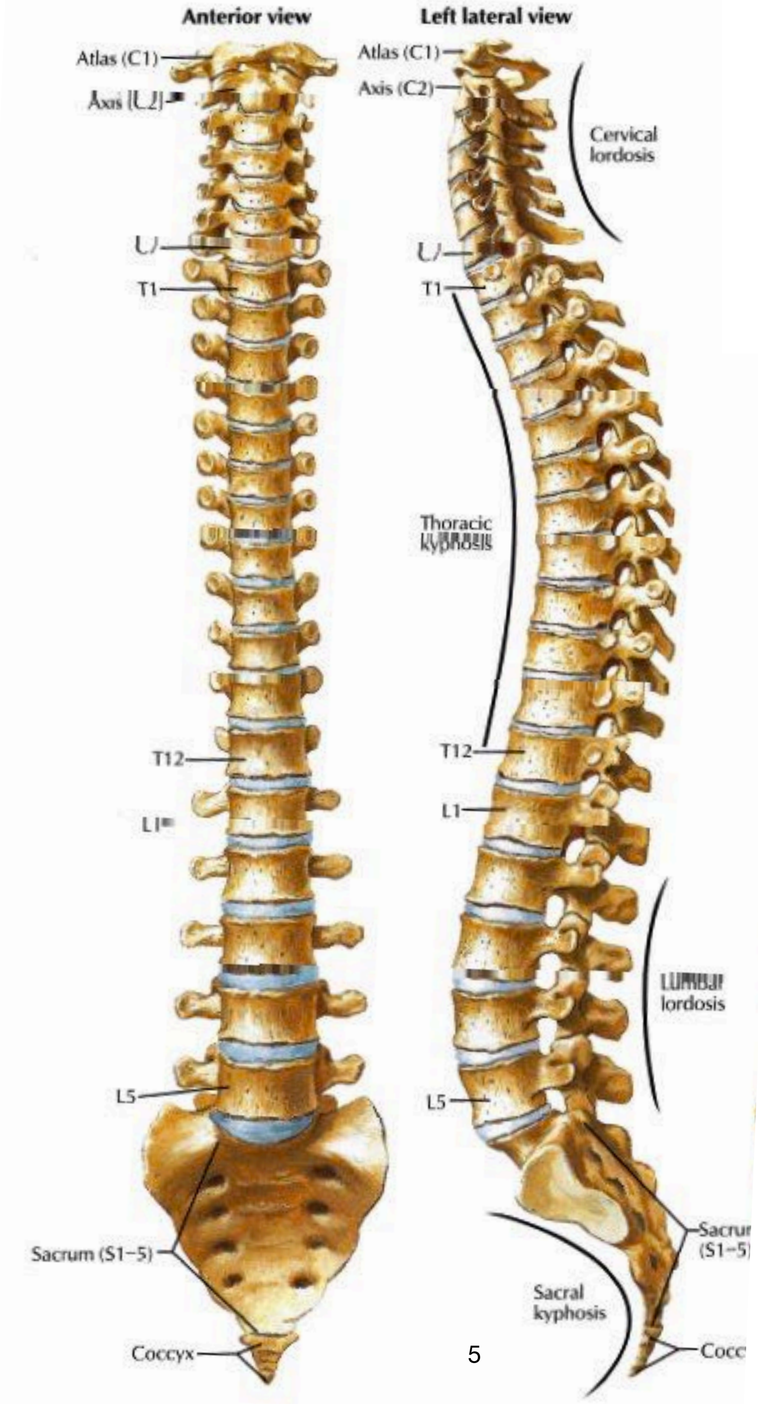
Intervertebral disc



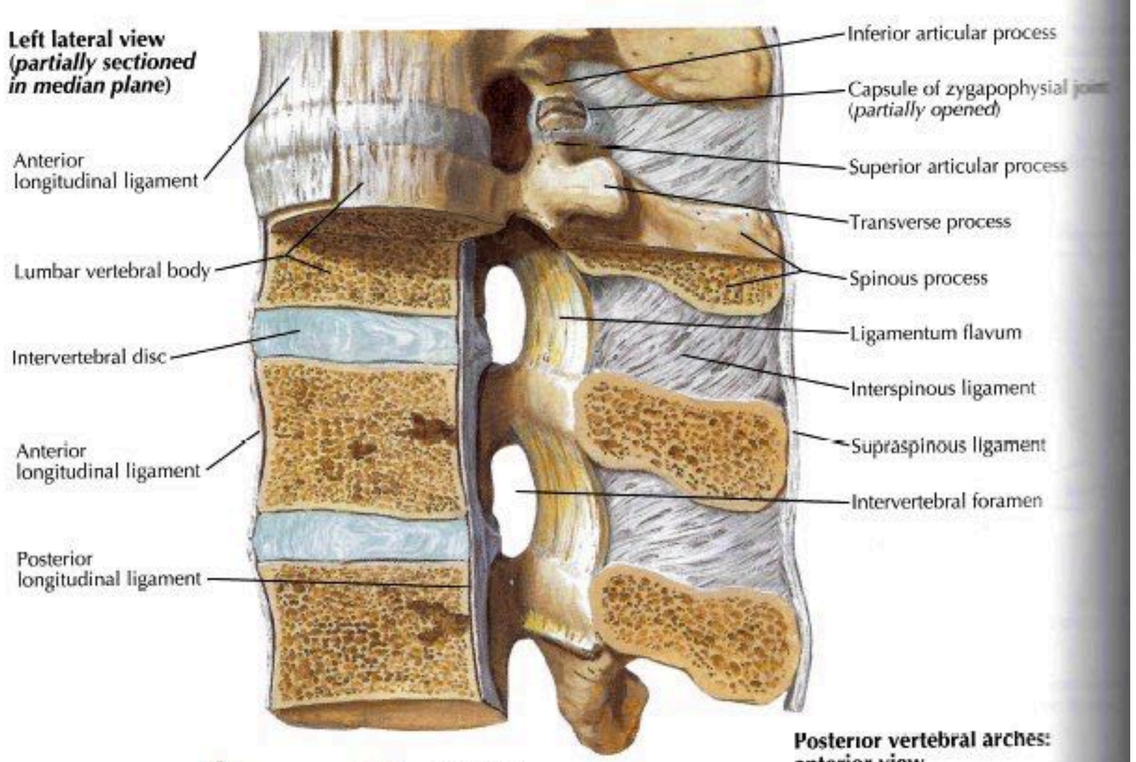
L3 and L4 vertebrae: posterior view

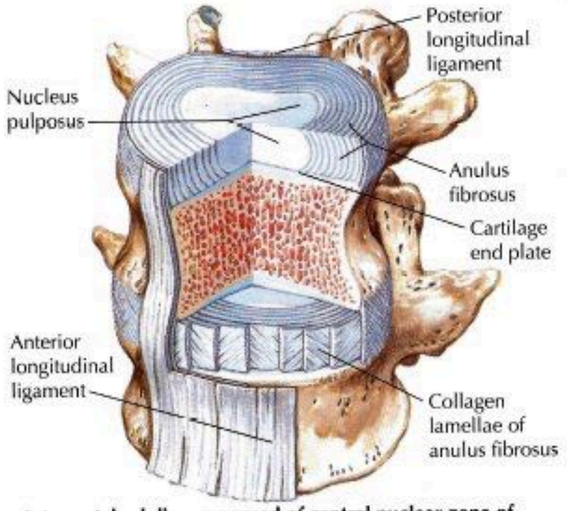


Lumbar vertebrae, articulated: left lateral view



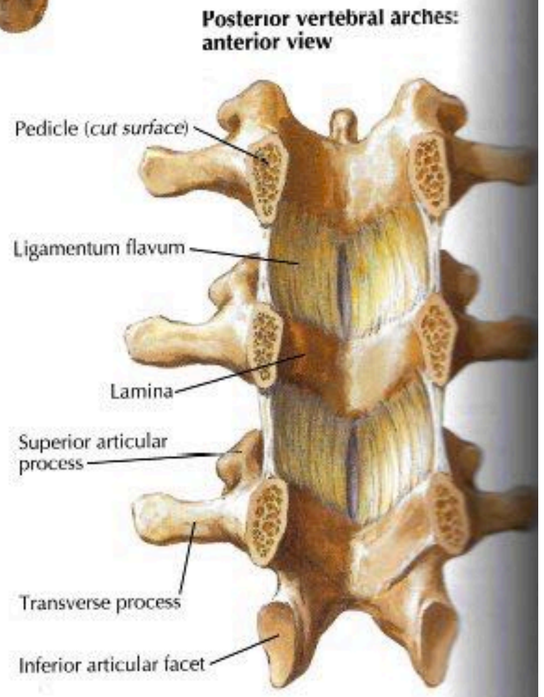
Back Anatomy



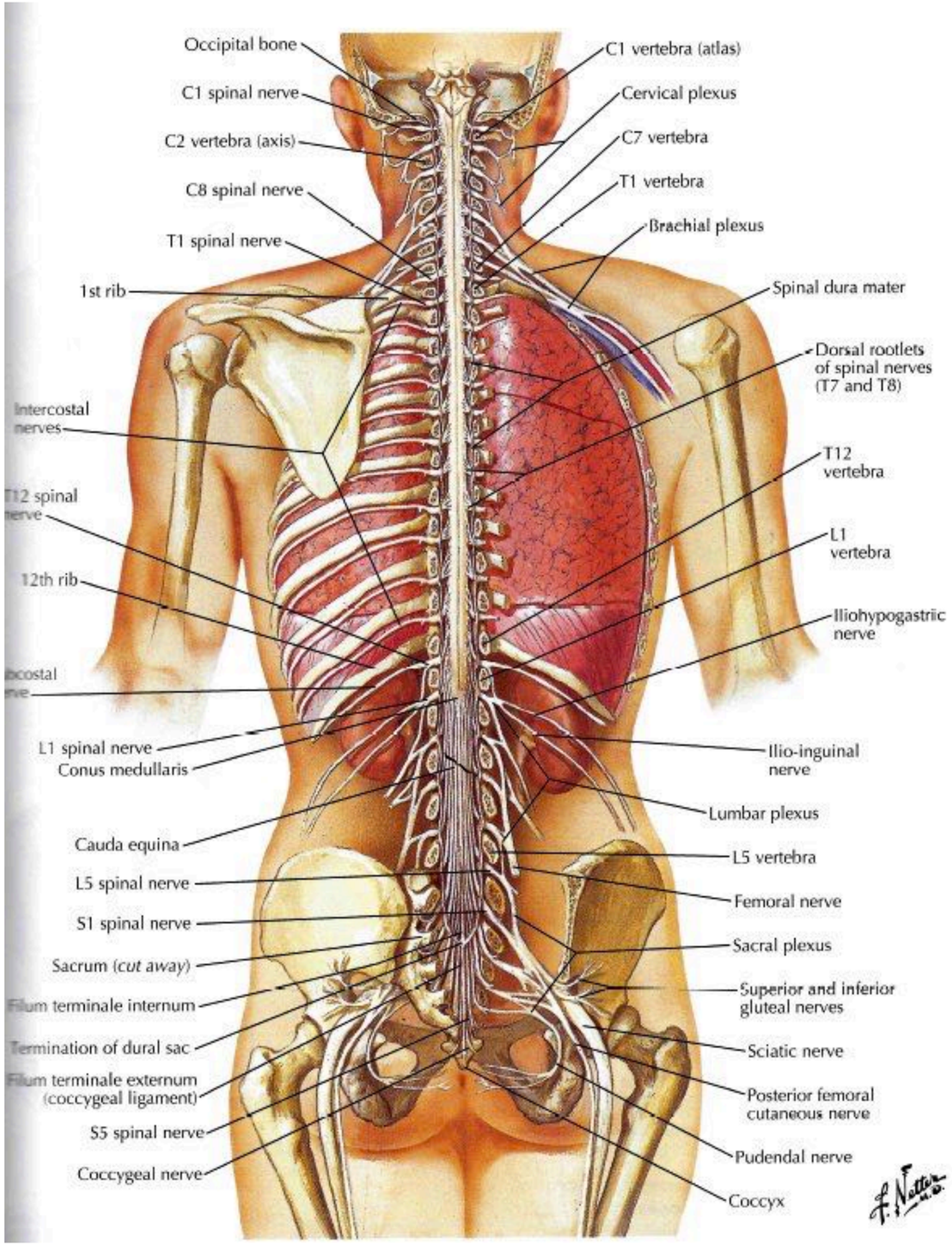


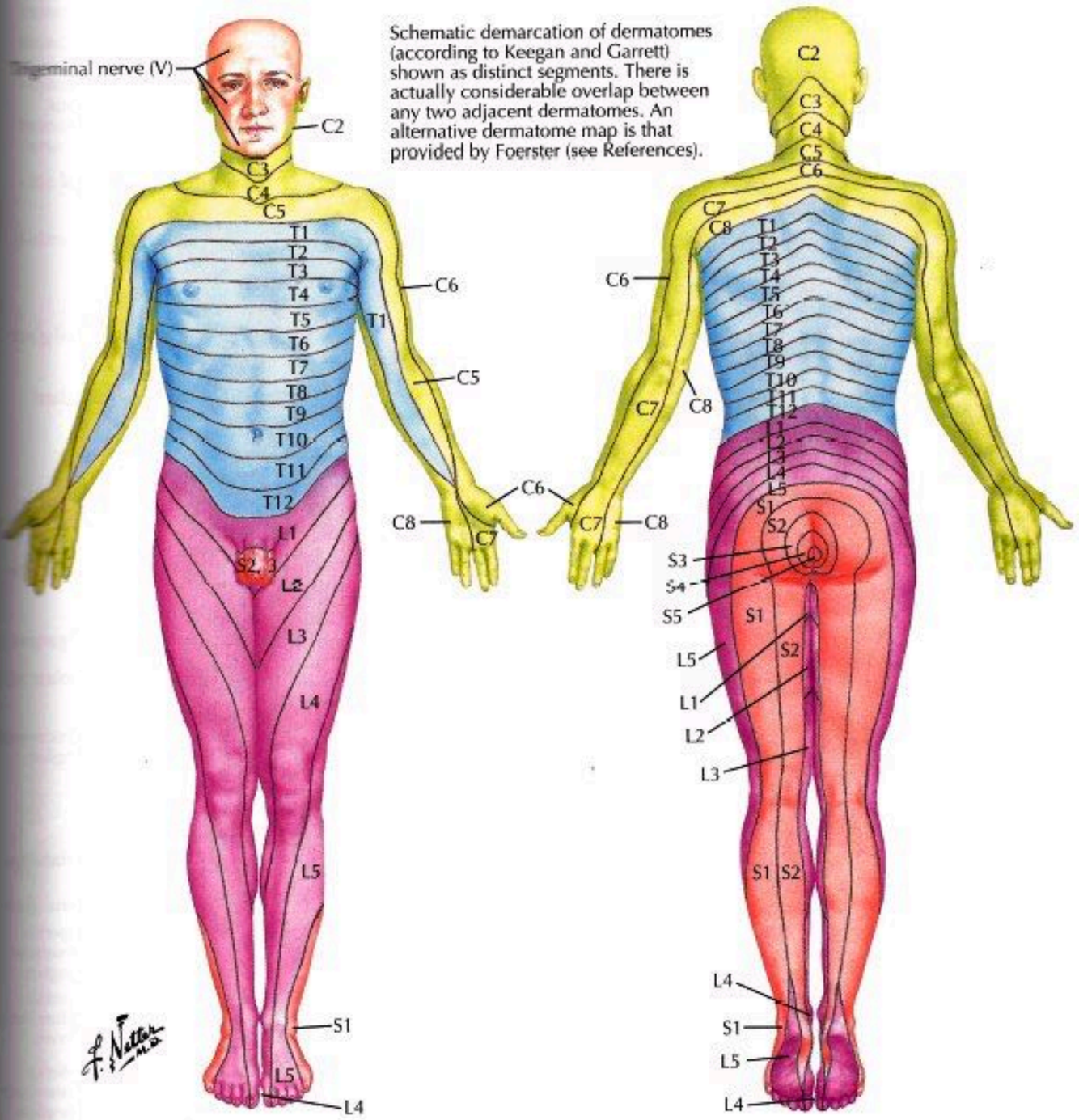
Intervertebral disc composed of central nuclear zone of collagen and hydrated proteoglycans surrounded by concentric lamellae of collagen fibers

F. Netter M.D. C. Machado M.D.

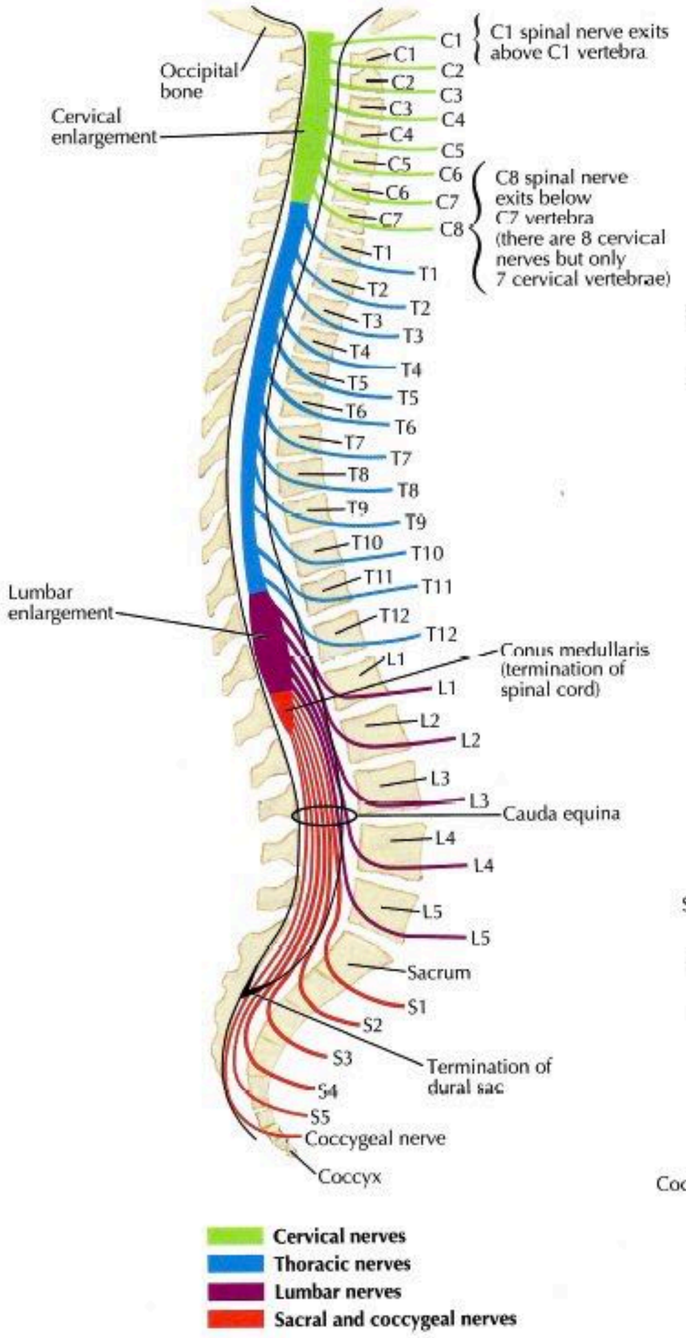


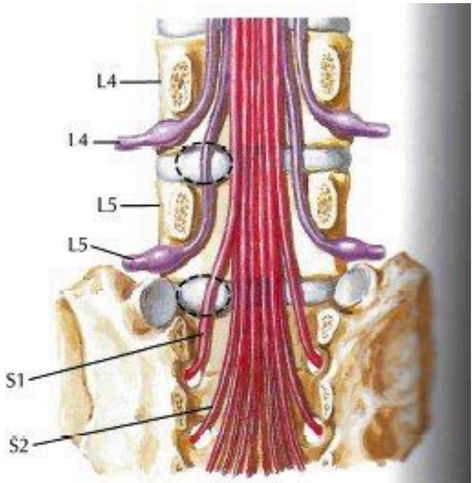
Back Anatomy



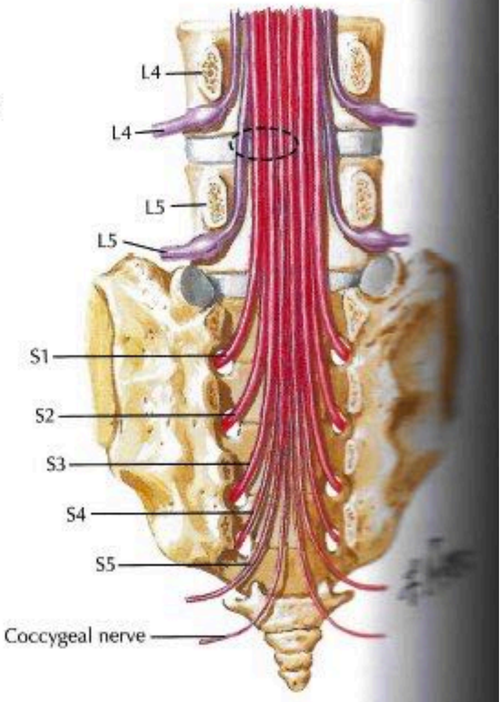


Schematic demarcation of dermatomes (according to Keegan and Garrett) shown as distinct segments. There is actually considerable overlap between any two adjacent dermatomes. An alternative dermatome map is that provided by Foerster (see References).

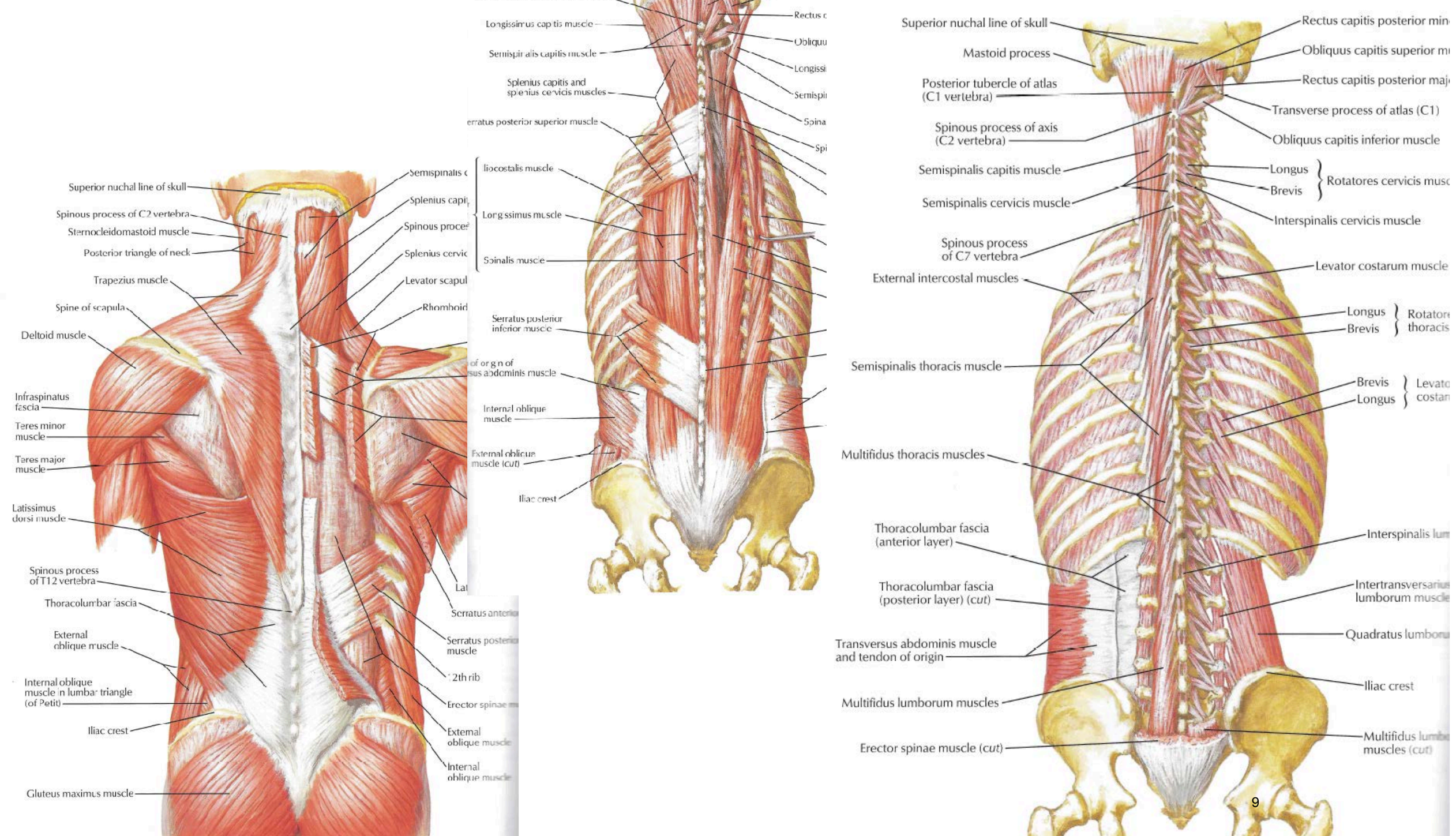


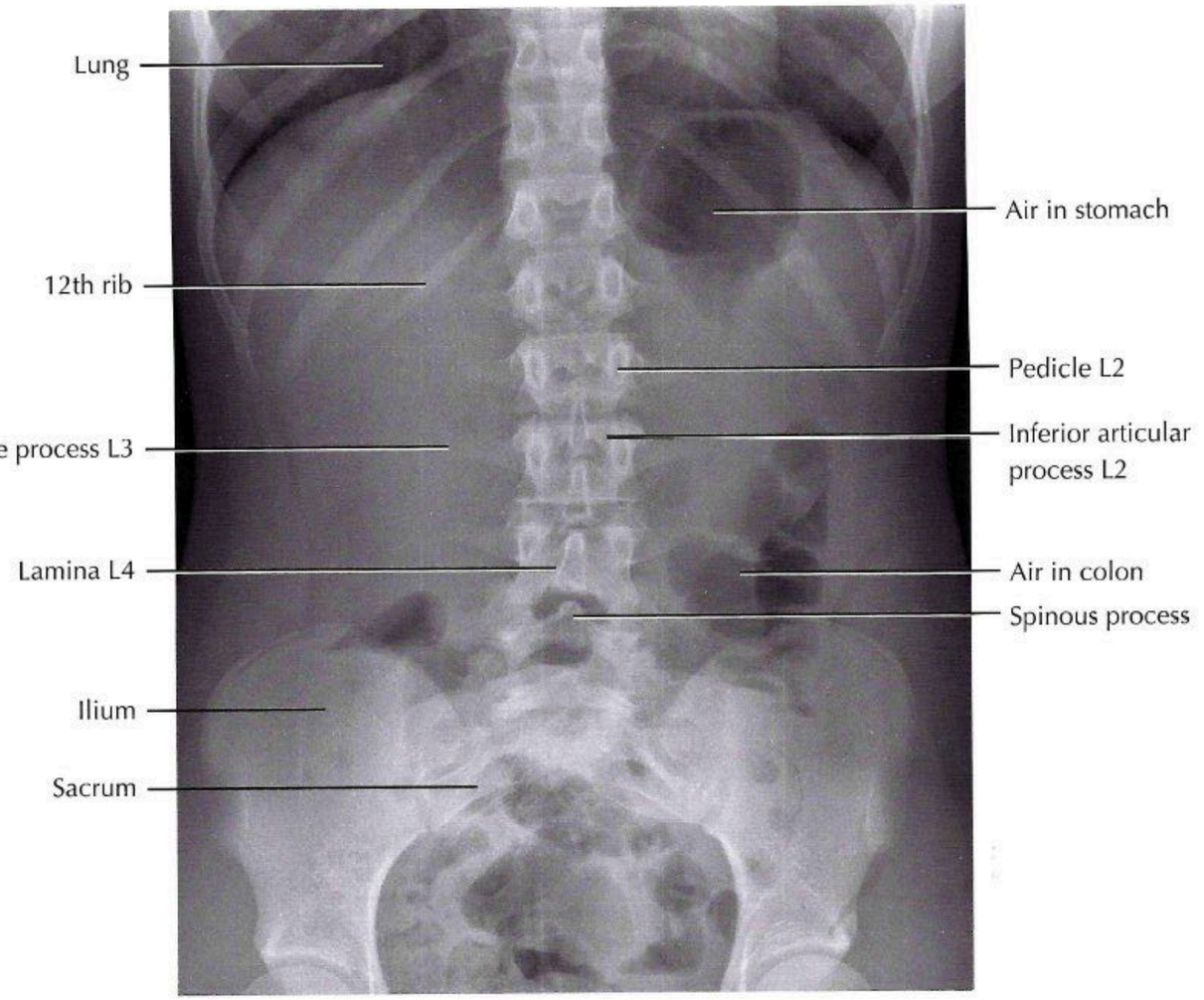


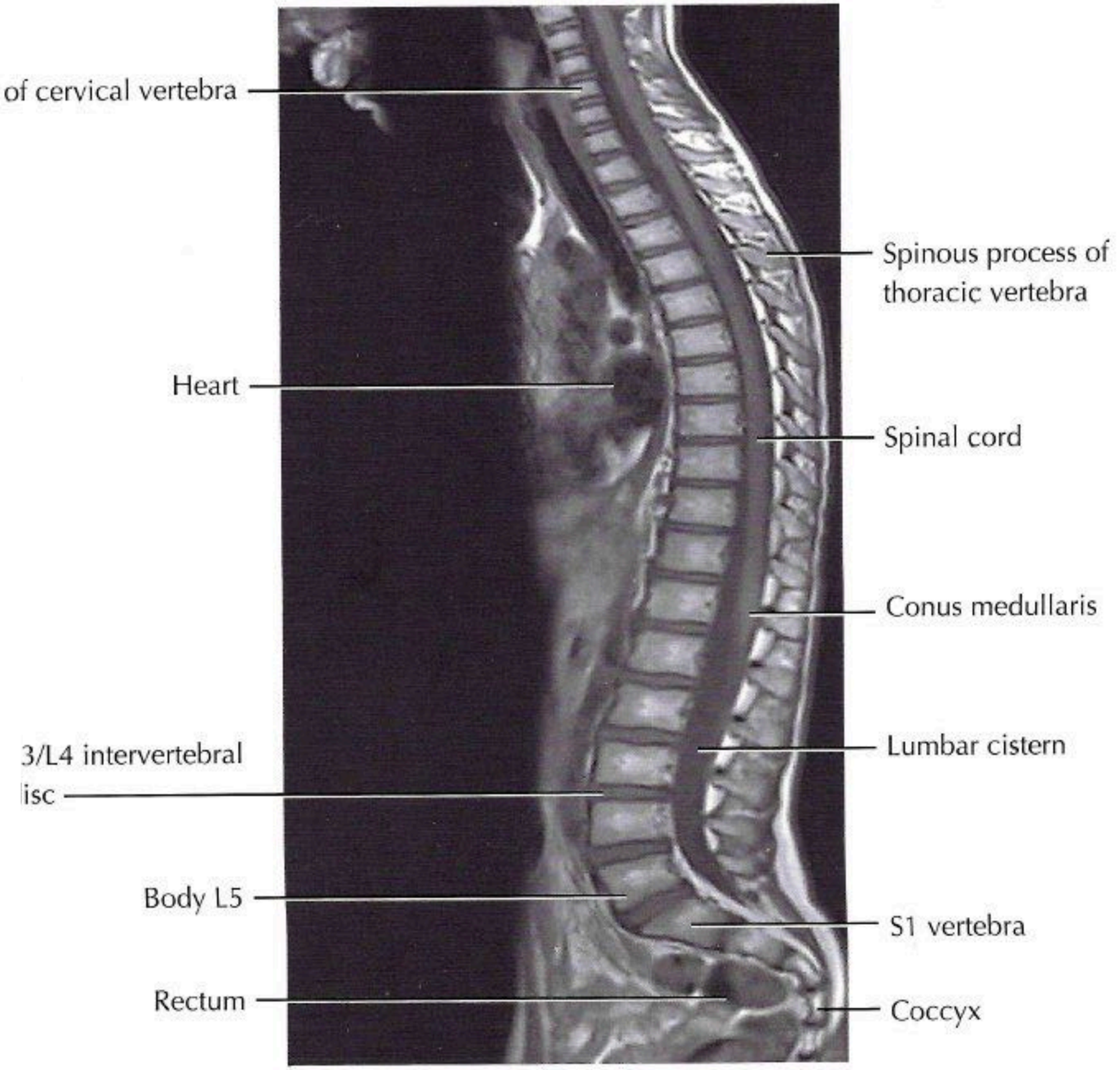
Lumbar disc protrusion (*dashed ovals*) does not affect nerve exiting above disc. Lateral protrusion at disc level L4–5 affects L5 spinal nerve, not L4 spinal nerve. Protrusion at disc level L5–S1 affects S1 spinal nerve, not L5 spinal nerve.



Medial protrusion at disc level L4–5 rarely affects L4 spinal nerve but may affect L5 spinal nerve and sometimes S1–4 spinal nerves.

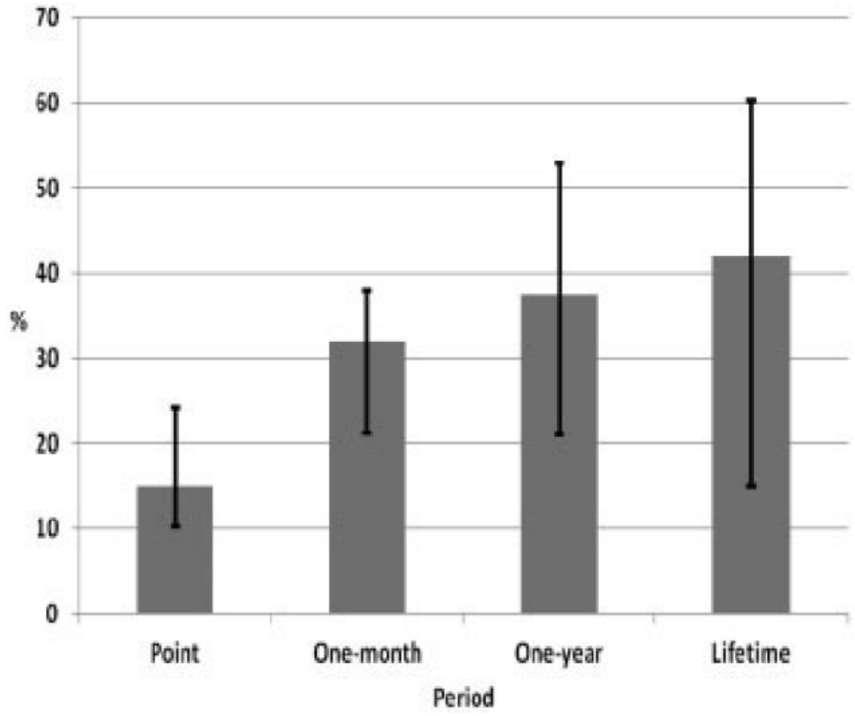

Superior nuchal line of skull
Spinous process of C2 vertebra
Sternocleidomastoid muscle
Posterior triangle of neck
Trapezius muscle
Spine of scapula
Deltoid muscle
Infraspinatus fascia
Teres minor muscle
Teres major muscle
Latissimus dorsi muscle
Spinous process of T12 vertebra
Thoracolumbar fascia
External oblique muscle
Internal oblique muscle in lumbar triangle (of Petit)
Iliac crest
Gluteus maximus muscle
Semispinalis c
Splenius capi
Spinous proce
Splenius cervic
Levator scapul
Rhomboid
Serratus anterior
Serratus posterior muscle
12th rib
Erector spinae
External oblique muscle
Internal oblique muscle
Longissimus capitis muscle
Semispinalis capitis muscle
Splenius capitis and splenius cervicis muscles
erratus posterior superior muscle
liocostalis muscle
Longissimus muscle
Spinalis muscle
Serratus posterior inferior muscle
of origin of sus abdominis muscle
Internal oblique muscle
External oblique muscle (cut)
Iliac crest
Rectus c
Obliquu
Longissi
Semispi
Spina
Spi
Superior nuchal line of skull
Mastoid process
Posterior tubercle of atlas (C1 vertebra)
Spinous process of axis (C2 vertebra)
Semispinalis capitis muscle
Semispinalis cervicis muscle
Spinous process of C7 vertebra
External intercostal muscles
Semispinalis thoracis muscle
Multifidus thoracis muscles
Thoracolumbar fascia (anterior layer)
Thoracolumbar fascia (posterior layer) (cut)
Transversus abdominis muscle and tendon of origin
Multifidus lumborum muscles
Erector spinae muscle (cut)
Rectus capitis posterior min
Obliquus capitis superior mu
Rectus capitis posterior maj
Transverse process of atlas (C1)
Obliquus capitis inferior muscle
Longus
Brevis
Rotatores cervicis musc
Interspinalis cervicis muscle
Levator costarum muscle
Longus
Brevis
Rotator
thoracis
Brevis
Longus
Levato
costar
Interspinalis lum
Intertransversarius lumborum muscle
Quadratus lumboru
Iliac crest
Multifidus lumb
muscles (cut)


Lung
Air in stomach
12th rib
Pedicle L2
e process L3
Inferior articular process L2
Lamina L4
Air in colon
Spinous process
Ilium
Sacrum


Body of cervical vertebra
Spinous process of thoracic vertebra
Heart
Spinal cord
Conus medullaris
3/L4 intervertebral isc
Lumbar cistern
Body L5
S1 vertebra
Rectum
Coccyx

Disease Burden of LBP

- Prevalence: 18% (point) - 31% (1-mo)
- More common in women
- Positive correlation: a country's Human Development Index and mean prevalence of LBP
- Leading cause of years lived with disability; 6th highest cause of global overall disease burden



Prevalence of low back pain

Costs of LBP

- Costly: AUS$9B total cost, but only AUS$1B direct health-care costs
- Profound individual effects:
  - leading chronic health problem forcing older workers to retire prematurely;
  - forces more people out of workforce that heart disease, diabetes, hypertension, neoplasm, respiratory disease and asthma *combined!*
  - people retiring early due to LBP **have 87% less total wealth** than those who remain in full-time employment!

Meyer et al. 2017; Schofield et al 2015

Modern History of Treatments for Low Back Pain

Using a bear to treat back pain. Romania, 1946.

‘Traditional’ treatment for LBP

1987 Volvo Award in Clinical Sciences

A New Clinical Model for the Treatment of Low-Back Pain

GORDON WADDELL, BSc, MD, FRCS

Observations on Natural History of LBP

1. At some stage in their life 80% of human race will experience low-back pain

2. 80-90% of LBP episodes recover in ~6-weeks

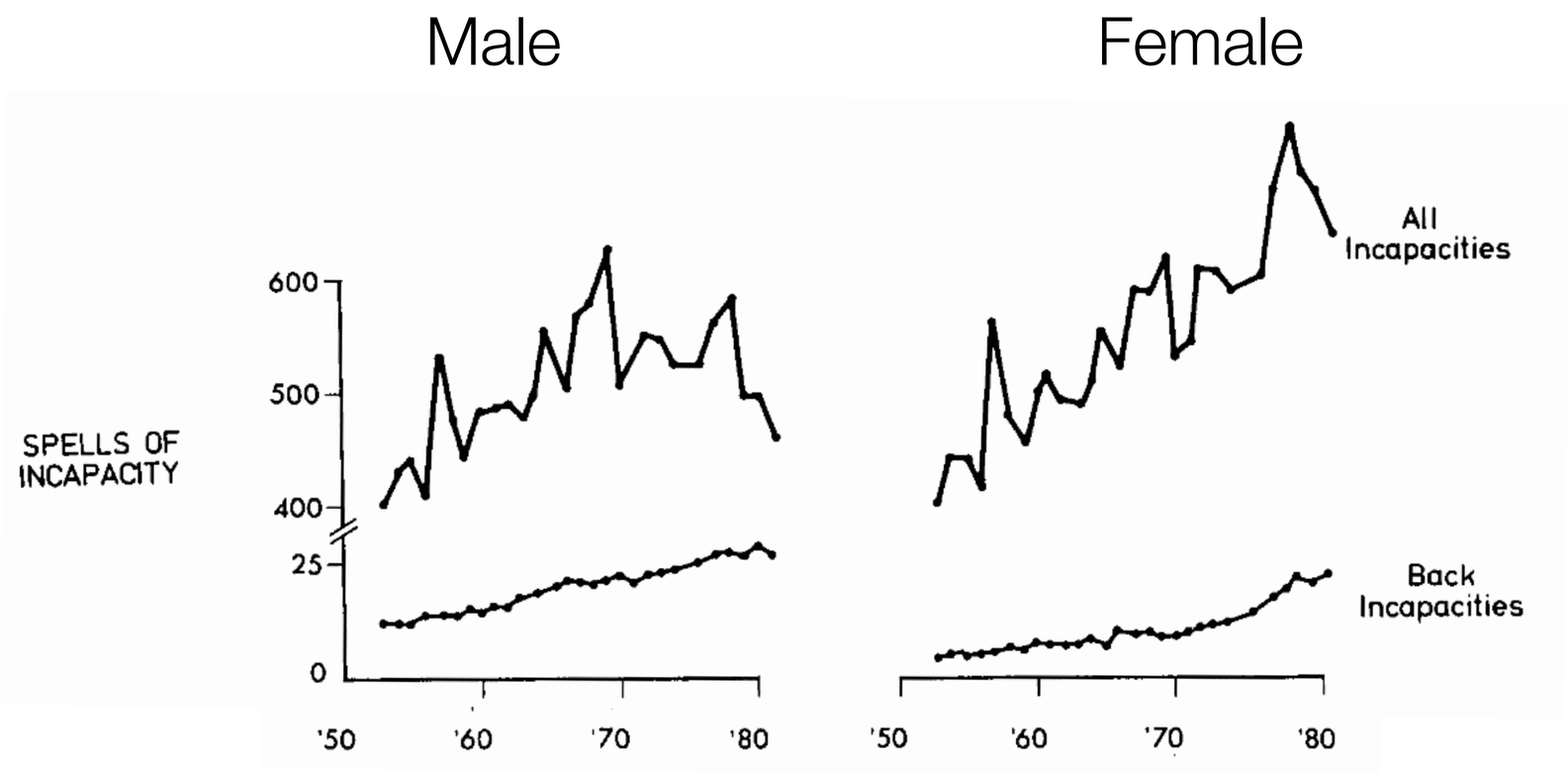
3. LBP wasn't disabling until introduction of Western medicine

   - 1996 LBP viewed as normal & non-threatening in Australian aboriginals and Oman residents; not disabling despite high prevalence

Lin et al. 2013, Waddell et al. 1985

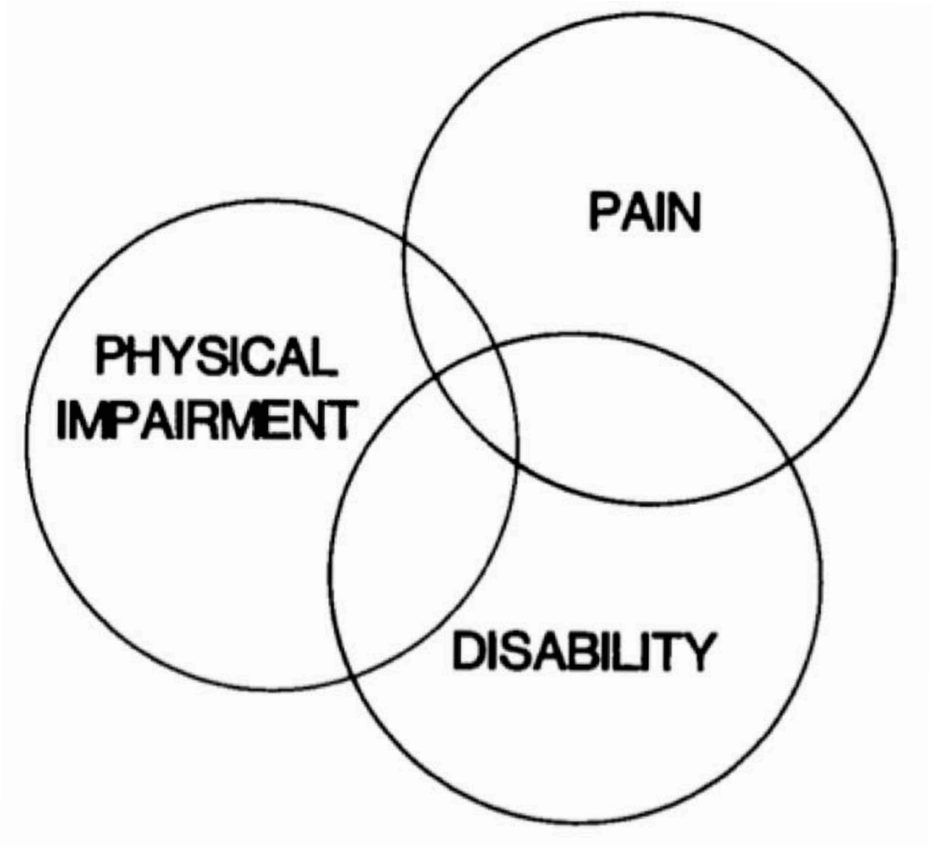
Observations on Natural History of LBP

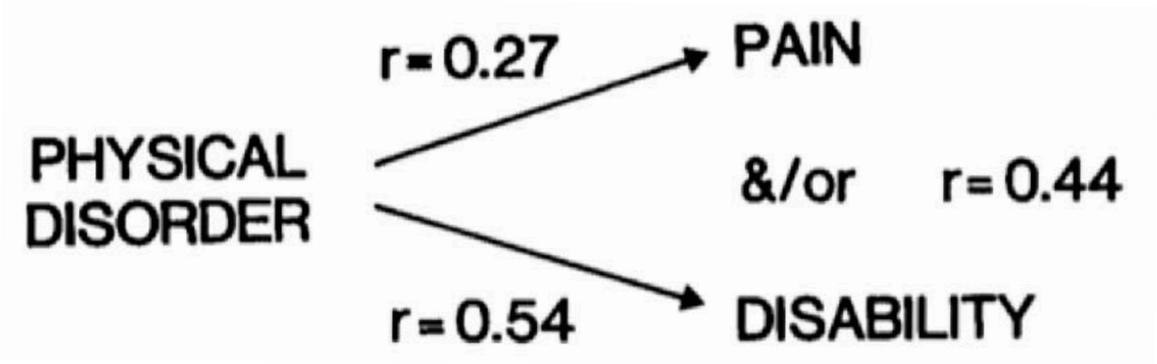
4. Low-back disability has increased throughout Western society since 1950s.



Observations on Natural History of LBP

5. Low-back pain and disability must be distinguished.





Observations on Natural History of LBP

6. LBP causes biggest problem* in the middle working years of life peaking around 40 years.

   - LBP *does not* progressively increase with age

   - LBP *does not* correspond to age-related changes of disc degeneration

Observations on Natural History of LBP

7. The majority of the population with LBP and disability cope with the problem themselves without medical treatment.

   - Seeking care depends more on patient perception and interpretation of symptoms, or learned cultural patterns of illness behaviour

Observations on Natural History of LBP

8. Medical assessment and treatment is influenced more by patient's distress and behaviour than actual physical disorder.

Main elements of illness	*Extent to which these account for the amount of treatment received (%)*
Duration of symptoms	14
Physical severity	11
Psychologic distress	9
Abnormal illness behavior	15
Total identified*	50

Observations on Natural History of LBP

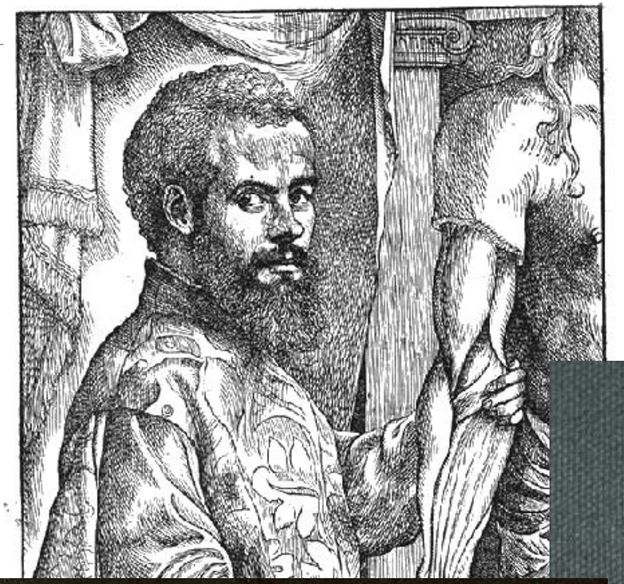
9. Chronic pain becomes a completely different clinical syndrome from acute pain.

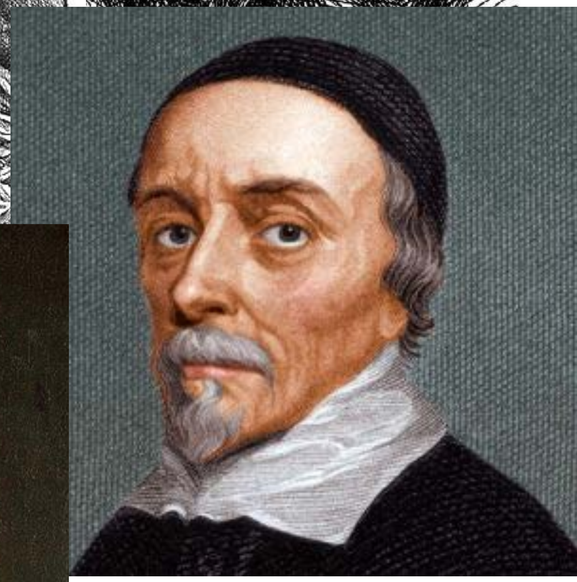
10. Prolonged time away from work *in itself* makes return to work progressively less likely.

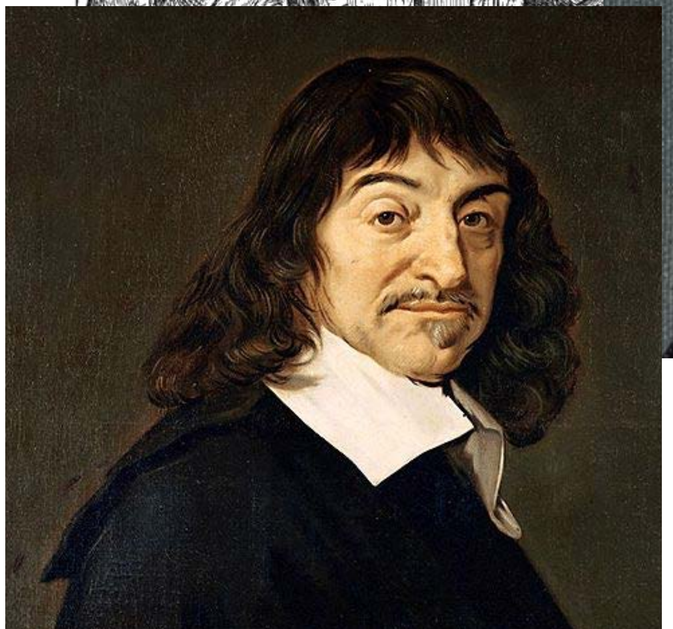
From Patho-Anatomical to Biopsychosocial…and Back Again

History of Patho-anatomical Model of Disease

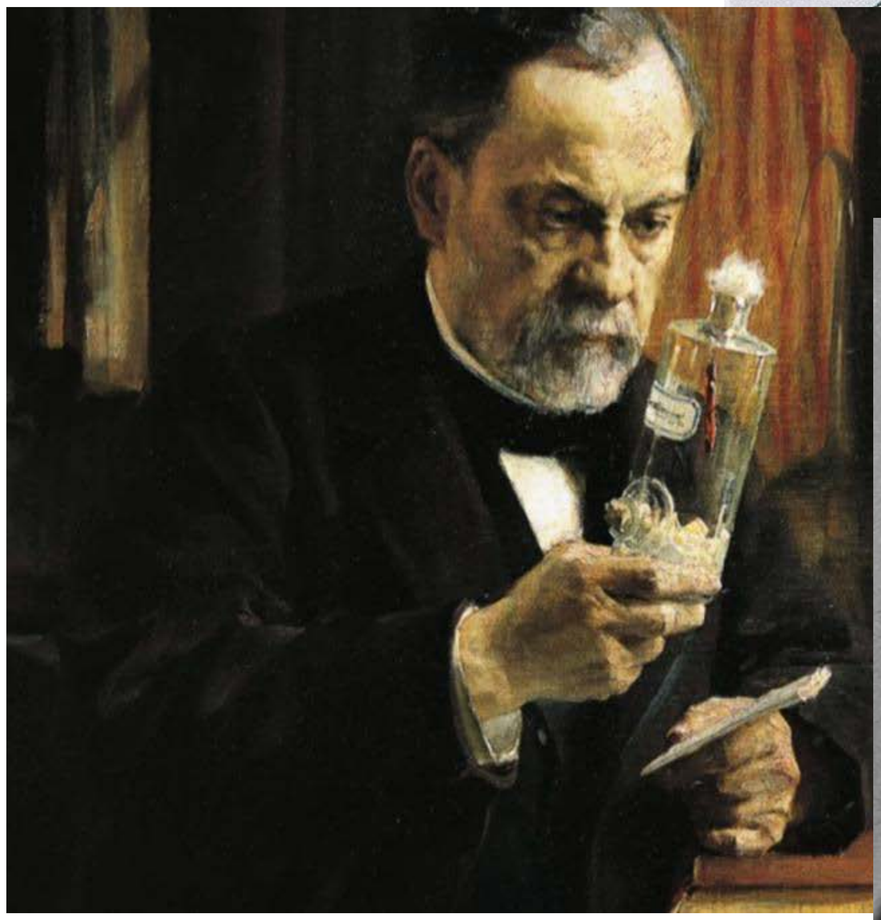
- Scientific treatment of disease back to renaissance
  - Paracelsus (1493-1541)
  - Andreas Vesalius (1514-1564)
  - William Harvey (1578-1657)
  - Rene Decartes (1596-1650) seperated ‘mind’ & ‘body’; pain simple reflex response to physical stimulus.

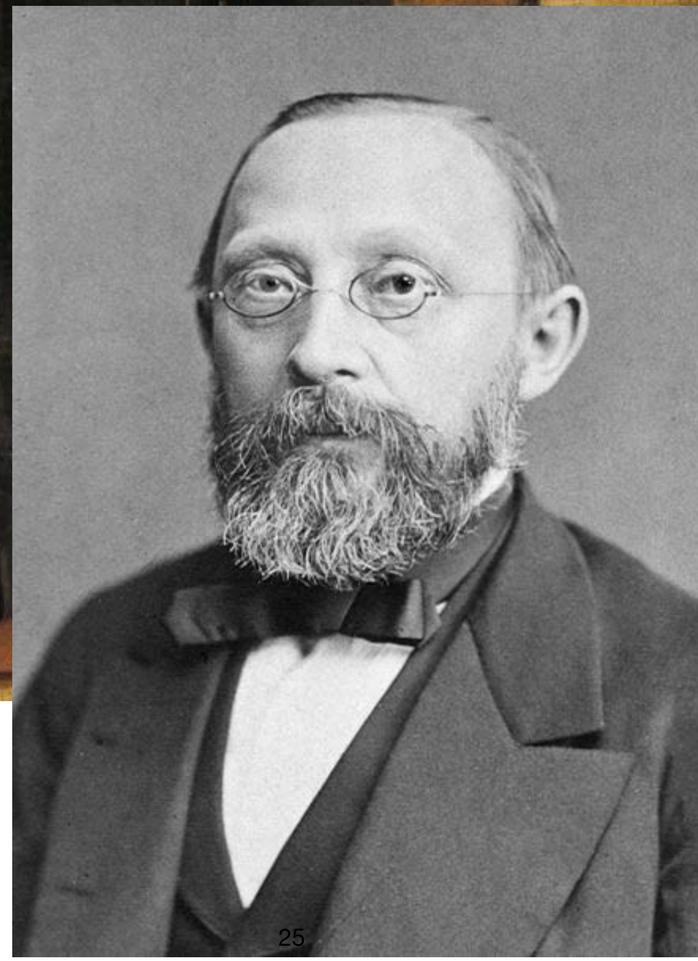


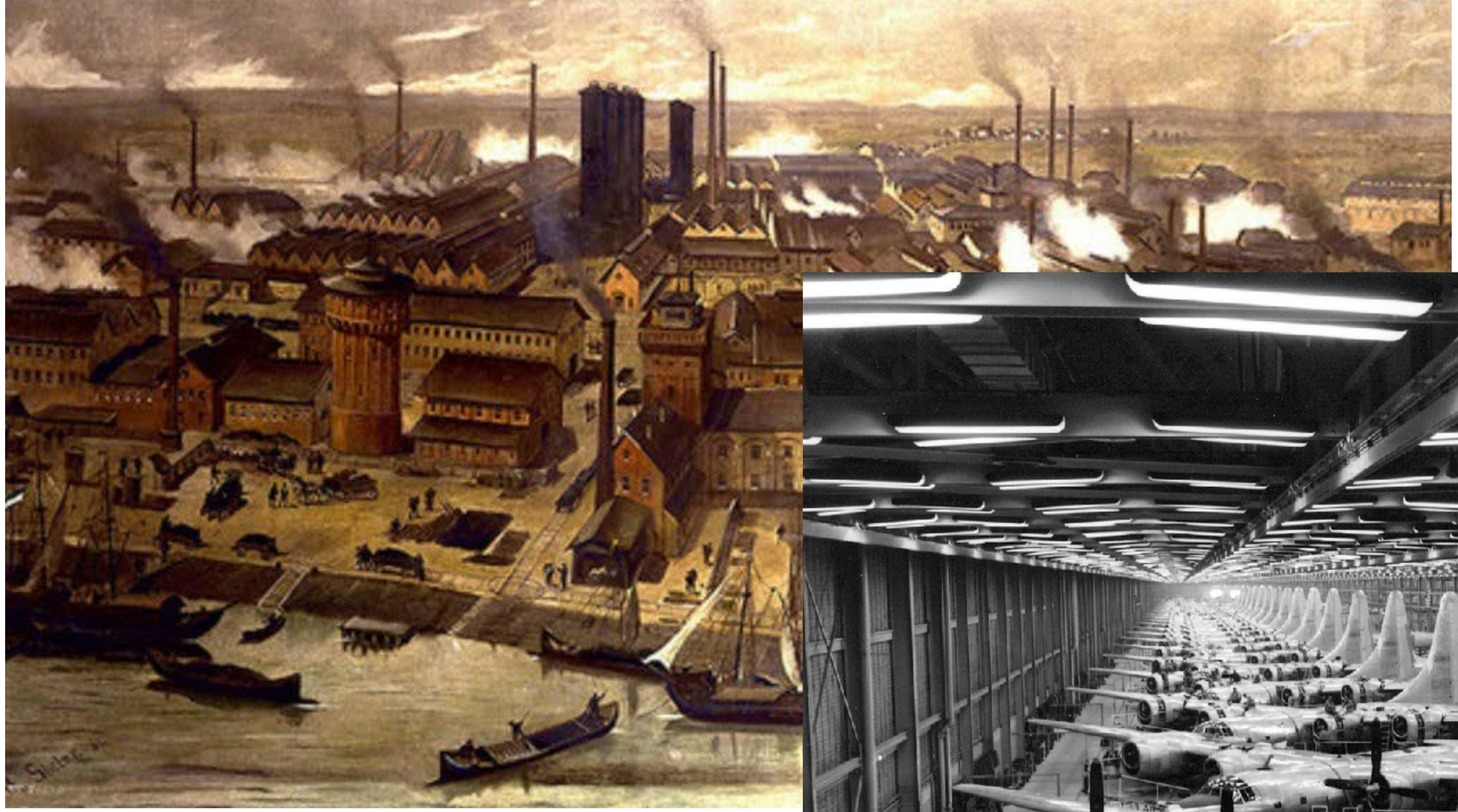


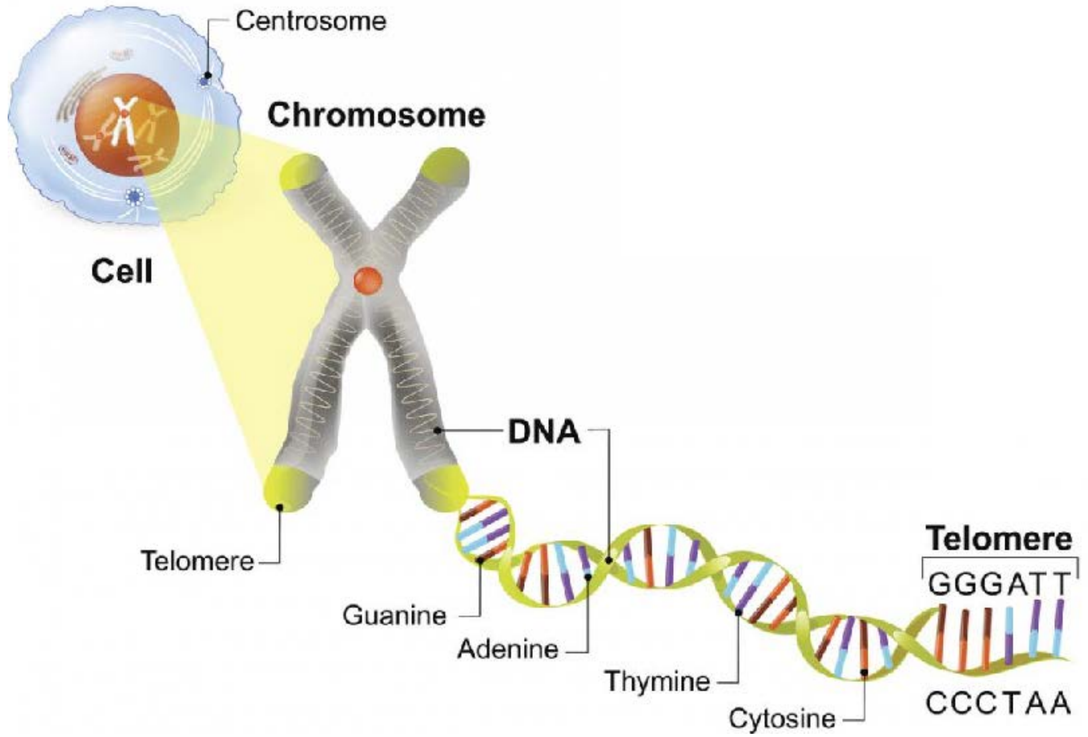


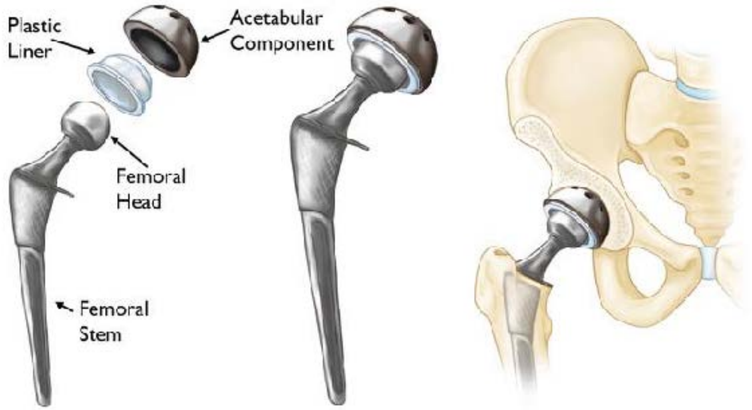
- Louis Pasteur (1822-1895) founder of medical microbiology
- Rudolf Virchow (1821-1902) proposed concept cellular pathology:
  - Recognize pattern of illness behaviour as Sx;
  - Infer underlying pathology for a diagnosis;
  - Relate treatments to underlying pathology;








Centrosome
Chromosome
Cell
DNA
Telomere
Guanine
Adenine
Thymine
Cytosine
Telomere
GGGATT
CCCTAA

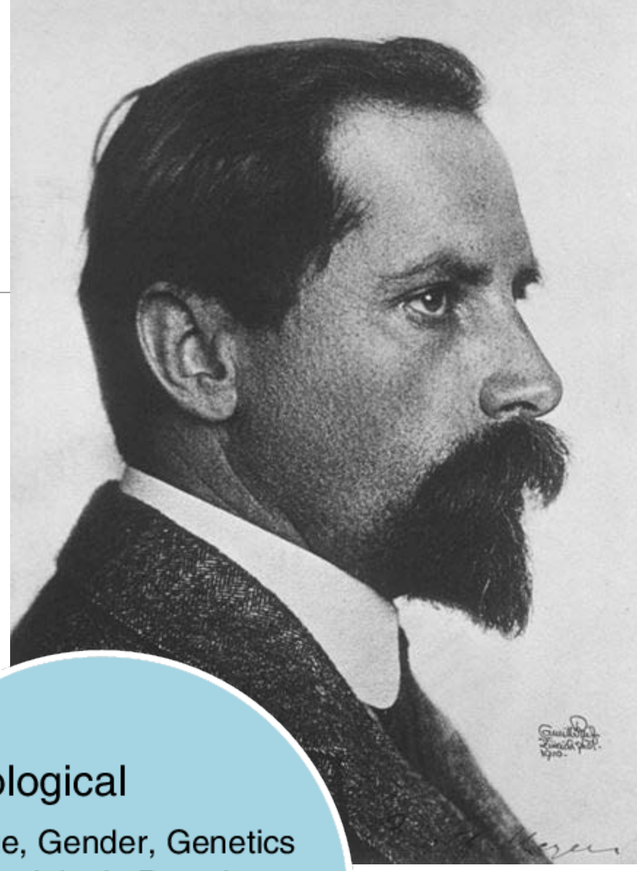

Plastic Liner
Acetabular Component
Femoral Head
Femoral Stem

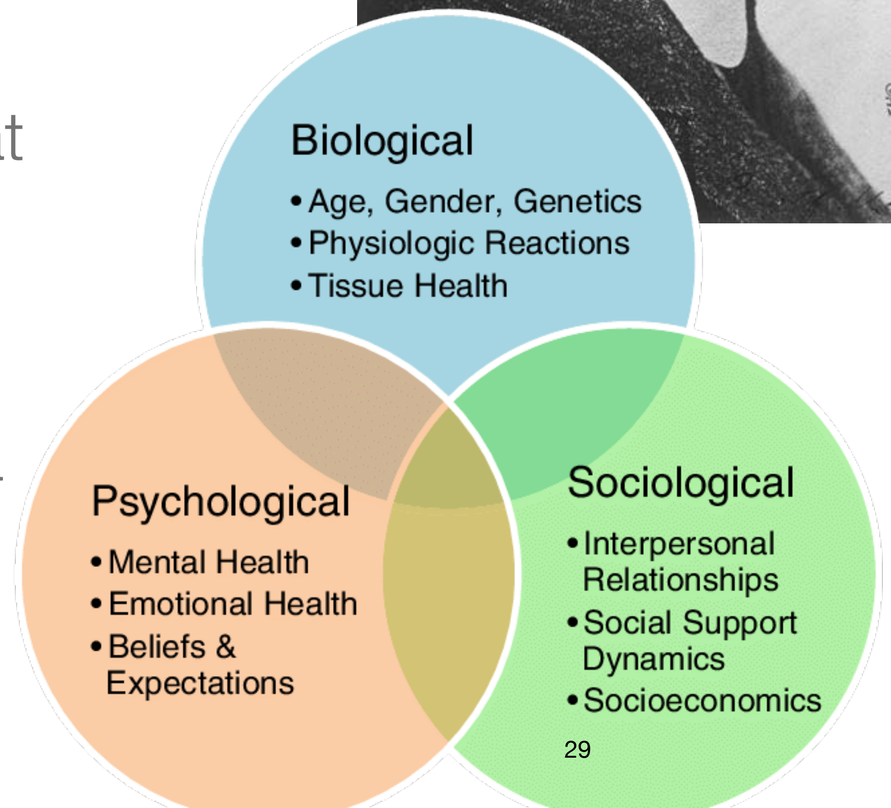
Biopsychosocial Model

- The concern with physical, mechanistic approach is that it may cure many serious diseases but only deals with one half of medicine's role in society.

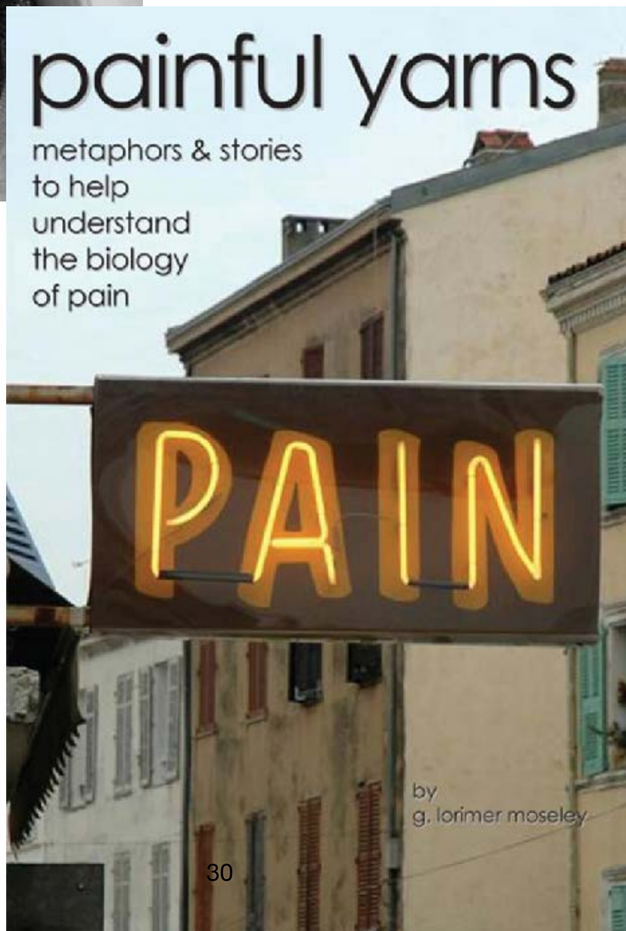
- Adolf Meyer (1866-1950) developed concept of 'multicausality' in psychiatry but this recognized that psychosocial factors influenced the course of every illness;

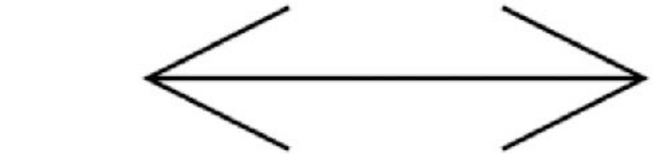
  - must treat each patient as a person, rather than a sick heart, knee or back.

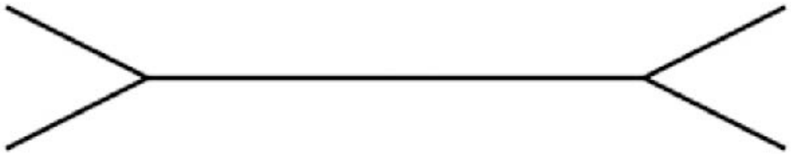




Pain Science





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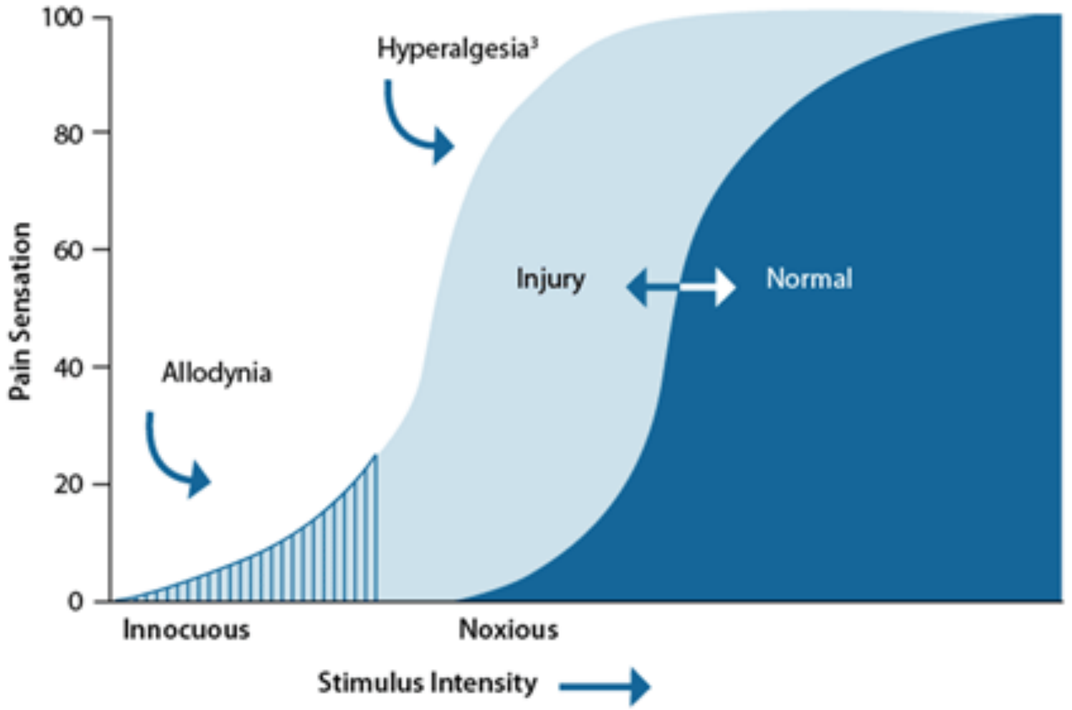
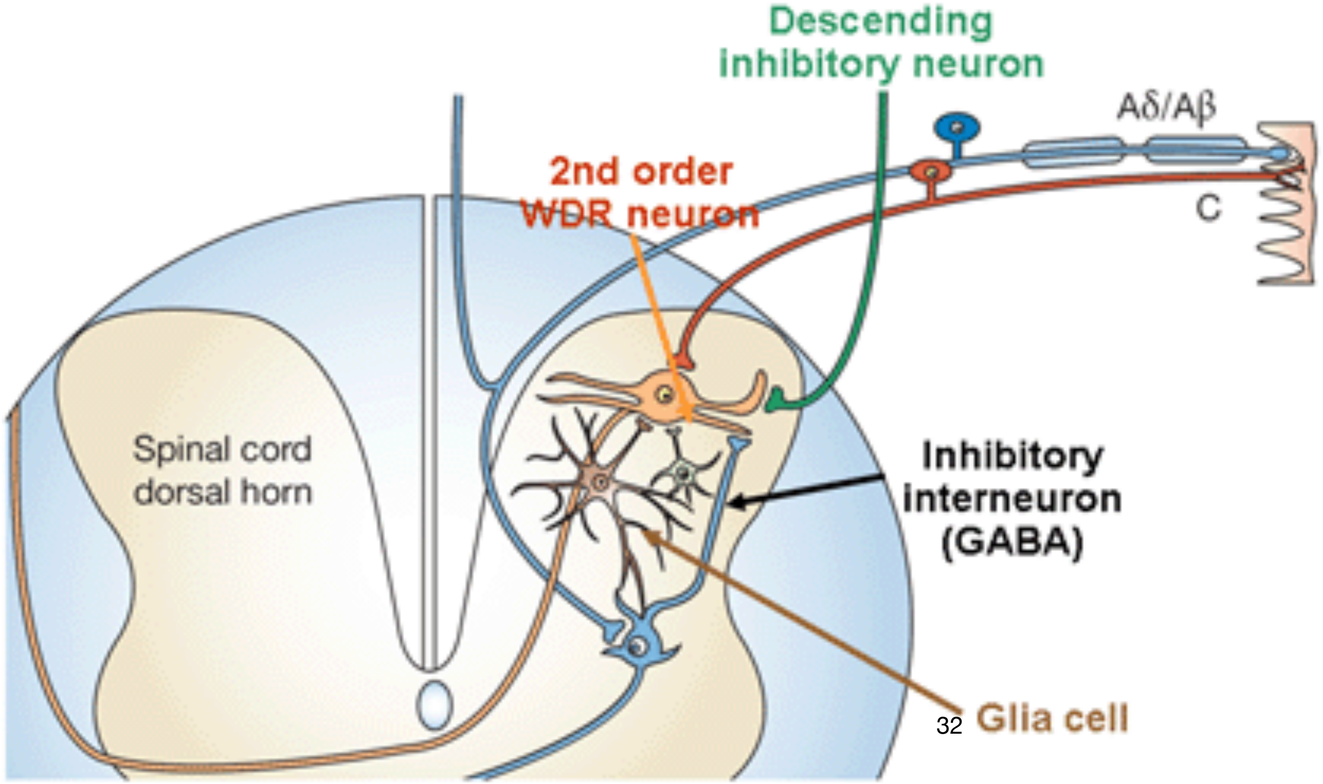
5
6
ABS

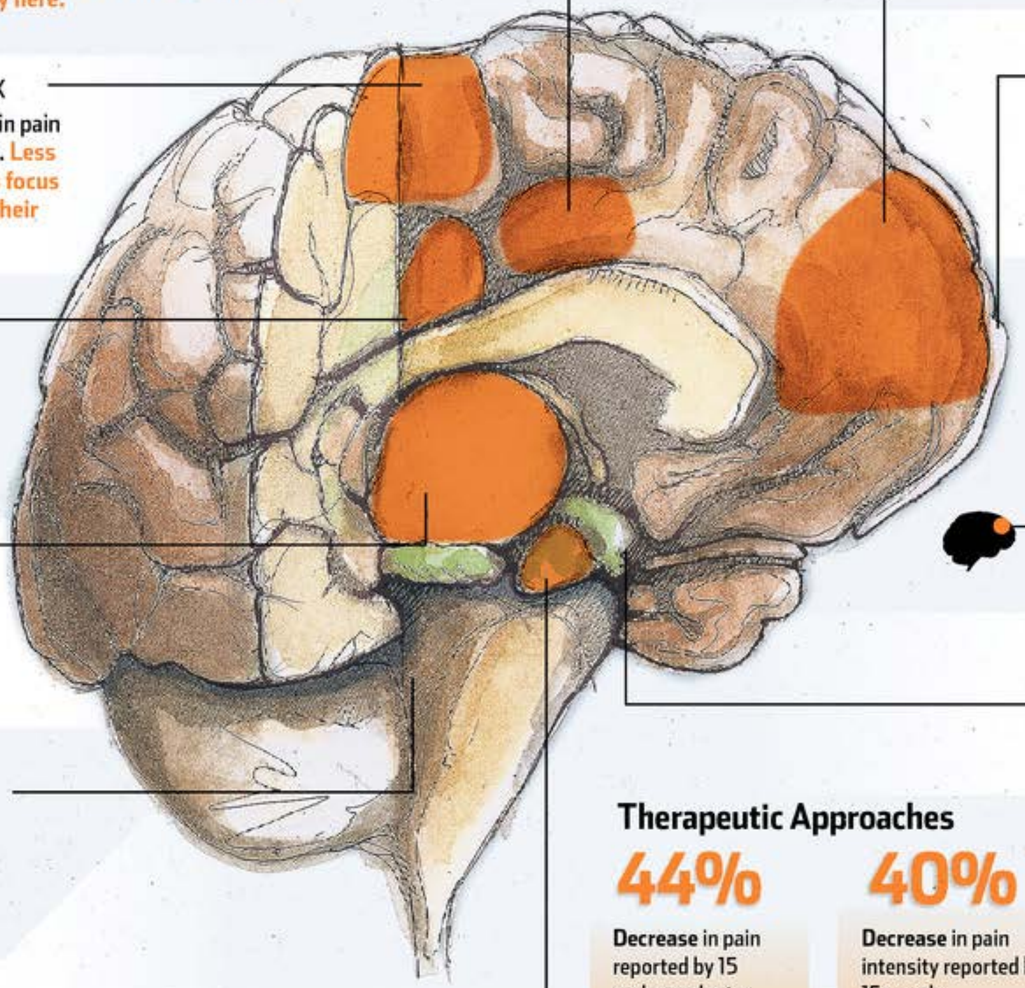
Allodynia vs Hyperalgesia



Primary Afferent Pathways and Their Connections in the Dorsal Horn



How the Mind Processes Pain



ANTERIOR CINGULATE CORTEX
Registers unpleasant feelings when things go wrong, either physically or emotionally. People who are highly sensitive to pain have greater activity here.

SOMATOSENSORY CORTEX
Registers which body part is in pain and the intensity of that pain. Less activity here when patients focus their attention away from their pain.

INSULAR CORTEX
Integrates sensory, emotional and cognitive states; **feels empathy for others' pain.**

THALAMUS
Receives **pain signals** from spinal cord and relays them to higher brain regions.

PERIAQUEDUCTAL GRAY
An area rich in natural opioids that act as a **pain reliever.**

AMYGDALA
Anticipates pain and reacts to perceived threats.

PREFRONTAL CORTEX
Processes pain signals rationally and plans action. **Active when trying to consciously reduce pain.**

MEDIAL PREFRONTAL GYRUS
Focuses on negative personal implications of pain. **Heightened activity seen in anxious people.**

RIGHT LATERAL ORBITOFRONTAL CORTEX
Evaluates sensory stimuli and **decides on response,** particularly if fear is involved. Mindfulness meditation calms down this response.

NUCLEUS ACCUMBENS
Releases **dopamine and serotonin** during pleasure or pain.

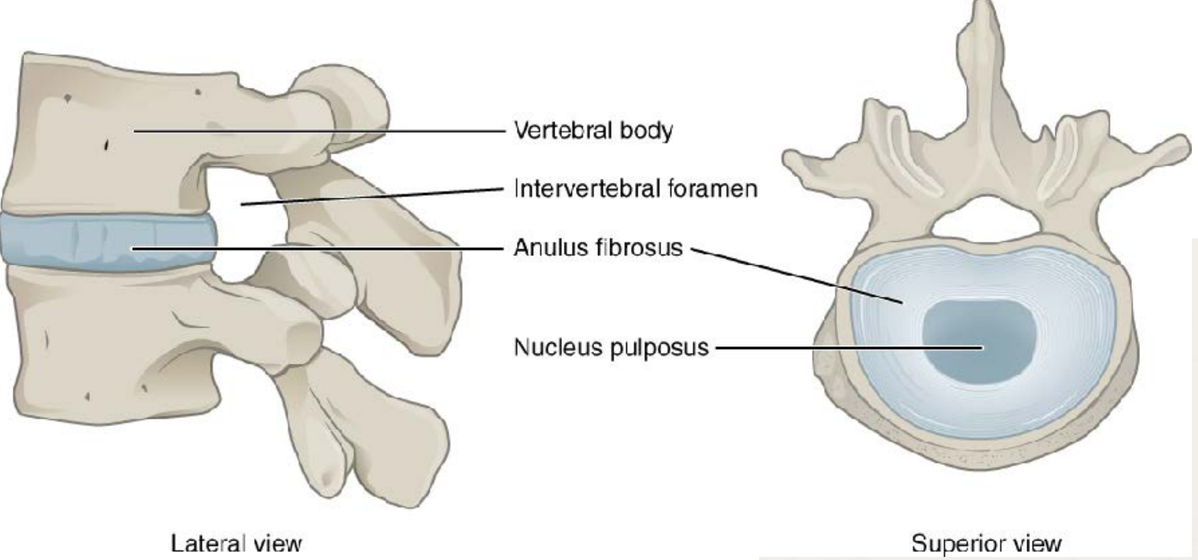
Therapeutic Approaches

44%
Decrease in pain reported by 15 undergraduates when they focused on a loved one's photo while exposed to a heated probe.

40%
Decrease in pain intensity reported by 15 people who learned mindfulness meditation and used it while exposed to a heated probe.

30%
Percentage of people in a study of 422 fibromyalgia patients who reported less pain after receiving cognitive behavioral therapy.

Sources: Sean Mackey, Stanford; PLoS One; Journal of Neuroscience; Archives of Internal Medicine


Vertebral body
Intervertebral foramen
Anulus fibrosus
Nucleus pulposus
Lateral view
Superior view

Pain Beliefs

"when (the current episode) first happened, the only thing that was going through my mind is the seriousness of my dis-alignment (sic) of my back…I was really petrified…you can get scared in the sense that you could damage your spinal cord, or anything, to such an extent that you might become paralyzed"

Table 2: Age-specific prevalence estimates of degenerative spine imaging findings in asymptomatic patients[a]

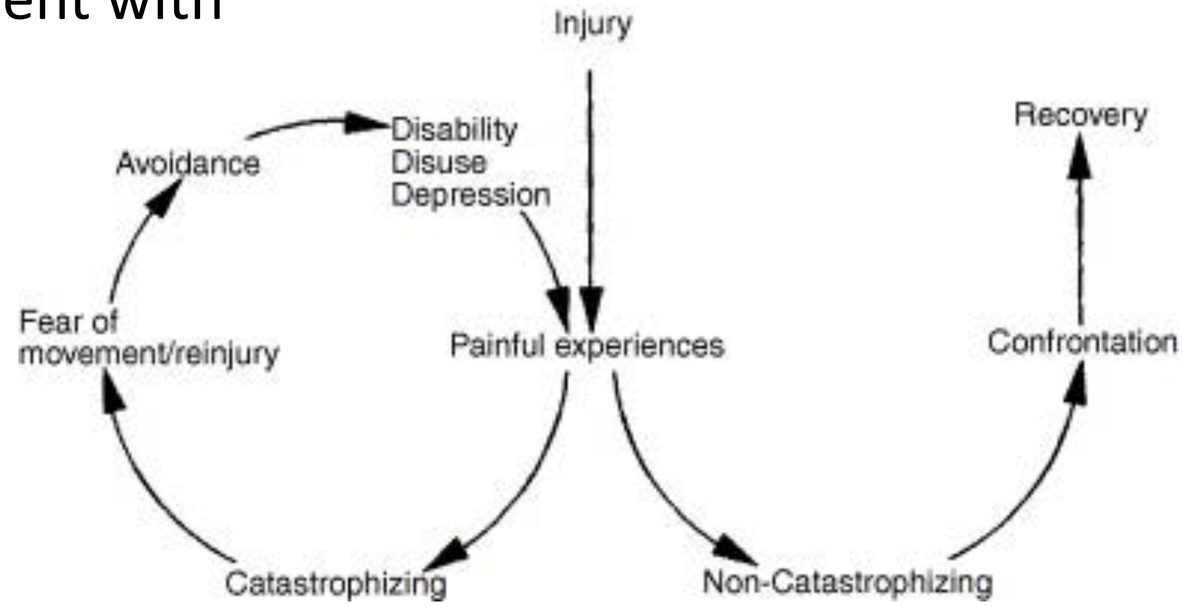
	Age (yr)						
Imaging Finding	20	30	40	50	60	70	80
Disk degeneration	37%	52%	68%	80%	88%	93%	96%
Disk signal loss	17%	33%	54%	73%	86%	94%	97%
Disk height loss	24%	34%	45%	56%	67%	76%	84%
Disk bulge	30%	40%	50%	60%	69%	77%	84%
Disk protrusion	29%	31%	33%	36%	38%	40%	43%
Annular fissure	19%	20%	22%	23%	25%	27%	29%
Facet degeneration	4%	9%	18%	32%	50%	69%	83%
Spondylolisthesis	3%	5%	8%	14%	23%	35%	50%

[a] Prevalence rates estimated with a generalized linear mixed-effects model for the age-specific prevalence estimate (binomial outcome) clustering on study and adjusting for the midpoint of each reported age interval of the study.

Darlow et al. 2013

Fear and Catastrophizing

- High levels of kinesiophobia exacerbates activity limitation and contributes to the persistence of pain in patients with chronic low back pain.
- Catastrophizing can increase pain perception to noxious stimuli.
- Catastrophization and depressed mood is linked to elevated levels of disability and absence of improvement with rehabilitation.



Krestiansen et al. 2014; Bergbom et al 2011; Bergsten et al. 2012

Contemporary Concepts Toward Managing Low-Back Pain

LBP Triage

- Most important: LBP triage - simple (non-specific) LBP, rediculopathy (treated similarly as simple), red flags (rare - incontinence, numbness in saddle)

Mechanical (80-90%)

Unknown cause—usually attributed to muscle strain or ligamentous injury (65%-70%)
Degenerative disc or joint disease
Vertebral fracture
Congenital deformity (such as scoliosis, kyphosis, transitional vertebrae)
Spondylolysis
Instability

Neurogenic (5-15%)

Herniated disc
Spinal stenosis
Osteophytic nerve root composition
Annular fissure with chemical irritation of nerve root
Failed back surgery syndrome (such as arachnoiditis, epidural adhesions, recurrent herniation); may cause mechanical back pain as well
Infection (such as herpes zoster)

Non-mechanical spinal conditions (1-2%)

Neoplastic (such as primary or metastatic) disease
Infection (such as osteomyelitis, discitis, abscess)
Inflammatory arthritis (such as rheumatoid arthritis and spondyloarthropathies, including ankylosing spondylitis)
Paget's disease
Other (such as Scheuermann's disease, Baastrup's disease)

Referred visceral pain (1-2%)

Gastrointestinal disease (such as inflammatory bowel disease, pancreatitis, diverticulitis)
Renal disease (such as nephrolithiasis, pyelonephritis)
Abdominal aortic aneurysm

Other (2-4%)

Fibromyalgia
Somatoform disorder (such as somatisation disorder, pain disorder)
Malingering

1. Non-specific

2. Potential radiculopathy, stenosis

3. Other cause

Cohen et al. 2008

Clinical Diagnostic Rules: LBP

- **Intervertebral disc ***
- Facet jont
- **Sacroiliac joint ***
- **Disc herniation with nerve root involvement ***
- **Spinal stenosis ***
- **Spondylolisthesis ***
- Fracture
- Myofascial pain
- Peripheral nerve
- Central sensitization

Petersen et al. 2017

" **Criterion 1.** Pain experience disproportionate to the nature and extent of injury or pathology, i.e. not sufficient evidence of injury, pathology, or objective dysfunctions capable of generating nociceptive input consistent with the patient' s severity of pain and disability.

Criterion 2. At least one of the following patterns present:

- bilateral pain/mirror pain (i.e., symmetrical pain pattern)
- pain varying in (anatomical) location/ travelling pain to anatomical locations unrelated to the presumed source of nociception e.g., hemilateral pain, large pain areas with non-segmental (i.e., neuroanatomically illogical) distribution
- widespread pain (defined as pain located axially, on the left and right side of the body and both above and below the waist)
- allodynia/hyperalgesia outside the segmental area of (presumed] nociception. These findings are based on testing of light touch by means of a swap or cold items (allodynia) as well as testing by pin prick or pressure (hyperalgesia).

Criterion 3. Hypersensitivity of senses unrelated to the muscular system. These findings are based on a score of at least 40 on the Central Sensitization Inventory."

Clinical Guidelines for Management of Non-Specific LBP in Primary Care

Summary of Common Recommendations for Treatment of Low back pain

Acute or Subacute Pain

* Reassure patients (favourable prognosis).
* Advise to stay active.
* Prescribe medication if necessary (preferably time-contingent): first line is paracetamol; second line is nonsteroidal antiinflammatory drugs, consider muscle relaxants, opioids or antidepressant and anticonvulsive medication (as co-medication for pain relief).
* Discourage bed rest.
* Do not advise a supervised exercise programme.

Chronic Pain

* Discourage use of modalities (such as ultrasound, electrotherapy)
* Short-term use of medication/manipulation
* Supervised exercise therapy
* Cognitive behavioural therapy
* Multidisciplinary treatment

Koes et al. 2010

Custom Foot Orthoses

Journal of Chiropractic Medicine (2013) 12, 15–19

ELSEVIER

JCM JOURNAL of CHIROPRACTIC MEDICINE

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Effects of customized foot orthotics on reported disability and analgesic use in patients with chronic low back pain associated with motor vehicle collisions

Robert Ferrari MD, MSC (Med), FRCPC, FACP*

Clinical Professor, Department of Medicine, University of Alberta, Edmonton, Alberta, Canada
Clinical Professor, Department of Rheumatic Diseases, University of Alberta, Edmonton, Alberta, Canada

Group	Change in Oswestry Disability Index from baseline	Prescription analgesic use (% yes)
Usual care (n = 30)	16.2 ± 10.5 (0-40)	56.7
Orthotics (n = 34)	23.1 ± 11.1 (2-46) *	29.4 *

* Indicates statistically significant difference between groups.

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Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

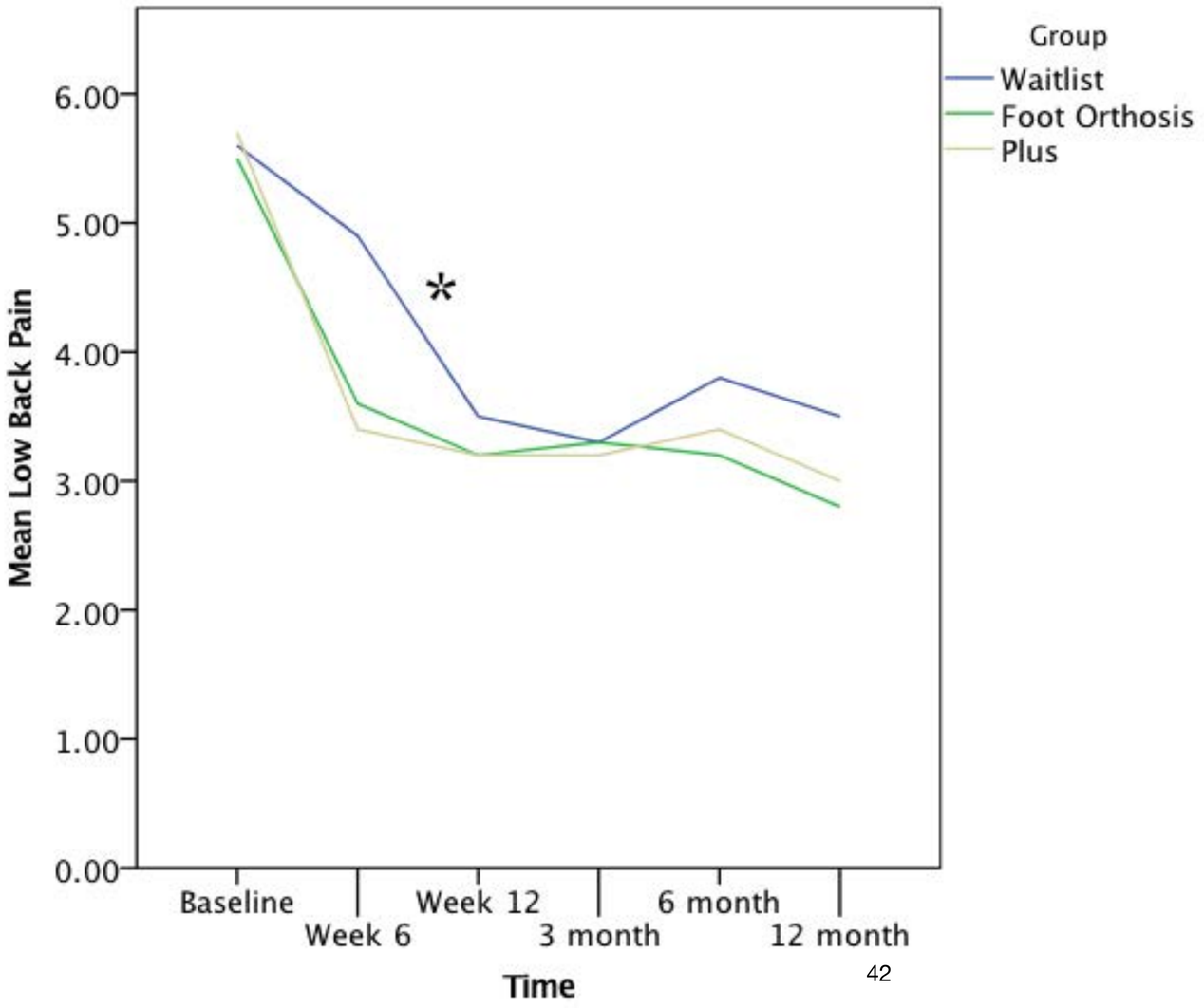
Archives of Physical Medicine and Rehabilitation 2017;98:1752-62

ORIGINAL RESEARCH

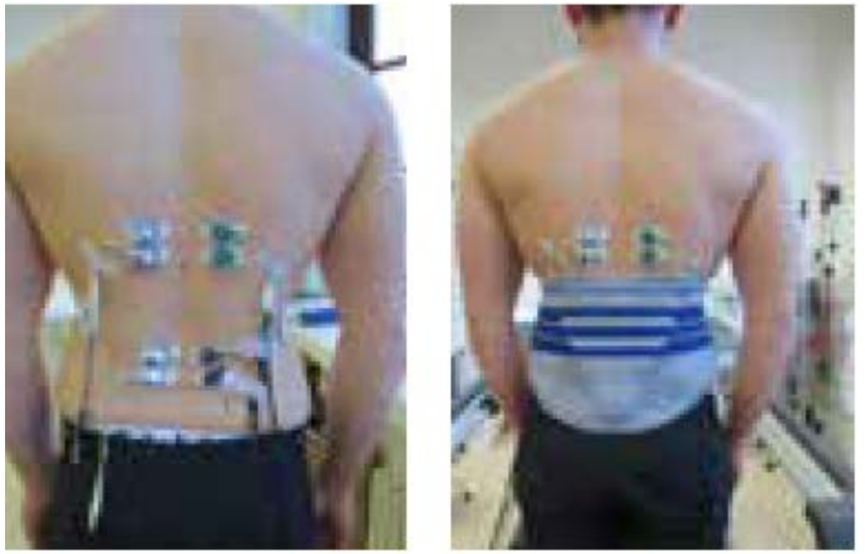
Shoe Orthotics for the Treatment of Chronic Low Back Pain: A Randomized Controlled Trial

Jerrilyn A. Cambron, DC, MPH, PhD,[a] Jennifer M. Dexheimer, BS, LMT,[a] Manuel Duarte, DC, MSAc, DABCO, DACBSP,[b] Sally Freels, MS, PhD[c]

From the [a]Department of Research, National University of Health Sciences, Lombard, IL; [b]Department of Clinical Practice, N of Health Sciences, Lombard, IL; and [c]School of Public Health, Division of Epidemiology and Biostatistics, University of Ill

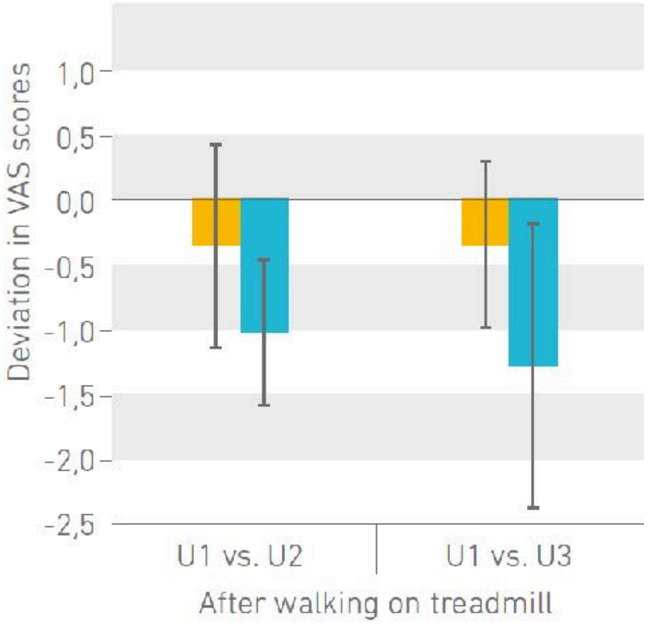


PROSPECTIVE STUDY OF THE TRUNK MUSCULATURE UNDER THE INFLUENCE OF COMPRESSIVE LUMBAR SUPPORTS IN PATIENTS WITH ACUTE LUMBAR BACK PAIN

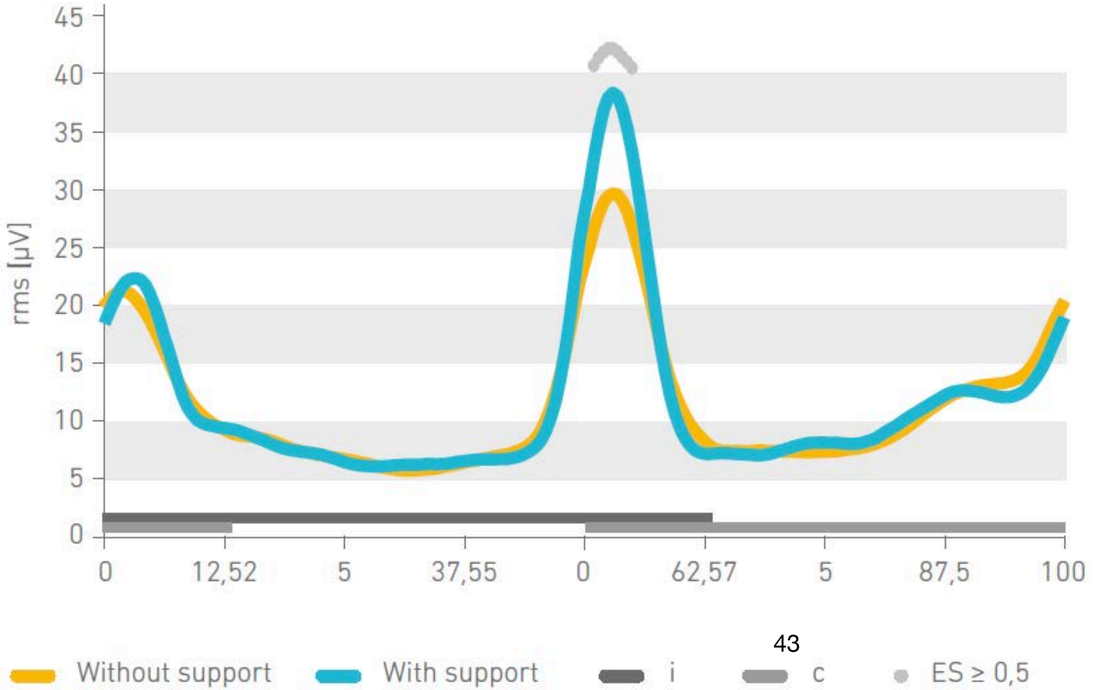


Anders, C. et al.

Jena University Hospital, Clinic for Trauma, Hand and Reconstructive Surgery, Division for Motor Research, Pathophysiology and Biomechanics, July 2016 unpublished data:



EMG back muscles:



Biomechanics
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Cite this article: Hubner A., Niemeyer F., Schilling K and Anders C. (2017). Effects of an abdominal belt on trunk muscle activity during treadmill walking, *Biomech Open Lib*, 1(1): 7-15

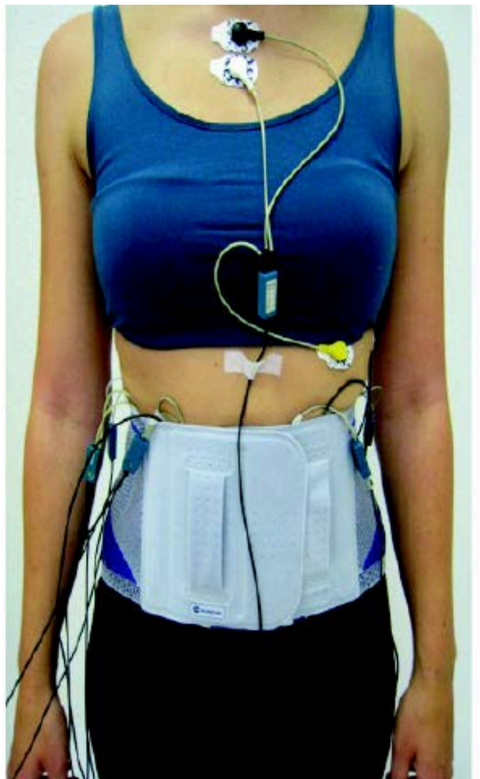
Research Article

Effects of an abdominal belt on trunk muscle activity during treadmill walking

Agnes Hubner[1], Friederike Niemeyer[1], Kirsti Schilling[1] and Christoph Anders[1*]

1-Clinic for Trauma, Hand and Reconstructive Surgery, Division of Motor Research, Pathophysiology and Biomechanics, Jenna University Hospital

- "After 3 hours of wearing [the brace] time values increased towards the original values with effects being unsystematic and non-significant."



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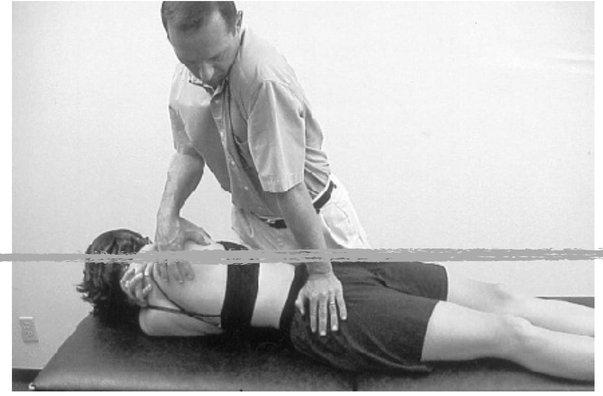
Kukkonen-Harjula et al. 2007; Park et al. 2014; Reuter et al. 2011

Conservative Model of Low Back Pain Care



Thank you