

The MedFit Classroom

Orthopedic Fitness Specialist Course

Module 7: The Lumbar Spine

Authors:

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Learning Objectives

Lesson 1

- Anatomy
 - Skeletal
 - Neural
 - Ligamentous
 - Muscular

Lesson 2

- Common issues
 - Mechanical issues
 - Discogenic pain
 - Interview with Preston Wakefield, D.C., ART
 - Interview with Stuart McGill, Ph.D.
 - The Great Core Debate
 - Spondylolisthesis/Spondylolysis
 - Sprains/Strains
 - Ankylosing Spondylitis
 - DISH
 - Facet Joint syndrome
 - Osteoporosis

Lesson 3

- Nerve entrapments
 - Piriformis syndrome
 - McKenzie vs Williams

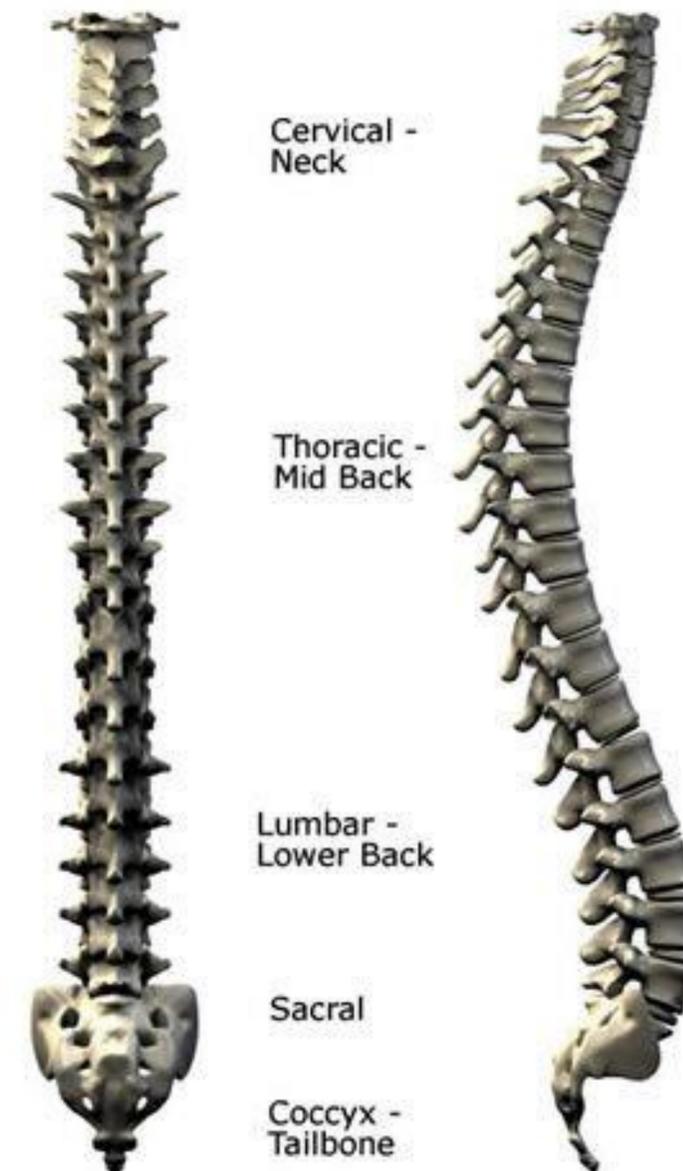
Lesson 4

- Exercise Options

Lesson 1: Skeletal Anatomy

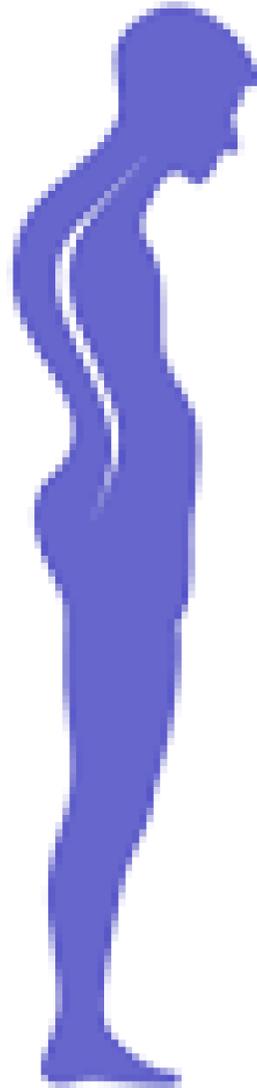
3 curves - cervical (concave), thoracic (convex), lumbar (concave)

**24 mobile vertebrae
plus fused vertebrae
sacrum (5) and coccyx (3-5)**

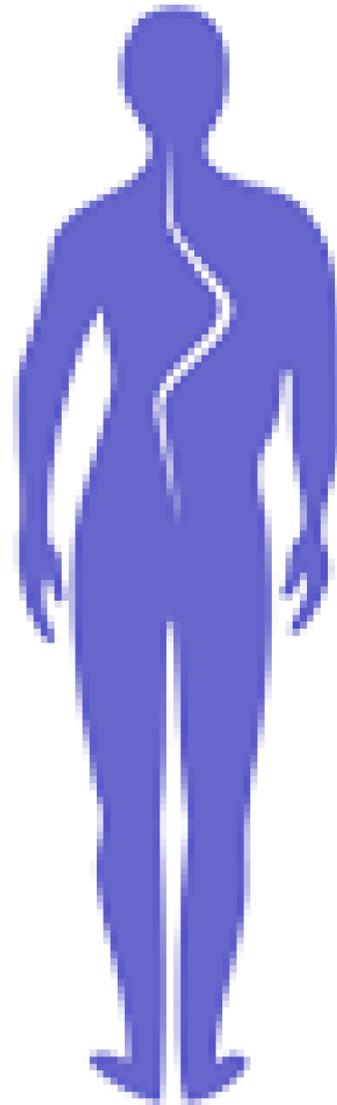


Curvatures

KYPHOSIS



SCOLIOSIS



LORDOSIS

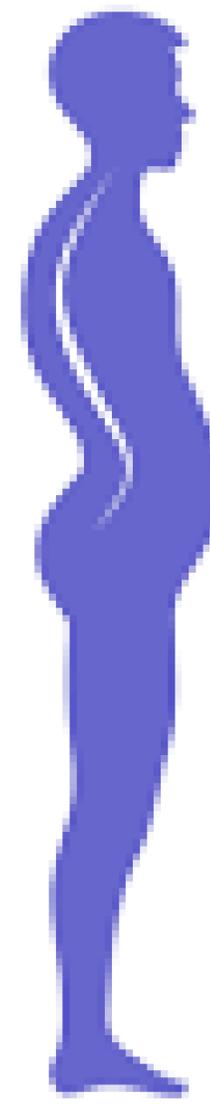


Image: vedanta.org

Vertebral Anatomy

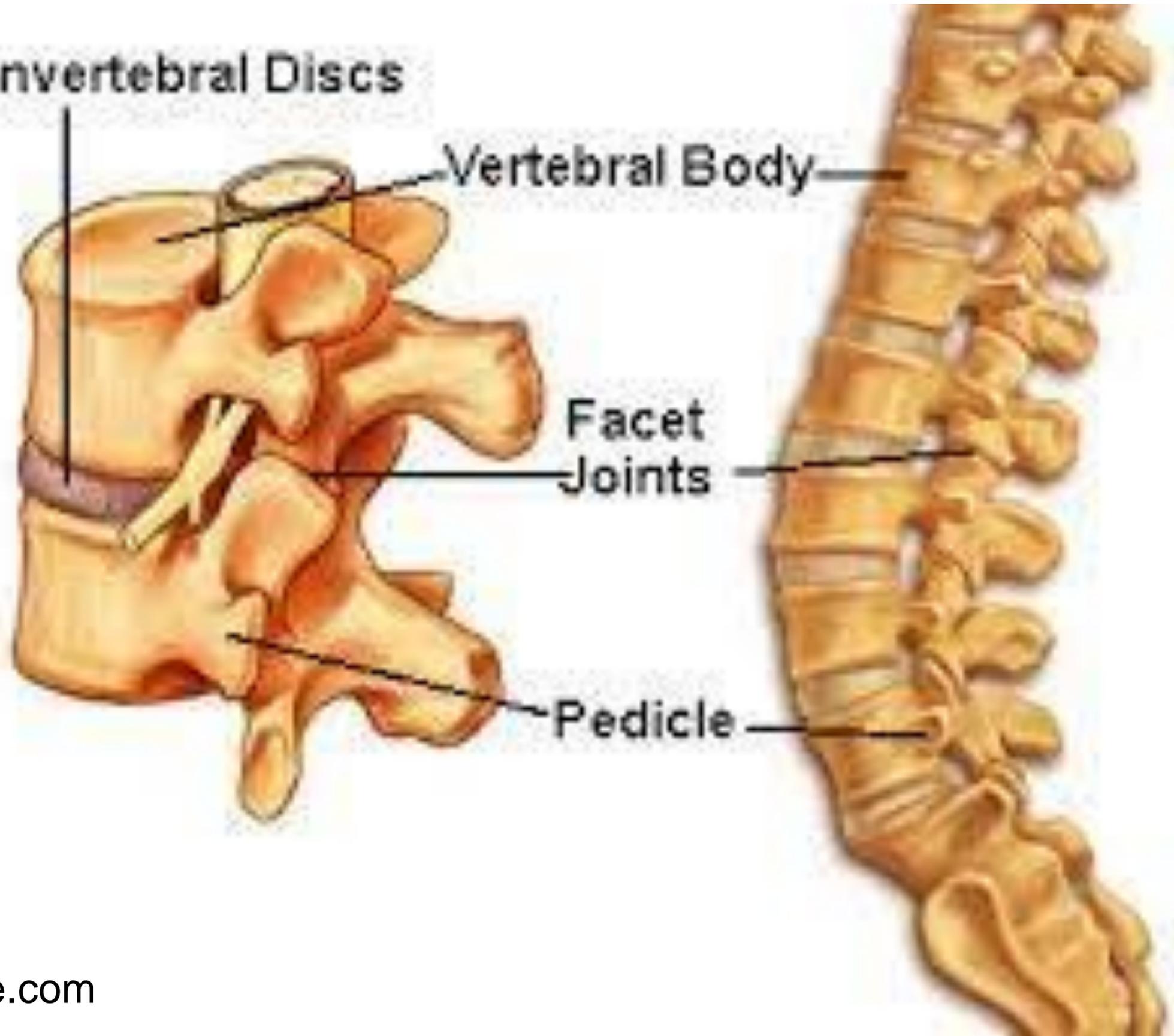
- **Vertebral body** - cylinder-shaped bone sitting below the intervertebral disk above, and below the one above it
- **Spinous process** - posterior bony protrusion, attachment site of many spinal extensors and rotators
- **Intervertebral Disks**
 - **Annulus** - criss-crossed collagen sheets, like plywood, allow for rotational resistance; can delaminate under stress or time
 - **Nucleus pulposus** - jelly-like hydraulic cushion that can absorb compressive shock
- **Facets** - cartilage-covered bony protrusions posterolaterally that interface with the ones above and below; source of arthritis

Invertebral Discs

Vertebral Body

Facet Joints

Pedicle



Neuro-Anatomy

Spinal cord - primary nerve complex that originates in the brain and carries signals to and from it

Nerve roots - 31 pairs of nerves branching off the spinal cord carrying signals to and from the periphery to signal the brain or transmitting reflex-speed messages to and from the periphery

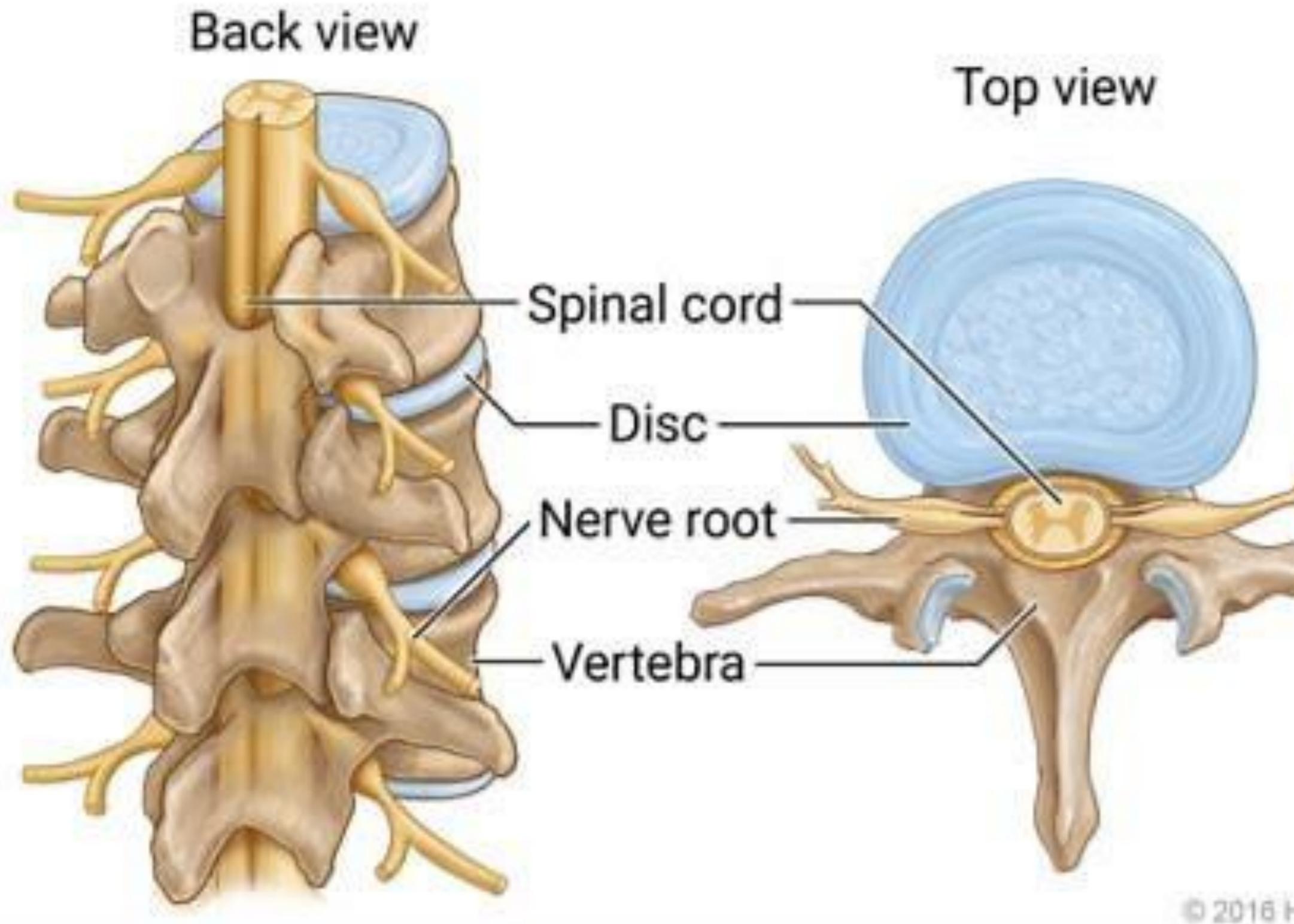
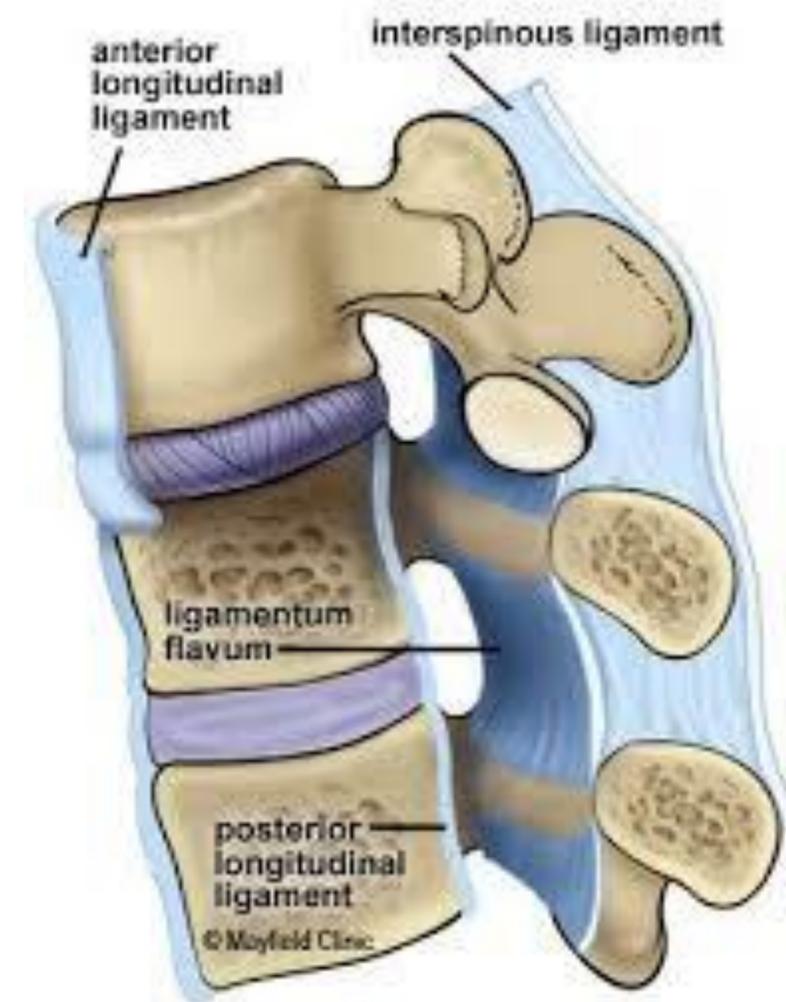


Image: UW (Wisconsin) Health

Passive Structural Anatomy

The Ligaments

- **Anterior longitudinal** - full length, front side of vertebral body
- **Posterior longitudinal** - full length, back side of the vertebral body, keeps disk from protruding
- **Interspinous and supraspinous ligaments**
- **Ligamentum flavum** - full length, strongest ligament, runs in front of and between lamina; protects spinal cord and nerves



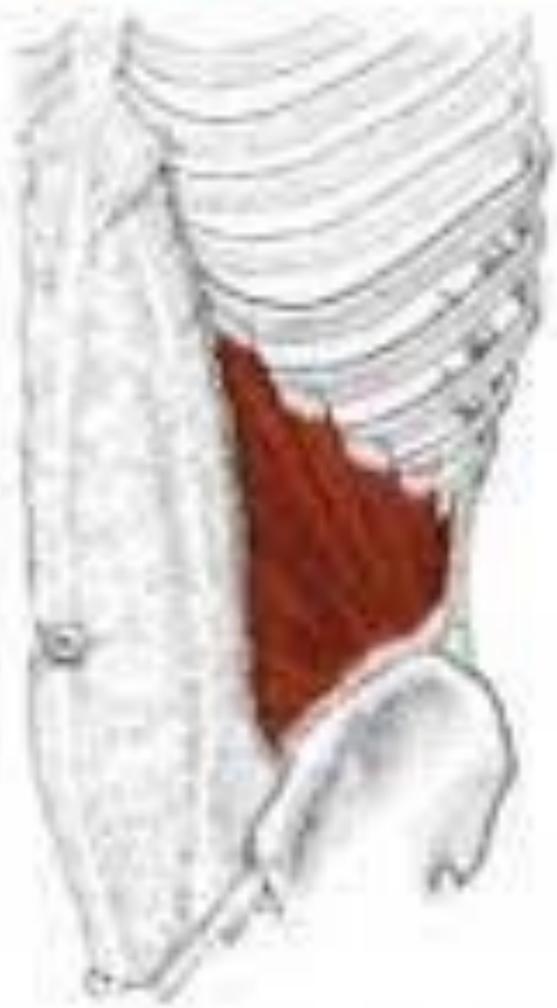
Intrinsic Spinal Muscles

- **Longissimus thoracis** - extensor and lateral flexor
- **Iliocostalis thoracic** - extensor and lateral flexor
- **Spinalis thoracis** - extensor
- **Transversospinal group of deep muscles** - bilaterally extend, unilaterally rotates to opposite side
- **Multifidus** - intervertebral muscles linking 3-6 vertebrae, stabilizers, control rotation
- **Semispinalis** - extensors
- **Rotatores** - high density of proprioceptors, facilitate postural control

Extrinsic Spine Muscles

- **Psoas major**
- **Psoas minor**
- **Quadratus lumborum**
- **Diaphragm**
- **Transversus abdominis**
- **Rectus abdominis**
- **External obliquus**
- **Internal obliquus**

Internal Obliques



External Obliques



Rectus Abdominis

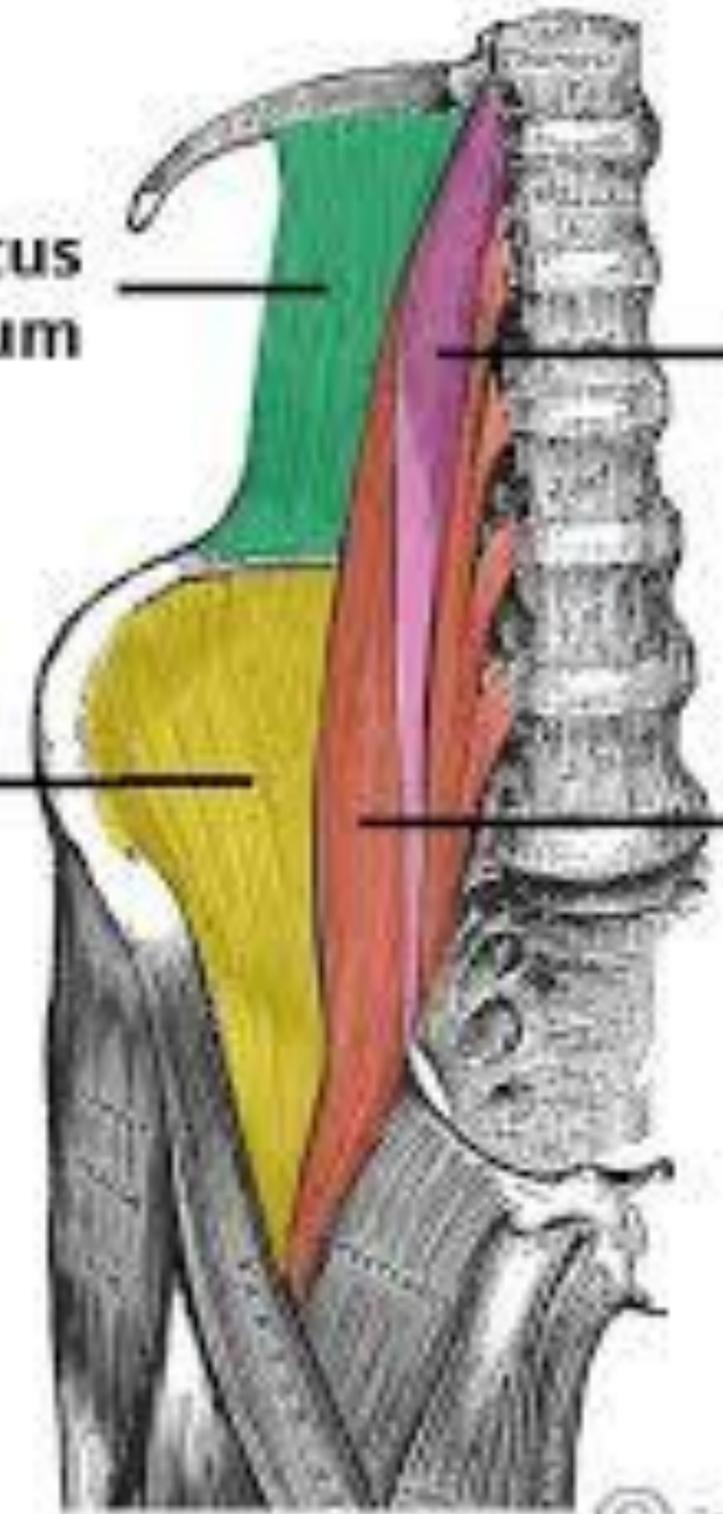


Quadratus lumborum

Psoas minor

Iliacus

Psoas major



© TeachMeAnatomy

Image: balancemotion.com

Image: teachmeanatomy.com



Does the RA Function as a Multi-segmental Muscle?

- “Region-specific regulation within RF (rectus femoris) muscle can be explained by innervation pattern and muscle anatomy.”
- “...it may be difficult that one motor nerve branch innervates multiple compartment.”

“As you know, upper and lower RA muscle is separated by tendon tissue. Therefore, they should be innervated by different motor nerve branches.”

Lesson 2: Common Lumbar Spine Issues

- Strains and sprains
- Arthritic conditions (ankylosing spondylitis, age)
- Bone spurs (arthritis-related, press on nerves)
- Nerve entrapments/impingements (stenosis, sciatica, 'pinched nerves')
- Spondylolitis vs Spondylolysis
- Spondylolisthesis
- Curvatures (scoliosis, hyperkyphosis or -lordosis)
- Osteoporosis

Uncommon Lumbar Spine Issues

- Spina bifida and other birth defects
- Neuromuscular diseases (amyotrophic lateral sclerosis (ALS), Parkinson's, etc.)
- Spinal cord injuries, vertebral fractures, herniated disks, paralyse
- Spine tumors and cancer
- Spine infections (meningitis, osteomyelitis)

Mechanical vs Discogenic Pain

- Mechanical pain is due to a structural defect or injury that causes positional and/or movement dysfunction and/or pain
 - Sprain, strain, fracture, osteoporosis, stress, posture, spasm
- Discogenic pain is due to a nerve or many nerves affected by posture, position, movement that radiates far from the source itself
 - Sciatica, ruptured disc, stenosis

Managing Mechanical Pain

- Identify the source of stress and strain
- Often manageable with the basics
 - PRICE (can't elevate), NSAIDs
 - Stretching - erectors, hamstrings, piriformis, hip flexors, ITB
 - Core - activation, endurance
 - Balance - one-leg, gait
 - Functional movement training
 - Walking, running???

NC Pocius, TF de Campos, C-W C Lin, D Merom, A Tiedemann, MJ Hancock. Walking, cycling, and Swimming for Non-specific low back pain: A systematic review with meta-analysis. JOSPT 2022.

52(2):85-99. <https://www.jospt.org/doi/10.2519/jospt.2022.10612>

Managing Discogenic Pain

- Need to find source of nerve pain generally through the history and assessment
- Generally manageable with:
 - Centration - moving irritation of nerve from distal to proximal via alleviating pressure at its source
 - Core activation/stabilization
 - Core endurance, strength

Dr. Preston Wakefield, ART

Licensed Chiropractor

Licensed Active Release Technician, master educator

Formerly with the Tennessee Titans

Formerly with the Nashville Predators

Interview with Dr. Preston Wakefield

Core Training Principles

Basic Stability

Activation
Deactivation
Endurance

Advanced Stability

Strength
Power



Core: The New “Abs”?

- Abs are large, anterior and external, global, palpable, even visible movers and stabilizers
- Core incorporates the smaller, internal, local spinal stabilizers PLUS larger, external, global movers and stabilizers
- Core includes: Lumbar erectors, rotatores, multifidi, transversus abdominis, iliopsoas, gluteals, adductors, piriformis, quadriceps, hamstrings, pelvic floor, diaphragm

The Crunch Dispute?

Main Arguments:

1. Pig spine (in vitro), not live, with fluid and muscle support (in vivo)
“Cadaveric tissue does not have the capacity to remodel”
2. Super-high reps beyond what anyone would do
Thousands vs hundreds, with rest periods
3. Are flexion exercises even that bad for some spine pain issues, especially if done at modest ranges (30 degrees)?
Depending on the spine issue, it may even be recommended

Contreras, B, Schoenfeld, B. To Crunch or Not to Crunch: An evidence-based examination of spinal flexion exercises, their potential risks, and their applicability to program design. *Strength and Conditioning Journal*, 33(4): 8-18, 2011

Dr. Stuart McGill, Biomechanist

- **Distinguished Professor Emeritus (after 32 years at the University of Waterloo, Canada)**
- **Over 240 scientific journal papers**
- **Clinical and lab-investigations into back injury and pain mechanisms, rehabilitation approaches, and performance training**
- **Consultant to various government agencies, corporations, legal firms and professional/international athletes and teams**
- **Author of Back Mechanic, for the lay public with LBP; Low Back Disorders, 3rd edition (2016), for clinicians; Ultimate Back Fitness and Performance, 2017, for coaches and athletes; Gift of Injury (2018), rehab manual for strength athletes**

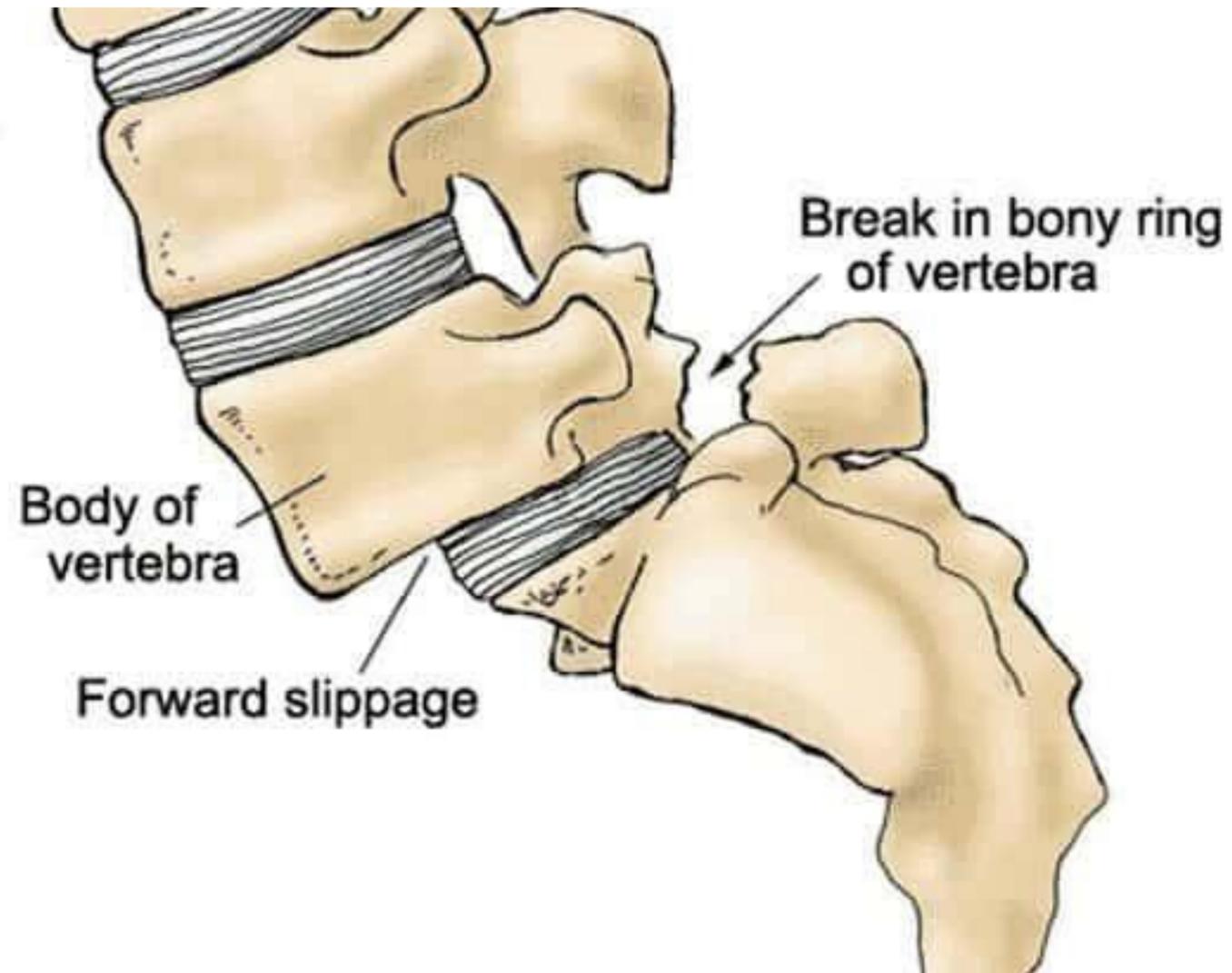
Website: www.backfitpro.com

Interview with Dr. Stuart McGill

1990s Introduction to the TrA

- Hodges, Richardson, Jules - Australian physiotherapists, 1990s
- Noted the pre-activation of the TrA milliseconds before moving the arm from the side into flexion
- Noted that it did not fire till later in those with SPONDYLOLISTHESIS (anterior shift of a vertebrae on top of another)
- An inherent spinal instability

Spondylolisthesis



Spondylolysis, Spondylolisthesis

- **Spondylolysis** (lysis = divide) - weakness or stress fracture of pars interarticularis which connects the upper and lower facet joints; may lead to a....
- **Spondylolisthesis** (listhesis = slip forward) - when a spondylolysis causes upper vertebrae to slip forward over the bottom one

Spondylolysis, Spondylolisthesis

- **Often due to a sudden or chronic hyperextension moment, as in gymnastics (back bend) or football tackle**
- **Creates an unstable spine anteriorly; hyperlordotic posture**
- **May impinge on nerves around the spine**
- **Best to avoid hyperextension exercises**
- **Navel Drawing-in Maneuver - get transverses abdomens firing again**
- **Flexion and IM (planks) exercises preferred**

Navel Drawing in Maneuver - With Cuff



Sprains & Strains

- **Sprain** - ligament, usually posterior ligament, causing muscles to spasm
- **Strain** - muscle/tendon, spasm
 - Often not spinal, e.g. iliopsoas
- Pain localized; if not, nerves are likely entrapped
- Causes: Errant moves, not warmed up, excessive loading in certain positions, age, excess weight, job duties, smoking, psychology

Sprains & Strains

- PRIC - can't really elevate
- Protect, rest, ice, compression, (elevate)
- Heat, including capsaicin
- Gentle stretching
- Continue moving within limits, more rests
- IM strengthening
- NSAIDs
- Short-term use of back brace

Arthritis - Anklyosing Spondylitis (or Spondylitis)

- Aka Spondylosis
- Progressive inflammatory disease, genetic
- Sclerotic changes (fusion of vertebrae) without loss of disc space; may impair respiration
- Men > women 4-10-fold
- Exercise: gentle stretching, core control/stabilization

DISH

Diffuse Idiopathic Skeletal Hyperostosis

- aka Forestier's disease - hardening of ligaments
- Progressive stiffness, pain, loss of ROM especially lateral flexion
- May cause difficulty swallowing if in cervical spine
- Men > women, age > 50, diabetes/prediabetes, obesity

Facet Joint/Bone Spurs

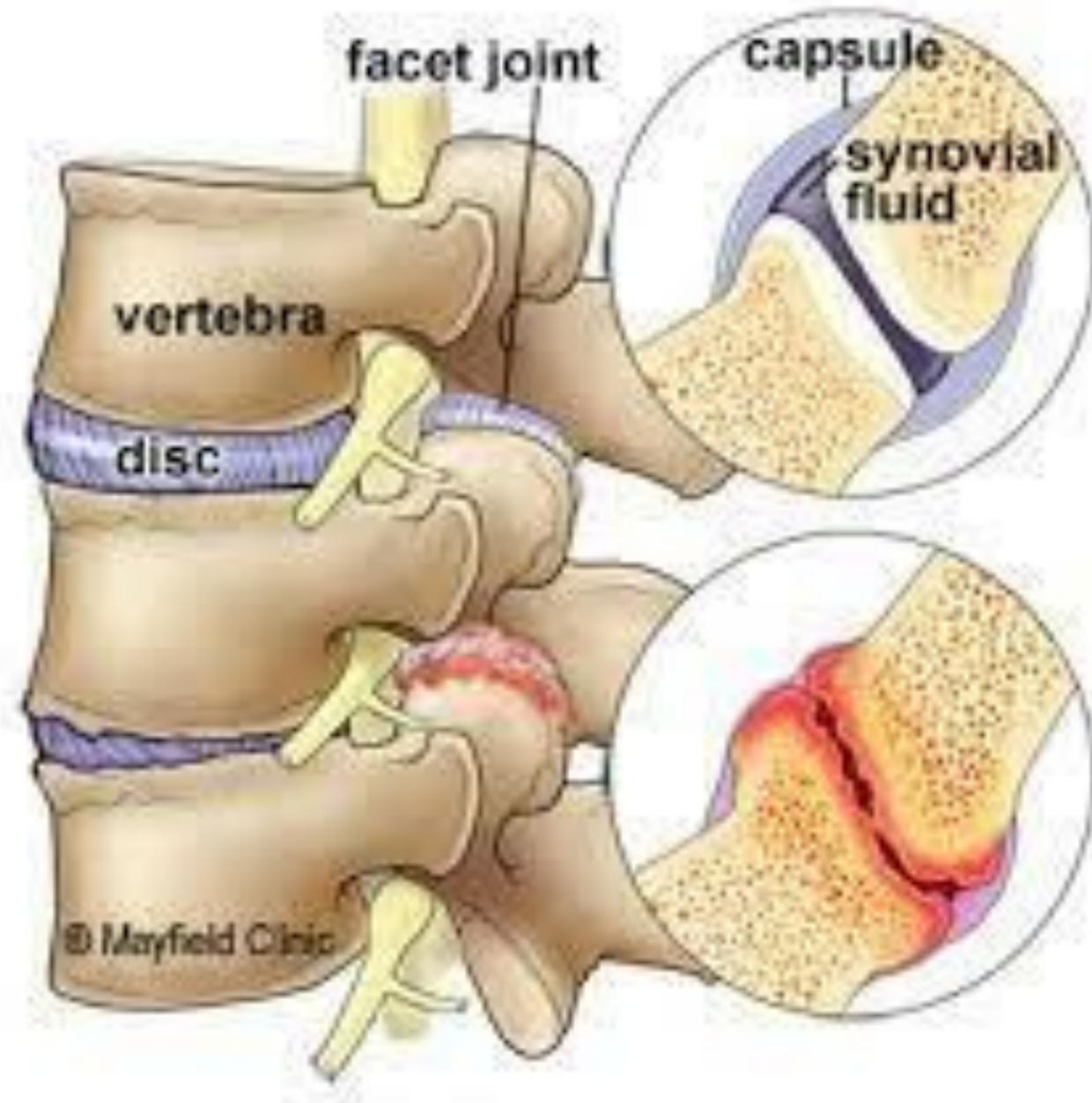


Image: peakformhealthcenter.com

When Bone Meets Bone

- Facet joints have articular cartilage
- Cartilage can be damaged or degenerate over time and conditions
- Bone spurs can form where bone rubs bone
- NSAIDs, braces, compensatory postures (flexion), compensatory movement patterns (minimize rotation)

Facet Joint Pain/Bone Spurs

- Related to age, arthritis, osteoporosis, disc compression, chronic postures (dentists, surgeons, etc.)
- Avoid hyperextension - IM vs ROM lifts, neutral spine
- Flexion > extension - crunches, curl-ups, Pilates, planks

IM, Williams flexion exercises

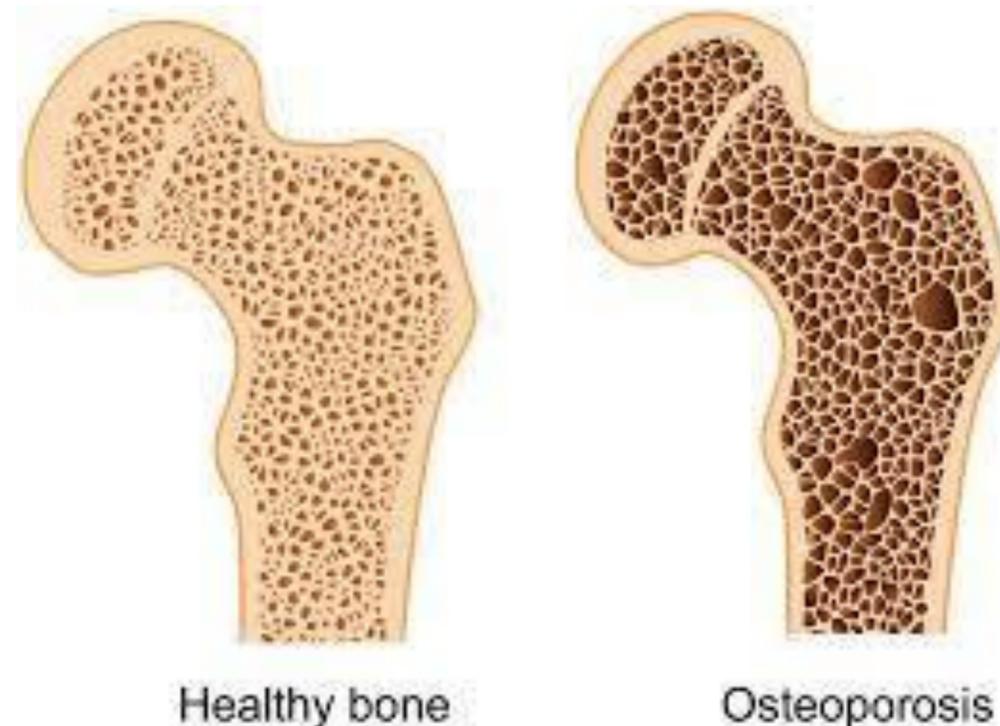
Osteoporotic Bone



Image: spine-health.com

Osteoporosis

- Softening of bone with disuse, menopause, nutritional deficiencies (including eating disorders, disordered eating, and energy availability imbalances relative to activity)
- Cortical bone thins, trabecular bone loses density
- Men lose at same rate as women after 70 - 80



<https://www.nia.nih.gov/health/osteoporosis>

Image: osc-ortho.com

Exercise for Osteoporosis

- Fast walking, reverse/sideways walking, hills (especially descents)
- 70-80% 1 RM, 2-3/wk
- Specific areas - spine, hips, wrists

IM or short-arc extensions

IM or short-arc flexions in osteopenia; IM for osteoporosis

<https://health.clevelandclinic.org/the-best-workouts-for-osteoporosis/>

Nerve Entrapments

- Stenosis
- Sciatica
- “Pinched nerve”
- Piriformis syndrome
- Ligament sprains
- Osteoporosis
- Poor posture

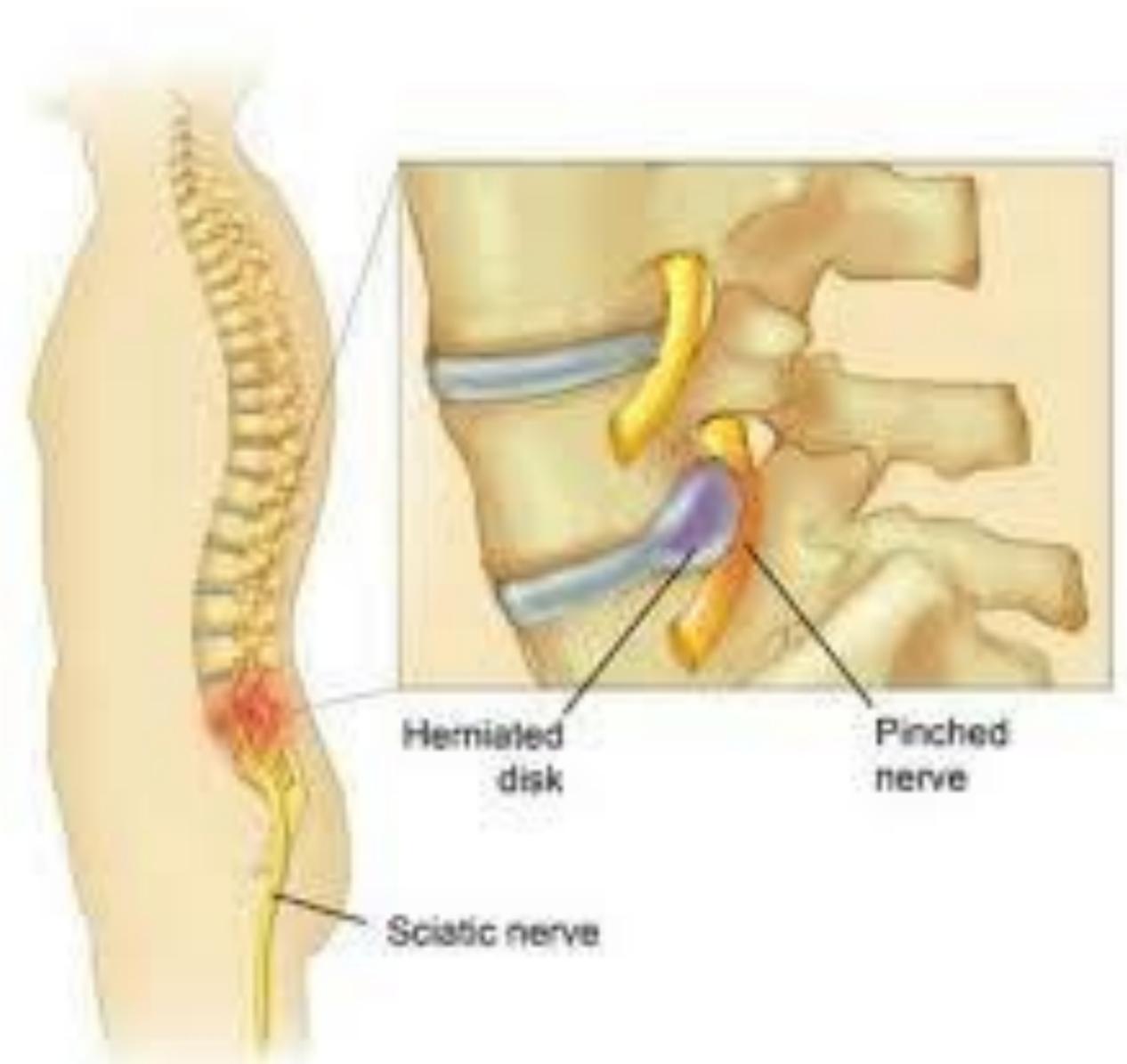


Image: discspine.com

A Word on the Piriformis

- Originates on anterior surface of sacrum, inserts on greater trochanter of femur
- Primarily an external hip rotator in **STANDING** but, when seated with hip flexed (ankle on opposite knee), it effectively becomes an internal rotator
- Sciatic nerve usually runs **UNDER** but sometimes through it
- Sitting or direct pressure may press nerve

The Piriformis



Image: pereacclinic.com

Piriformis Syndrome

- Sharp, burning, aching pain in buttocks or upper posterior thigh, especially from sitting or stair climbing
- Usually eliminate or reduce sources of pressure, PRICE, and gentle stretching can manage it



Image: cssctr.com

McKenzie vs Williams Exercises

- Centration - retracting nerve pain back to the back
 - Shifting the disc's protrusion away from the nerve root (lateral bend toward the pain)
- McKenzie - extension-based exercises
 - Quadruped (bird dog), Supermans, bridges, planks, cobras
- Williams - flexion-based exercises
 - Curl-up/crunch, knee(s)-to-chest, hamstring stretch

PT vs Discectomy vs Laminectomy

- CBT > PT?
- “Existing evidence was too limited to draw conclusions about the effects of exercise therapy.” (J Orthop Sports Phys Ther 2021;51(12):103–114. Epub 25 Dec 2020.)
- Discectomy/microdiscectomy - remove pieces
- Laminectomy - remove lamina to open space in posterior vertebrae for extruding disc

Which Exercises Should You Do?

- If sciatic nerve is..
 - Pinched at spinal or nerve root level, Mckenzie
 - Inflamed by sprain or strain as it exits spine, McKenzie
 - Irritated in the buttocks, consider piriformis syndrome, do either/both
 - Osteoporosis-related, Williams
 - Posture-related, McKenzie

Spinal Flossing



For discogenic or nerve-impinging conditions where the nerve is 'tethered', not just for the sciatic nerve (e.g. femoral, ulnar, etc.)

1. Sit tall
2. Tuck chin
3. Hyperextend neck and extend one knee with foot in dorsiflexion

Lesson 3: Exercise Options for Spine Health



Image: emedicinehealth.com

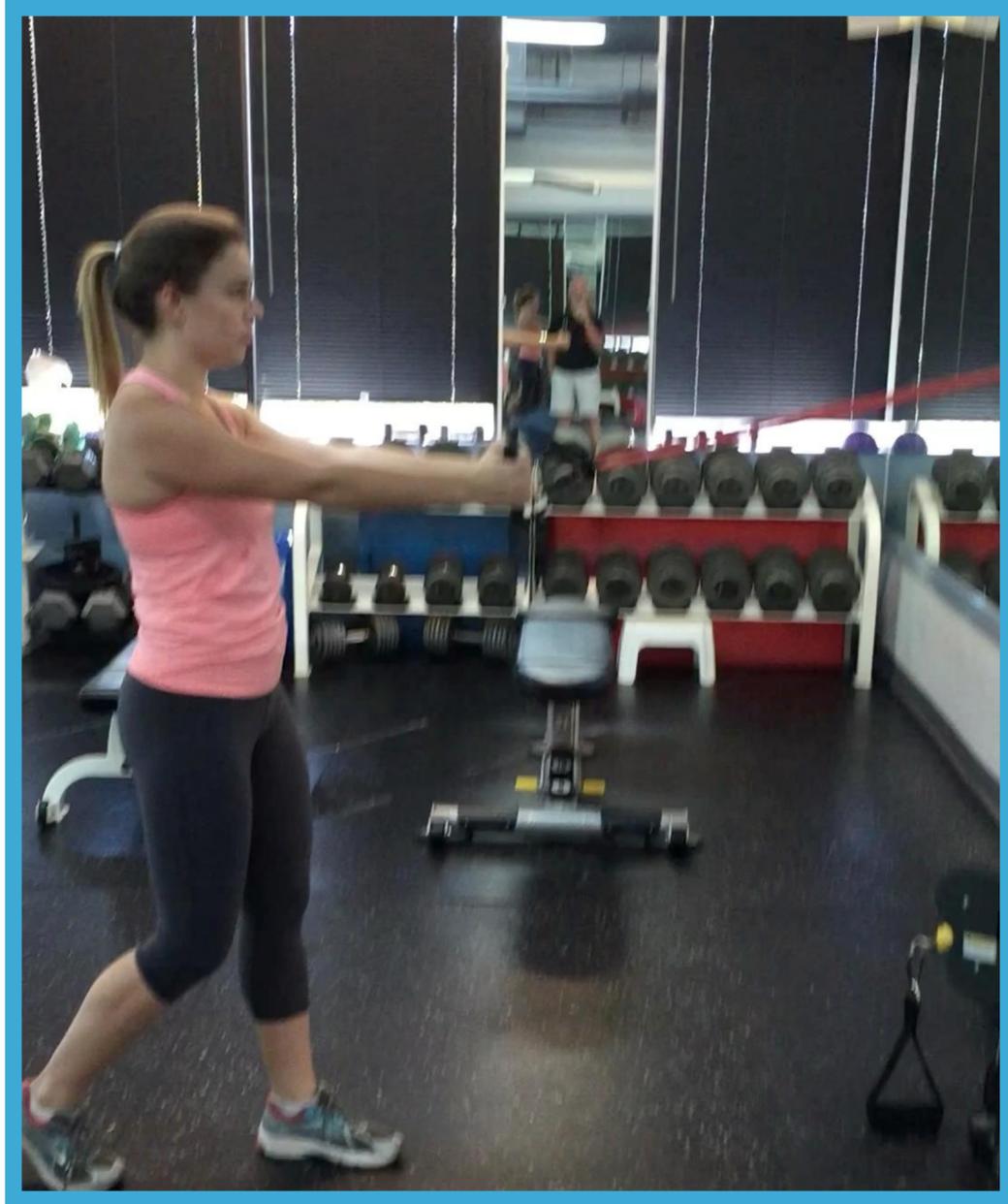
Weight-Biased RDL



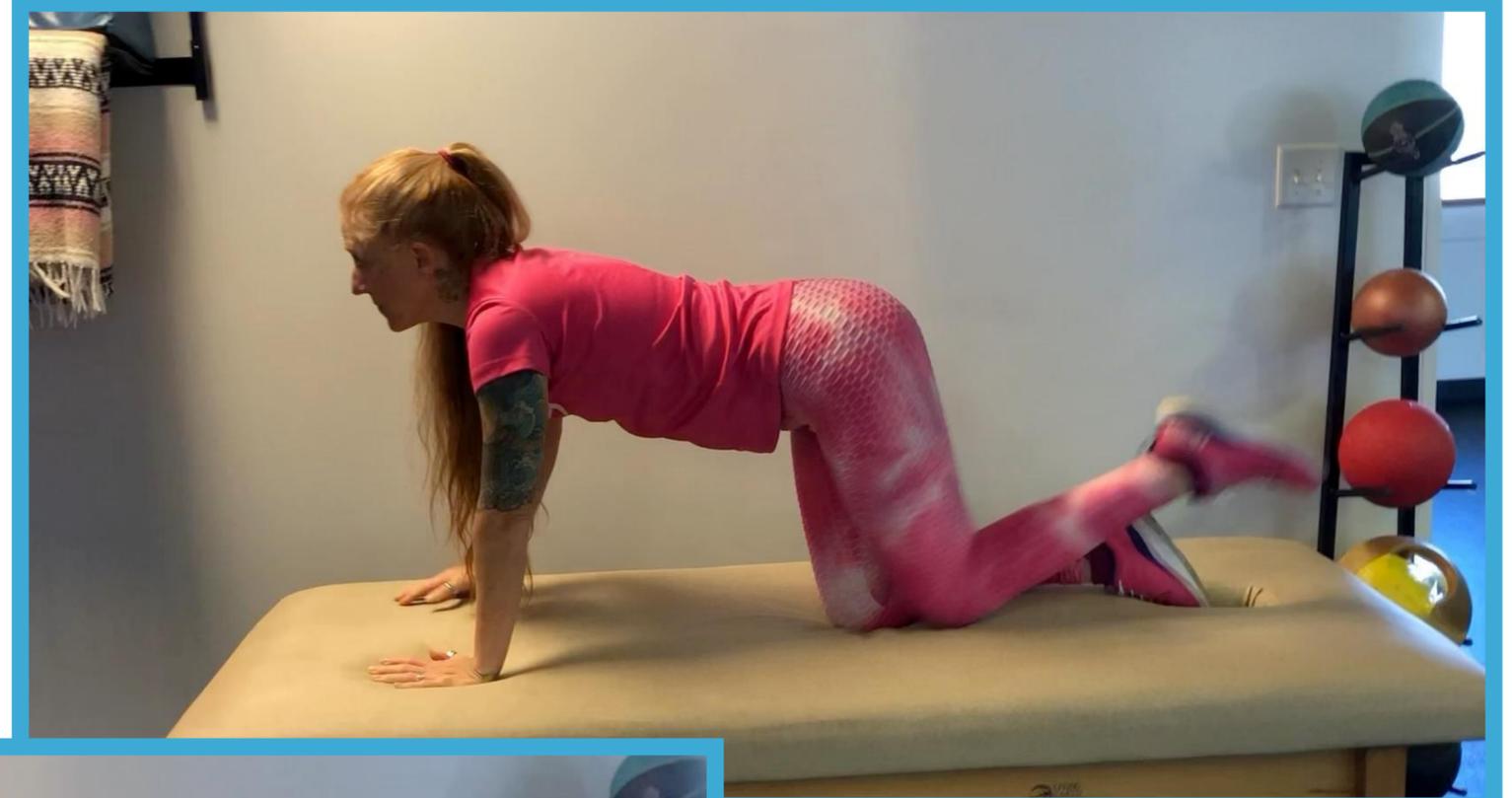
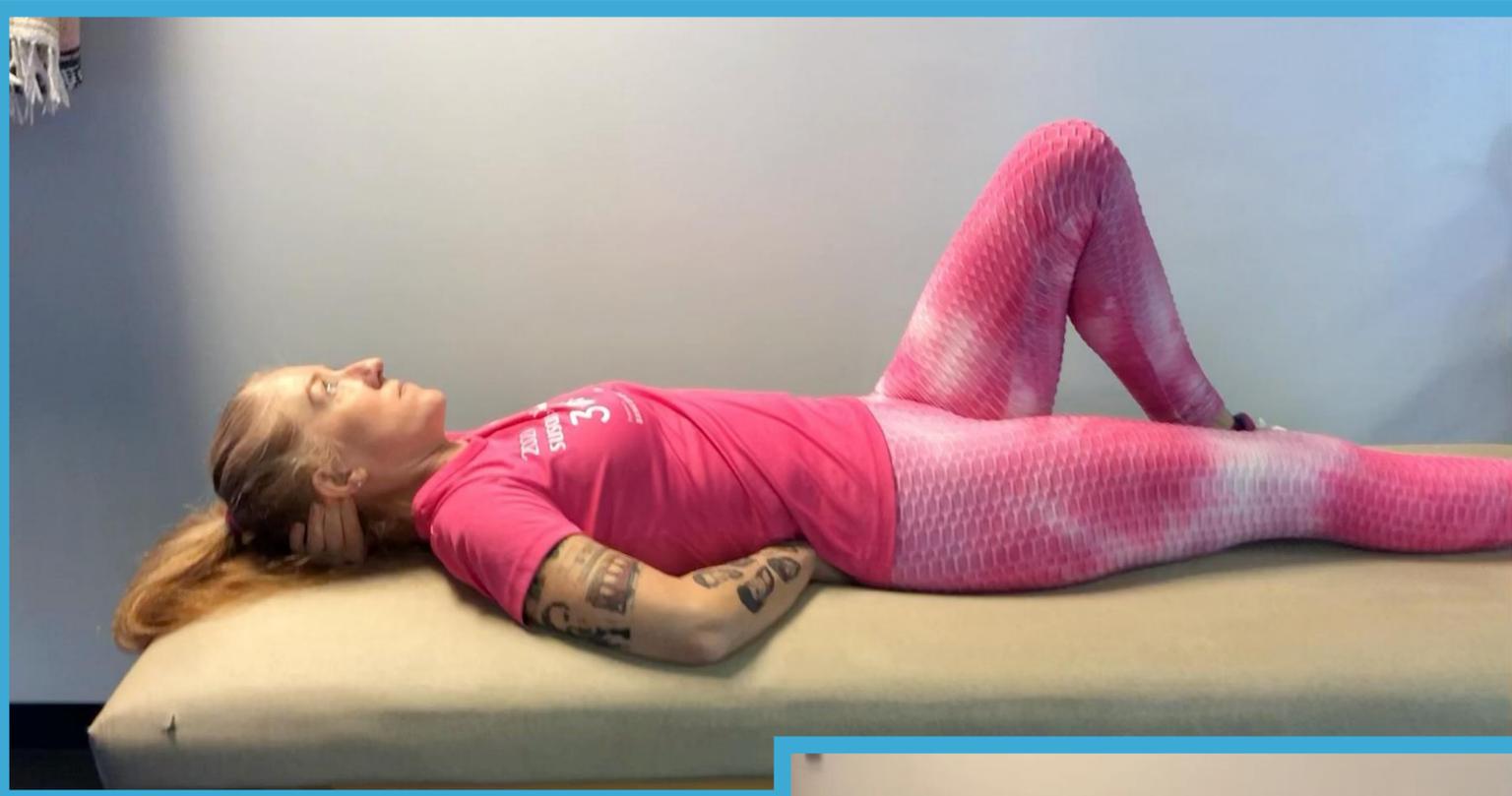
Weight- and Leg-Biased RDL



Tubing Rows



McGill Big Three



Palof Press

Self



Trainer-Assist



3-Speed Anti-Rotation Drills



Med Ball Rotations

“Only the Rotational Med Ball Throw Velocity whole-body power test displayed significant relationships with bat swing velocity, batted baseball velocity, and pitching velocity. Significant relationships were not identified for either the two-legged standing broad jump for distance or the lateral-to-medial jump for distance whole-body power tests and bat swing velocity or pitching velocity.”

Taniyama, D, Matsuno, J, Yoshida, K, Pyle, B, and Nyland, J. Rotational medicine ball throw velocity relates to NCAA Division III college baseball player bat swing, batted baseball, and pitching velocity. *J Strength Cond Res* 35(12): 3414–3419, 2021

Active Torso Rotations



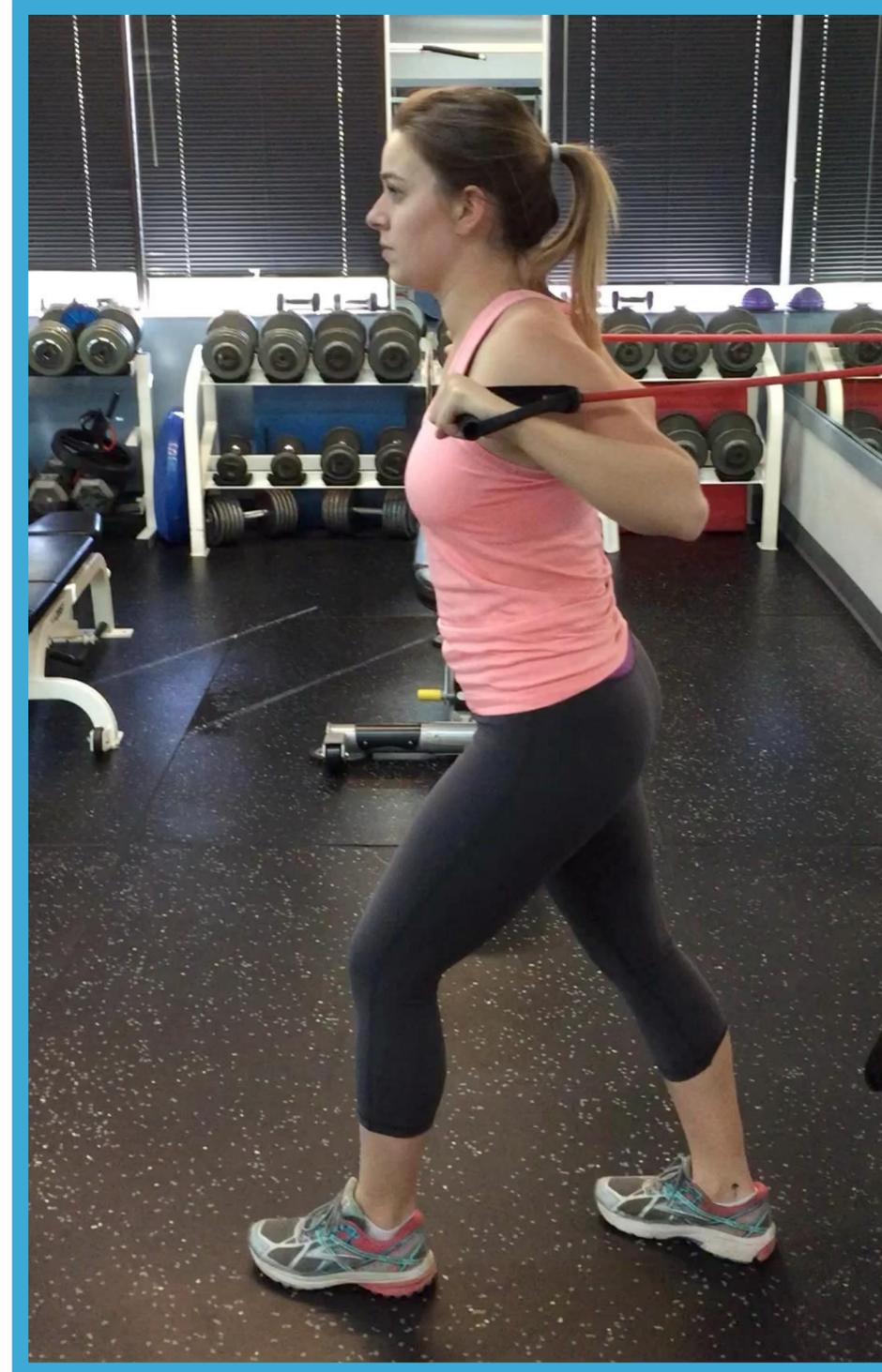
Woodchops



Swings



2-Arm Chest Press



Uni-Carry



Stability Ball Core Work

- Sitting: rock A/P, sideways, circles
- Sitting, unilaterally-weighted: curls, lateral raises
- Supine: bridges, bridge-tucks, dead bugs, tables
- Prone: planks, bird dogs, push ups
- Kneeling: roll-outs, roll-out-to-plank
- Standing: NO!!!!!!

Seated Rock 'n Rollin'

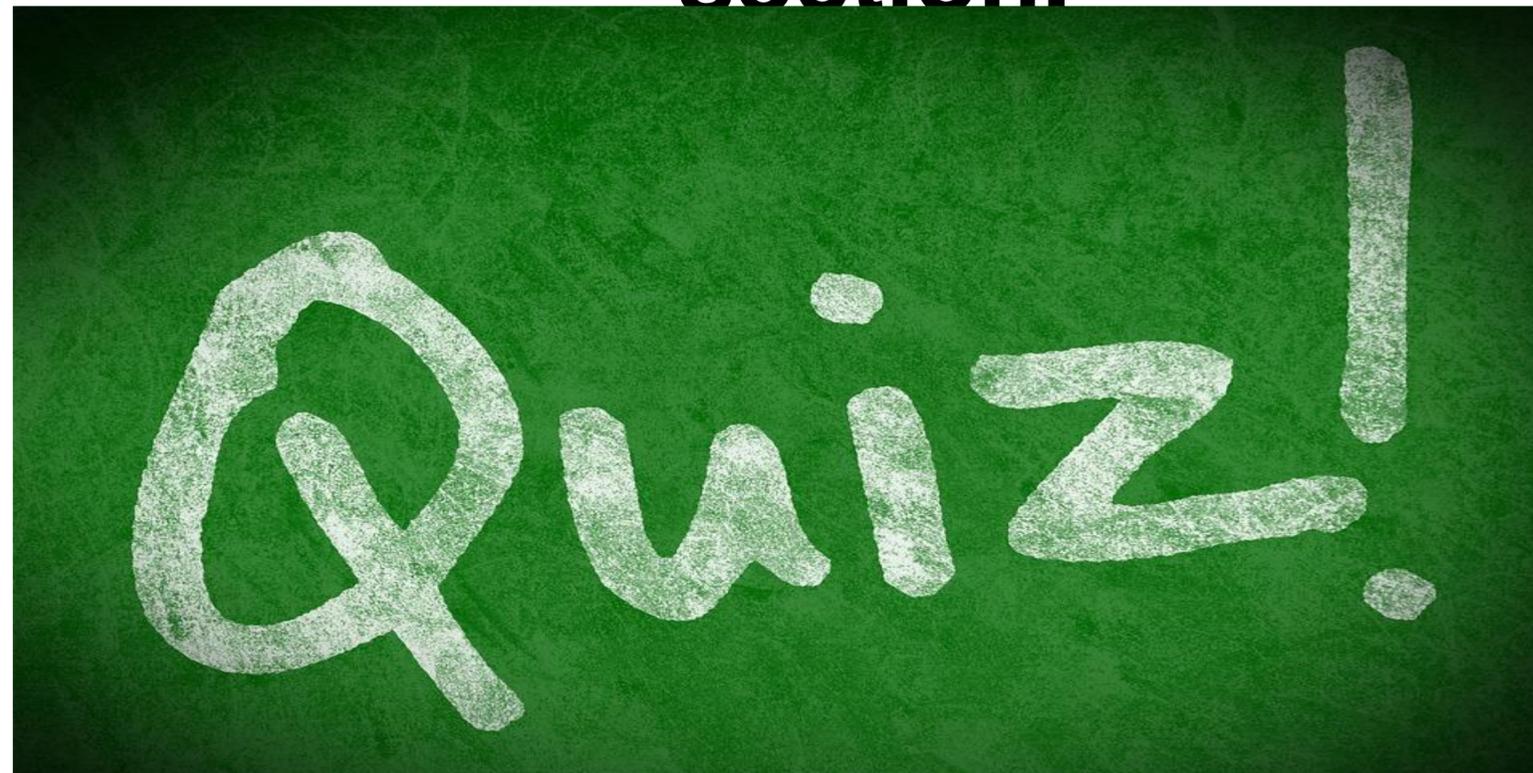


Roll Outs



Lumbar Spine QUIZ

At this time, please complete and successfully pass the “Lumbar Spine Quiz” before continuing to the next section.



References

- Watanabe, K., Vieira, T. M., Gallina, A., Kouzaki, M., & Moritani, T. (2021). Novel insights into biarticular muscle actions gained from high-density electromyogram. *Exercise and Sport Sciences Reviews*, 49(3), 179–187.
<https://doi.org/10.1249/jes.0000000000000254>
- Pocovi, N. C., de Campos, T. F., Christine Lin, C.-W., Merom, D., Tiedemann, A., & Hancock, M. J. (2022). Walking, cycling, and swimming for nonspecific low back pain: A systematic review with meta-analysis. *Journal of Orthopaedic & Sports Physical Therapy*, 52(2), 85–99. <https://doi.org/10.2519/jospt.2022.10612>
- Contreras, B., & Schoenfeld, B. (2011). To crunch or not to crunch: An evidence-based examination of spinal flexion exercises, their potential risks, and their applicability to program design. *Strength and Conditioning Journal*, 33(4), 8–18.
<https://doi.org/10.1519/ssc.0b013e3182259d05>
- Mayo Foundation for Medical Education and Research. (2021, November 25). *Ankylosing spondylitis*. Mayo Clinic. Retrieved April 11, 2022, from <https://www.mayoclinic.org/diseases-conditions/ankylosing-spondylitis/symptoms-causes/syc-20354808>
- U.S. Department of Health and Human Services. (n.d.). *Osteoporosis*. National Institute on Aging. Retrieved April 11, 2022, from <https://www.nia.nih.gov/health/osteoporosis>

References

Bone, M. and J. T. (2021, November 5). *The best workouts for osteoporosis*. Cleveland Clinic. Retrieved April 11, 2022, from <https://health.clevelandclinic.org/the-best-workouts-for-osteoporosis/>

Treating acute and chronic low back pain. (2021). *Journal of Orthopaedic & Sports Physical Therapy*, 51(12), 628–628. <https://doi.org/10.2519/jospt.2021.9003>

Taniyama, D., Matsuno, J., Yoshida, K., Pyle, B., & Nyland, J. (2021). Rotational medicine ball throw velocity relates to NCAA Division III college baseball player Bat Swing, batted baseball, and pitching velocity. *Journal of Strength and Conditioning Research*, 35(12), 3414–3419. <https://doi.org/10.1519/jsc.00000000000004148>