



AAO- Osteopathic Neuromusculoskeletal Medicine in the 21st Century—OMED 2016

Yoga

for Low Back Pain & Rehabilitation

**Stacey Pierce Talsma DO,
MS, FNAOME**

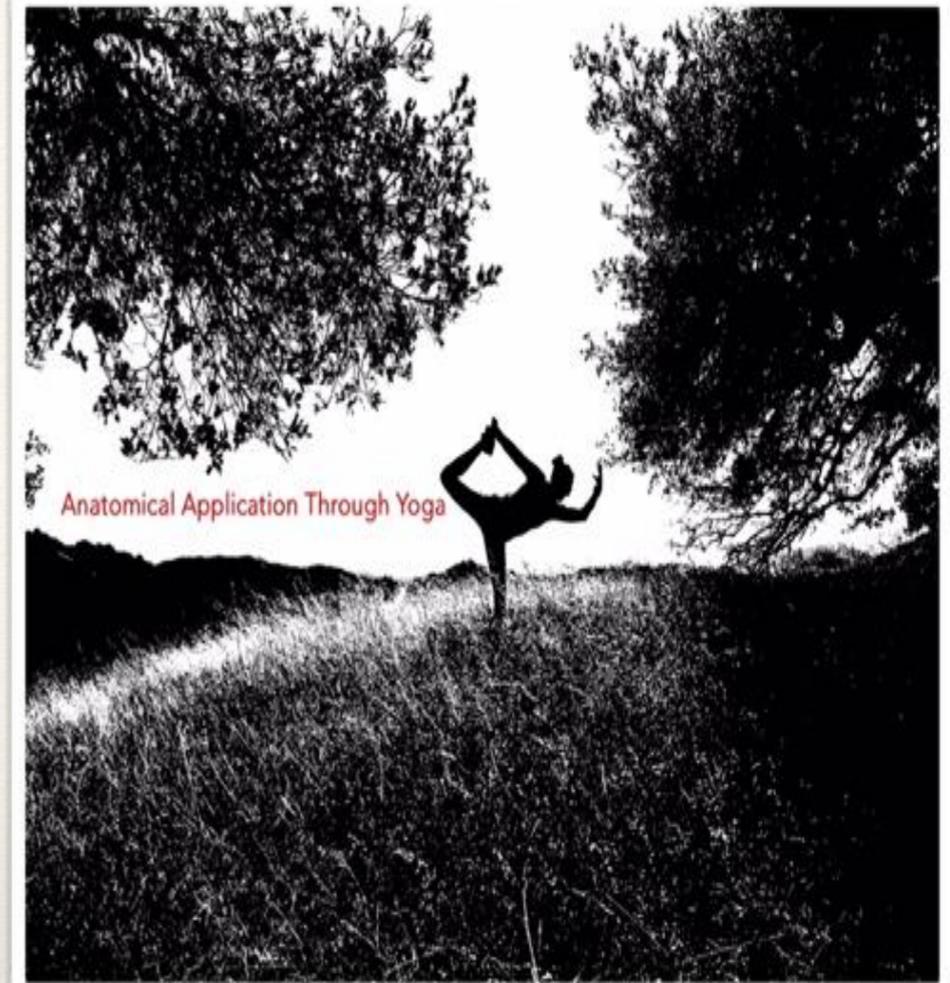
Touro University California
College of Osteopathic Medicine

OBJECTIVES

- ❖ Describe how yoga may be beneficial for the care and **rehabilitation of patients with low back pain**
- ❖ Identify yoga as a **system of health promotion**
- ❖ Describe **ideas central** to the practice of yoga
- ❖ Compare and contrast **yogic principles with osteopathic philosophy and practice**
- ❖ Review **literature** for yoga for low back pain
- ❖ Identify **yoga best** for patients with low back pain

DISCLOSURES

- ❖ Dr. Pierce-Talsma has no financial interests or relationships to disclose
- ❖ The opinions offered in this presentation are of the presenter and do not represent the opinions of the American Academy of Osteopathy
- ❖ All materials and content are the intellectual property of the presenter or are cited and do not infringe on the intellectual property of any other person or entity
- ❖ The speaker does not endorse any product, service or device with this presentation



D.O. -Michigan State University
RYT- Cape Elizabeth, Maine
Yoga Therapy- Current student, Niroga Institute

“The vast majority of low back pain cases are of unknown origin and are classified as non-specific”¹²

Low Back Pain

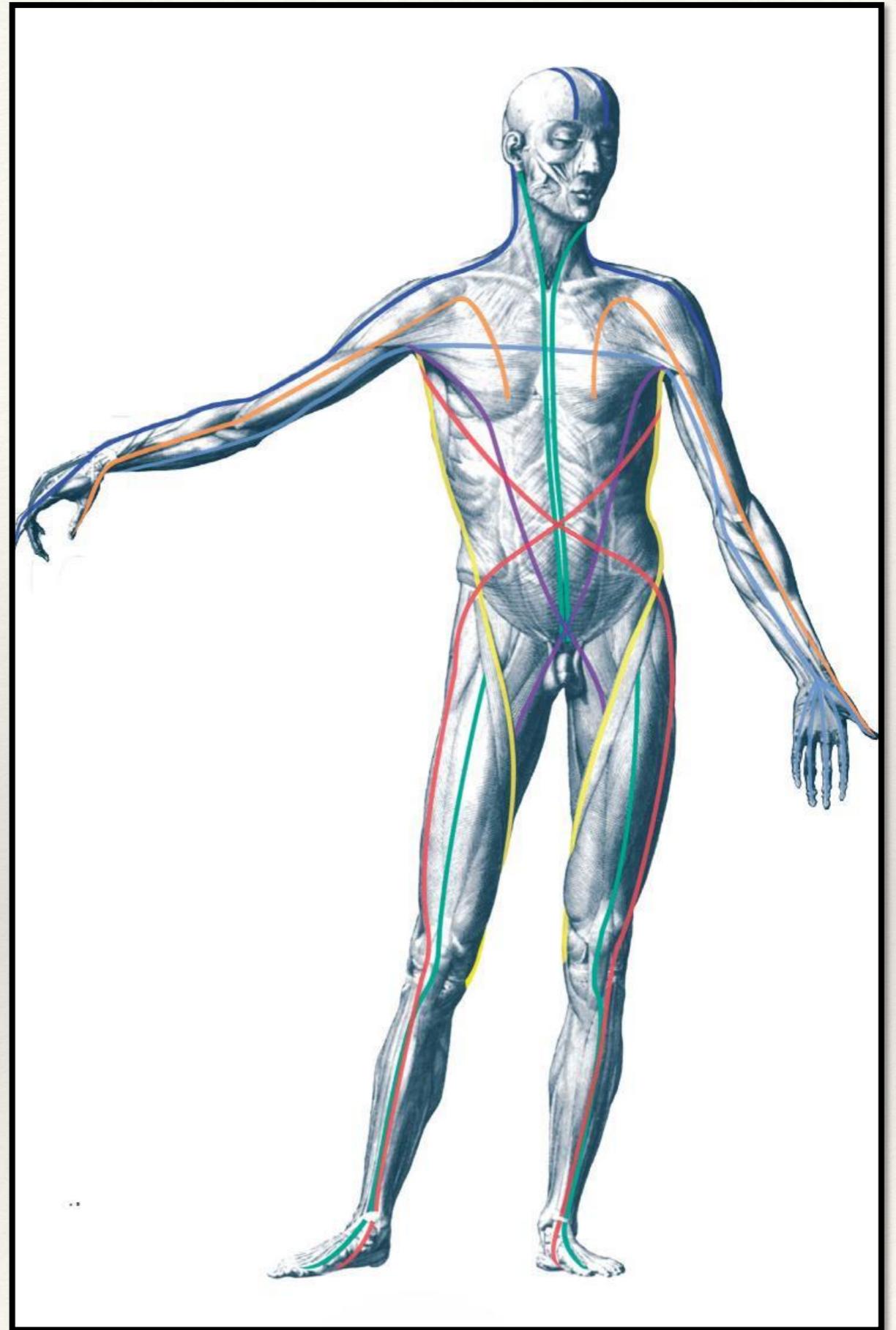
- Major reason why people use Complementary and Alternative Methods (CAM)
- Secondarily suffer anxiety, depression, disability, reduced quality of life
- Causes are not well understood and therapy frequently fails



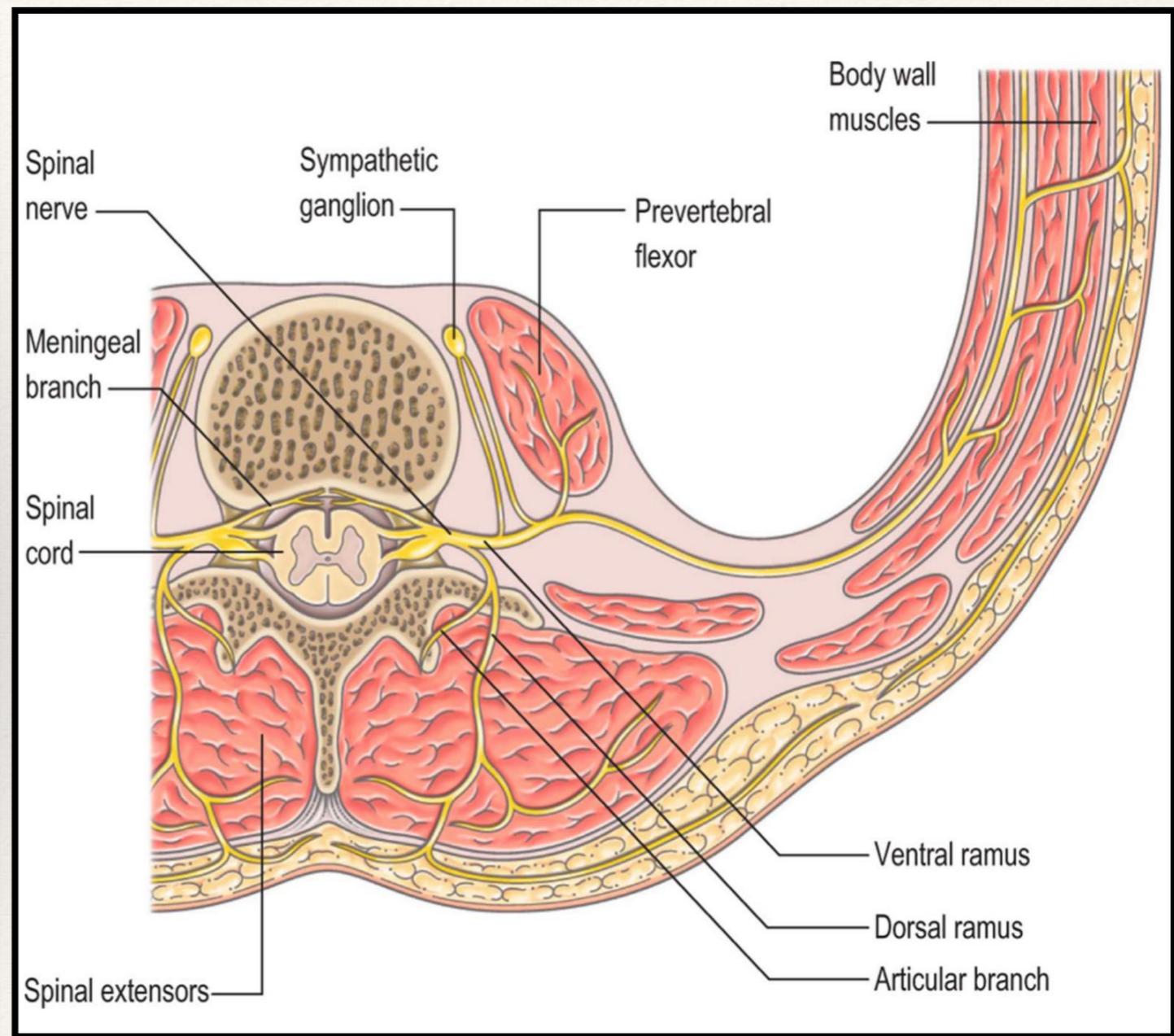
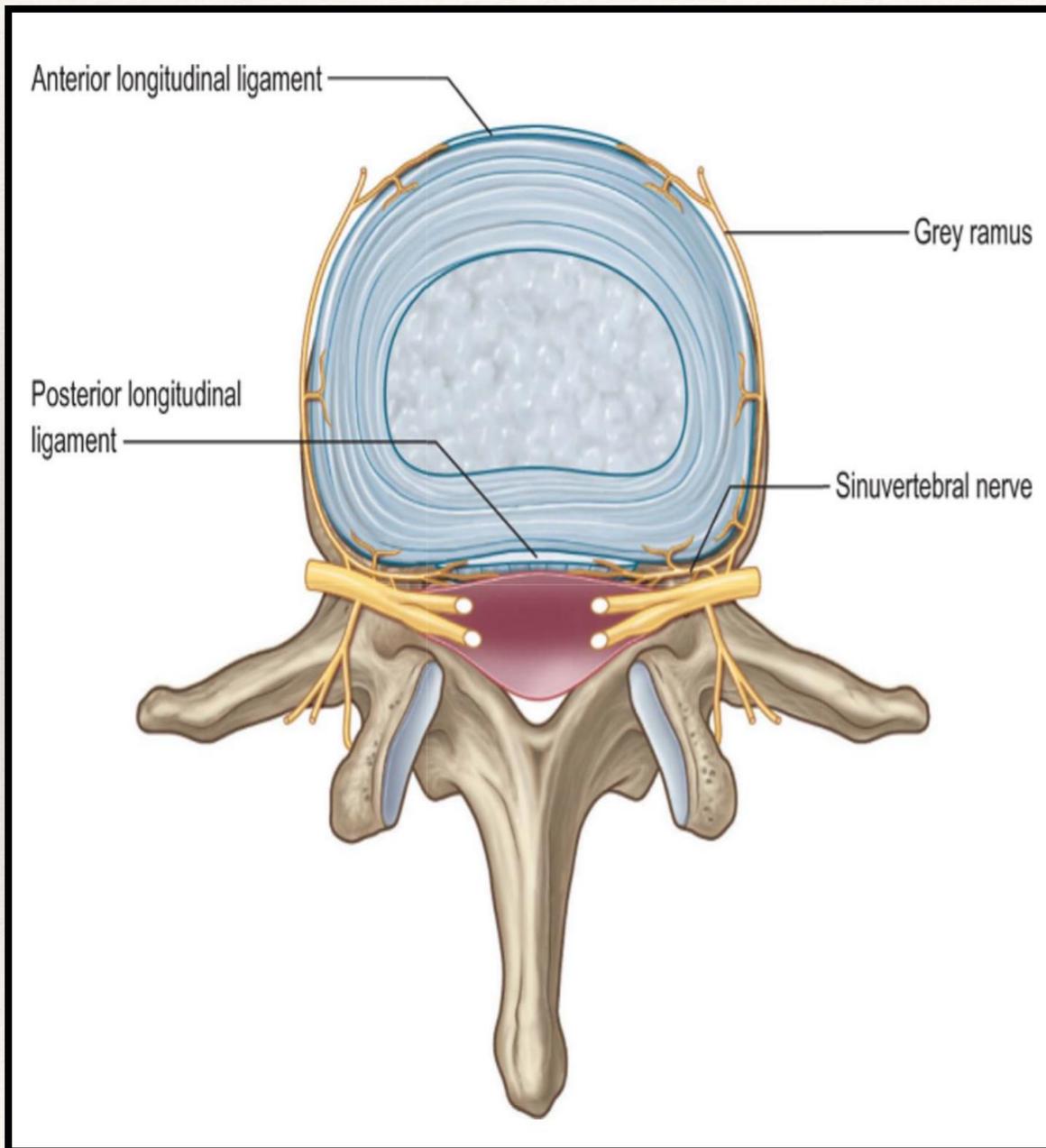
“The pain response is due to the loss of load attenuating capacity of multiple tissues that must work in concert together”²⁴

Functional Anatomy

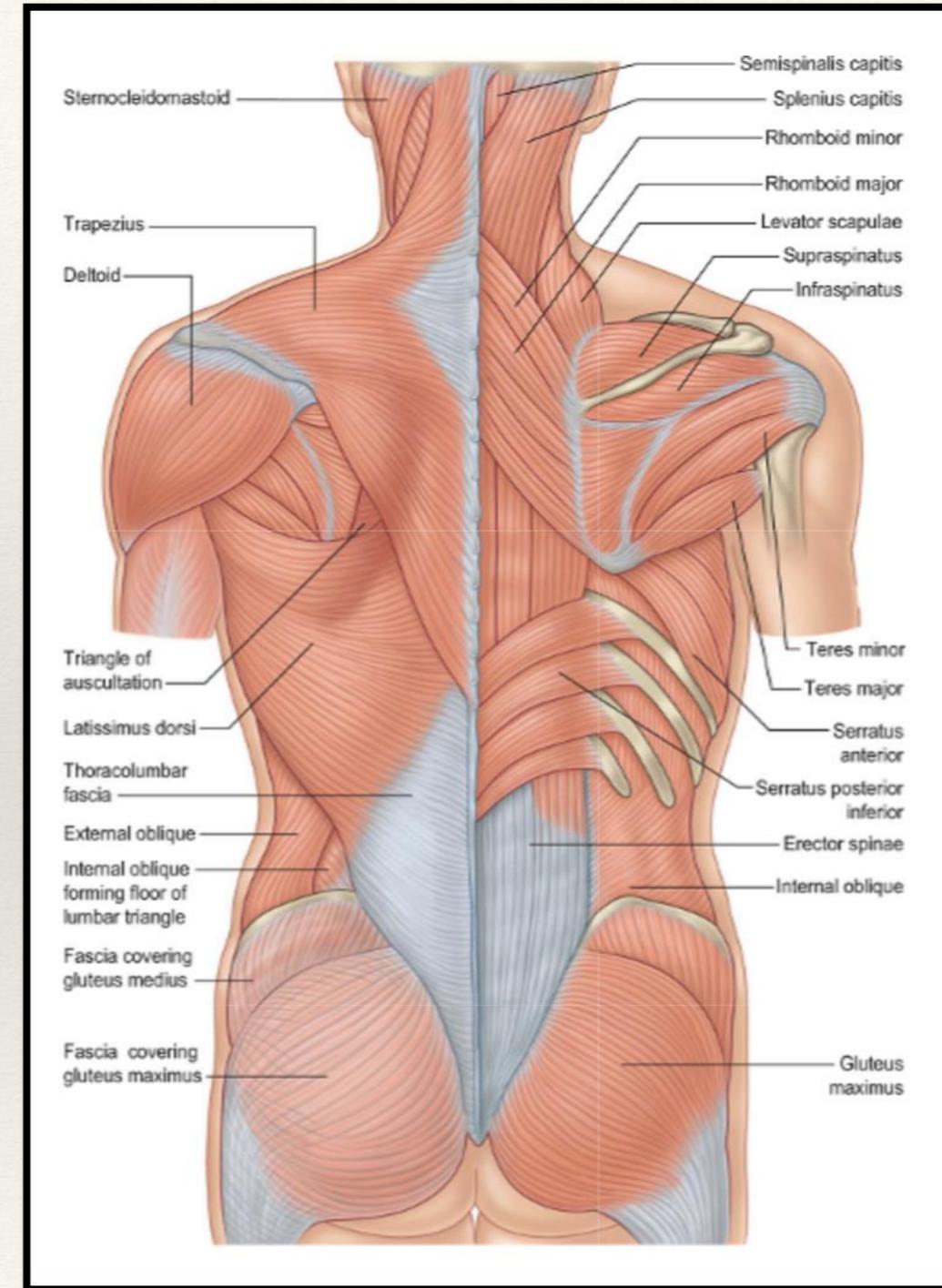
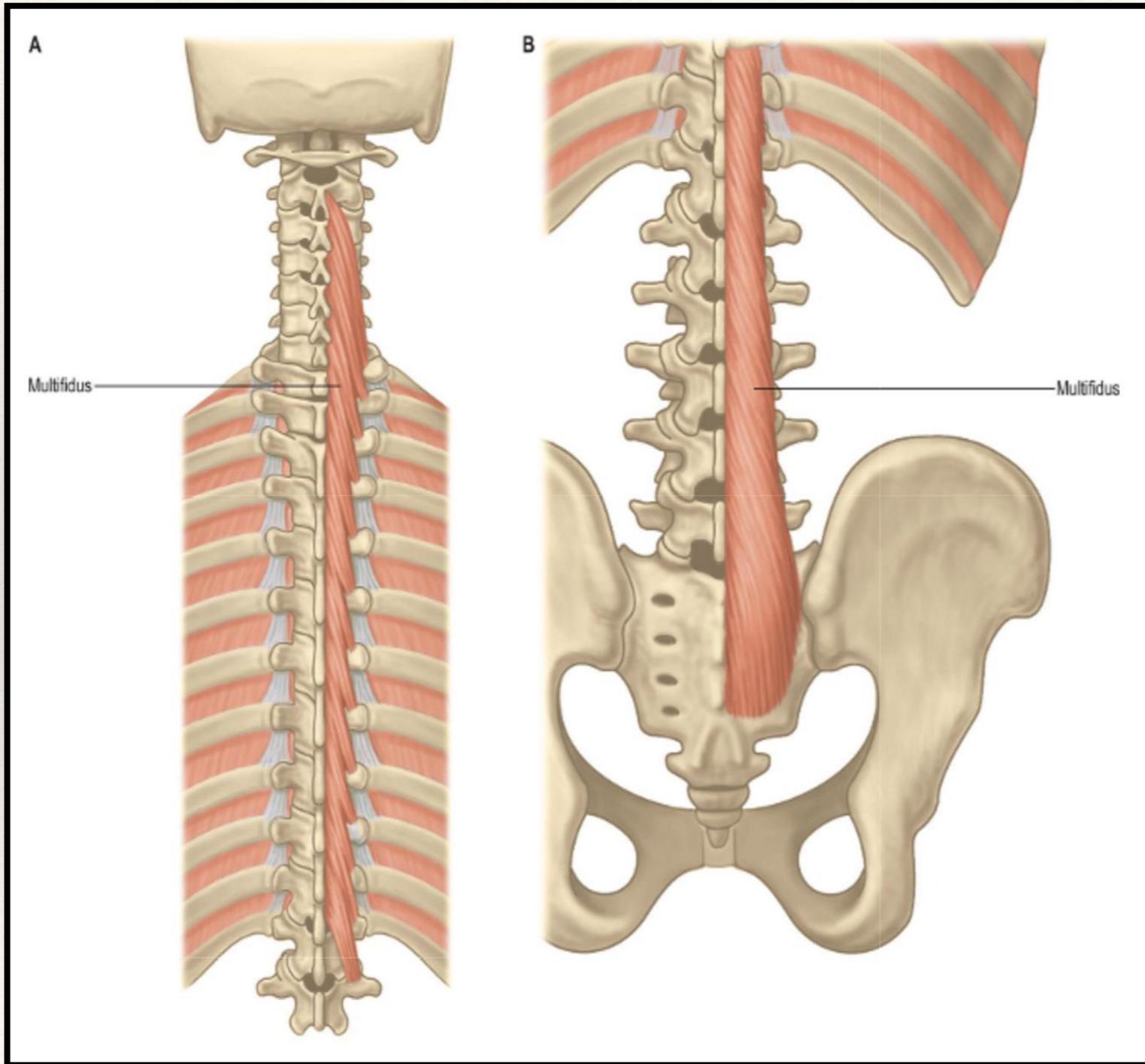
- Difficult to identify the source of pain
- Structural vs. Functional
- Lumbar musculature as spinal stabilizers
- Retraining should target multiple muscles that influence spinal loading



Anatomic Considerations Innervation

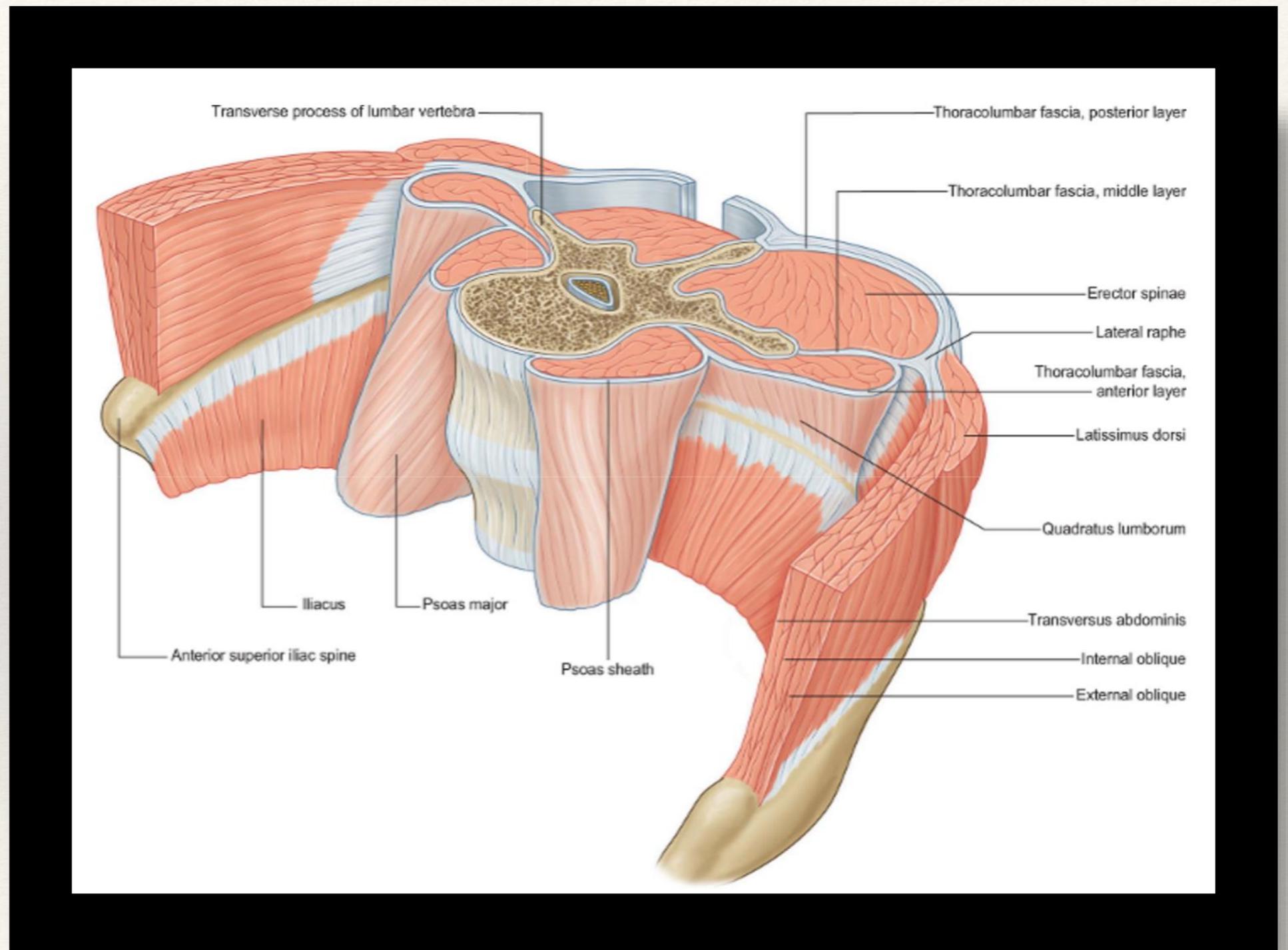


Anatomic Considerations Muscles



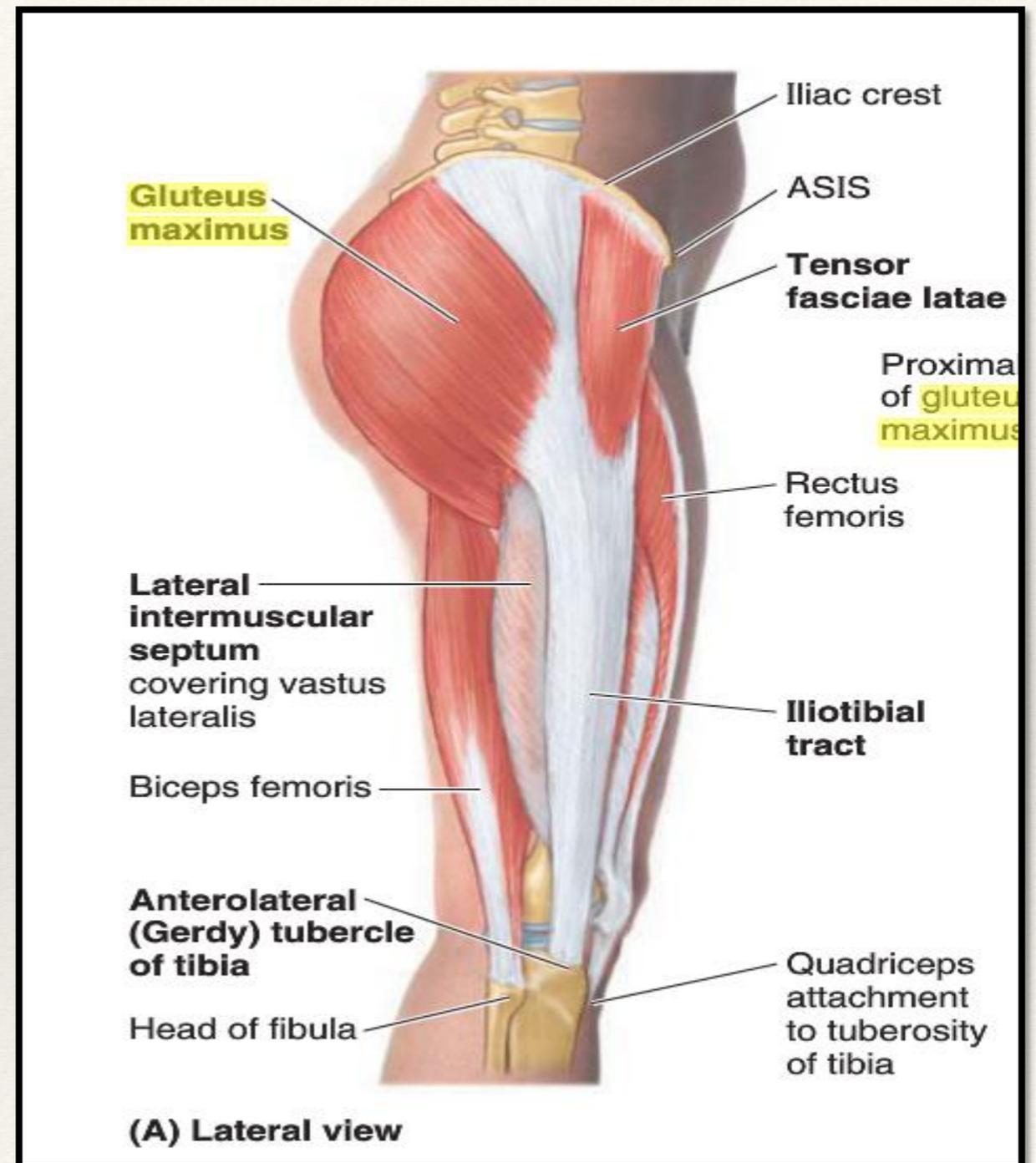
Thoracolumbar Fascia System

- ❖ Three layers
 - ❖ Posterior
 - ❖ Middle
 - ❖ Anterior
- ❖ Point of attachment for abdominal musculature (EO, IO, TA)



Muscles of the LE, Pelvis, Abdominals

- ❖ Strengthening of the Pelvis and LE muscles is important for rehabilitation due to muscular, fascial and ligamentous linkages
- ❖ Fascia Lata system
- ❖ Iliopsoas as a stabilizer



To Rehabilitate Low Back Pain

- ❖ Form Closure
- ❖ Force Closure
- ❖ Neural Function
 - ❖ Motor control
 - ❖ Emotional State
 - ❖ Body Awareness

❖ Vleeming et al²⁴

- ❖ “Multidimensional approaches that incorporate the dimensions of physical, psychological, and social function, are now generally accepted as better determinants of the individual’s experience with pain.”

❖ ~Galantino et al.

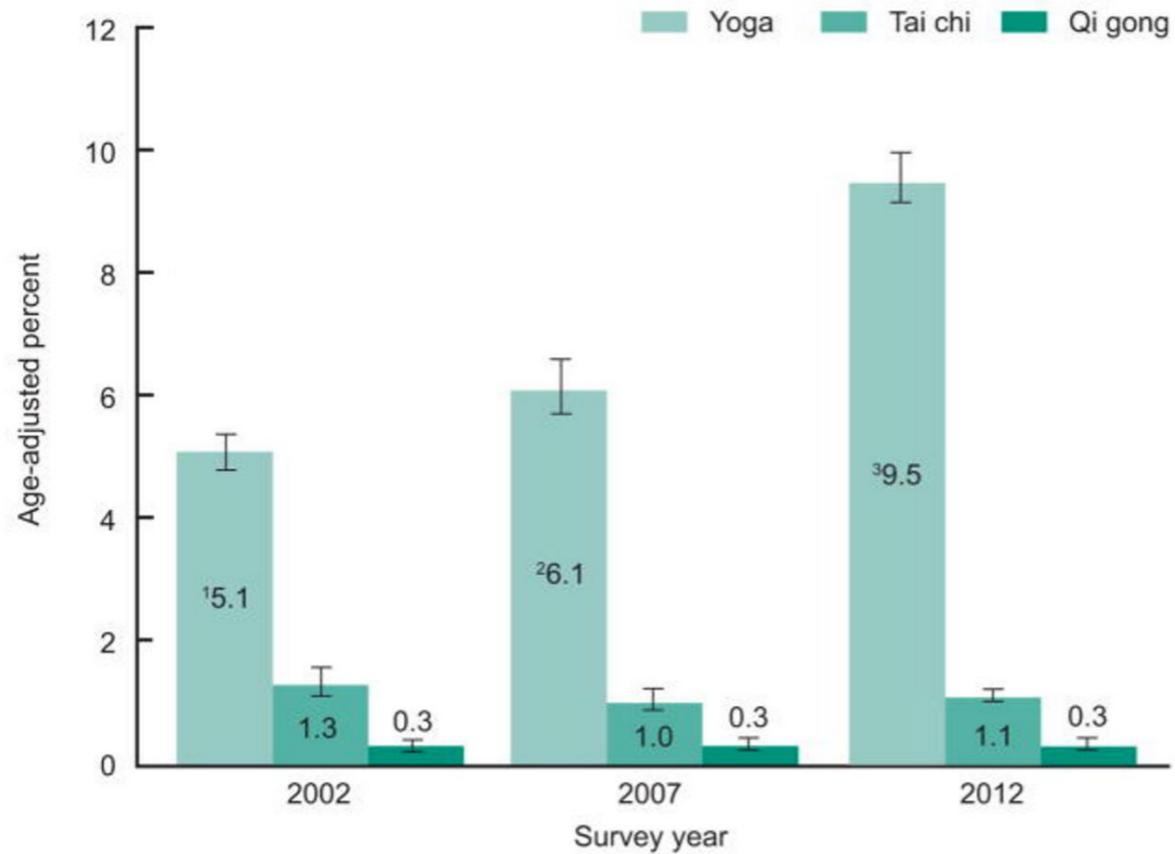


“The study of asana is not about mastering Posture. It’s about using posture to understand & transform yourself.”

**Can My Patients
Do Yoga?**

I hope to prove to you today
that yoga is for
EVERY BODY

Utilization of Yoga



I 95% confidence interval.

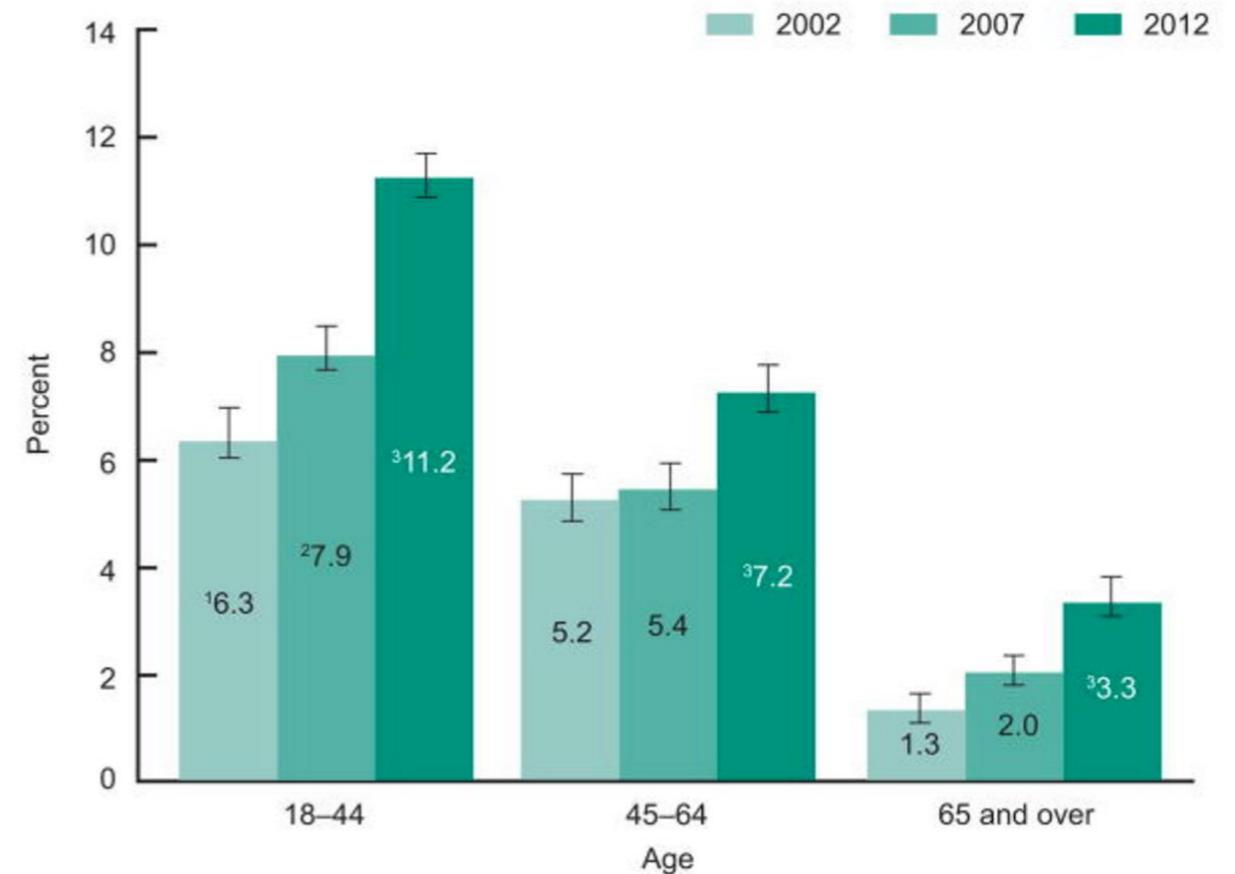
¹Significantly different from 2007 and 2012 ($p < 0.05$).

²Significantly different from 2012 ($p < 0.05$).

³Significantly different from 2002 and 2007 ($p < 0.05$).

NOTES: Estimates are age-adjusted using the projected 2000 U.S. population as the standard population and four age groups: 18–24, 25–44, 45–64, and 65 and over. Estimates are based on household interviews of a sample of the civilian noninstitutionalized population.

SOURCE: CDC/NCHS, National Health Interview Survey, 2002, 2007 and 2012.



I 95% confidence interval.

¹Significantly different from 2007 and 2012 ($p < 0.05$).

²Significantly different from 2012 ($p < 0.05$).

³Significantly different from 2002 and 2007 ($p < 0.05$).

NOTE: Estimates are based on household interviews of a sample of the civilian noninstitutionalized population.

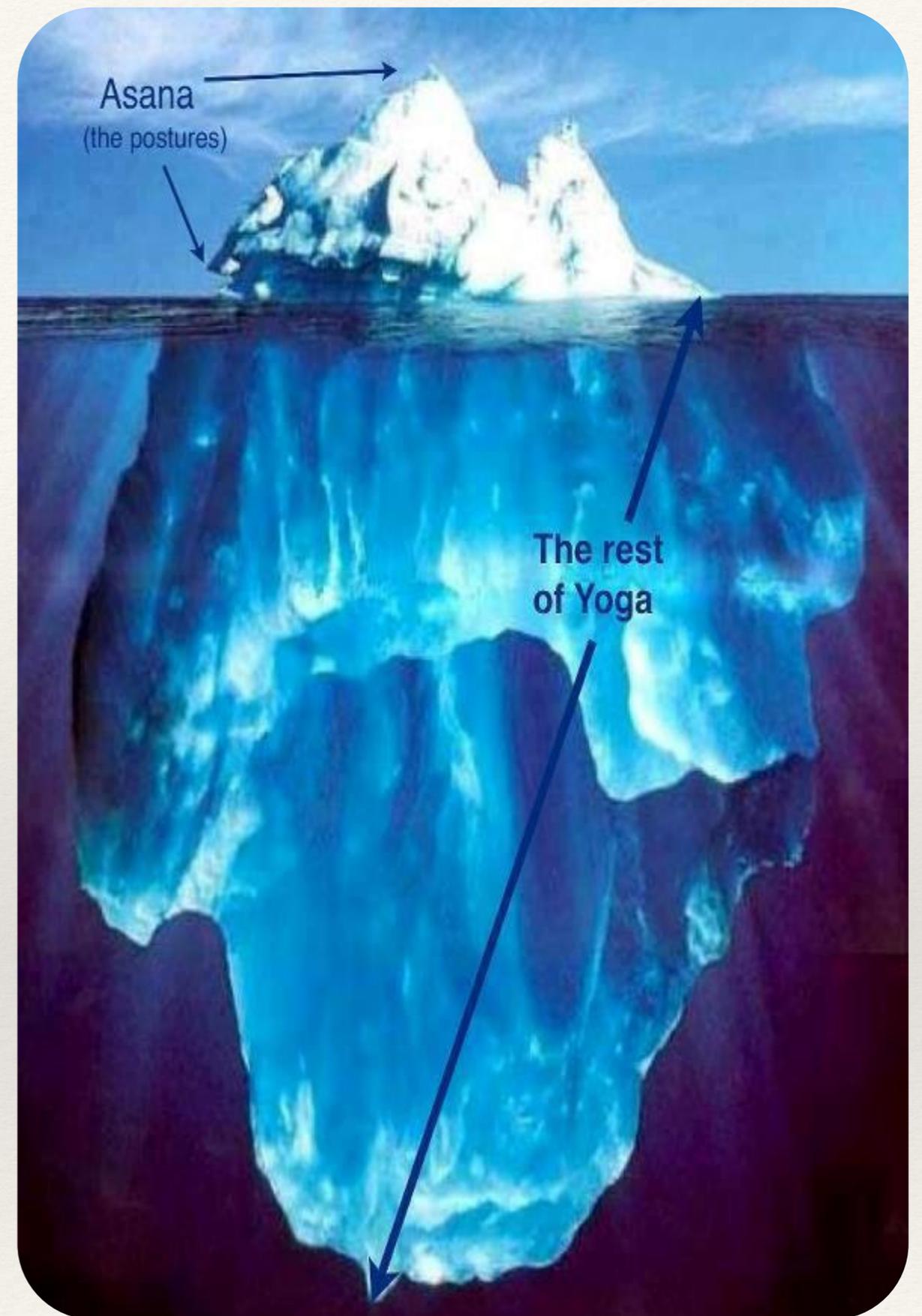
SOURCE: CDC/NCHS, National Health Interview Survey, 2002, 2007 and 2012.

“Yoga does not just change the way we see things, it transforms the person who sees.”

- B.K.S. Iyengar

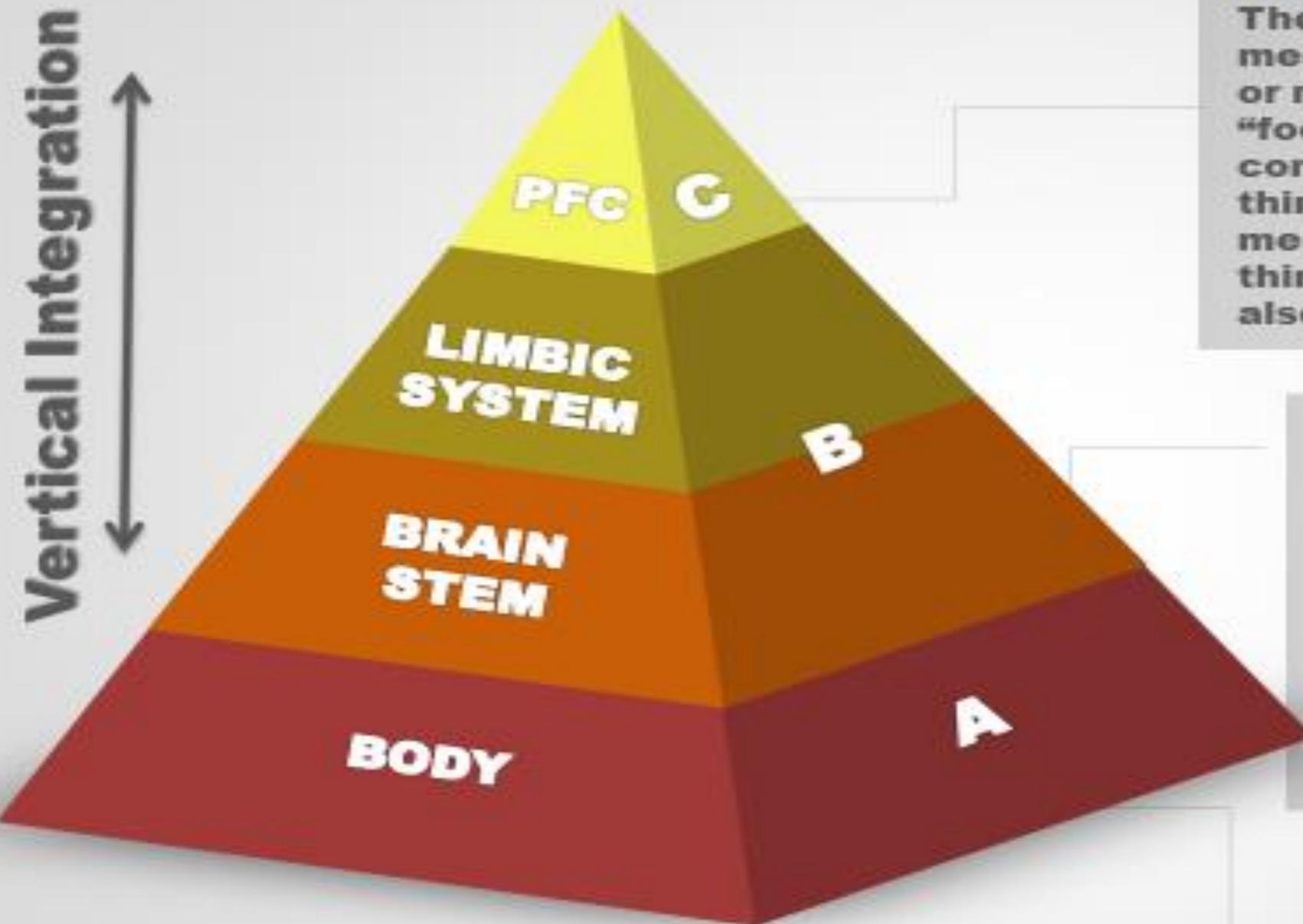
Yoga- The 8 Limbs

1. Yamas- Restraints
2. Niyamas- Observances
3. Asanas- Postures
4. Pranayama- Breath work
5. Pratyahara- Inhibit the senses
6. Dharana- Concentration
7. Dhyana- Meditate on the truth
8. Samadhi- Union with the divine



A-B-C's by Niroga Institute

Vertical Integration



A, B, C's

CENTERING

The essence of Mindful Centering or meditation are "open monitoring," or noticing our thoughts, and "focused attention," or concentrating on one thought or thing at a time. Regular practice of meditation improves critical thinking and productivity, and it also foments contentment.

BREATHING

Through Mindful Breathing we can activate the parasympathetic nervous system, which is responsible for the body's ability to recuperate and return to a balanced state after experiencing pain or stress. In addition, Mindful Breathing helps us control and regulate our emotions.

ACTION

Mindful Action helps heal trauma and reduce/manage stress stored in the body.

Yoga's Mechanical Attributes

- ❖ Rest
- ❖ Flexibility
- ❖ Strength/Endurance
- ❖ Correct action
- ❖ Alignment
- ❖ Postural Awareness
- ❖ Proprioception/
Balance

“These Movements are “intricate” and highlight the mind-body nature of Yoga that emphasizes awareness, concentrations, and bidirectional communication between the mental, nervous, skeletal and muscular systems”¹³

Rest

- ❖ Rest and relaxation of the affected area
- ❖ Awareness of where you are holding tension
- ❖ **Restorative Yoga**
 - ❖ Total relaxation
 - ❖ Uses props to allow for surrender into the pose
- ❖ **Yoga Nidra**
 - ❖ A guided meditation-"yogic sleep"- deep relaxation while still remaining conscious
- ❖ **Yin Yoga**
 - ❖ Slow yoga with LONG holds- 5 minutes or longer
 - ❖ Passive postures that target deep connective tissue stretching



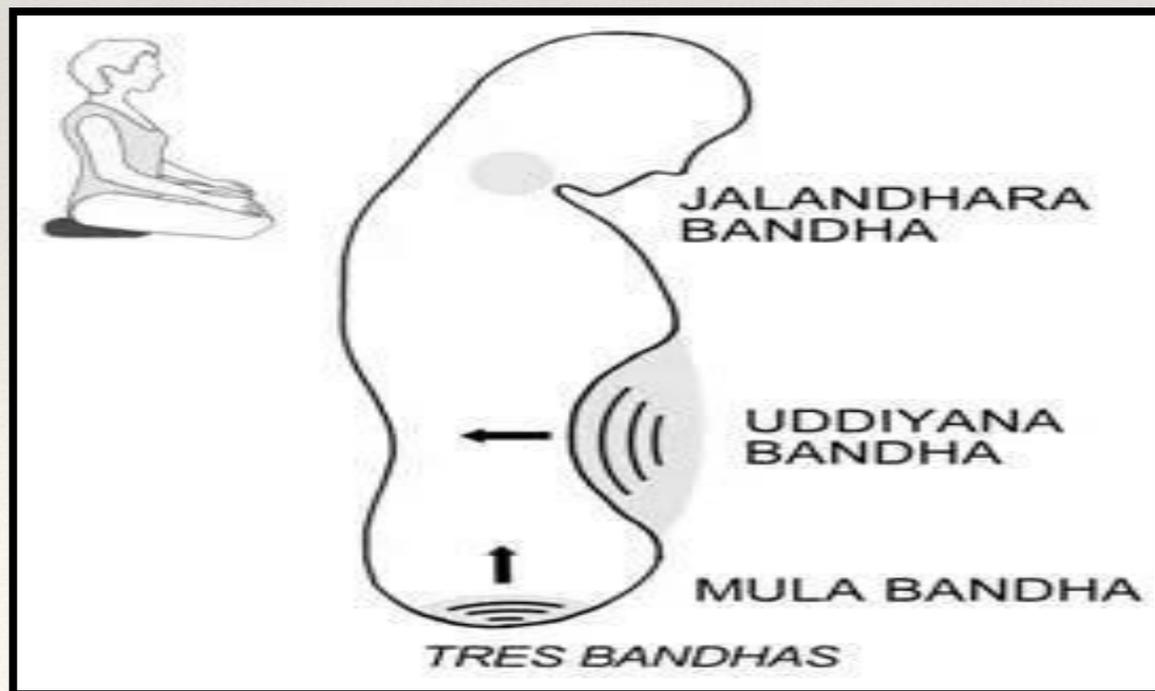
Flexibility

- ❖ Reciprocal inhibition
- ❖ Breath as activation
- ❖ Long holds in stretches
 - ❖ Affects intrafusal muscle fibers and golgi tendon
- ❖ Range of Motion work
- ❖ Stretching what is tight

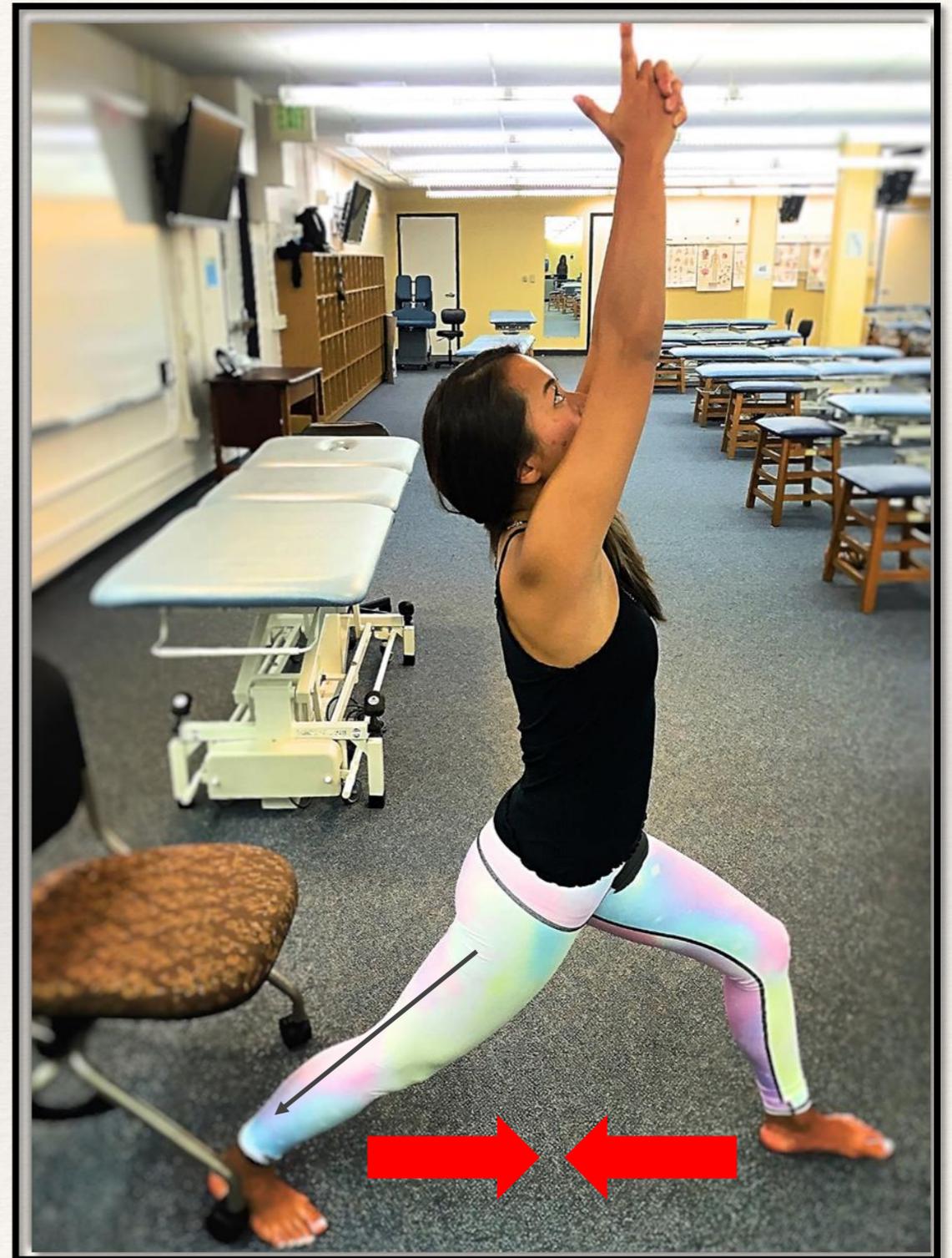


Strength/ Correct Action

- ❖ Working against gravity
- ❖ Isometric contraction
- ❖ Balance of left and right hemispheres
- ❖ Engagement of core muscle groups



Mindbodygreen.com



Alignment/Postural Awareness

- ❖ Release of subconscious gripping
- ❖ Self-knowledge
 - ❖ Asymmetry
 - ❖ Correct posture
- ❖ Identification of tendencies/ patterns
- ❖ Strength to hold correct posture



Renewed Body Awareness

*“ Pain Distorts individuals’ body perception by demanding attention, blocking their awareness of non-painful body parts. This is even measurable on the cortical level, where the **painful** body part becomes **overrepresented**, influencing perception of form and position of the body in space.”*²²

Interoception- Looking Within

“We are a geometry of somatic consciousness”³³

~ Stanley Keleman

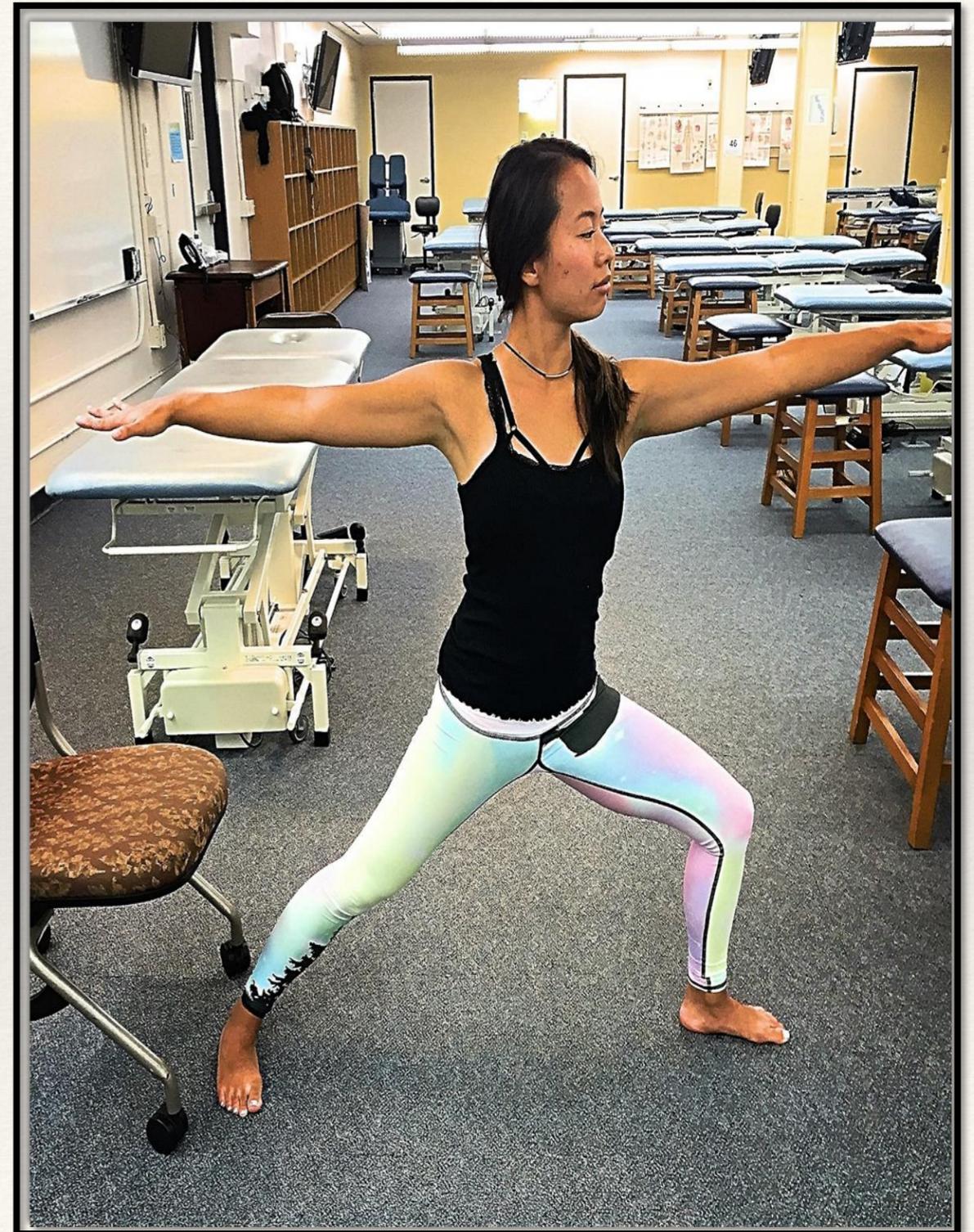
- ❖ **Proprioception- reception of stimuli- body position in space**
- ❖ **Kinesthesia- a sense mediated by muscle tension and movement**
- ❖ **Visceral Sensation**

“Without the unimpeded perceiving of these sensations, it simply is not possible to know who you are and what you need in life.”

~Peter Levine

Proprioception

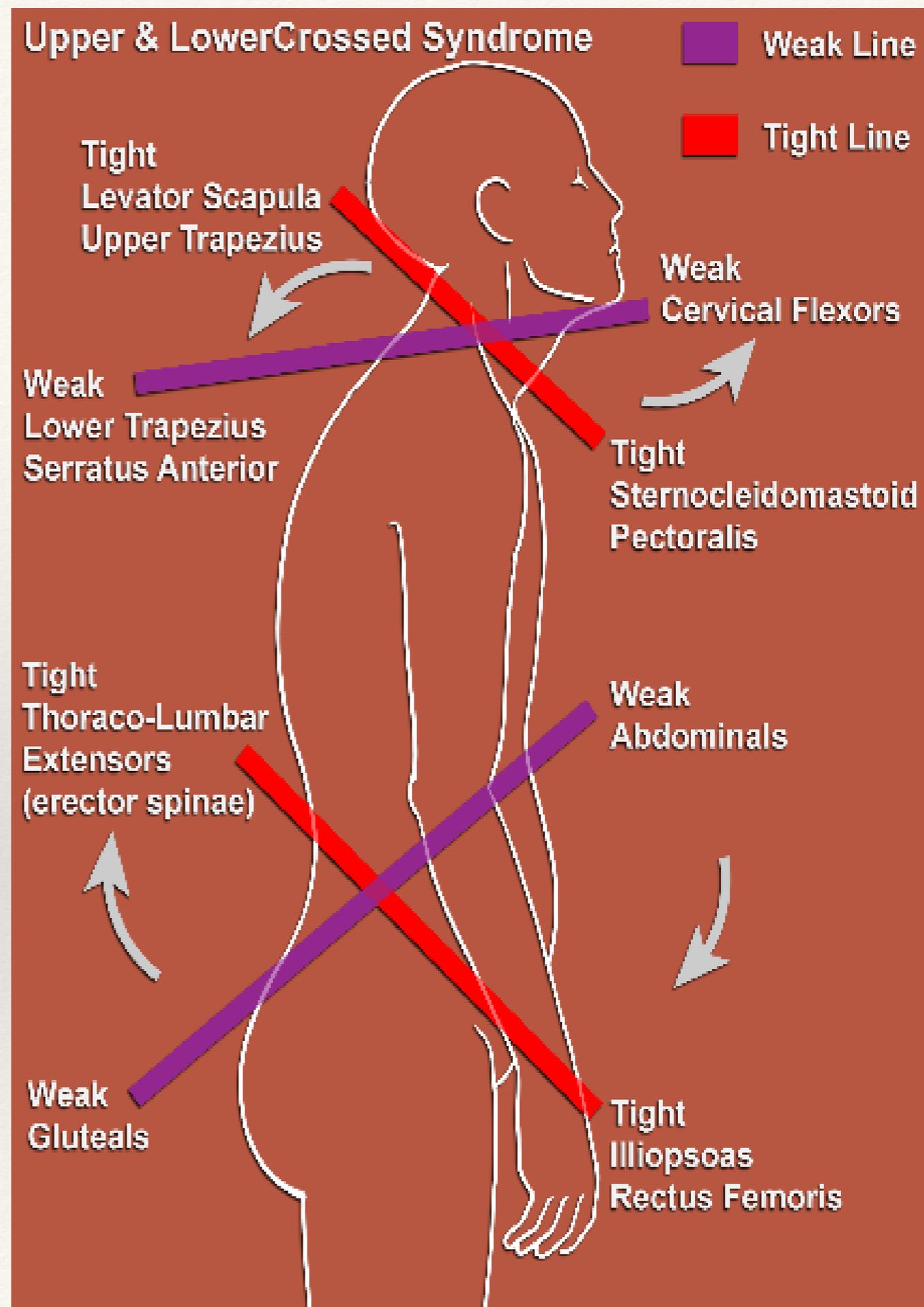
- ❖ Sensorimotor System
 - ❖ Altered input = altered output
- ❖ Balance
- ❖ Concentration

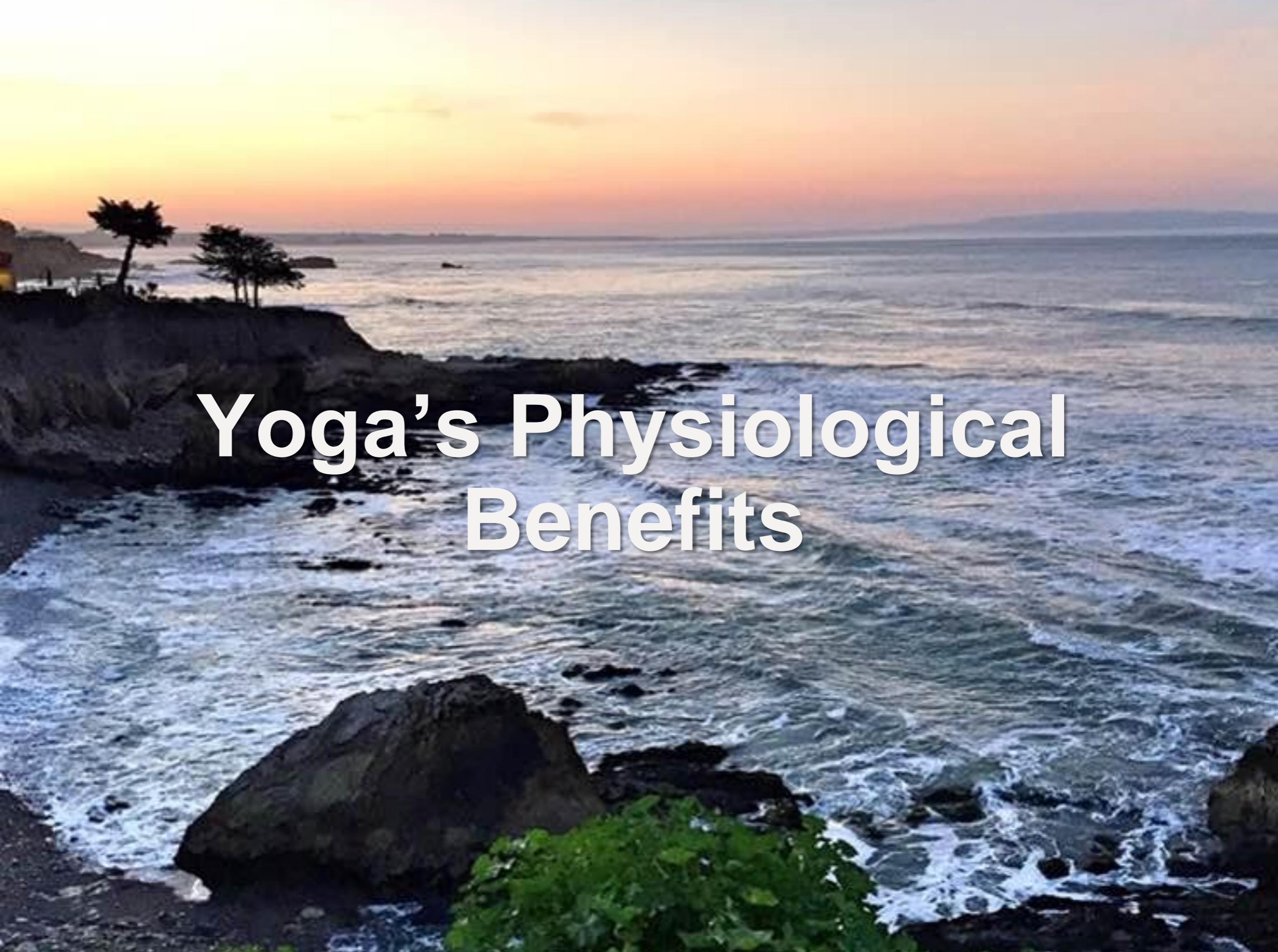


Exercise Prescription

Upper and Lower Crossed Syndromes

- Retrain Proprioception
- Stretch what is tight
- Strengthen what is weak





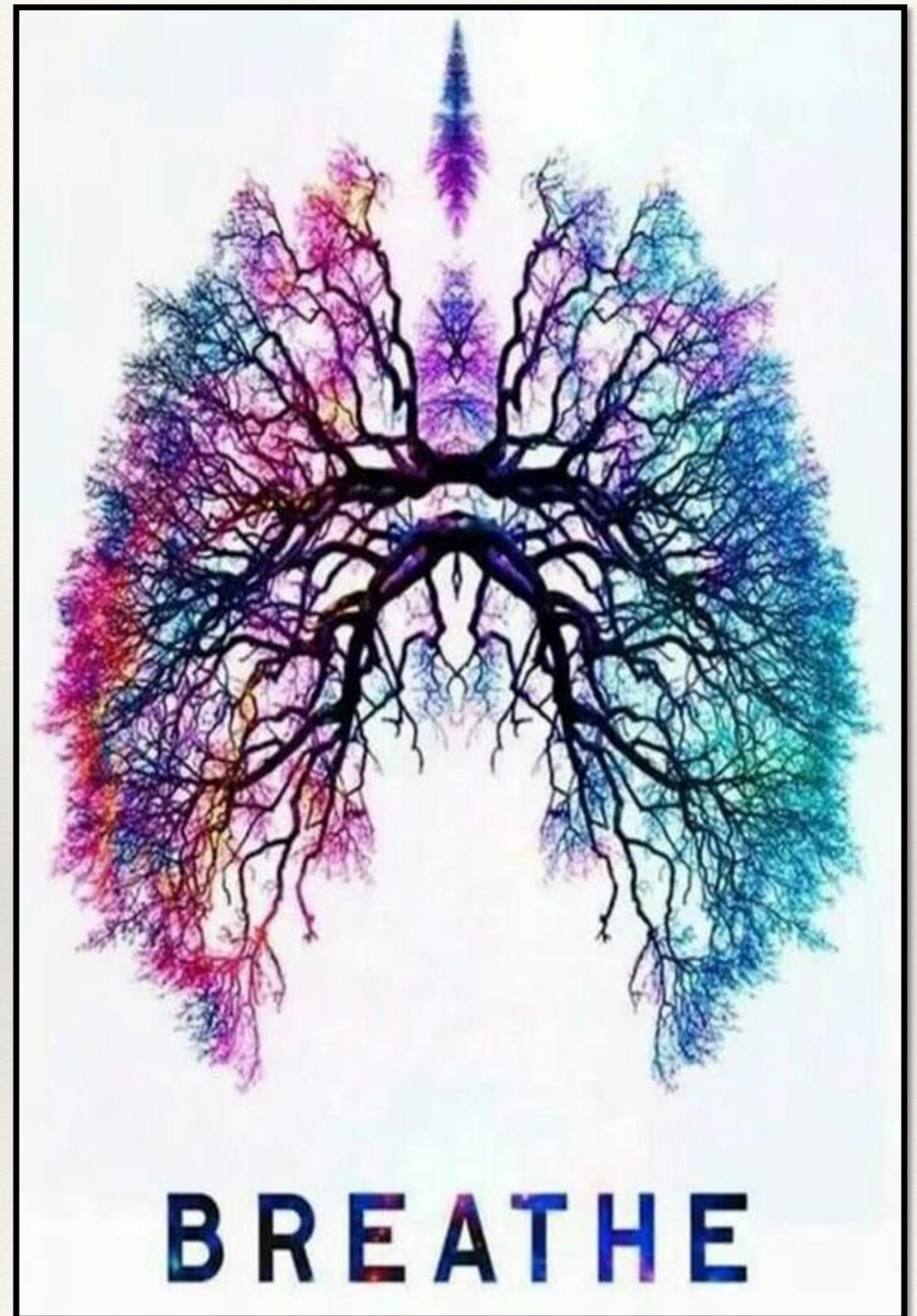
Yoga's Physiological Benefits

“Breath is the King of the Mind”

~B.K.S Iyengar

The Breath-Pranayama

- Reduces dead space ventilation
- Decreases sympathetic tone
- Down regulates the HPA axis
- Calms the mind
- Alters fascial tensions
- Combined with asana can change ventilation to perfusion ratio in different parts of the lungs



How Does Breathing Affect LBP?

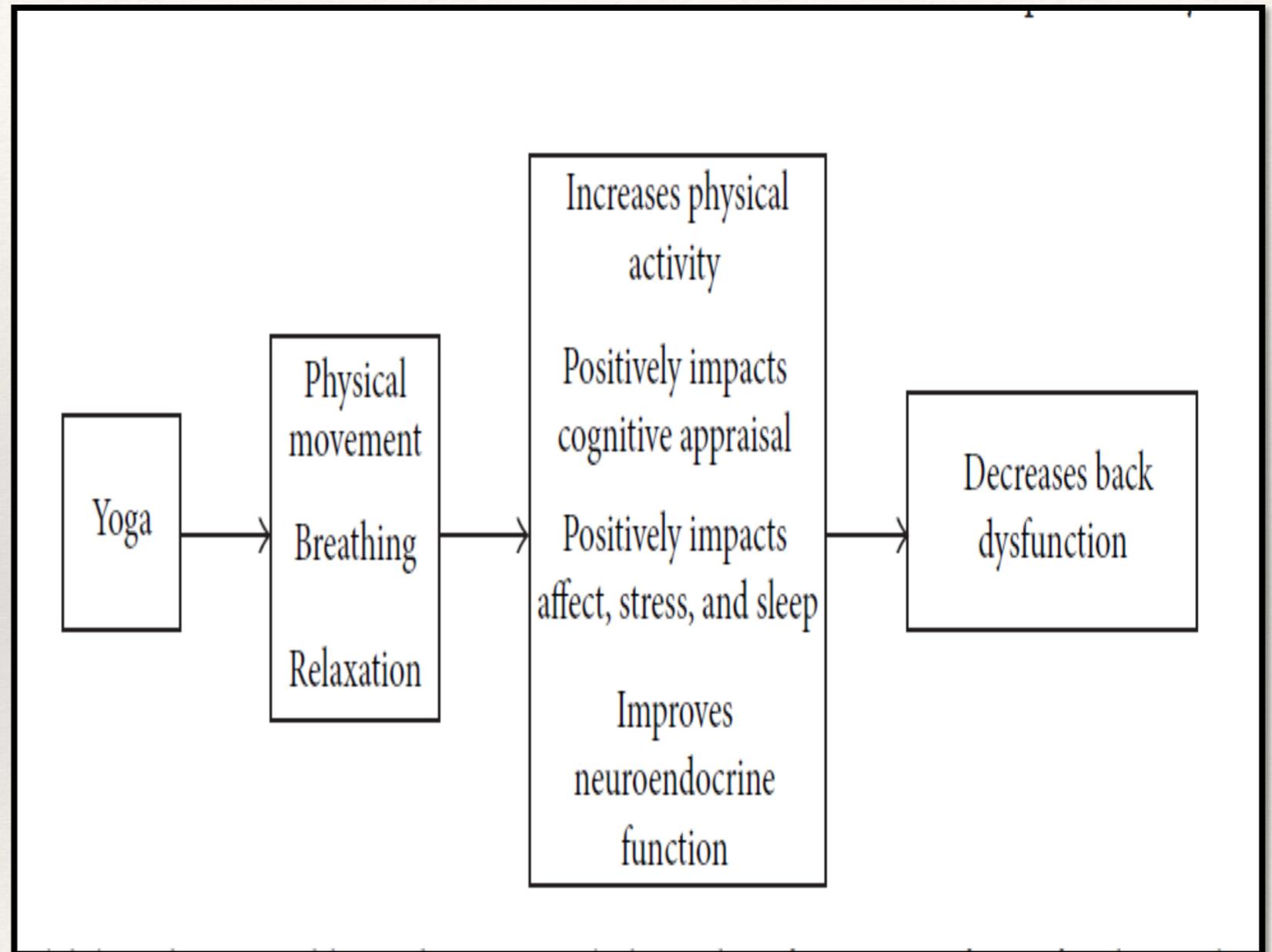
❖ Hyperventilation or Breathing Pattern Disorder²⁴

- ❖ Increases Respiratory Alkalosis
 - ❖ Increases sympathetic tone
 - ❖ Alters serum calcium and phosphate
 - ❖ Increases anxiety
- ❖ A shift from a diaphragmatic to a thoracic breathing pattern
 - ❖ Increased tension in muscles of thoracic breathing
 - ❖ Increase in excitability of the corticospinal system

“During moderate **hyperventilation**, loss of CO₂ ions from neurons stimulates neuronal activity, causing increased sensory and motor discharges, **muscular tension** and spasm, speeding of spinal reflexes, heightened perception (photophobia, hyperacusis) and other **sensory disturbances**”²⁴

A Few Physiologic Responses

- Serotonin- increases
- BDNF- increases
- GABA-increases
- **Autonomic Balancing**
- Decreases salivary cortisol
- Decreases 24-h urine NE/EPI levels
- Decreases HR, BP
- Decreases pro-inflammatory cytokines
- Increases antioxidants



Sherman et al. Mediators of Yoga and Stretching for Chronic Low Back Pain. *Evidence-Based Complementary and Alternative Medicine*. 2013

Resilience vs Vulnerability

- ❖ Promote Health
- ❖ Physical Resilience
- ❖ Emotional Resilience

“What ever happened to mental hygiene?”³⁷

“We don’t teach children how to be resilient, how to cope with stress on a daily basis”³⁷

RESILIENCE

1. The capability of a strained body to recover its size and shape after deformation caused especially by compressive stress.

2. An ability to recover from or adjust easily to misfortune or change.

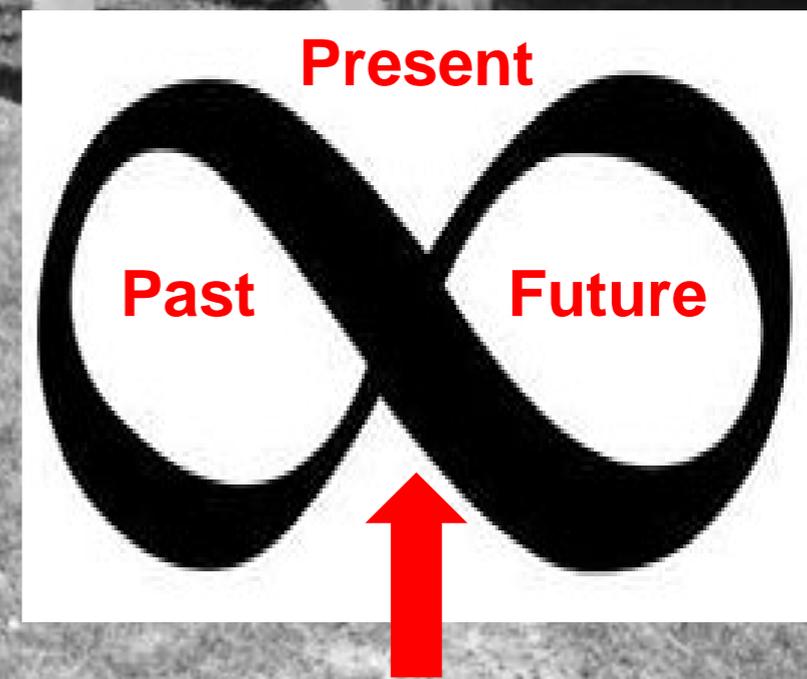
BLOG.ZERODEAN.COM



Yoga- Mechanisms of Action- Psychological

- ❖ Group intervention- motivation
- ❖ Relaxation, stress management, coping skills
- ❖ New Awareness/Learning
- ❖ Identification of emotional response to pain
- ❖ Self-efficacy
- ❖ Cognitive Behavioral Treatment
 - ❖ “Treatment with MBSR (yoga) or CBT compared with usual care resulted in greater improvements in back pain and functional limitations at 26 weeks”¹⁸

Be Here Now

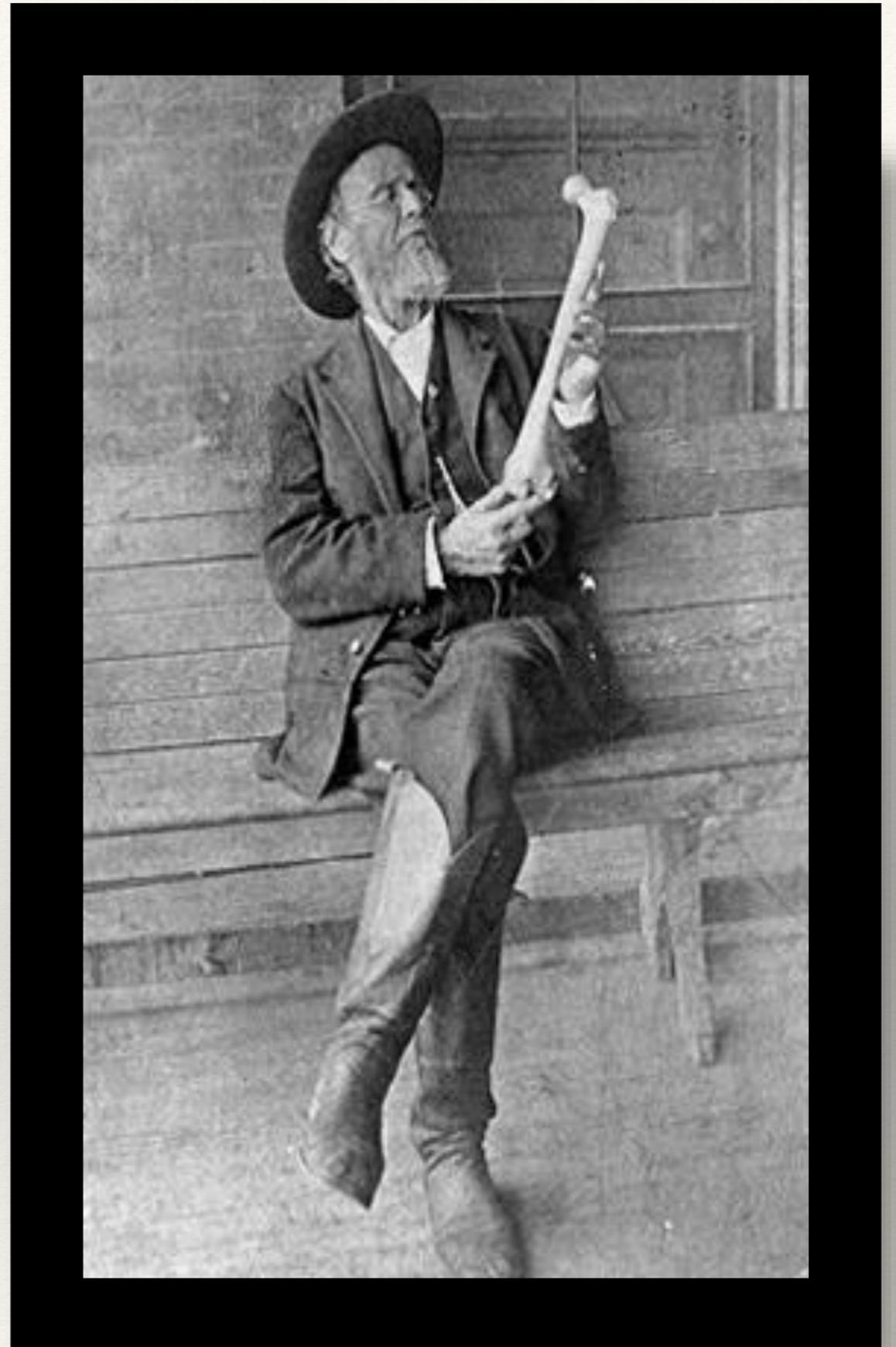


“We look at the body in health as meaning perfection and harmony, not in one part, but in the whole.”

—A.T. Still- *Philosophy and Mechanical Principles of Osteopathy*

Yoga & Osteopathic Principles

- Mind, Body, Spirit
- Structure and function
- The Still Point
- Autonomic Balancing
- Innate self healing
- Improvement of somatic dysfunction



Yoga Similarities to OMT

- ❖ MFR
- ❖ LVLA
- ❖ ME
- ❖ Articulatory
- ❖ Addresses factors contributing to:
 - ❖ Trigger points
 - ❖ Muscle imbalance
 - ❖ Autonomic balancing
 - ❖ Posture



Research Difficulties

- ❖ Style of Yoga
 - ❖ Duration of class
 - ❖ Variations in poses
 - ❖ Inclusion of other limbs of yoga
 - ❖ short term vs long term practice
- ❖ Length of Intervention
- ❖ Practice at home vs class
- ❖ Outcome measured
 - ❖ scale used
- ❖ Quality of teacher
- ❖ Difficult to blind
- ❖ Self referral
- ❖ Attention/Group support

Research-Meta/Systemic Analysis

- ❖ **2007 Annals of Internal Medicine- (3)**

- ❖ Fair evidence that viniyoga are effective for CLBP

- ❖ **2013 Clin J Pain (10/8)**

- ❖ Strong evidence short term effect on pain/long term effect on pain, Moderate evidence on long term effect on disability

- ❖ **2011 Clin Rheumatol (7)**

- ❖ “The evidence that yoga alleviates chronic LBP in the majority of studies is positive. Several caveats, prevent a firm conclusion”

- ❖ **2016 J Orthop Rheumatol (14)**

- ❖ “yoga can reduce pain and disability, can be practiced safely, and is well received by participants”

- ❖ **2012 The Journal of Pain (19)**

- ❖ “Yoga is a useful supplementary approach with moderate effect size on pain and associated disability”

| Author/Year | Yoga Protocol | Main Result |
|---------------------|--|---|
| Williams 2009 | 24 weeks- 2X weekly 90 min sessions- 30 min daily home practice- Iyengar | Improved functional disability, pain intensity, and depression |
| *Sherman 2005/ 2011 | 12 week- 75 min practice asked to practice daily at home Viniyoga | Yoga slightly superior to exercise, moderately superior to self care book |
| Galantino 2004 | 6 week twice weekly 60 minute Hatha yoga- encouraged to practice daily | No statistical difference yoga vs observation |
| Williams 2005 | 16 week- one 1.5 hr class- home practice 30 min 5 days a week Iyengar | Reduction in pain intensity, functional disability & pain med use |
| Tilbrook 2011 | Yoga vs usual care (book) 12 weeks- 75 min- home practice 30 min X2- Iyengar | Greater improvement in back function at 3,6,12 months- no change in pain |
| *Tekur 2008/ 2010 | 7 day residential yoga program | Improved pain related disability and flexibility > exercise |

Adverse Events

◆ **Surveys³⁹**

◆ Finnish Ashtanga survey- 62% at least 1 yoga injury

◆ Australian- 2500 79% never been injured- most were minor

◆ US- less than 1% of yoga practitioners reported a yoga related adverse event

◆ Germany survey- 303 patients- 4% reported adverse events

◆ **Cramer 2013- 10 RCT- Not associated with serious adverse events**

◆ 3 studies with mild to moderate adverse events, 1 study with severe- n=1 herniated disc, n=1 severe pain

◆ **Chang Systematic Review 2016-**

◆ “10-15% incidence of temporarily increased LBP”

◆ **Cramer 2015 Systematic review of RCT- the safety of yoga**

◆ 301 RCT (8,430 participants) 92 reported on adverse events

◆ “yoga appears as safe as usual care and exercise”

◆ **Better reporting of harms has been suggested as a need**

“The Study of asana is not about mastering
posture...
It is about using posture to understand and
transform yourself”

~B.K.S. Iyengar



Awareness and Breath

- ❖ Attention to breath- abdominal breathing
 - ❖ Nasal breathing
 - ❖ Abdomen expands in inhale
 - ❖ 3 part breath
 - ❖ Lengthen exhalation
- ❖ Body Scan
 - ❖ Tense and relax each part of your body slowly, systematically, either from the top down or the bottom up
- ❖ Benefit
 - ❖ Relaxation, parasympathetic (relaxation) response



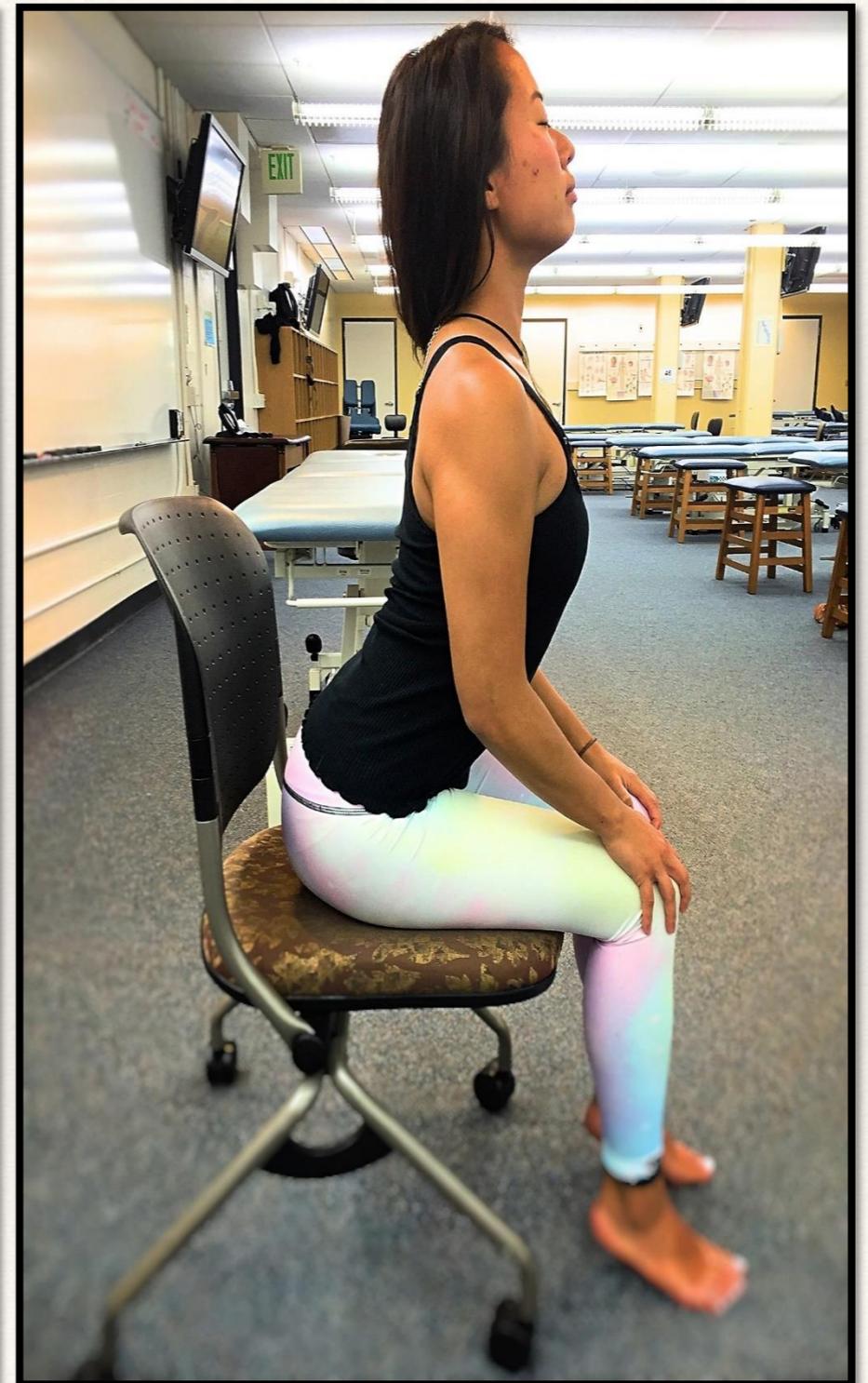
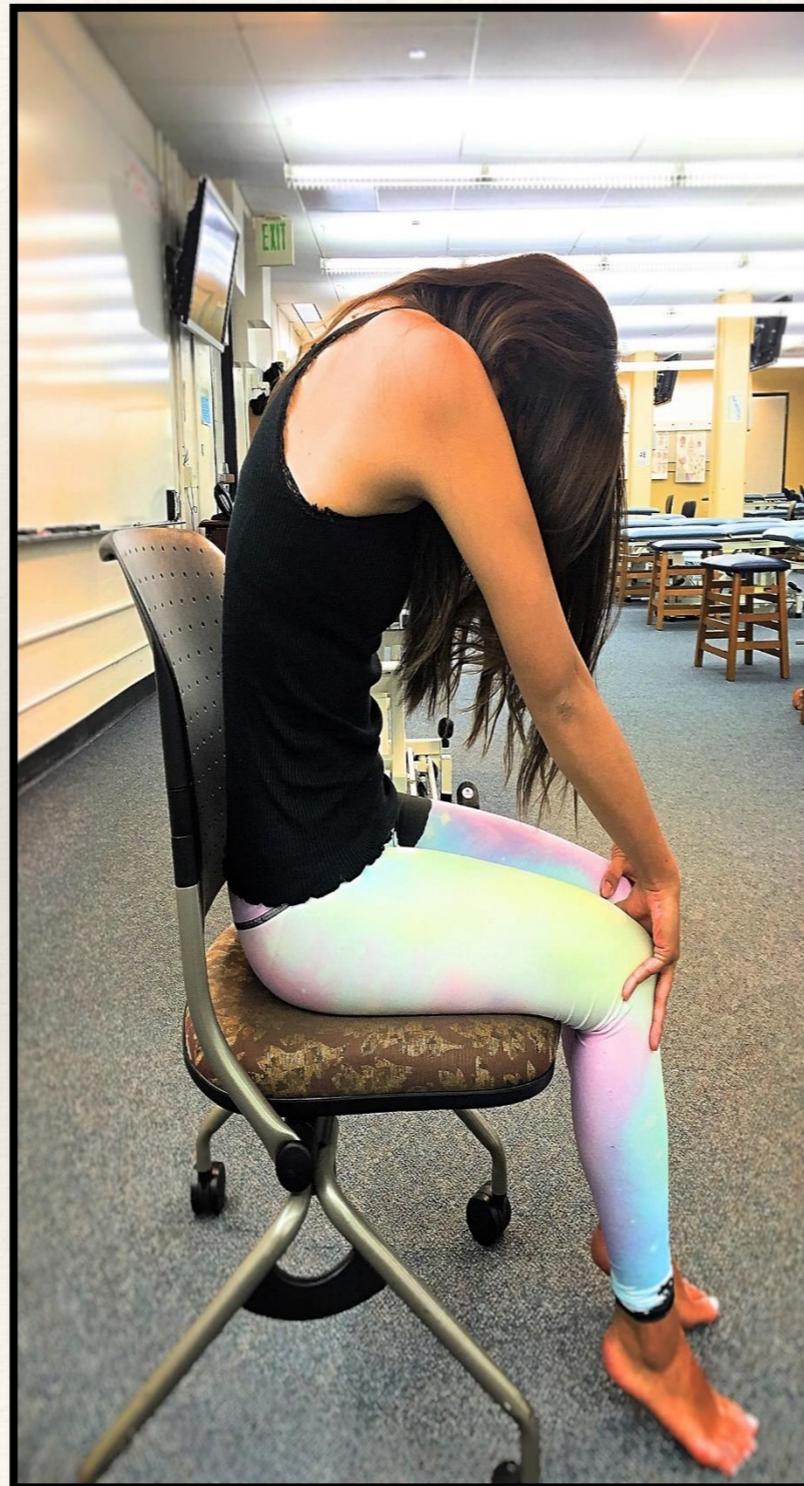
Cat/Cow with the Breath

❖ Exhale

- ❖ Round Forward
- ❖ Head drops
- ❖ Push into upper thoracic spine
- ❖ Coccyx rolls under

❖ Inhale

- ❖ Arch back- extend
 - ❖ Shoulders down and back
 - ❖ Coccyx draws posterior
- ❖ Benefit- improved spine range of motion



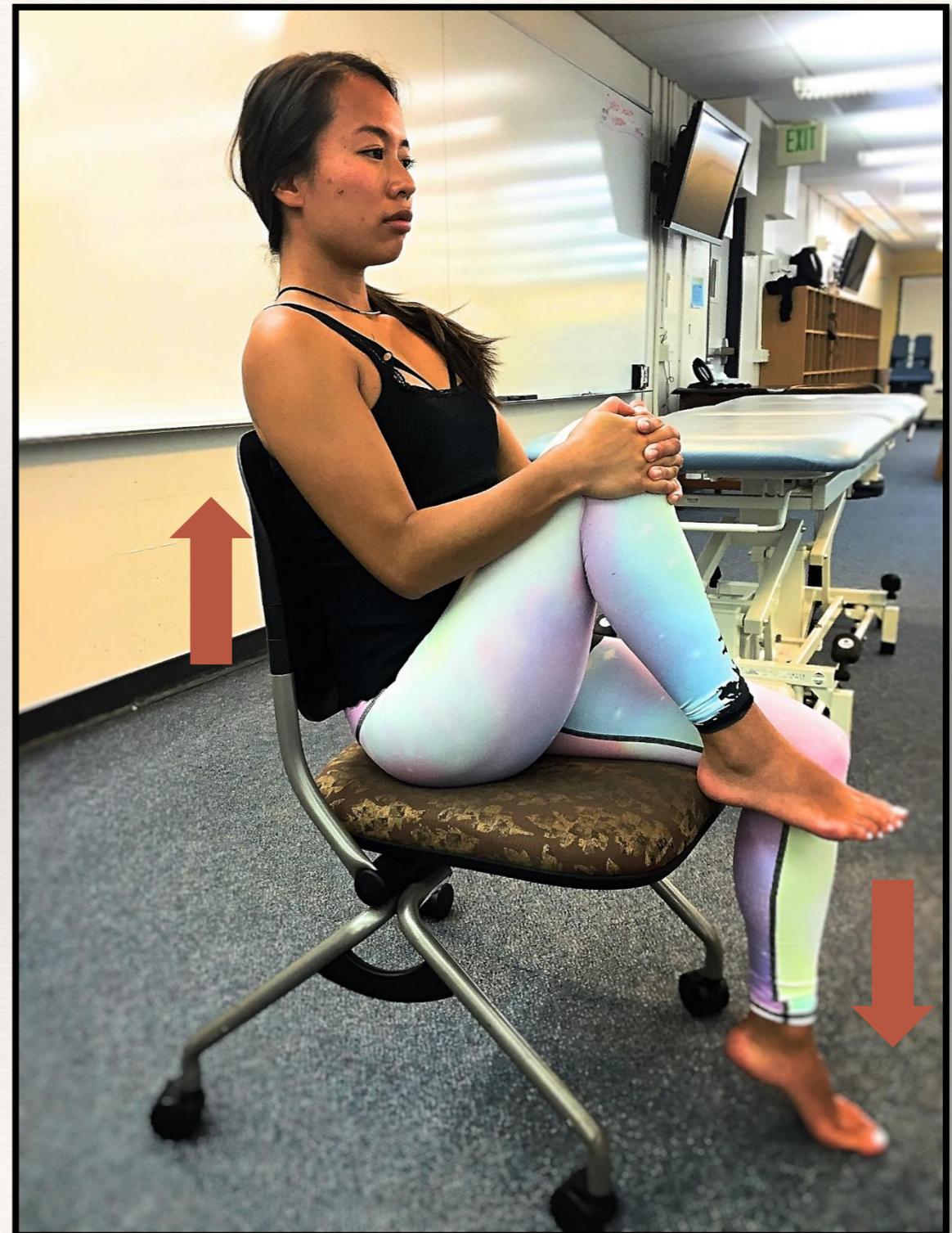
Seated Pawanmuktasana

❖ Inhale

- ❖ Draw the knee to the chest
- ❖ Maintain a straight spine
- ❖ Other foot remains planted on floor

❖ Exhale

- ❖ Release the leg back down
- ❖ Can also do this supine
- ❖ Benefit- improved Hip Range of motion, hip flexion strength



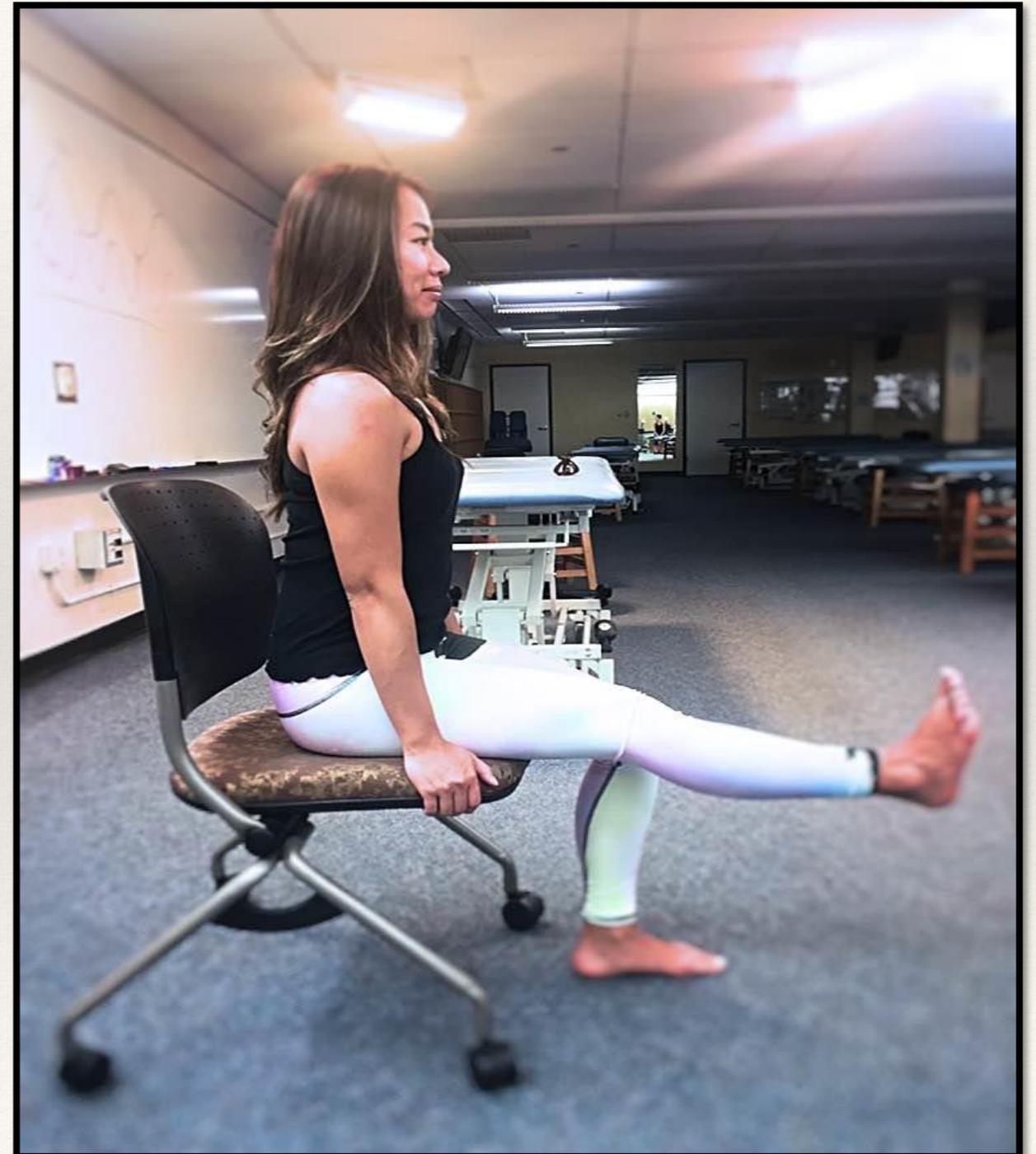
Seated Leg Extension

- ❖ **Inhale**

- ❖ Extend the knee, flex the toes

- ❖ **Exhale**

- ❖ Bend the knee, point the toes
- ❖ Utilizing breath and awareness in movement
- ❖ Spine straight and long
- ❖ Benefit
 - ❖ Strengthening of knee extensors, stretching of hamstrings



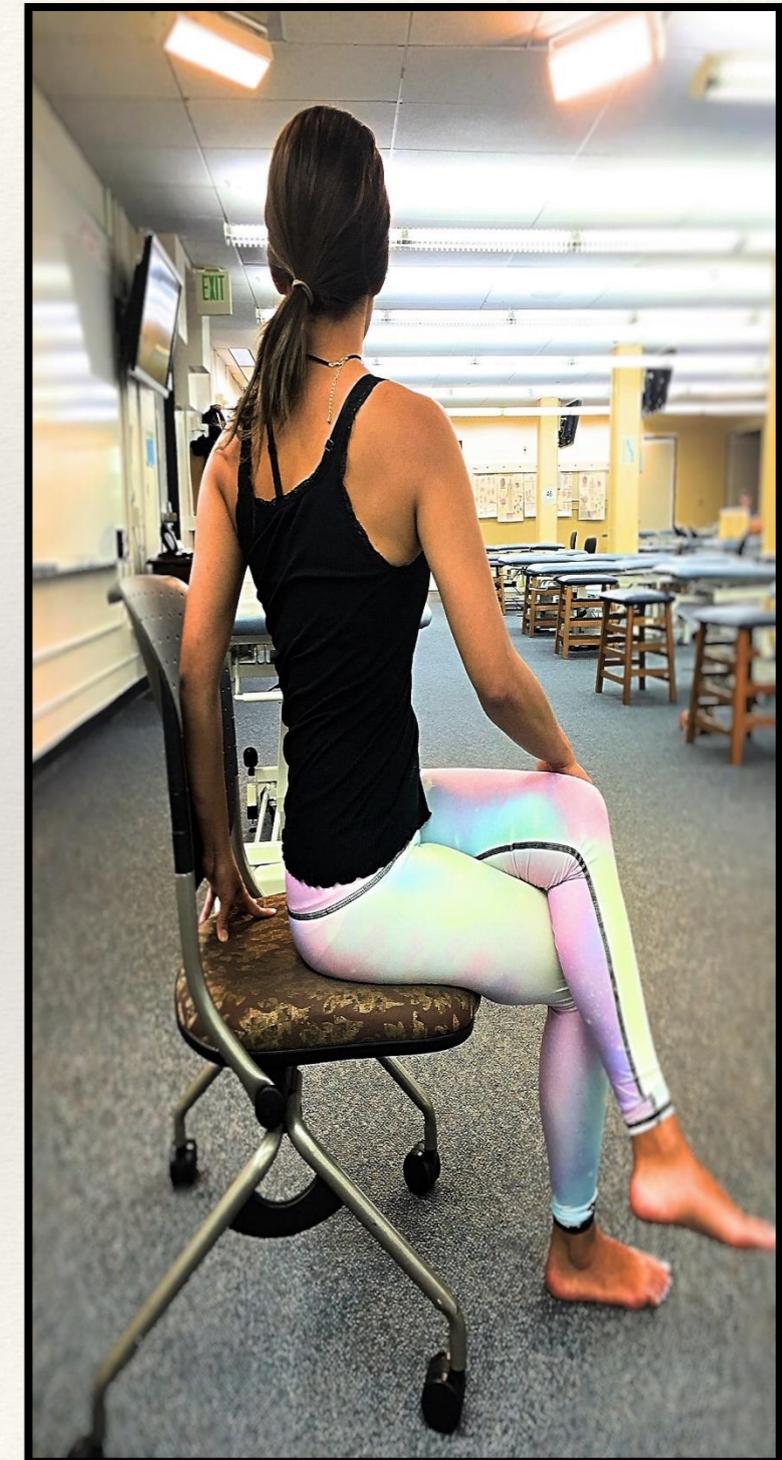
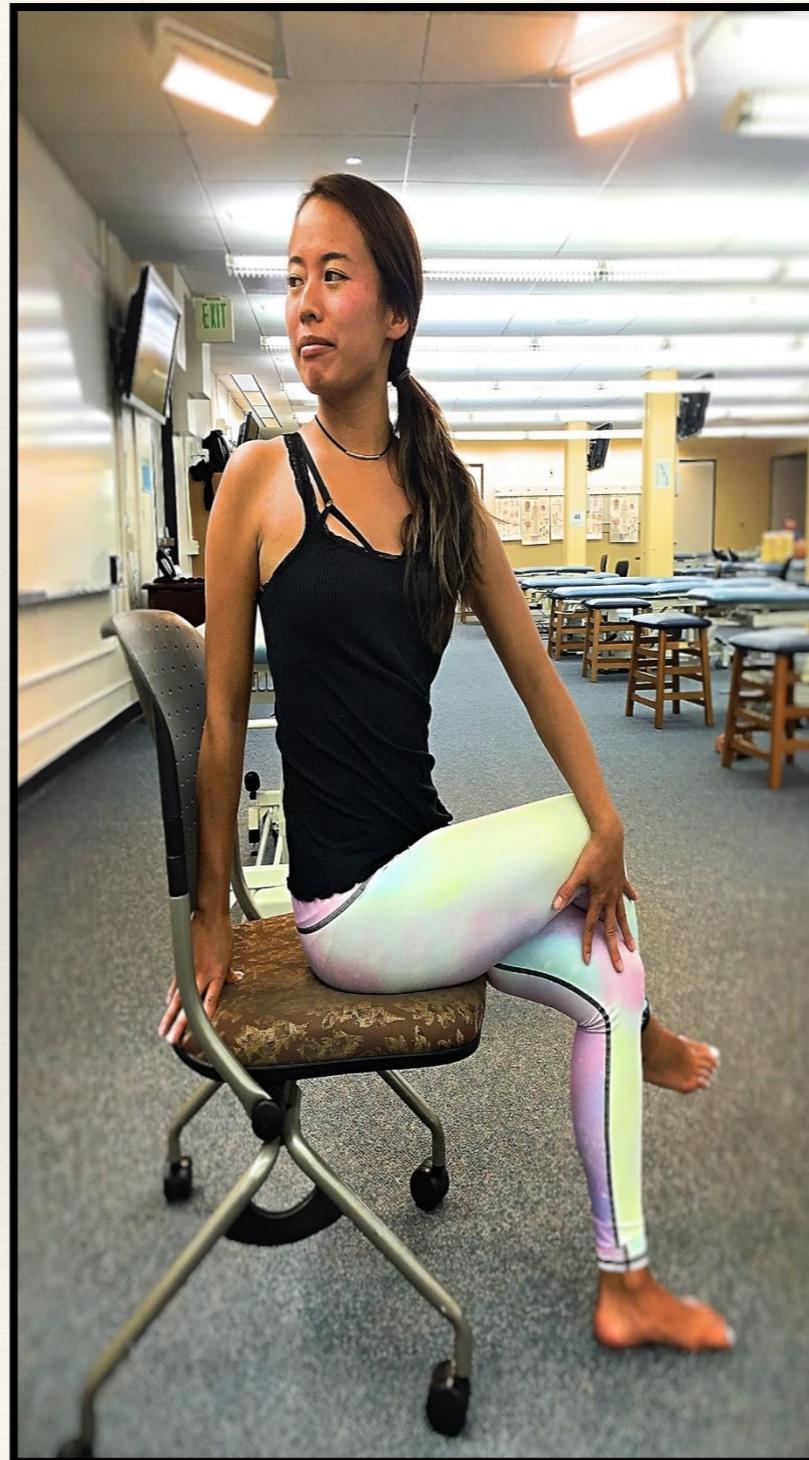
Bharadvajasana- (simple twist)

❖ Inhale

- ❖ Both sits bones (IT) evenly grounded
- ❖ Lengthen through the spine

❖ Exhale

- ❖ Twist
 - ❖ Navel to spine
- ## ❖ Benefit
- ❖ Improved spinal ROM, hip adduction



Seated Ardha Chandrasana

- ❖ May perform and hold on each side for several breaths
- ❖ Or move with the breath
- ❖ Push through the feet and isometrically pull the heels back
- ❖ **Inhale**
 - ❖ Sits bones (IT's) firmly pushing into the chair
 - ❖ Stretch and reach
- ❖ **Exhale**
 - ❖ Release
- ❖ Benefit
 - ❖ Improved spine ROM, improved core strength, stretching of latissimus dorsi



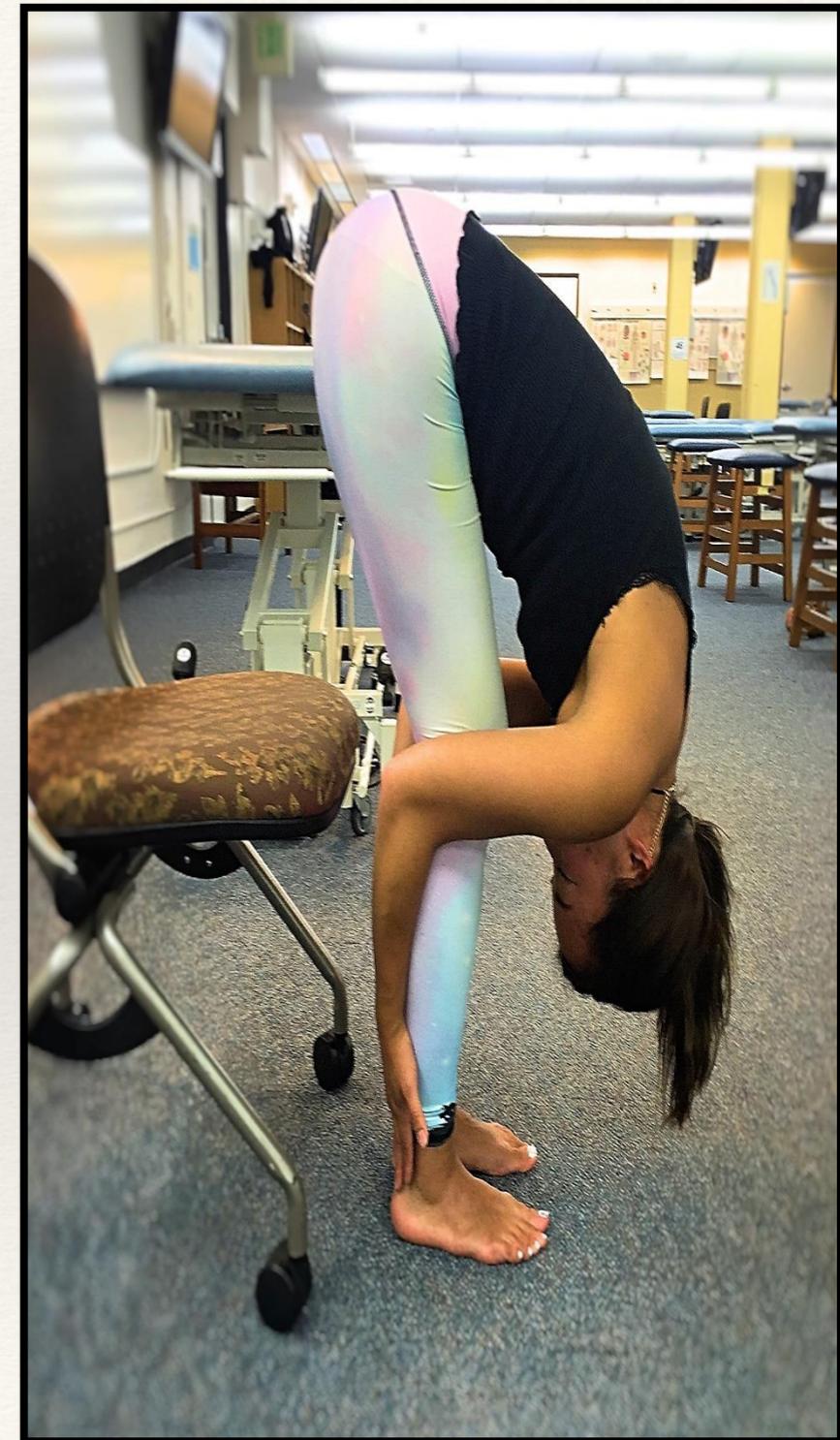
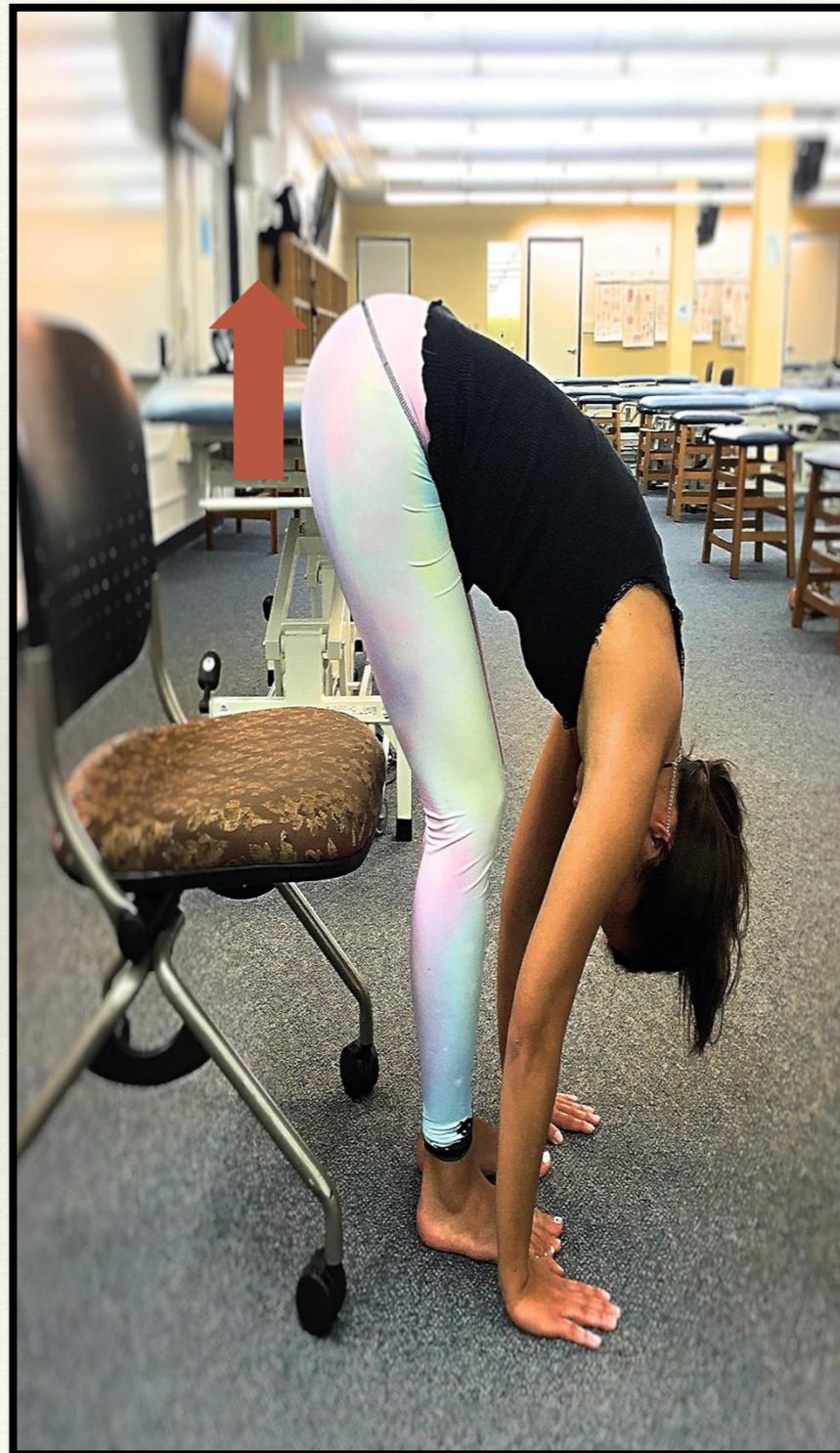
Tadasana (Mountain Pose)

- ❖ Feel the four corners of the feet
- ❖ Engage the quads
- ❖ Slight posterior pelvic tilt
- ❖ Navel to spine
- ❖ Shoulders down and back
- ❖ Chin elevates a little, slight chin tuck
- ❖ **Inhale**
 - ❖ Arms rise overhead
- ❖ **Exhale**
 - ❖ Return to stand
- ❖ Benefits
 - ❖ Balance, strengthening of the lower extremities



Uttanasana (Forward fold)

- ❖ Hinging from the hips
- ❖ Maintain the spine straight
- ❖ Attempting lay the chest on the legs
- ❖ Bending the knees as needed to accommodate tight hamstrings
- ❖ Can stretch here- claspng opposite elbow



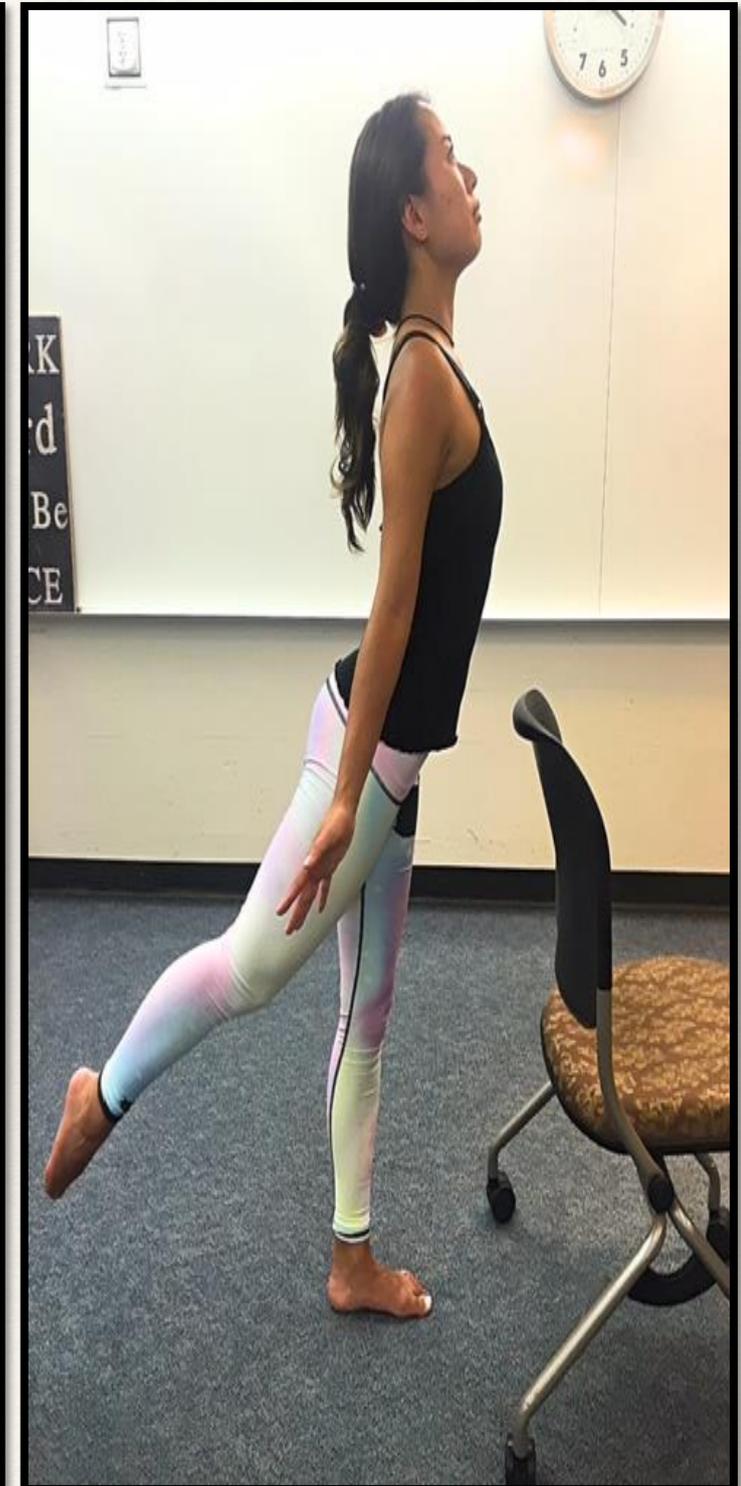
Ardha Uttanasana (half forward fold)

- ❖ Strengthen through legs
- ❖ Hands can rest on the chair, shins or blocks
- ❖ Spine long, tail bone lifts posteriorly
- ❖ **Flow**
 - ❖ Inhale stand
 - ❖ Exhale forward fold
 - ❖ Inhale half forward fold
 - ❖ Exhale forward fold
 - ❖ Inhale stand
- ❖ Benefit
 - ❖ Spinal ROM, hamstring flexibility, core strengthening



Standing Locust

- ❖ Stabilize the standing leg
- ❖ Contract the glutes to extend the hip
- ❖ **Inhale**
 - ❖ Lift the leg
- ❖ **Exhale**
 - ❖ Release
- ❖ Leading to sustained holding of the posture
- ❖ Benefit
 - ❖ Balance, hip extensor strengthening, spinal extension



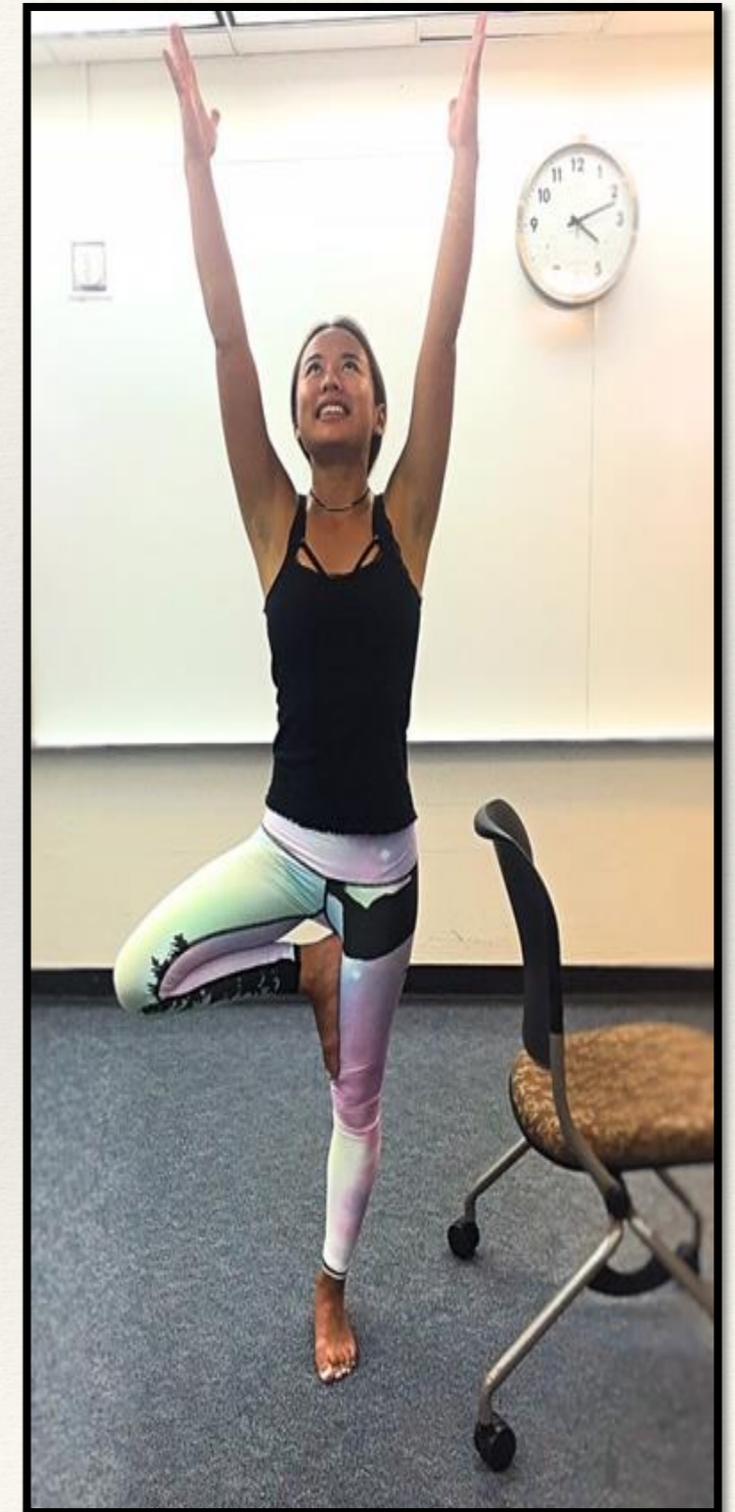
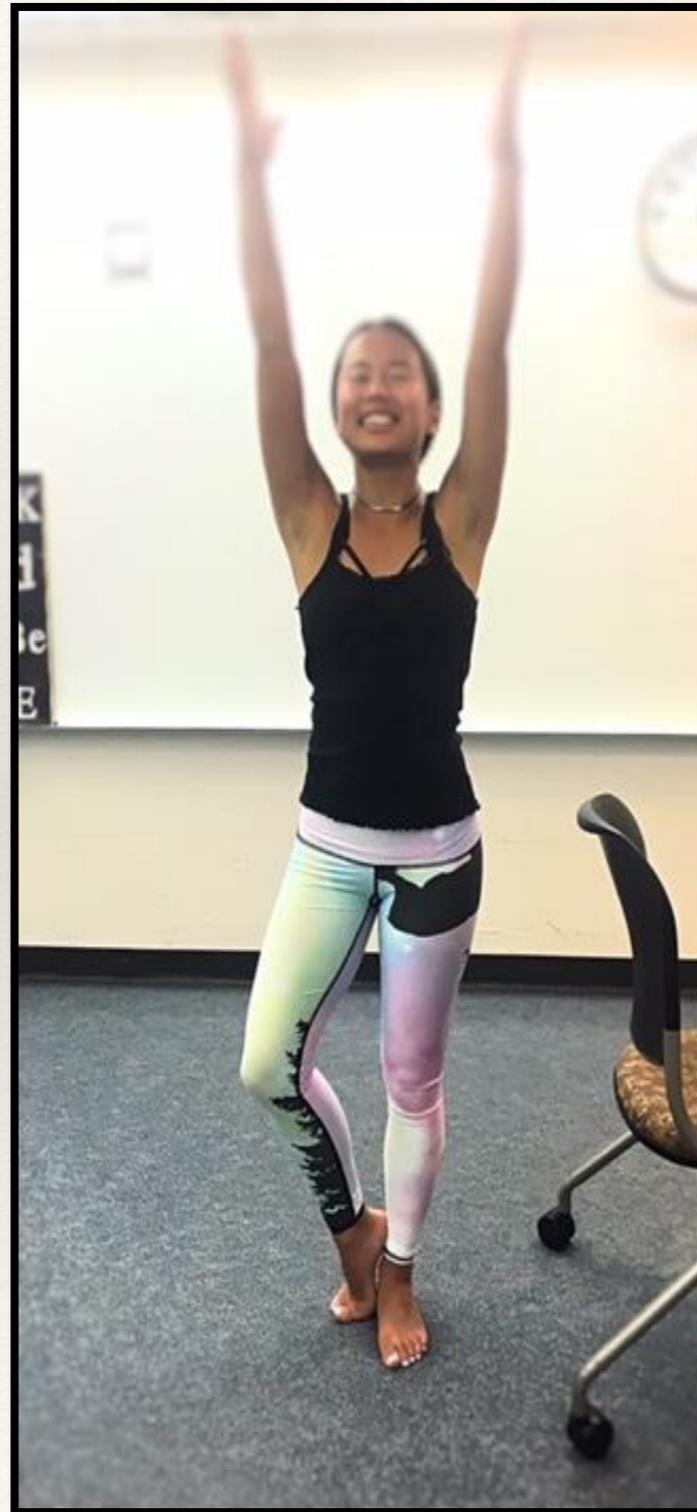
Chair Pose (Utkatasana)

- ❖ Begin in standing (Tadasana)
- ❖ Sit back as you would be lowering yourself into a chair
- ❖ Keeping your knees together
- ❖ **Inhale**
- ❖ stand and lift your arms up
- ❖ **Exhale**
- ❖ Release stand back up
- ❖ To advance hold the form through several cycles of breath
- ❖ Benefits
 - ❖ Gluteus and lower extremity strengthening, core strengthening



Tree Pose (Vrksasana)

- ❖ Find strength and stability on the standing leg
- ❖ Other foot may toe touch, rest on the lower calf, or rest on the upper thigh
 - ❖ Do not let it rest on the knee joint
- ❖ Find a place of focus with your eyes to assist with steadiness
- ❖ Hands can begin at your heart
- ❖ Or arms can elevate
- ❖ Benefit
 - ❖ Balance, Lower extremity strengthen, lengthening of spine



Savasana

- ❖ Find your way to your mat, or a comfortable seat
- ❖ Optimally this would be a position you could totally relax in
- ❖ You may complete a body scan
- ❖ Focusing on the breath to clear the mind
- ❖ Benefit
 - ❖ Relaxation response



How to Recommend a Yoga Teacher

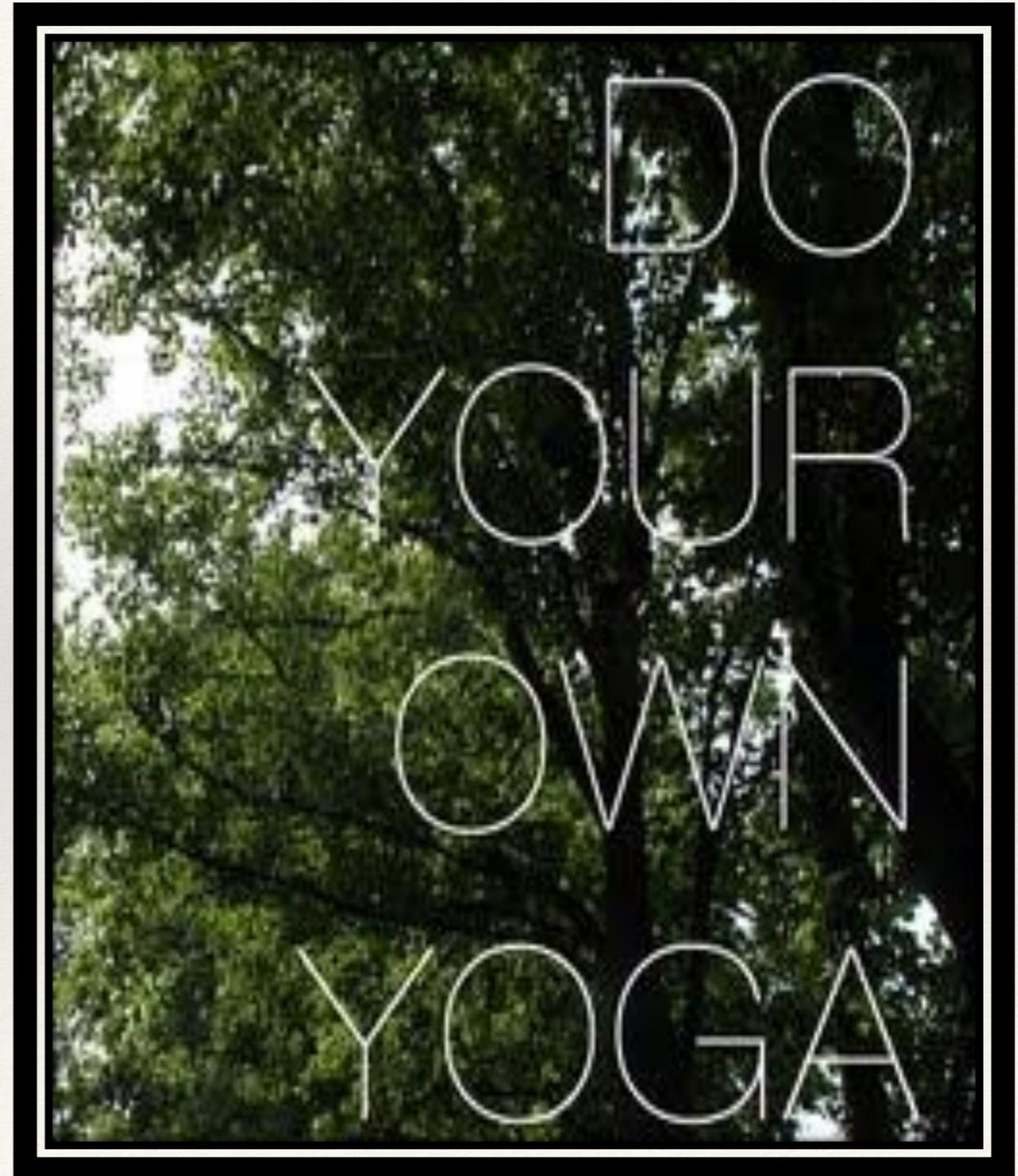
- ❖ Look for types of yoga including “hatha”, “anusara”, “beginner”
- ❖ Avoid “hot”, “bikram”, “ashtanga”, “power”, “vinyasa”
- ❖ Find teachers who also provide private sessions
- ❖ RYT 200, ERYT-200, RYT-500, ERYT 500
 - ❖ Number denotes hours of training- e denotes number of hours teaching
 - ❖ Yoga Alliance (www.yogaalliance.org)
- ❖ **Yoga Therapy**
 - ❖ International Alliance of Yoga Therapists (IAYT)
 - ❖ <http://www.iayt.org/>

Questions Your Patient Can Ask

- ❖ How strenuous will the workout be?
- ❖ How many poses are done in what period of time?
- ❖ The level of difficulty of the poses?
- ❖ How and where the teacher was trained?
- ❖ What kind of yoga the teacher does?
- ❖ Whether there is attention to physical problems like back pain?
- ❖ Whether meditation is included in the lesson?
 - ❖ From “*Cure Back Pain with Yoga*”²⁵
- ❖ Do the teachers modify postures?
- ❖ Does the patient connect or identify with other people in the class?
- ❖ What populations of people has the teacher worked with before?

Practice Advice

- Patients may begin with 1-2 poses per day- holding for 15-20 seconds
- Shorter holds before longer holds
- Moderation
- Slow medicine
- Start simple
- Listen to pain- good pain- vs injury
- **INJURIES DO HAPPEN**
- Flexible people at greater risk of injury
- Neck injuries most serious



Special Thanks To.....



My Teachers and Classmates at Niroga Institute Yoga Therapy training Program, with special thanks to:

- Bidyut Bose PhD, Founder, Executive Director
- Rosalind Lwin, Health Program Director
- <http://www.niroga.org/>
- **TUCOM Students Extraordinaire!**
- Hiroe Hu OMS II
- Cara Vernacchia OMS II
- **Questions?**
- Email: Stacey.piercetalsma@tu.edu

Bibliography

1. Clarke, T. Et al. Trends in the use of complementary health approaches among adults: United States, 2002-2012. *Natl Health Stat Report*. 2015 Feb 10; (79):1-16
2. Cramer, H. Et al. Prevalence, Patterns, and Predictors of yoga use. *American Journal of Preventative Medicine*. 2015.
3. Williams, K. et al. Evaluation of the effectiveness and efficacy of Iyengar yoga therapy on chronic low back pain. *SPINE*. 2009; 34(19):2066-2076
4. Sherman, K. et al. Comparing yoga, exercise, and a self-care book for chronic low back pain. *Annals of Internal Medicine*. 2005; 43(12):849-856
5. Chou, R. Huffman, L. Nonpharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American pain society/american college of physicians clinical practice guideline. *Annals of Internal Medicine*. 2007; 147:492-504
6. Galantino, M. et al. The impact of modified hatha yoga on chronic low back pain: a pilot study. *Alternative Therapies in Health and Medicine*. 2004;10(2):56-59
7. Cramer, H. et al. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*. 2013;29(5):450-460
8. Williams, K. et al. Effect of Iyengar yoga therapy for chronic low back pain. *Pain*. 2005; 115: 107-117
9. Tilbrook, H. Et al. Yoga for chronic low back pain. *Annals of Internal Medicine*. 2011; 155:569-578
10. Cox, H. et al. A pragmatic multi-centered randomized controlled trial of yoga for chronic low back pain: trial protocol. *Complementary Therapies in Clinical Practice*. 2010; 16:76-80

Bibliography Continued

11. Posadzki, P. Ernst, E. Yoga for low back pain: a systemic review of randomized clinical trials. *Clin Rheumatol.* 2001; 30:1257-1262
12. Wieland, LS. et al. Yoga treatment for chronic non-specific low-back pain (protocol). The Cochrane Collaboration. 2013 John Wiley & sons, Ltd.
13. Williams, K. et al. therapeutic application of iyengar yoga for healing chronic low back pain. *International Journal of Yoga Therapy.* 2003; 13:55-67
14. Chang, D. et al. Yoga as a treatment for chronic low back pain: A systematic review of the literature. *J Orthop Rheumatol.* 2016;3(1):1-8
15. Tekur, P. et al. Effect of Short-Term Intensive Yoga Program on Pain, functional disability, and spinal flexibility in chronic low back pain: a randomized control study. *The Journal of Alternative and Complementary Medicine.* 2008, 14;(6):637-644
16. Saper, R. et al. Yoga for chronic low back pain in a predominantly minority population: a pilot randomized controlled trial. *Altern Ther Health Med.* 2009;15(6):18-27
17. Jacobs, B. et al. Feasibility of conducting a clinical trial on hatha yoga for chronic low back pain: methodological lessons. *Alternative Therapies.* 2004;10(2):80-83
18. Cherkin, D. et al. Effect of mindfulness-based stress reduction vs cognitive behavioral therapy or usual care on chronic low back pain a randomized clinical trial. *JAMA* 2016;315(12):1240-1249
19. Bussing, A. Effects of yoga interventions on pain and pain-associated disability: a meta-analysis. *The Journal of Pain,* 2012; 13(1):1-9
20. Kelly, Z. Is yoga an effective treatment for low back pain: a research review. *International Journal of Yoga Therapy.* 2009; 19: 103-112

Bibliography Continued

21. Sengupta, P. Health Impacts of yoga and pranayama: a state-of-the-art review. *Int J Prev Med* 2012;3:444-58
22. Cramer, H. et al. I'm more in balance: a qualitative study of yoga for patients with chronic neck pain. *The Journal of Alternative and Complementary Medicine*. 2013; 19(6):536-542
23. Wren, A. Yoga for persistent pain: new findings and directions for an ancient practice. *Pain* 2011; 152(3):477-480
24. Vleeming, A., Mooney, V., Stoeckart, R. Movement, stability and lumbopelvic pain integration of research and therapy. 2nd edition. *Churchill Livingstone Elsevier* 2007
25. Fishman, L. Ardman, C. Cure Back Pain with Yoga. 2005. W. W. Norton and Company. NY, NY.
26. B.K.S. Iyengar. Light on Yoga.
27. Standing S. Gray's Anatomy the anatomical basis of clinical practice. Elsevier 2016
28. Lee, M. Effect of Yoga on Pain, Brain-Derived Neurotrophic Factor, and Serotonin in premenopausal women with chronic low back pain. *Evidence-Based Complementary and Alternative Medicine* 2014
29. Sherman, K. et al. Mediators of yoga and stretching for chronic low back pain. *Evidence Based Complementary and Alternative Medicine*. 2013
30. Dum, R. et al. Motor, cognitive, and affective areas of the cerebral cortex influence the adrenal medulla. *PNAS*, 2016: 113(35)

Bibliography Continued

31. Hartigan, C. et al Exercise-based therapy for low back pain. *UpToDate*. Updated April 5, 2016
32. Wheeler, S. et al. Evaluation of low back pain in adults. *UpToDate*. Updated April 27, 2016
33. Keleman, S. Emotional Anatomy. *Center Press*, Berkeley 1985
34. McCall Timothy. Yoga as medicine the yogic prescription for health and healing. *Bantam Books* 2007
35. Schlereth, T. Birklein, F. The sympathetic nervous system and pain. *Neuromolecular medicine*, 2008;10(3):11-147
36. Streeter, C. et al. Effects of yoga versus walking on mood, anxiety and brain GABA levels: A randomized controlled MRS study. *The Journal of Alternative and Complementary Medicine*. 2010; 16(11):1145-1152
37. Broad, W. The science of yoga the risks and the rewards. *Simon & Schuster*. 2012
38. Robin, M. A physiological handbook for teachers of yogasana. *FENESTRA* 2002
39. Cramer, H. Et al. The safety of yoga: a systematic Review and meta-analysis of randomized controlled trials. *American Journal of Epidemiology*. 2015; doi:10.1093/aje/kwv071