2019 NSCA TACTICAL
ANNUAL TRAINING

Conflict of Interest Statement

I have no actual or potential conflict of interest in relation to this presentation.

Back Off: Strong Backs
From Rehabilitation to Performance

Dr Rob Orr Phd, MPHTY, BFET, APAM, TSAC-F

https://tru.bond.edu.au/

Contents

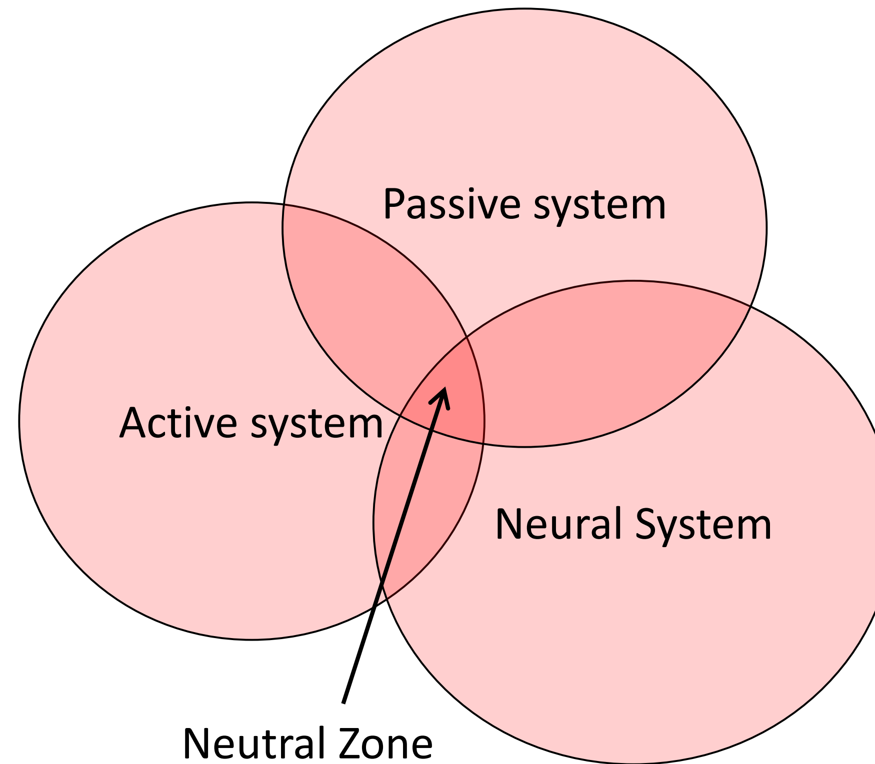
- About the back
- Rehabilitation – It's not that easy
- Developing strong backs

Outcomes

- Explain how the back is compromised by both passive and active duties
- Compare the active, passive and control systems that allow the lower back to transfer load
- Construct programs to optimizing the physical conditioning and reconditioning of the lower back in tactical personnel

About the Back

- Punjabi’s Concept of Back Stability
  - The passive system
  - The active system
  - The control system

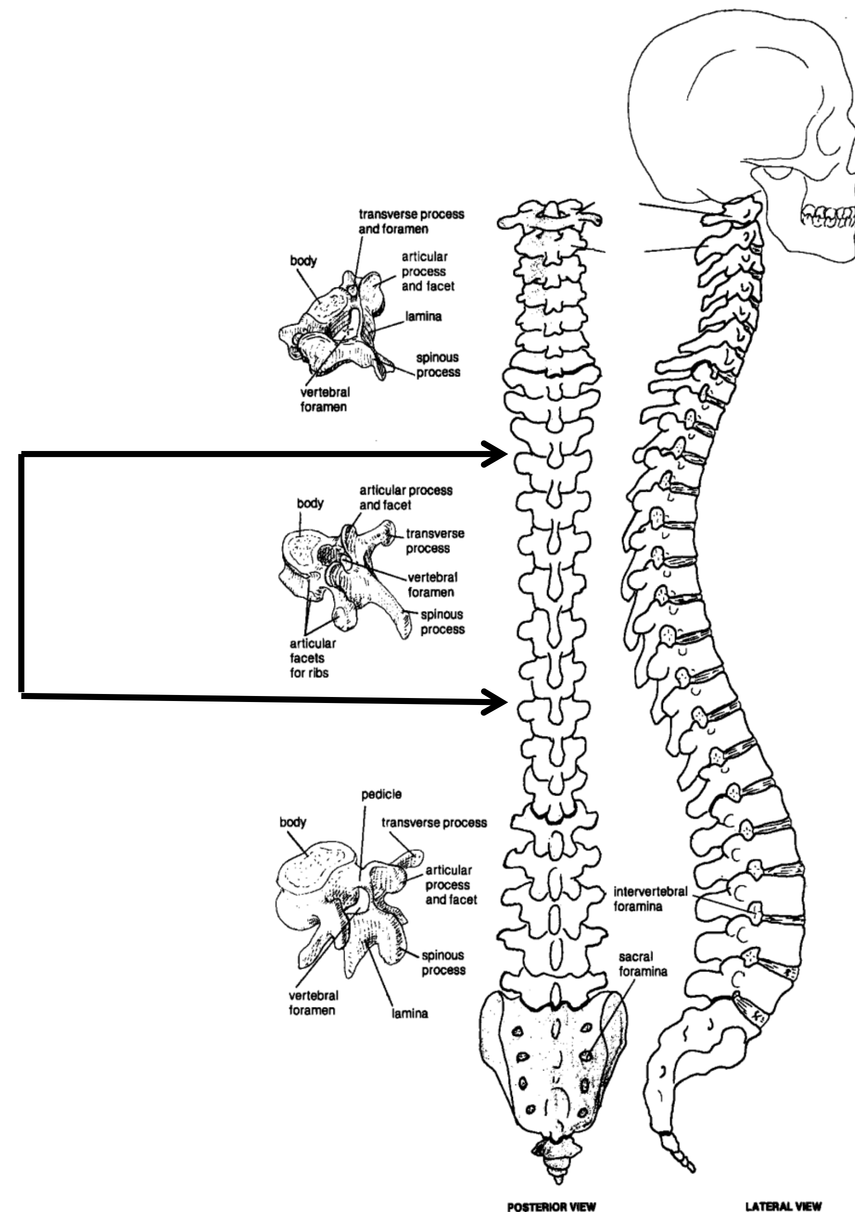


Panjabi MM. The stabilizing system of the spine. Part 1, function, dysfunction and enhancement. Journal of Spinal Disorders 1992; 5 (4): 383-9.

The Passive System

- Basic Anatomy – The Spinal Column

Segmented to allow movement

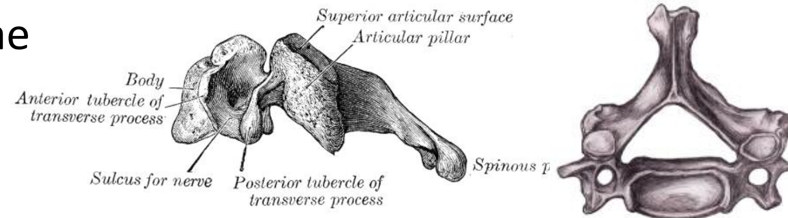


Restriction of motion at ANY level of the spine will increase the range requirement of the joints above and below

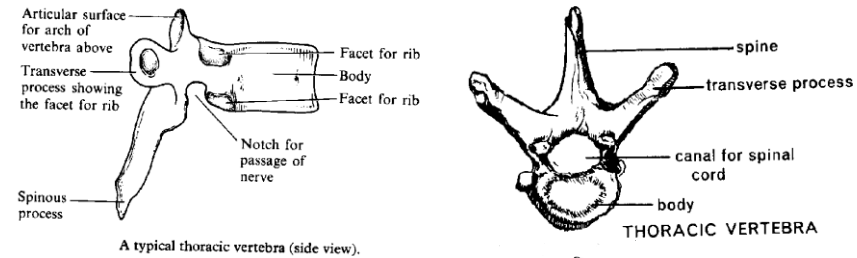
The Passive System

- Basic Anatomy – The Spinal Column

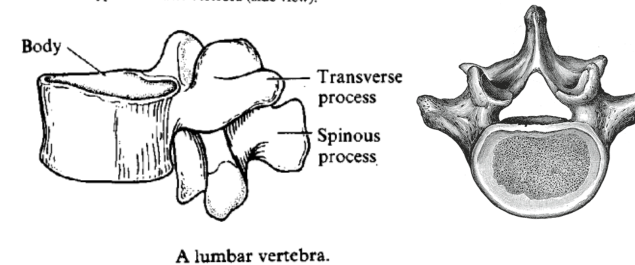
The Cervical Vertebrae
- Moderate F/E
- Good Rot



The Thoracic Vertebrae
- Limited F/E
- Limited Rot

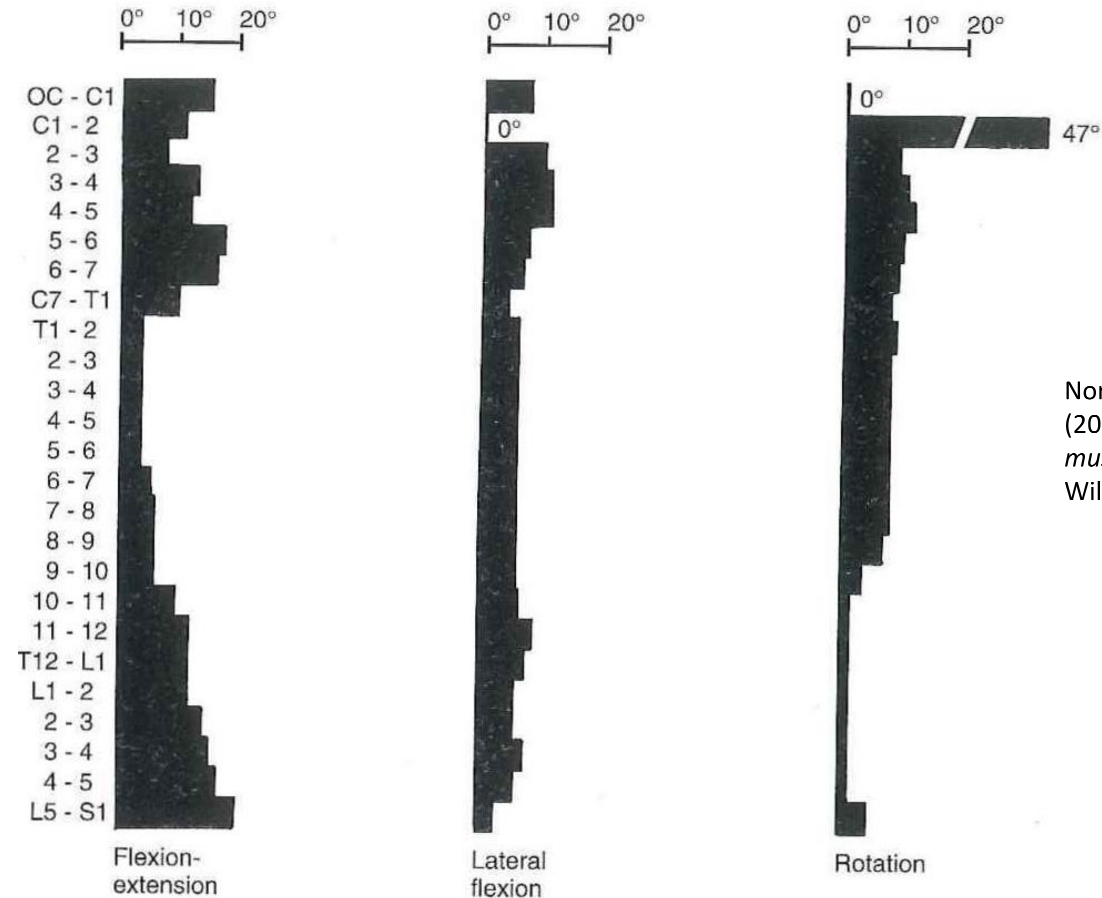


The Lumbar Vertebrae
- Good F/E
- Limited Rot



The Passive System

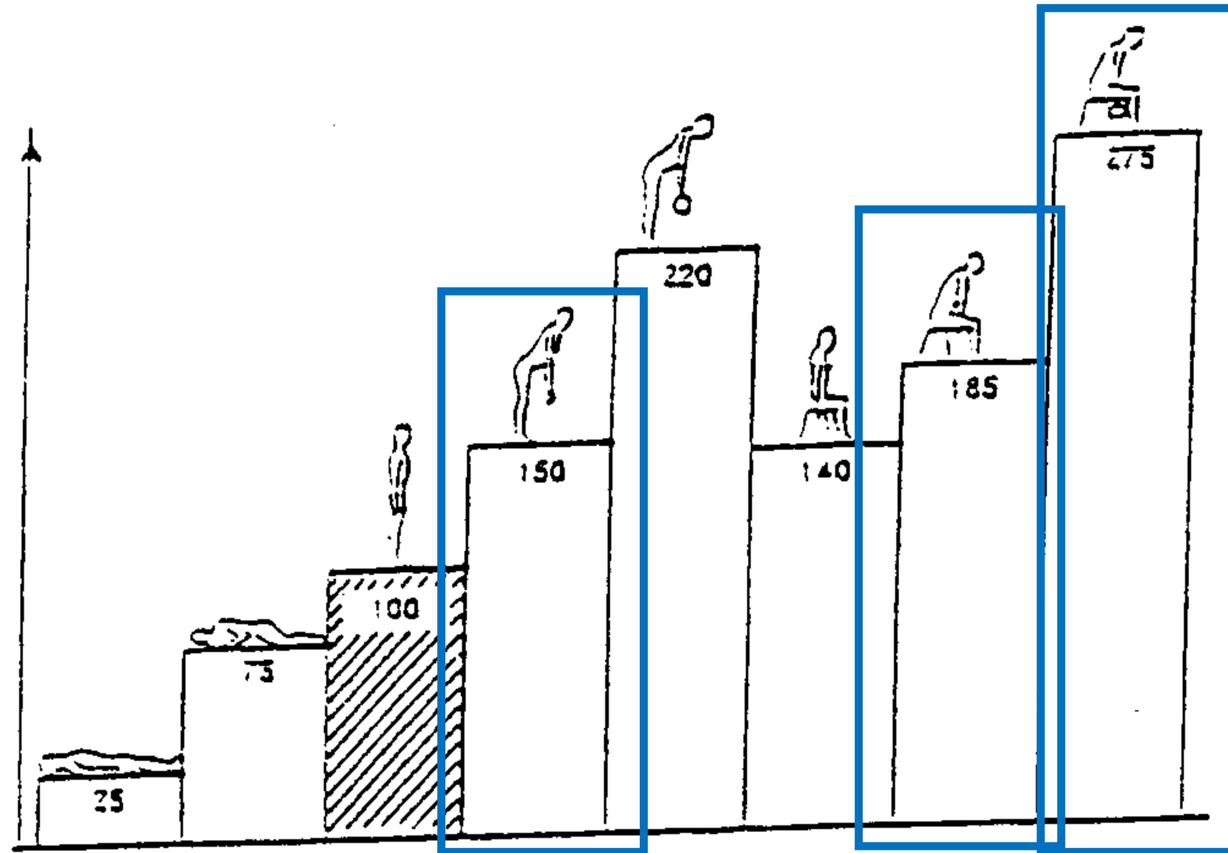
- Basic Anatomy – The Spinal Column



Nordin, M., & Frankel, V. H. (Eds.). (2001). *Basic biomechanics of the musculoskeletal system*. Lippincott Williams & Wilkins. Fig. 10-7

The Passive System

- Basic Anatomy – The Spinal Column



Nachemson, A(1975). Towards a better understanding of back pain. *A review of the mechanics of the lumbar disc.* Rheumatol Rehabil, 14, 129.

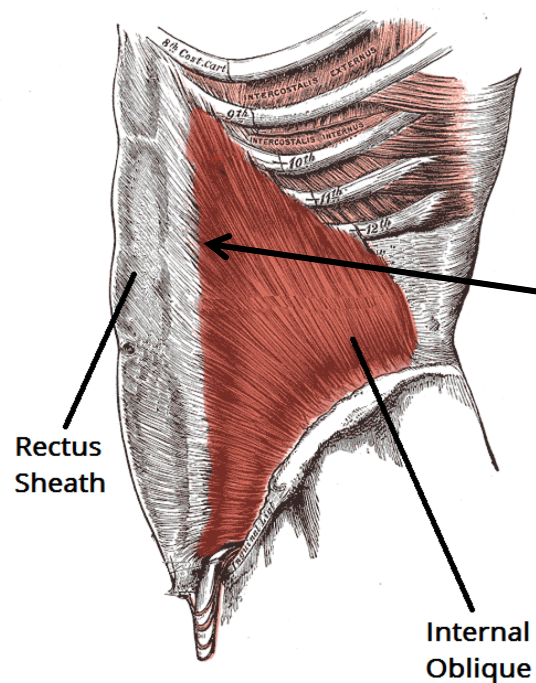
The Passive System

- Basic Anatomy – The Spinal Column

The Active System

- Basic Anatomy – Rectus Abdominus (RA)

Upper ¾ enclosed by a sheath formed from the aponeurosis of the Obliques and TA



IO divides into 2

- Anterior sheath blends with EO to pass in front
- Posterior sheath with TA to pass behind
- All join again at the Linea Alba

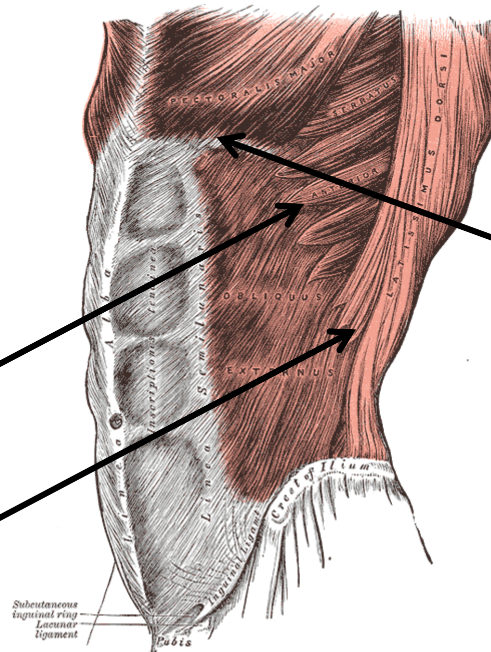
Williams, P. L. (Ed.). (1995). *Gray's anatomy* (Vol. 58). New York: Churchill Livingstone

The Active System

- Basic Anatomy – External Oblique (EO)

8 Fleshy digitations from the lower 8 ribs–

- 5 superior are received between corresponding Serratus Anterior and
- 3 lower from the lats dorsi



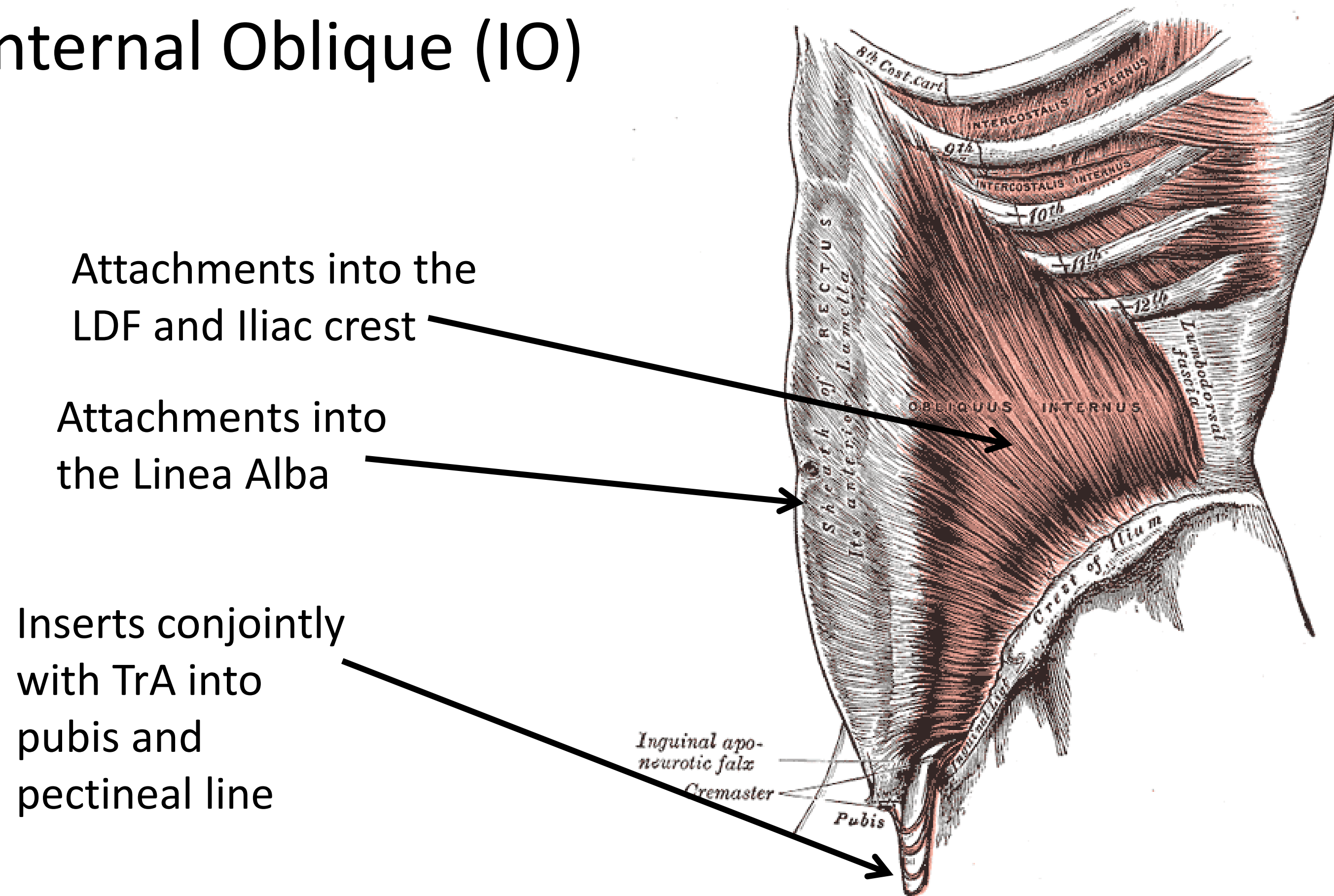
Mid and Upper fibre's spread into an aponeuroses which connects left and right but also to the lower Pec Major

Internal surface connects with the IO

Williams, P. L. (Ed.). (1995). *Gray's anatomy* (Vol. 58). New York: Churchill Livingstone

The Active System

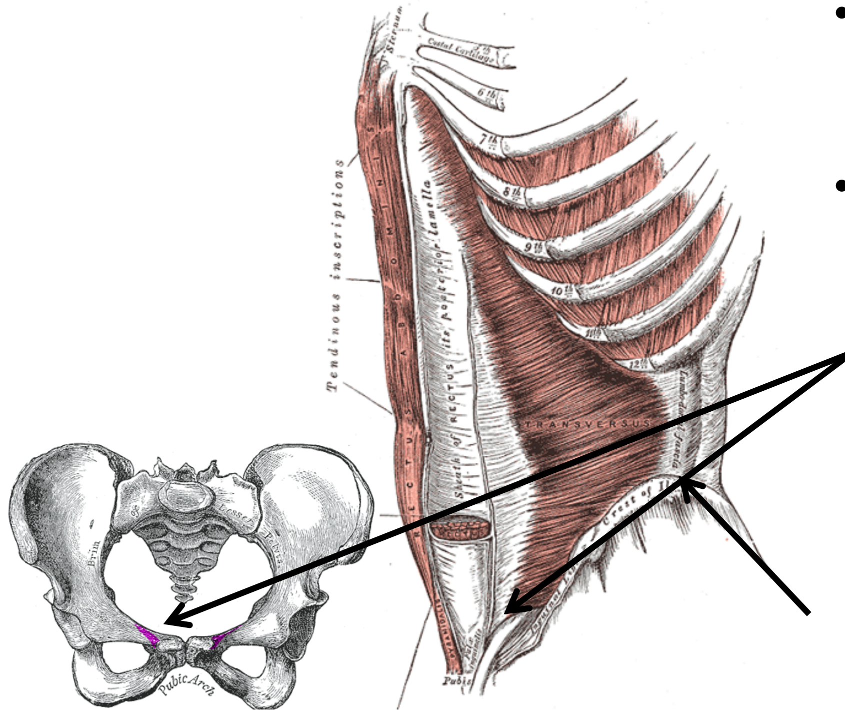
- Basic Anatomy – Internal Oblique (IO)



Williams, P. L. (Ed.). (1995). *Gray's anatomy* (Vol. 58). New York: Churchill Livingstone

The Active System

- Basic Anatomy – Transverse Abdominals (TA)



- O – Crest of the ilium, lower six costals – Interdigitates with the diaphragm & through a broad aponeurosis to the Lx processes
- Fibres insert together in a conjoined tendon with the IO into the crest of the pubis and pectineal line (purple)

Vertabral aponeuroses of the TrA divides into three layers
-Between anterior and middle layer = QL
- Between Mid and Post – ES
- Posterior lamella of this aponeurosis also receives the IO attachment and Lat Dorsi forming the Lx Fascia

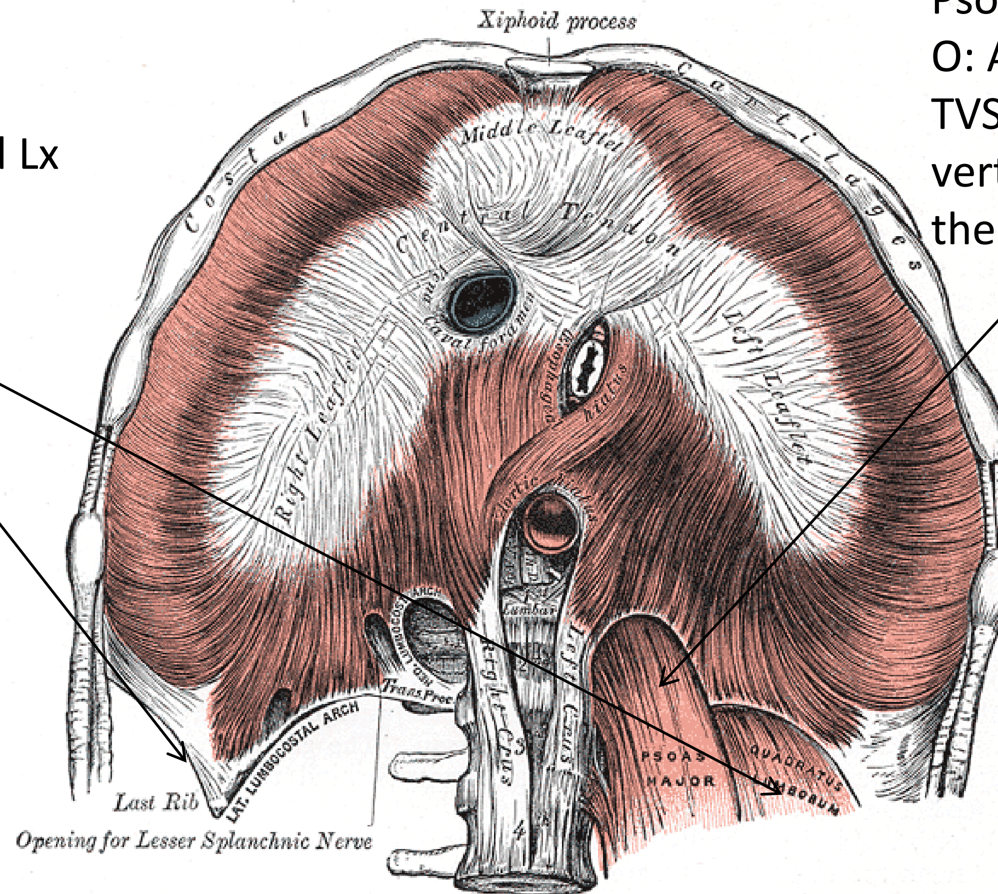
Williams, P. L. (Ed.). (1995). *Gray's anatomy* (Vol. 58). New York: Churchill Livingstone

The Active System

- Basic Anatomy

O: Costal margin and Lx Vert 1-3

Psoas Major
O: Anterior surfaces of the TVSE processes of T12-L5 vertebrae, Posterior wall of the abdomen



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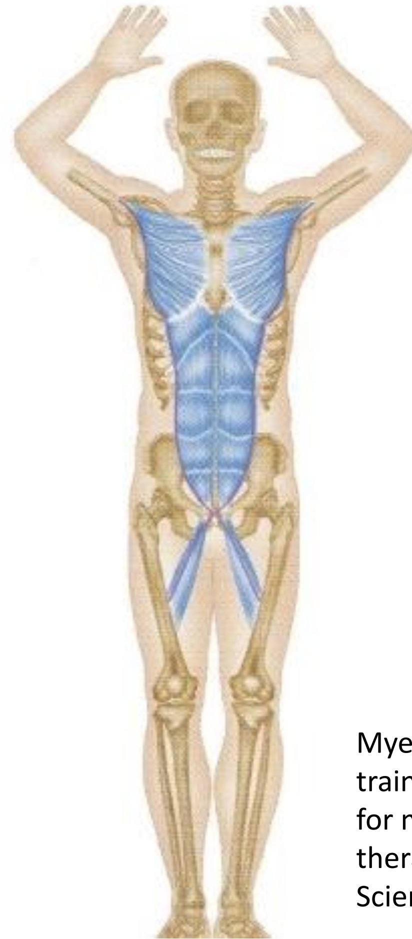
The Active System

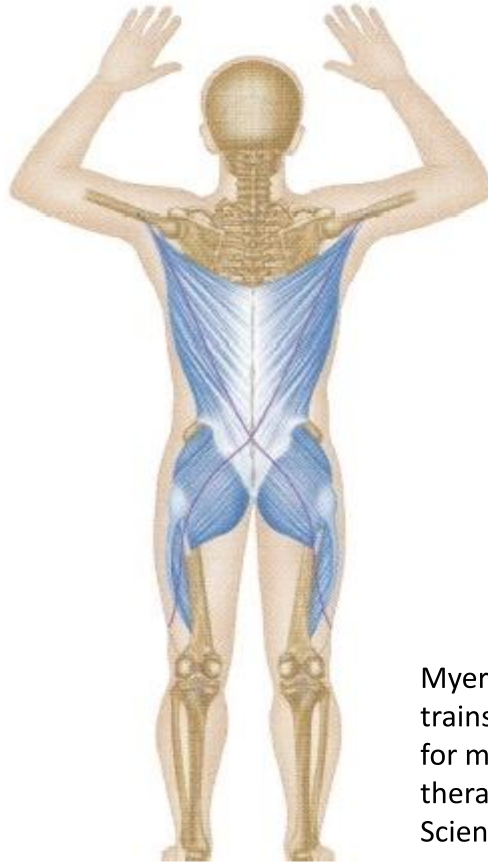
- Myofascial slings and force tra



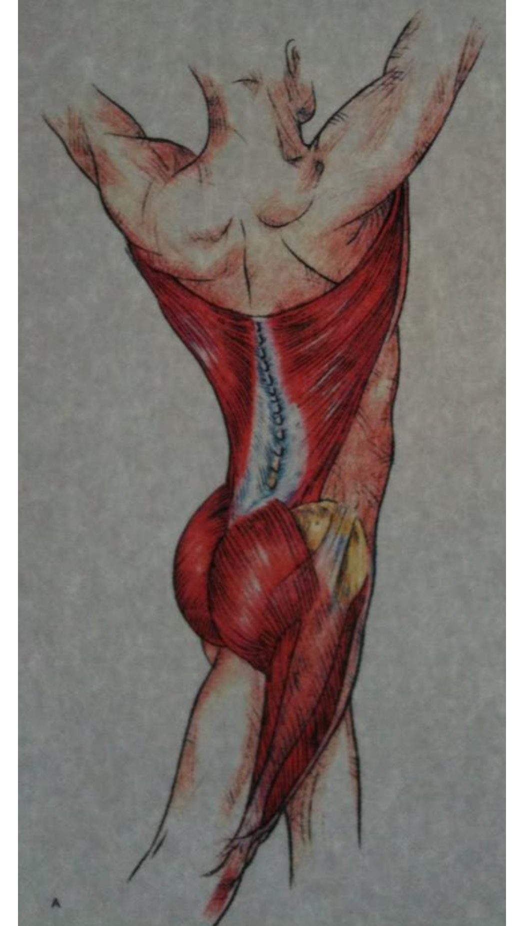
Myers, T. W. (2009). Anatomy trains: myofascial meridians for manual and movement therapists. Elsevier Health Sciences.

The Active System

- Myofascial slings and force transfer



Myers, T. W. (2009). Anatomy trains: myofascial meridians for manual and movement therapists. Elsevier Health Sciences.



The Active System

- Myofascial slings and force transfer

ORIGINAL CONTRIBUTION

Three-Dimensional Mathematical Model for Deformation of Human Fasciae in Manual Therapy

Hans Chaudhry, PhD; Robert Schleip, MA; Zhiming Ji, PhD; Bruce Bukiet, PhD; Miriam Maney, MS; and Thomas Findley, MD, PhD

Context: Although mathematical models have been developed for the bony movement occurring during chiropractic manipulation, such models are not available for soft tissue motion.

Objective: To develop a three-dimensional mathematical model for exploring the relationship between mechanical forces and deformation of human fasciae in manual therapy using a finite deformation theory.

Methods: The predicted stresses required to produce plastic deformation were evaluated for a volunteer subject's fascia lata, plantar fascia, and superficial nasal fascia. These stresses were then compared with previous experimental findings for plastic deformation in dense connective tissues. Using the three-dimensional mathematical model, the authors determined the changing amounts of compression and shear produced in fascial tissue during 20 seconds of manual therapy.

Results: The three-dimensional model's equations revealed that very large forces, outside the normal physiologic range, are required to produce even 1% compression and 1% shear in fascia lata and plantar fascia. Such large forces are not required to produce substantial compression and shear in superficial nasal fascia, however.

Conclusion: The palpable sensations of tissue release that are often reported by osteopathic physicians and other manual therapists cannot be due to deformations produced in the firm tissues of plantar fascia and fascia lata. However, palpable tissue release could result from deformation in softer tissues, such as superficial nasal fascia.

J Am Osteopath Assoc. 2008;108:379-390

From the departments of Biomedical Engineering (Drs Chaudhry and Findley), Mechanical Engineering (Dr Ji), and Mathematical Sciences (Dr Bukiet) at the New Jersey Institute of Technology in Newark; the Department of Applied Physiology at Ulm University in Germany (Mr Schleip); and the War-Related Illness and Injury Study Center at the Veterans Affairs Medical Center in East Orange, NJ (Drs Chaudhry and Findley, Ms Maney).

This study was partially supported by a dissertation grant from the International Society of Biomechanics to Mr Schleip's Fascia Research Project.

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E-mail: ji@njit.edu

Submitted March 23, 2006; revision received June 20, 2006; accepted August 10, 2006.

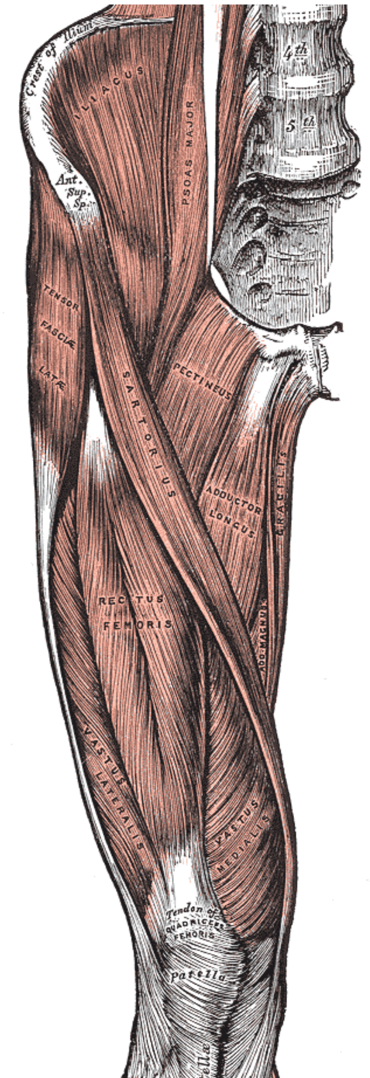
Fascia is dense fibrous connective tissue that connects muscles, bones, and organs, forming a continuous network of tissue throughout the body. It plays an important role in transmitting mechanical forces during changes in human posture. Several forms of manual fascial therapies—including myofascial release and certain other techniques in osteopathic manipulative treatment (OMT)—have been developed to improve postural alignment and other expressions of musculoskeletal dynamics.[1,2] The purpose of these therapies and treatments is to alter the mechanical properties of fascia, such as density, stiffness, and viscosity, so that the fascia can more readily adapt to physical stresses.[3,4] In fact, some osteopathic physicians and manual therapists report local tissue release after the application of a slow manual force to tight fascial areas.[2,4,5] These reports have been explained as a breaking of fascial cross-links, a transition from gel to sol state in the extracellular matrix, and other passive viscoelastic changes of fasciae.[2,4,5]

The question of whether the applied force and duration of a given manual technique (eg, myofascial) could be sufficient to induce palpable viscoelastic changes in human fasciae is unresolved, with some authors[1,5,6] supporting the likelihood of such an effect and others[7,8] arguing against it.

Our intent in undertaking the present study was to resolve this question. Therefore, we present an original mathematical model to determine if forces applied in manual therapy are sufficient to produce tissue deformation in human fasciae.

Background

The mechanical properties of ex vivo rat superficial fascia (ie, subcutaneous tissue) under uniaxial tension have been reported by Iatridis et al,[9] who investigated the potential importance of uniaxial tension in a variety of therapies involving mechanical stretch. The mechanical properties of in vitro human superficial nasal fascia and nasal periosteum were investigated by Zeng et al[10] to determine under which tissue layer silicon implants should be inserted for improved results in aesthetic surgical corrections of congenital saddle nose and flat nose. Similarly, the mechanical properties of in vitro fascia lata and plantar fascia have been investigated by Wright and Rennels.[11] The results of each of these studies of fascial mechanical properties can be used in determining the types and strengths of mechanical forces needed to produce desired deformations during manual therapy.



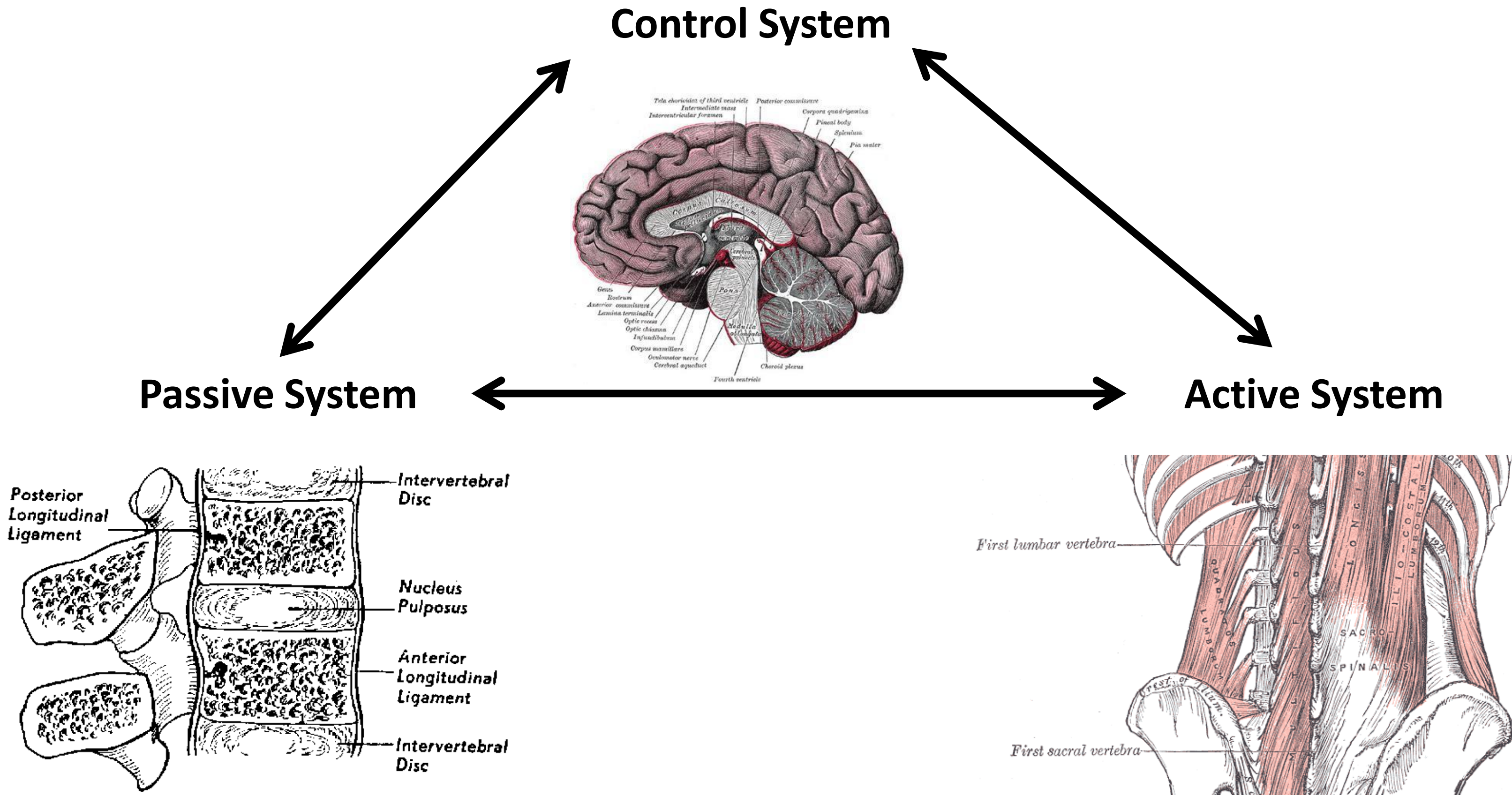
https://anytimeyoga.files.wordpress.com/2012/09/gray430.png

Chaudhry, H., Schleip, R., Ji, Z., Bukiet, B., Maney, M., & Findley, T. (2008). Three-dimensional mathematical model for deformation of human fasciae in manual therapy. The Journal of the American Osteopathic Association, 108(8), 379-390.

The Control System

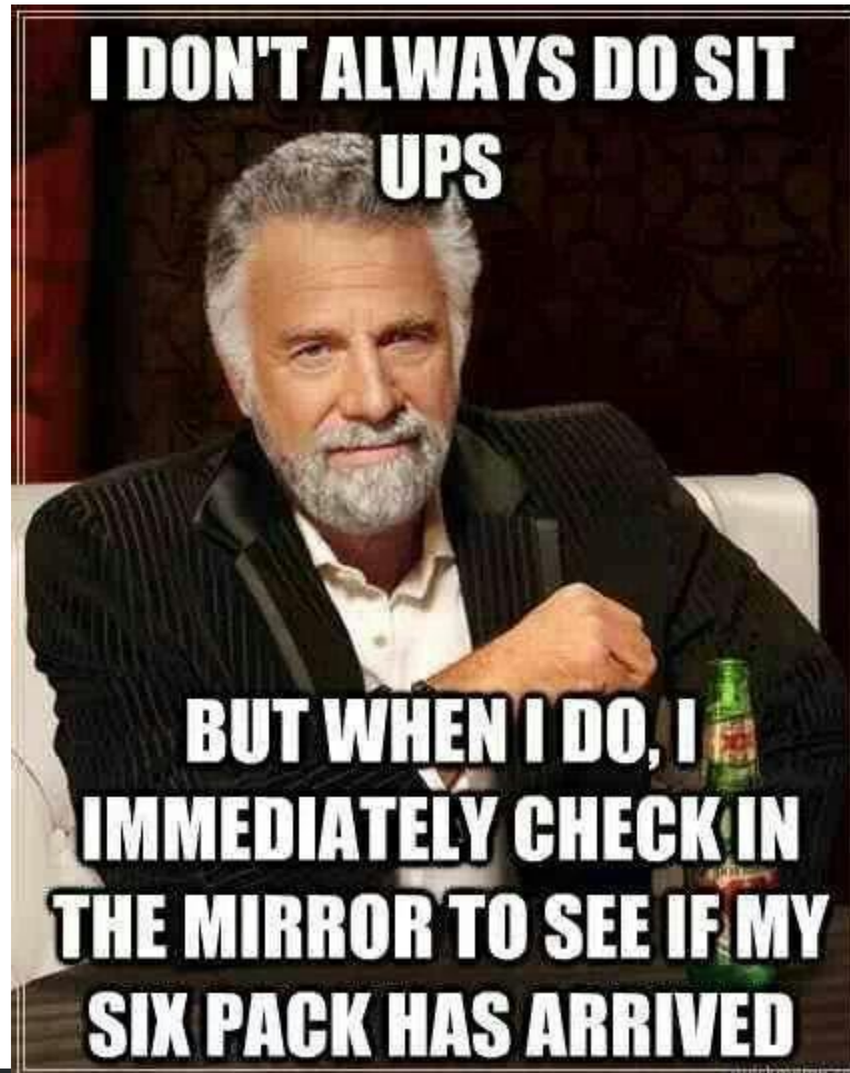
- Central nervous system
  - Activation which can be slowed by fatigue
  - Inhibition from pain
  - Faulty motor patterns
  - Faulty Joint Position Sense

System Integration



Panjabi MM. The stabilizing system of the spine. Part 1, function, dysfunction and enhancement. Journal of Spinal Disorders 1992; 5 (4): 383-9.

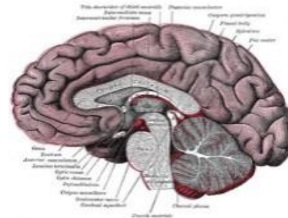
Rehabilitation – It's not that easy



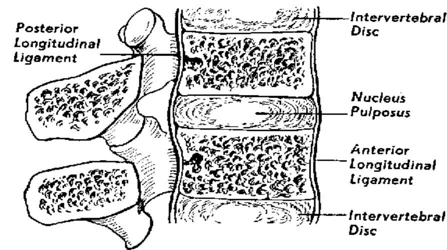
System Integration

- Active System Dysfunction – Active System Dysfunction

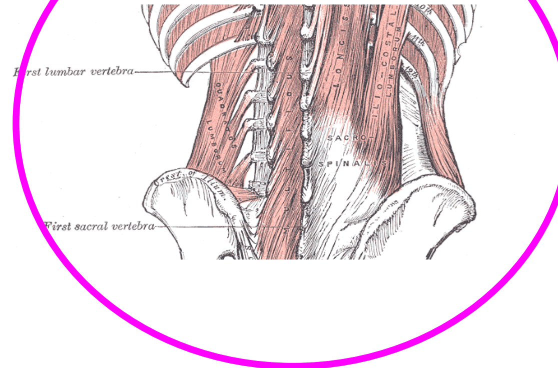
Control System



Passive System



Active System

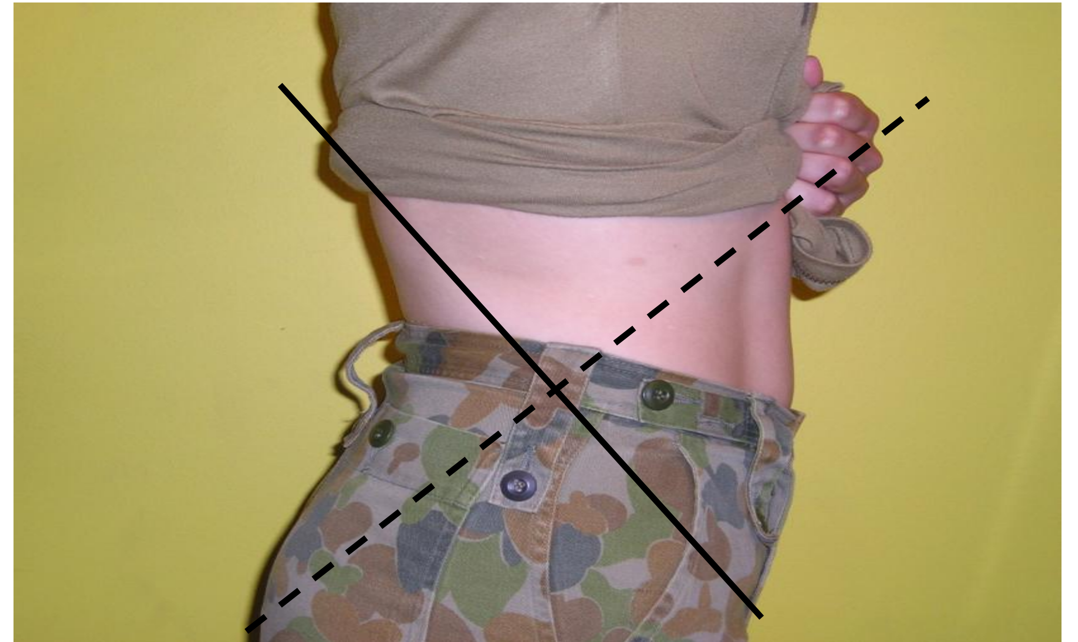


System Integration

- Active System Dysfunction – Active System Dysfunction
  - Muscle weakness
    - Typically load (acute of chronic) is too much
      - E.g. load carriage

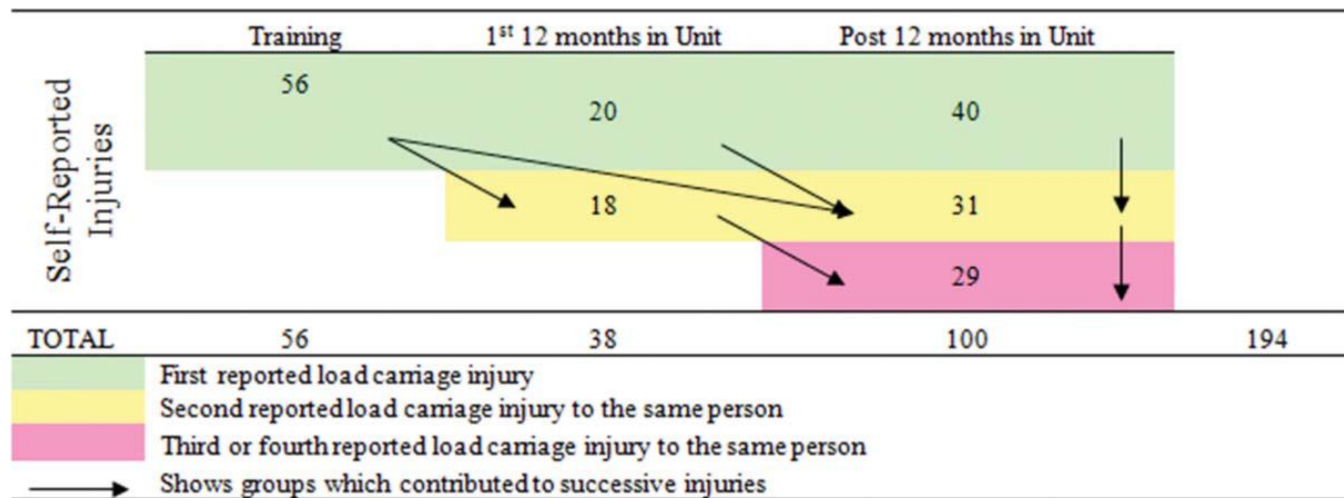
System Integration

- Active System Dysfunction – Active System Dysfunction
  - Muscle weakness
    - Relative weakness
      - E.g. Weaker than opposing muscles
    - Lower Cross Syndromes



System Integration

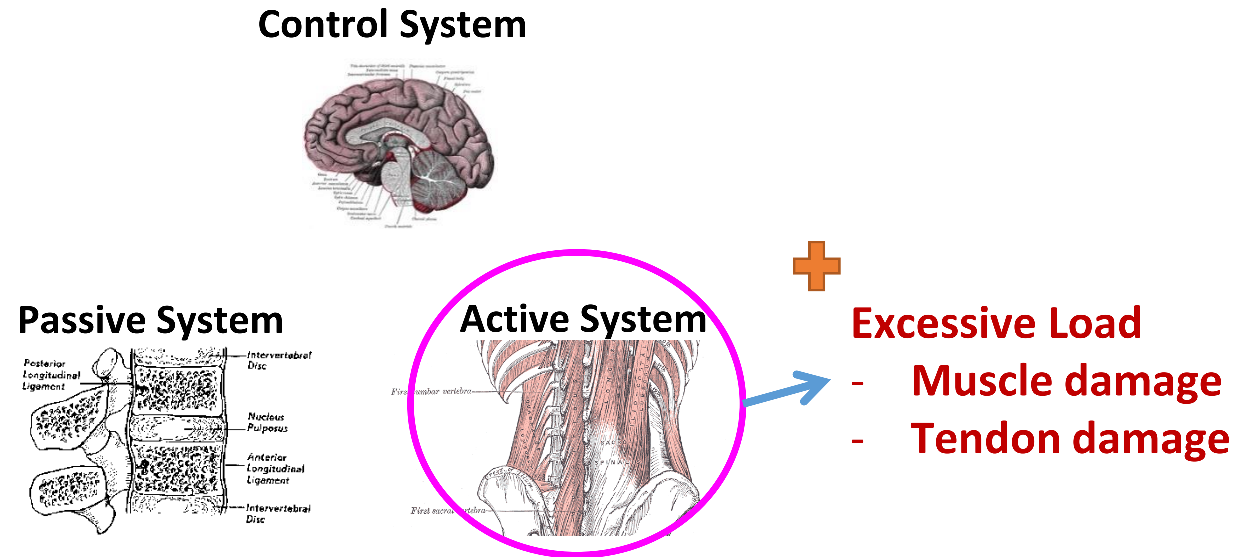
- Active System Dysfunction – Active System Dysfunction
  - Muscle weakness
    - Previous injury
      - E.g. Incomplete recovery
    - Re-injure weakened structure
      - E.g. Load carriage (Orr, et al., 2016)



Orr, R. M., Coyle, J., Johnston, V., & Pope, R. (2016). Self-reported load carriage injuries of military soldiers. *International journal of injury control and safety promotion*, Fig 1, pg 4

System Integration

- Active System Dysfunction – Active System Dysfunction

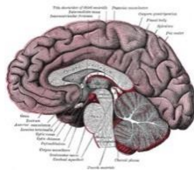


- Injury to the active system
  - Weakness – Absolute or Relative
  - Previous injury

System Integration

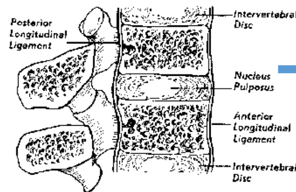
- Passive System Dysfunction - Active System Dysfunction

Control System

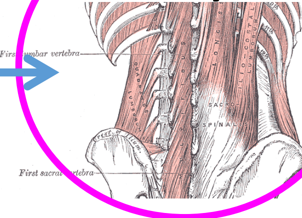


Lax ligaments
Hypo-Hypermobile joints

Passive System



Active System

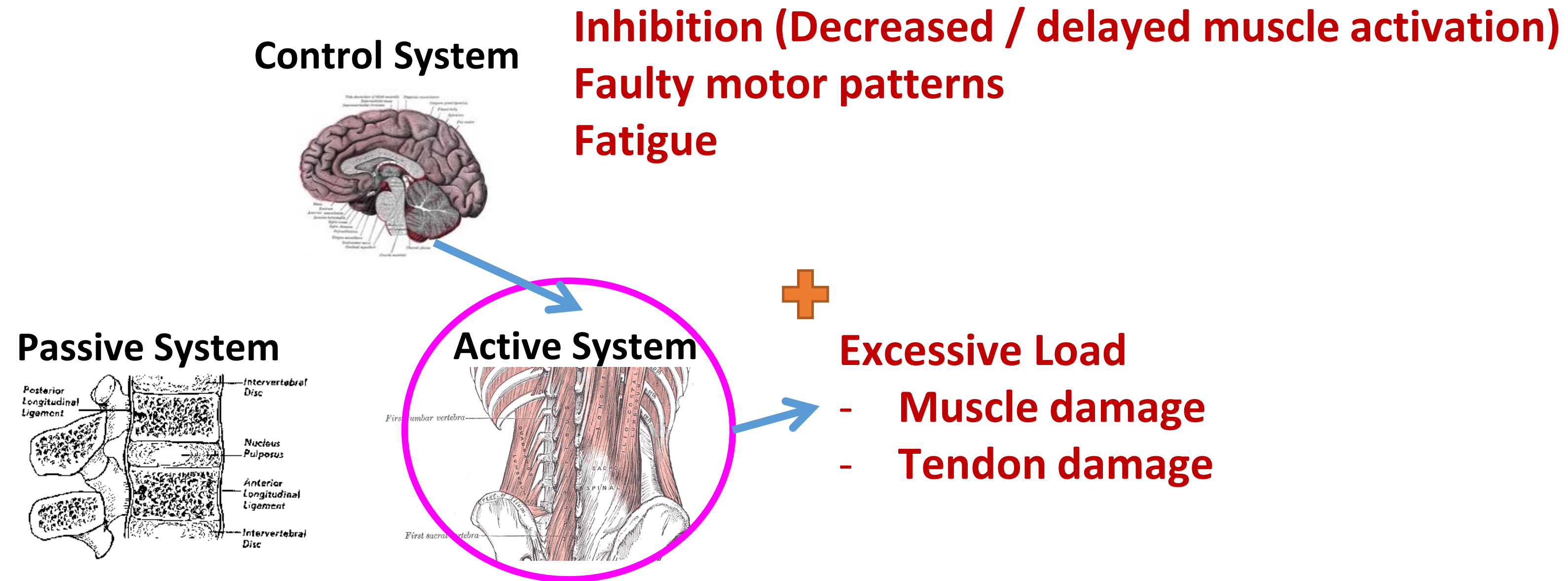


Excessive Load
- **Muscle damage**
- **Tendon damage**

- Injury to the active system
  - Previous passive system injury
  - Hypo/hypermobile joints

System Integration

- Control System Dysfunction - Active System Dysfunction



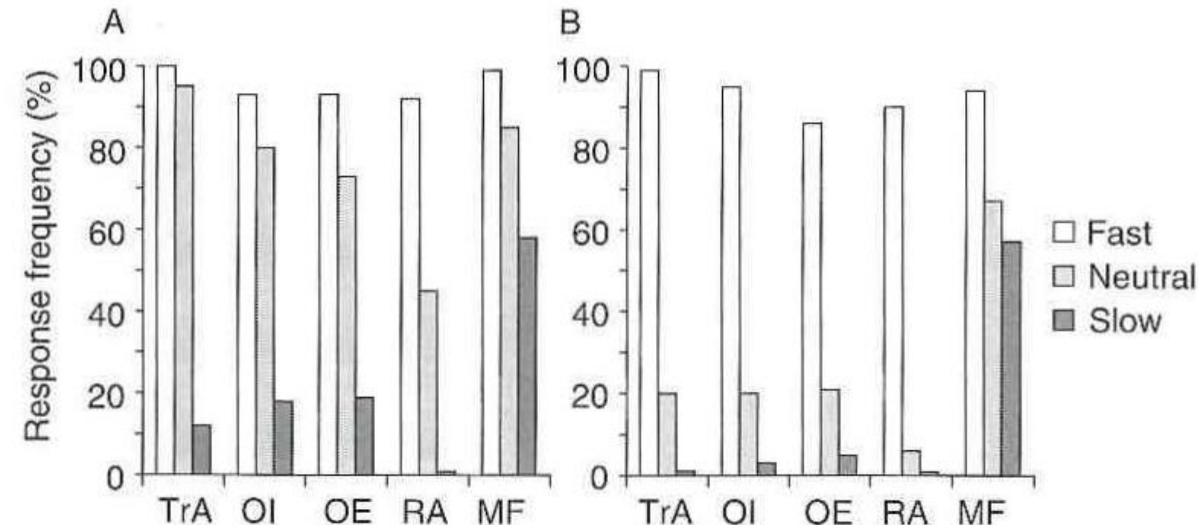
- Injury to the active system
  - Previous injury and pain inhibition
  - Faulty timing / motor patterns
  - Fatigue

System Integration

- Control System Dysfunction – Active System Dysfunction
  - Faulty motor control
    - Incorrect movement pattern
    - Incorrect muscle activation
      - E.g. Glutes vs hamstrings / TFL vs HF

System Integration

- Control System Dysfunction – Active System Dysfunction
  - Faulty motor control
    - Incorrect movement pattern
    - Incorrect muscle activation
      - E.g. Glutes vs hamstrings / TFL vs HF
    - Incorrect timing
      - Research by Jull et al., (1999) suggests that the problem is not one of strength or endurance but of motor control



Jull, G., Hodges, P., Hides, J., & Panjabi, M. M. (1999). Therapeutic exercise for spinal segmental stabilization in low back pain: scientific basis and clinical approach (pp. 61-76). Edinburgh: Churchill Livingstone

System Integration

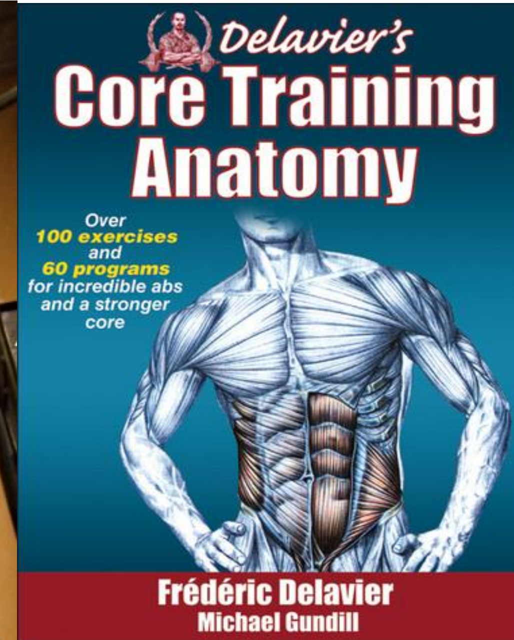
- So what?

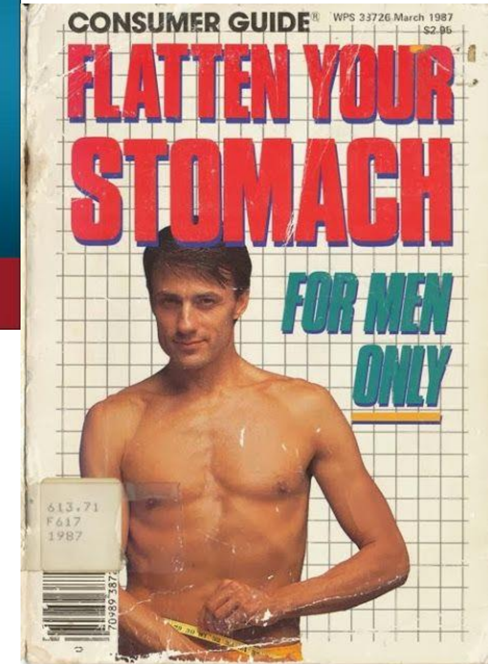
System Integration

- So what?

- Member comes in post back pain
  - You give them core strengthening…but what if….
    - Poor motor timing (abdominals firing late)
    - Poor motor pattern (caused by poor technique)
    - Poor muscle activation (Gluteals not firing)
    - Faulty JPS (think they are in the right position)
    - Joint dysfunction (loss of joint ROM)
- …means that you cant just give an exercise (e.g. core for lower back) and hope for the best…

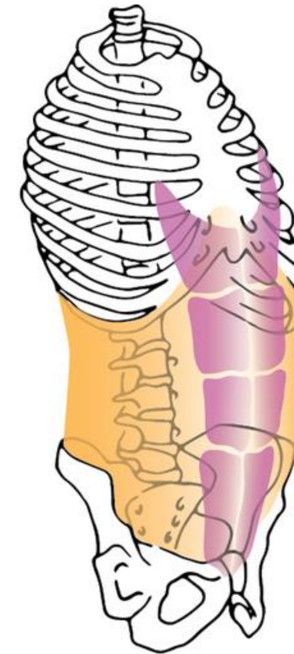
How do you protect the back ?





What is the core /core training?

- TA, MF, PF – Physioworks
- TA, MF, PF, Diaphragm – CORE Restore Physiotherapy
- RA, TA, Obliques – Core Assessment and Training (Human Kinetics)



What is the core /core training?

- Major muscles included are the pelvic floor muscles, transversus abdominis, multifidus, internal and external obliques, rectus abdominis, erector spinae (sacrospinalis) especially the longissimus thoracis, and the diaphragm. The lumbar muscles, quadratus Lumborum (deep portion), deep rotators, as well as cervical muscles, rectus capitus anterior and lateralis, longus coli may also be considered members of the core group.[2]
- Minor core muscles include the latissimus dorsi, gluteus maximus, and trapezius.

https://en.wikipedia.org/wiki/Core_(anatomy)

https://en.wikipedia.org/wiki/Core_%28anatomy%29

What is the core /core training?

- The core is used to stabilize the thorax and the pelvis during dynamic movement
- …. and it also provides internal pressure to expel substances (vomit, feces, carbon-laden air, etc.).

https://en.wikipedia.org/wiki/Core_%28anatomy%29

What is the core /core training?

Full Length Article

The impact of core muscles training on the range of anterior pelvic tilt in subjects with increased stiffness of the hamstrings

Michał Tomasz Kuszewski [a], Rafał Gnat [a, b], Anna Gogola [a]

The exercises simultaneously and globally activate the core, upper trunk, and lower limbs musculature. In order to offer the neuromuscular system a constant challenge, an individually shaped 'progression ladder' was used. Together with such a challenge, an

What is the core /core training?

Full Title: Isolated core training improves sprint performance in national-level junior swimmers

Submission Type: Original Investigation

performance. The aim of our study was to quantify the effects of a 12-week isolated core training programme on 50-m front crawl swim time and measures of core musculature functionally relevant to swimming.

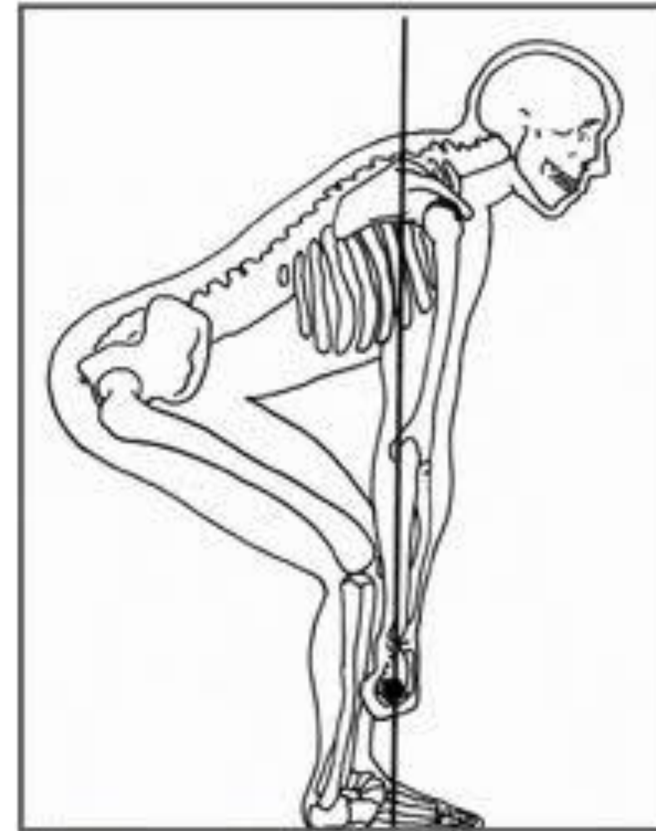
Intervention

The intervention group completed a 12-week core training programme in addition to their normal pool-based swimming regimen. For the purposes of this study, the regions of the body which are included in the term "the core" are the upper legs, pelvis, trunk and shoulders.[7] Specifically, the regions targeted in this training programme were the lower spine, lumbo-pelvic complex and upper region extending to the scapula. The core training programme consisted of five exercises based on the existing literature (Table 1) which were as follows; prone-bridge (Figure 1a), side-bridge (Figure 1b), bird-dog (Figure 1c), straight leg raise (Figure 1d), overhead squat (Figure 1e) and medicine ball sit twist (Figure 1f).[12-16] In a

How do you protect the back ?

How do you protect the back ?

- Train movement
  - Transfer force



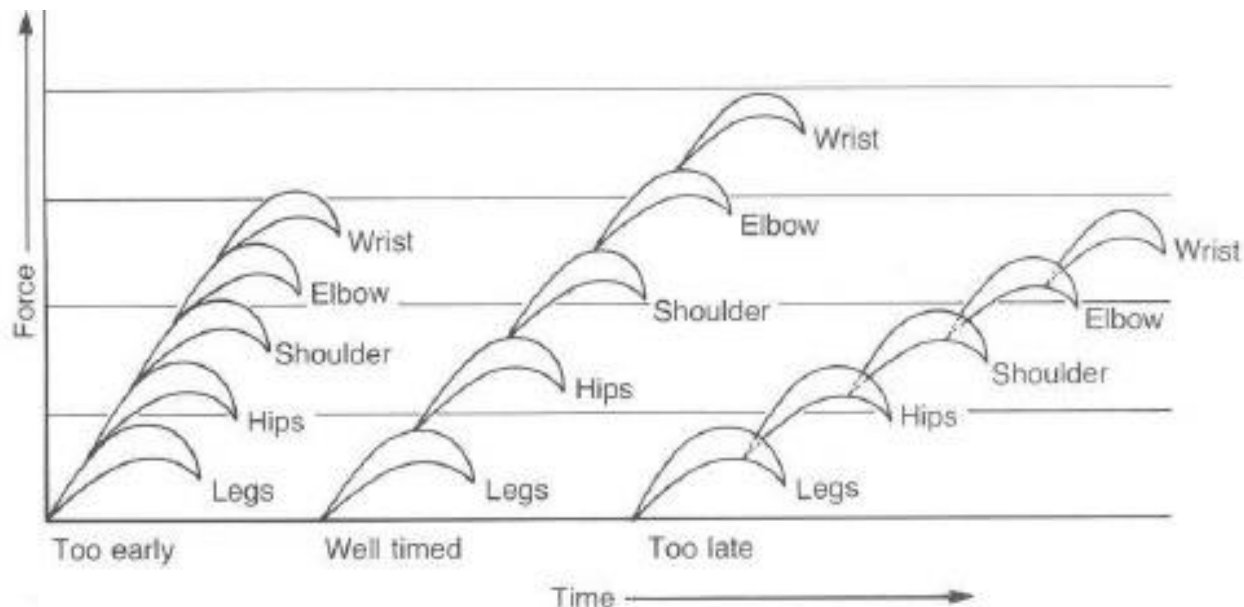
How do you protect the back ?

- Train movement
  - Transfer force
  - Train large movement patterns with a focus on timing

How do you protect the back ?

Segmental Summation of Velocity

- Optimal coordinated sequence of movement that allows for optimal velocity development
- Each segment begins to move the instant the previous segment begins to slow down



Elliott, B.C. Biomechanics in Sport in eds. Pyke, FS. Better Coaching, Australian Sports Commission, Figure 7-13, p.107

How do you protect the back ?

- Train movement
  - Transfer force
  - Train large movement patterns with a focus on timing
    - For rehab Isolate then Integrate

How do you protect the back ?

- Train movement
  - Transfer force
  - Train large movement patterns with a focus on timing
    - For rehab Isolate then Integrate
  - Train many movements to build redundancy

Seated rows *better* than pull-downs for the back muscles?

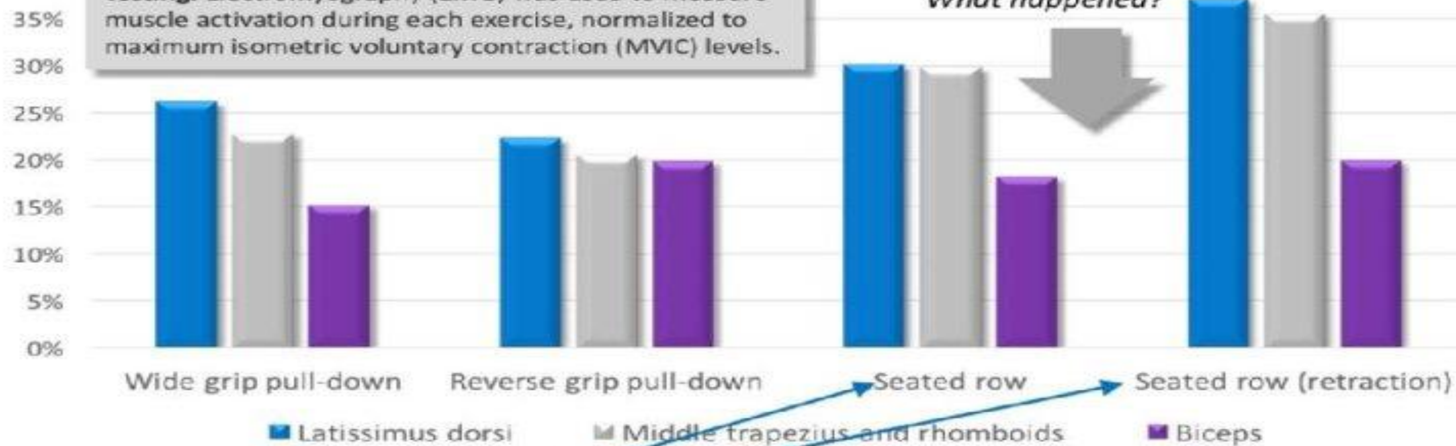
STUDY OBJECTIVE

To compare activation of the back muscles between the wide-grip pull-down, reverse grip shoulder-width pull-down, seated row, and seated row with scapular retraction

What was measured?

MEASUREMENTS

- Latissimus dorsi EMG
- Middle trapezius and rhomboids EMG
- Biceps brachii EMG
- Exercises done with the same absolute load (wide-grip pull-down 10-12RM), and not the same relative load



WHAT DOES THIS MEAN?

The seated row variations showed a *tendency* to produce more latissimus dorsi and more middle trapezius and rhomboids muscle activation than the pull-down variations, but all exercises produced similar levels of biceps activation.

Lehman, G. J., Buchan, D. D., Lundy, A., Myers, N., & Nalborczyk, A. (2004). Variations in muscle activation levels during traditional latissimus dorsi weight training exercises: An experimental study. *Dynamic Medicine*, 3(1), 1.

Strength & Conditioning Research

Romanian deadlift and kettlebell swing for *medial* hamstrings?

STUDY OBJECTIVE

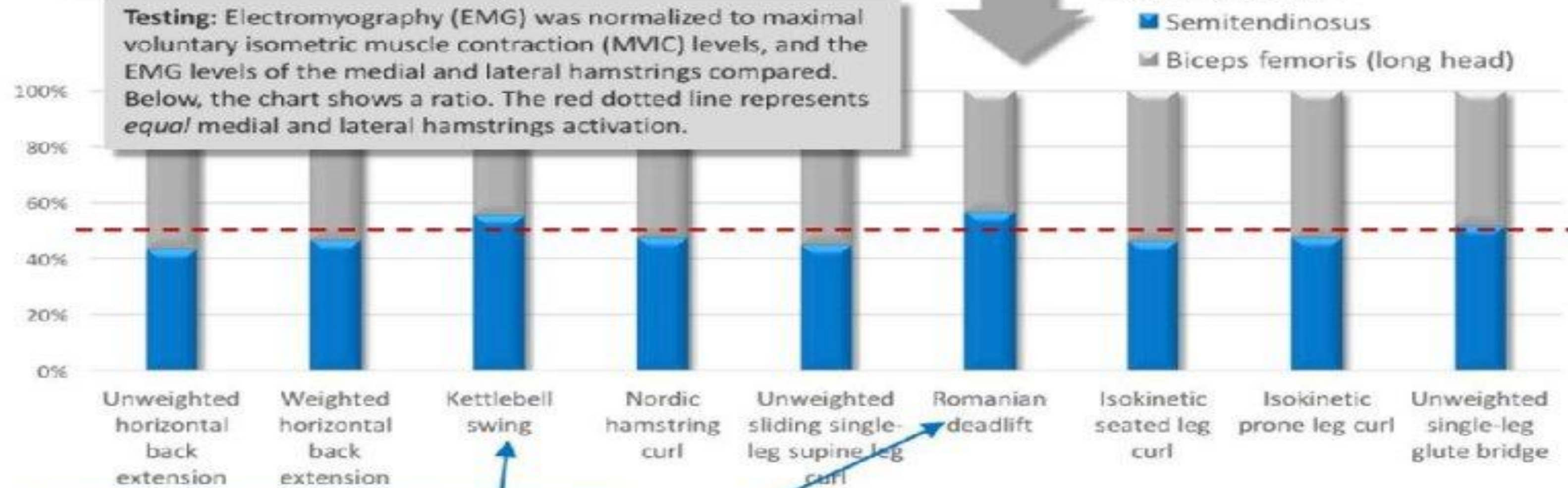
To compare the balance of activation levels between the lateral (biceps femoris long head) and medial (semitendinosus) hamstrings during several exercises

What was measured?

MEASUREMENTS

- Balance of muscle activation of the medial to lateral hamstrings, using EMG
- Hip and knee joint angles at which peak EMG occurred (data not shown)

What happened?



WHAT DOES THIS MEAN?

Both the kettlebell swing and Romanian deadlift exercises displayed proportionately more medial hamstrings activation than lateral hamstrings activation. All of the horizontal back extensions and leg curls *tended* to display proportionately more lateral hamstrings activation.

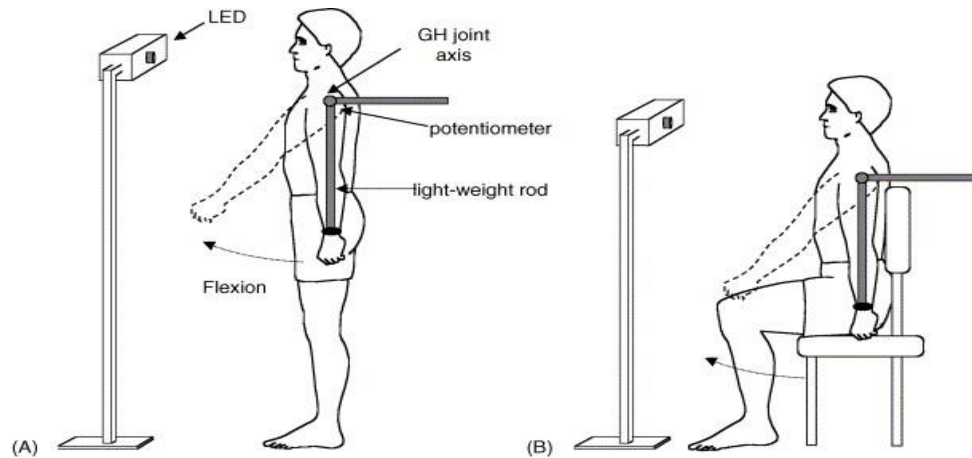
Zebis, M. K., Skotte, J., Andersen, C. H., Mortensen, P., Petersen, H. H., Viskær, T. C., & Andersen, L. L. (2012). Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications. *British Journal of Sports Medicine*.

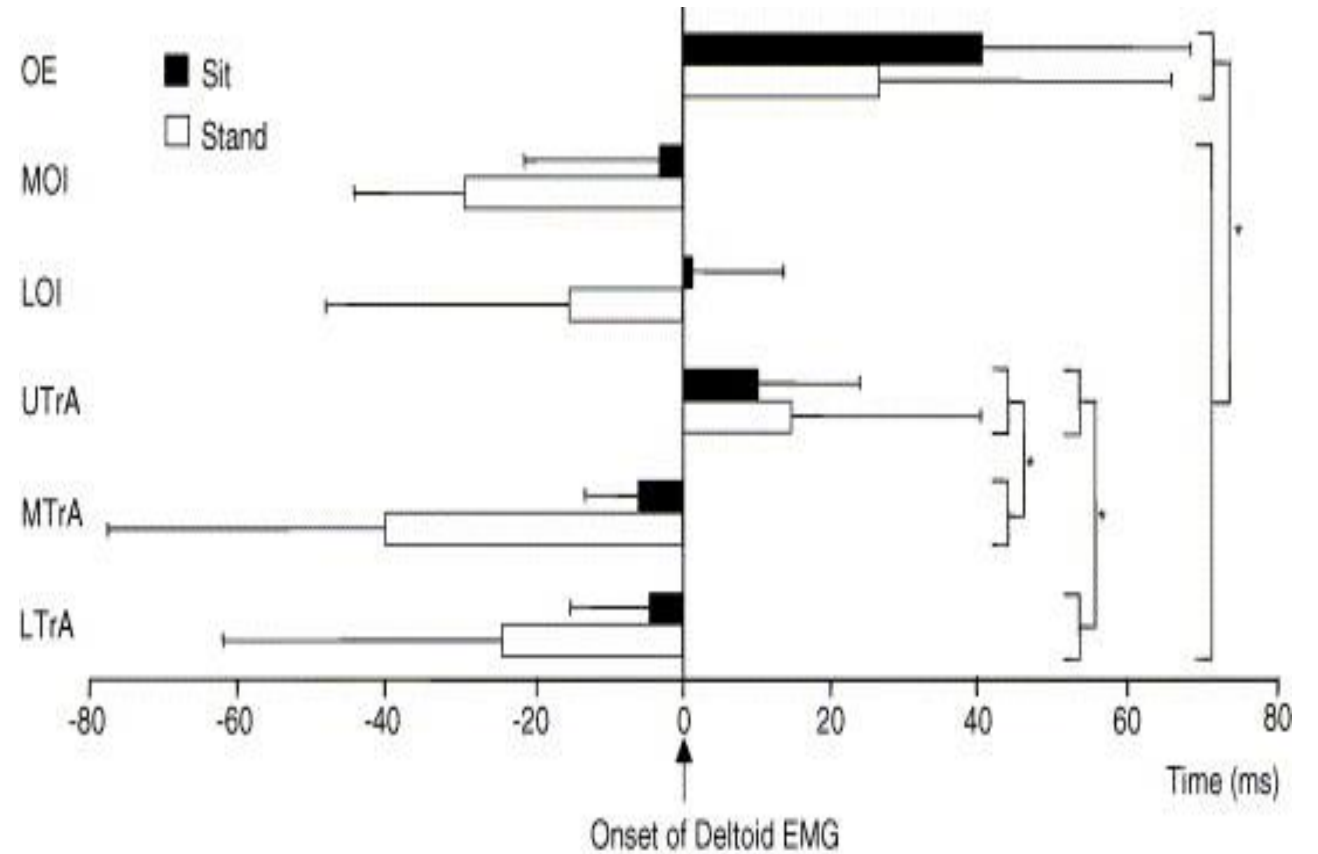
Strength & Conditioning Research

The Active System

- Abdominal Muscle Recruitment

Urquhart, D. M., Hodges, P.W. & Story, I. H. (2004). Postural activity of the abdominal muscles varies between regions of these muscles and between body position. Gait & Posture, 22(2005), 295-301





So how do you protect the back ?

- Consider the other 'passive duty' loads imparted on the back and their downstream impacts
- Following injury (and even prehabilitation) **cause - effect - cause - effect**
- Consider load 'holiday' periods or create deload periods
- Train quality movement
  - Transfer force
  - Train large movement patterns with a focus on timing
  - Train many movements to build redundancy

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From Rehabilitation to Performance

Dr Rob Orr Phd, MPHTY, BFET, APAM, TSAC-F

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