NSCA®
NATIONAL STRENGTH AND CONDITIONING ASSOCIATION

2022 NSCA TACTICAL ANNUAL TRAINING

#NSCATactical22

CONFLICT OF INTEREST STATEMENT

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

Movement Orientated Training for Tactical Personnel

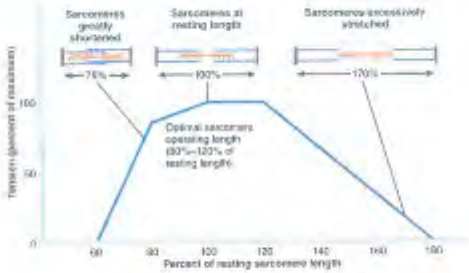
Dr Rob Orr Phd, MPHTY, BFET, APAM, TSAC-F

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

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

Movement Patterns

Exercise Selection - Physiology

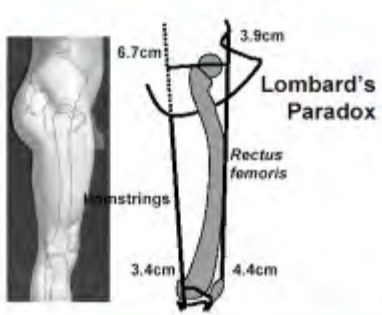


Rob Orr (PhD, MPHTY, BFET, ADFPTI, TSAC-F D*)
Movement Orientated Strength and Conditioning for Tactical Personnel
2022 NSCA TACTICAL ANNUAL TRAINING

Exercise Selection – Motor Control

Exercise Selection - Anatomy

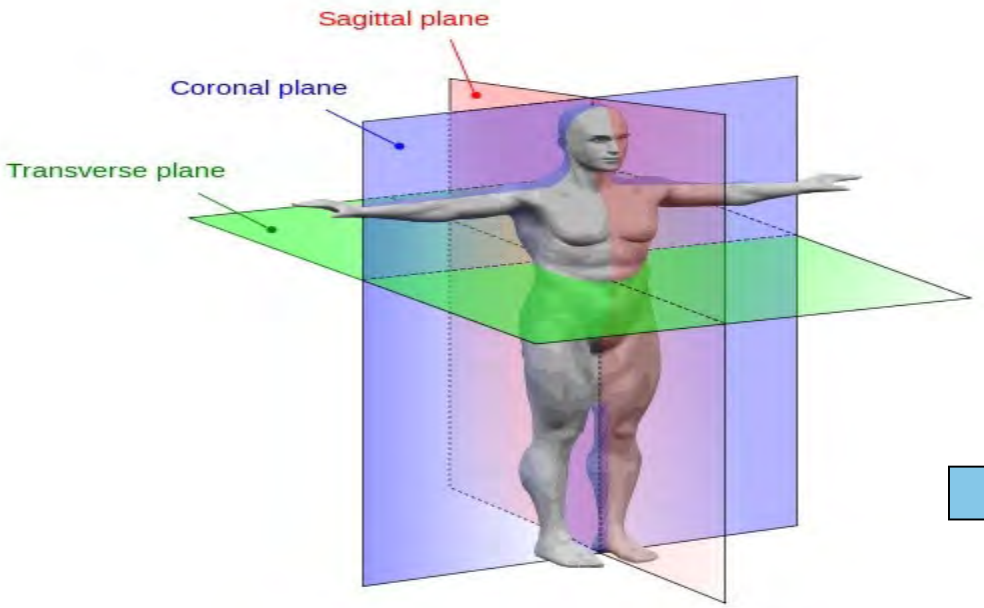
Exercise Selection – Biomechanics

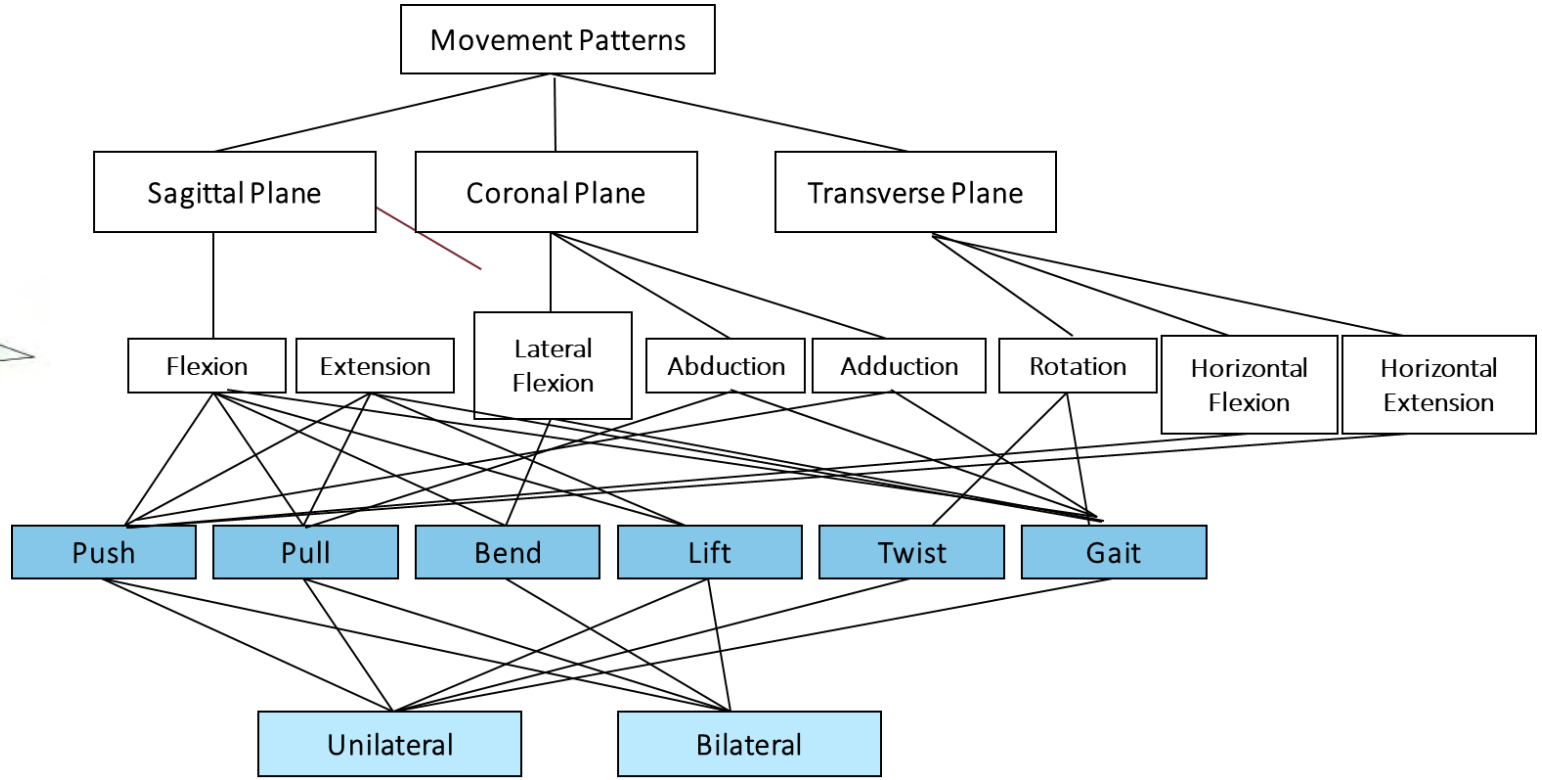


Rob Orr (PhD, MPHTY, BFET, ADFPTI, TSAC-F D*)
Movement Orientated Strength and Conditioning for Tactical Personnel
2022 NSCA TACTICAL ANNUAL TRAINING

Summation

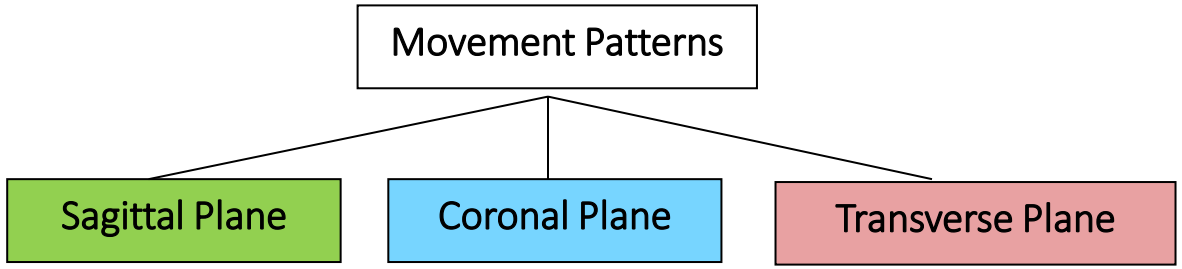
Movement Patterns

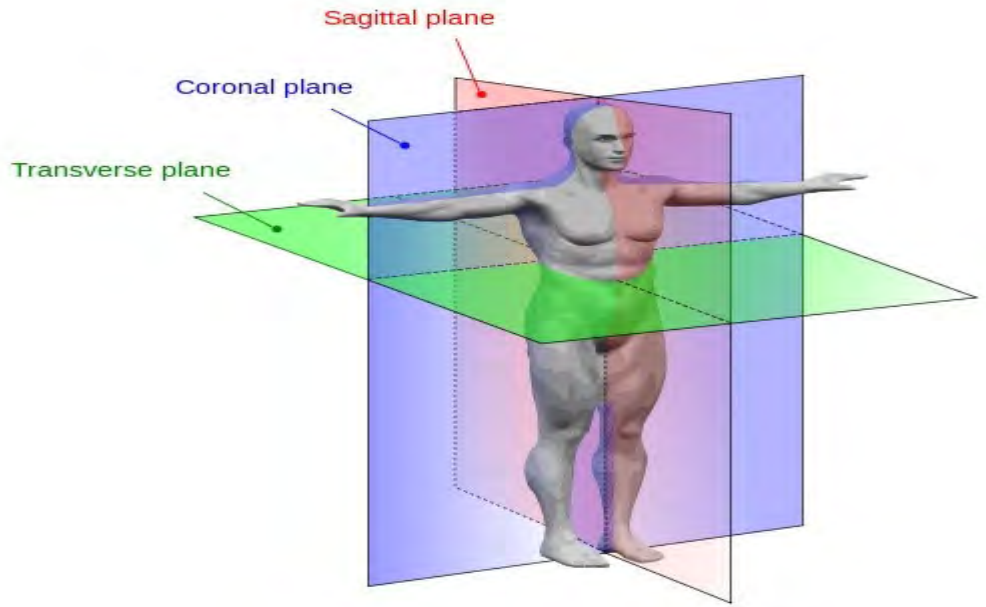




http://healthpages.org/wp-content/uploads/2011/03/anatomy-planes.png

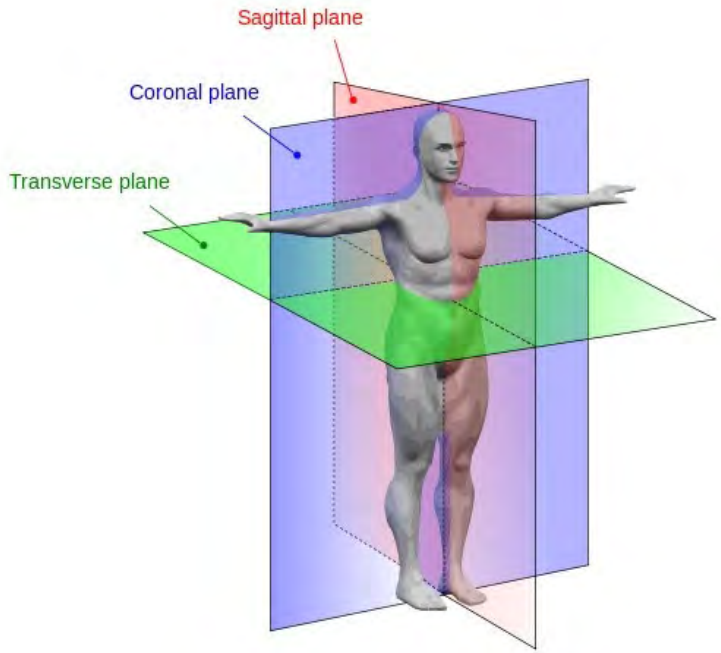
Movement Patterns





http://healthpages.org/wp-content/uploads/2011/03/anatomy-planes.png

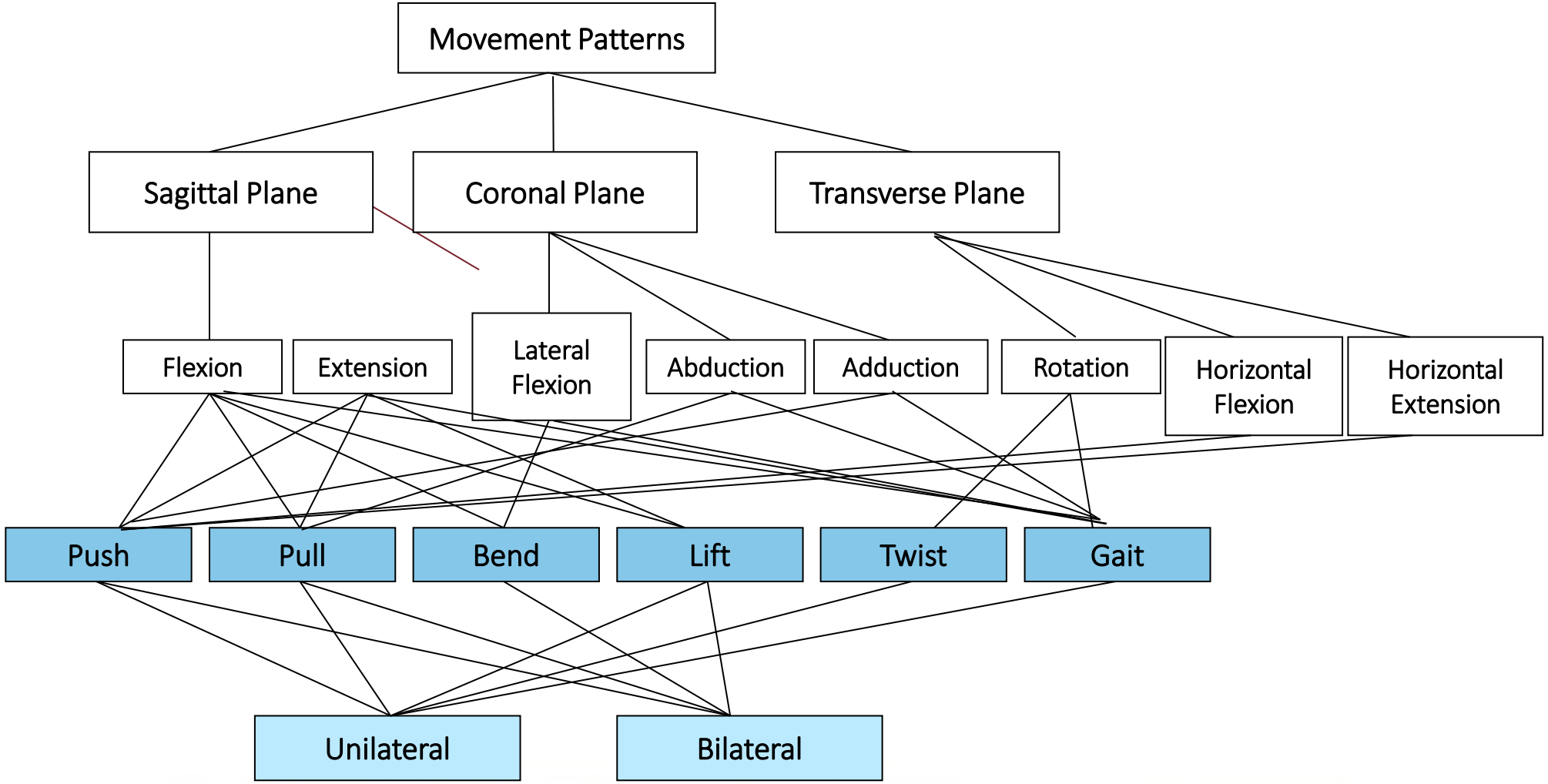
Movement Patterns



- Movement Patterns
  - Sagittal Plane
    - Flexion
    - Extension
  - Coronal Plane
    - Lateral Flexion
    - Abduction
    - Adduction
  - Transverse Plane
    - Rotation
    - Horizontal Flexion
    - Horizontal Extension

http://healthpages.org/wp-content/uploads/2011/03/anatomy-planes.png

Movement Patterns



Movement Patterns

What are the: GAS, SAID & Specificity Principles?

General Adaption Syndrome

Specific Adaptation to Imposed Demand

Principle of Specificity

…i.e., you adapt to what you are doing…for good OR for bad

Movement Patterns

What are the common movements / postures during a soldier's day?

https://www.google.com.au/?gfe_rd=cr&ei=asbeU8n1OOnC8gfPloCgAg&gws_rd=ssl

https://www.homeenergysavings.net/sites/default/files/ckfinder/images/325x200-homeElectronics.jpg

Military images from 1 Joint Public Affairs Unit – Achieves

http://www.autoinsurance.org/images/Why-do-men-pay-more-than-women-on-auto-insurance-2.jpg

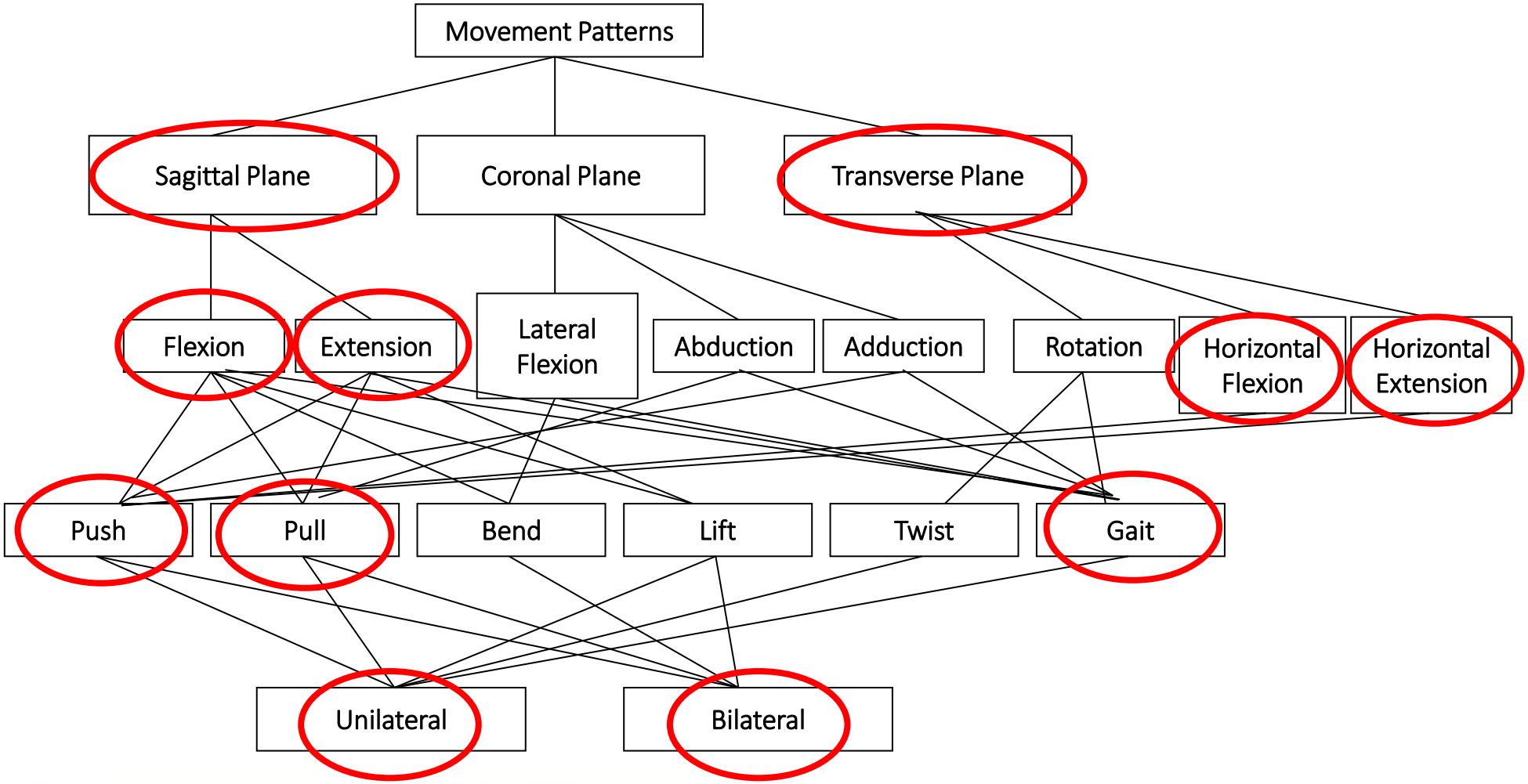
Movement Patterns

What causes an overuse injury?

'A considerable percentage of injuries in sports or musculoskeletal medicine are related to overuse, caused by the repetitive nature of skills for a specific sport'.

Sevier, T. "The industrial athlete?." *Occupational and environmental medicine* 57.4 (2000): 285.

Movement Patterns



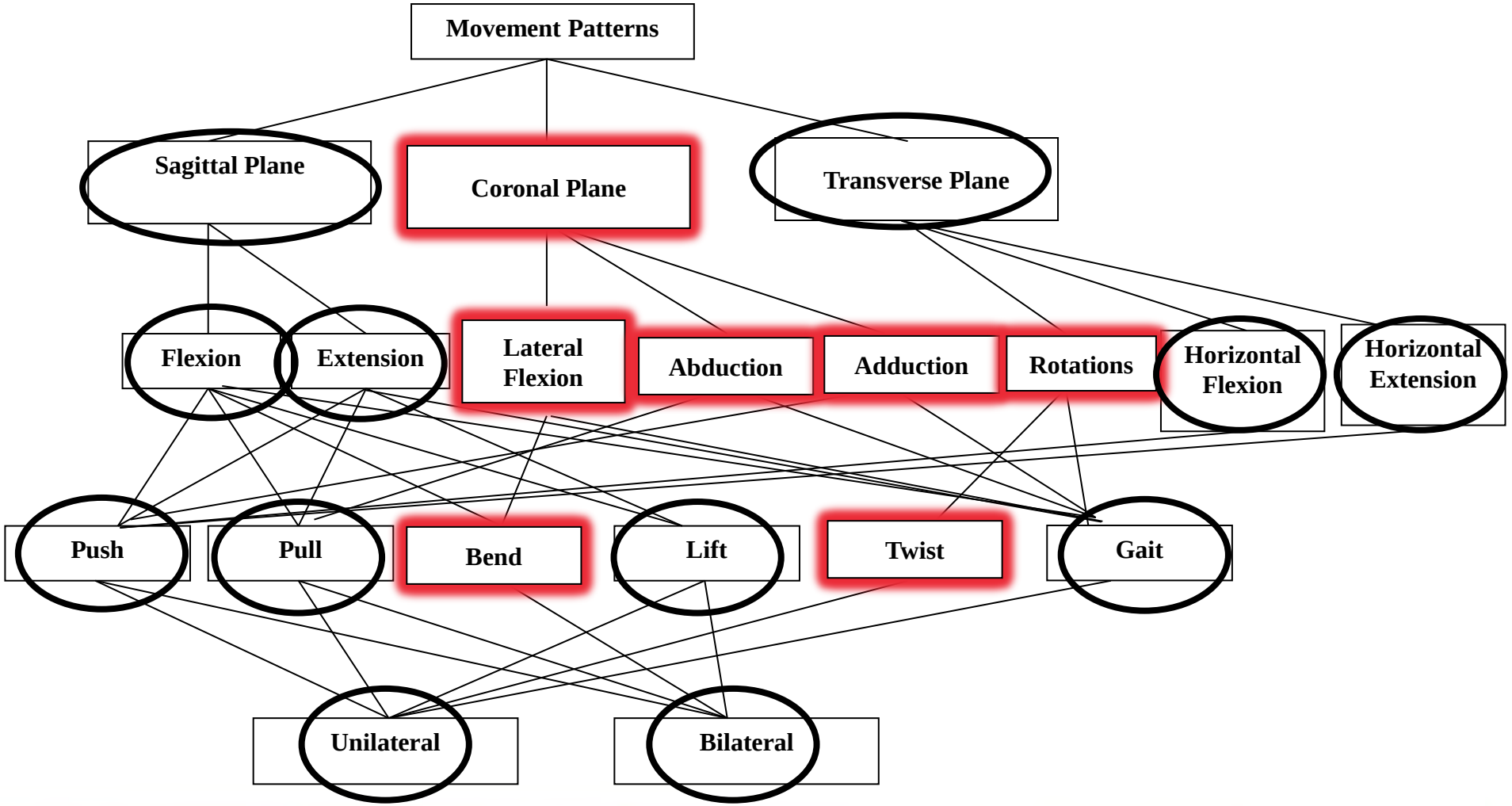
Movement Patterns

What can be a cause of injury?

Moving into ranges where the system is weak

i.e., the weakest link

Movement Patterns

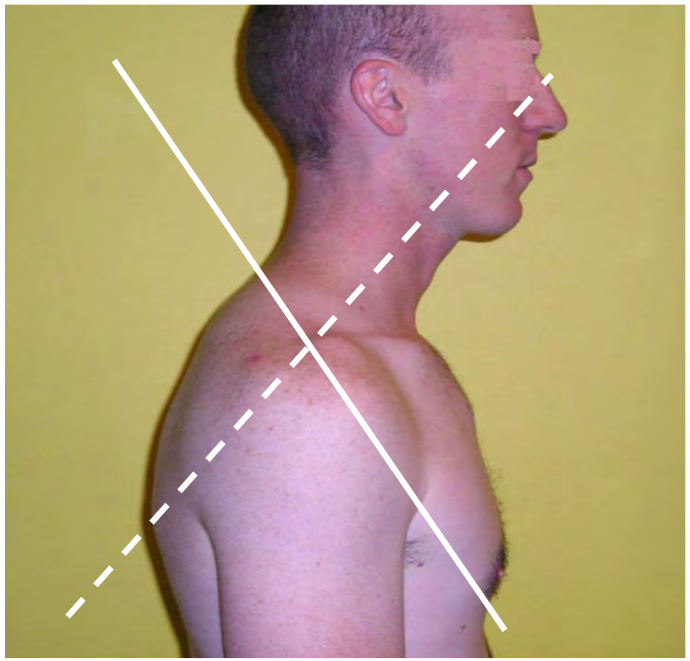


Movement Patterns

Yanda's Upper Cross Syndrome

Tightness of
+ Upper Trapezius
+ Levator Scapula

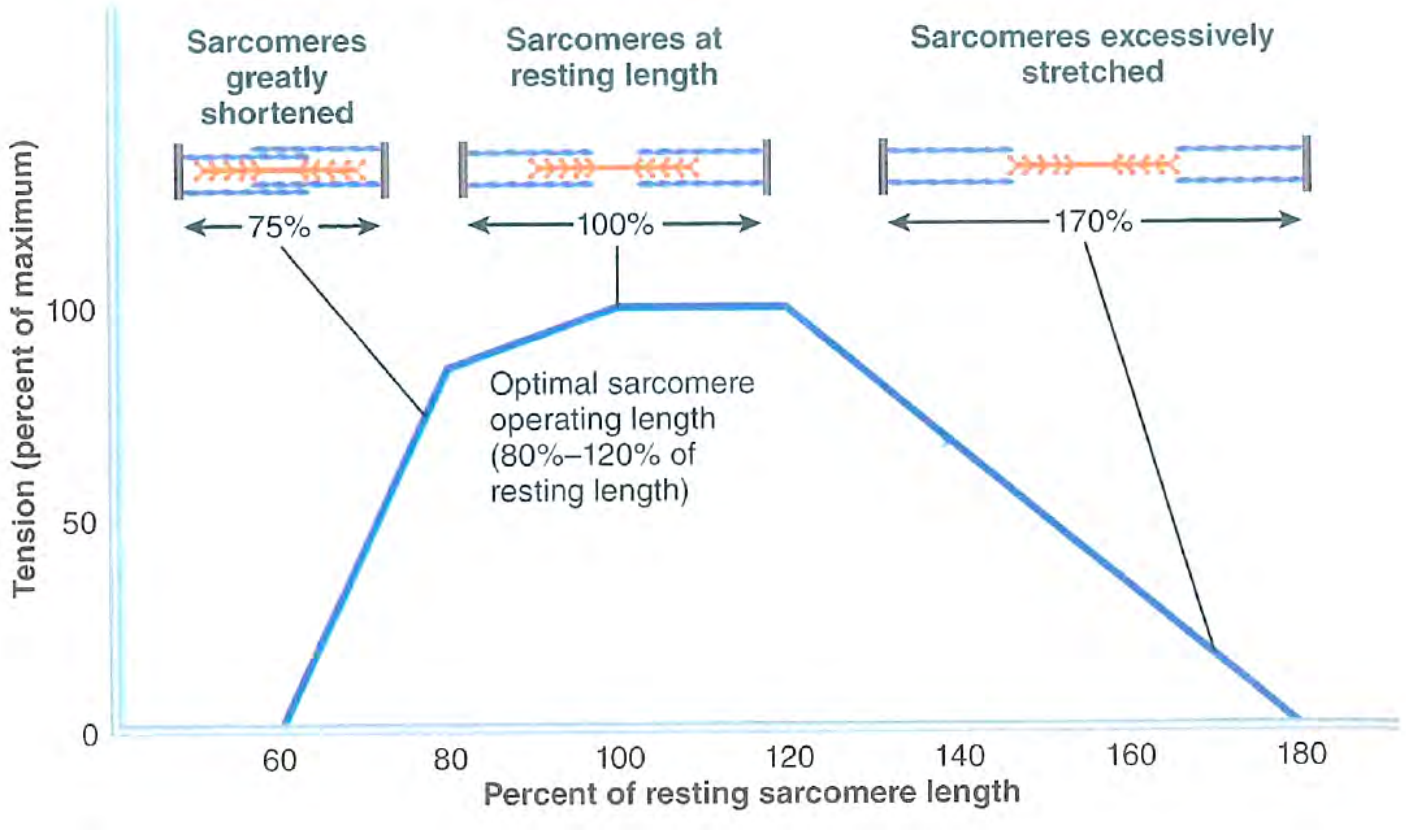
Weakness of
– Deep cervical flexors



Weakness of
– Middle and Lower Trapezius

Tightness of
+ Pectoralis Major / Minor
+ Sternocleidomastoid?

Movement Patterns



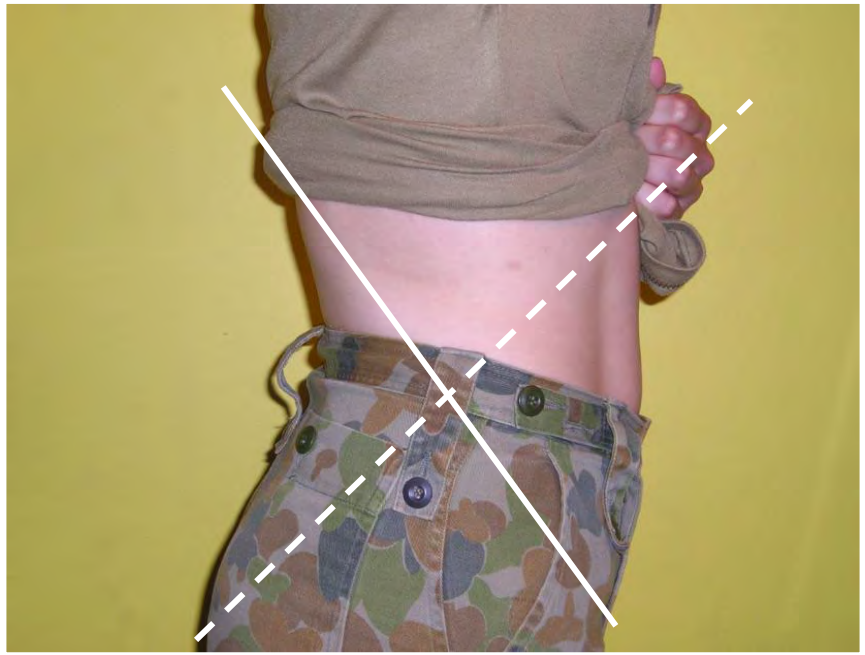
Marieb, E. N., & Hoehn, K. (2019). Human anatomy & physiology. 11th Edition Pearson education, fig 9.19, pg. 339

Movement Patterns

Yanda's Lower Cross Syndrome

Tightness of
+ Erector Spinae

Weakness of
- deep abdominals



Weakness of
- Gluteus Maximus
/ Medius

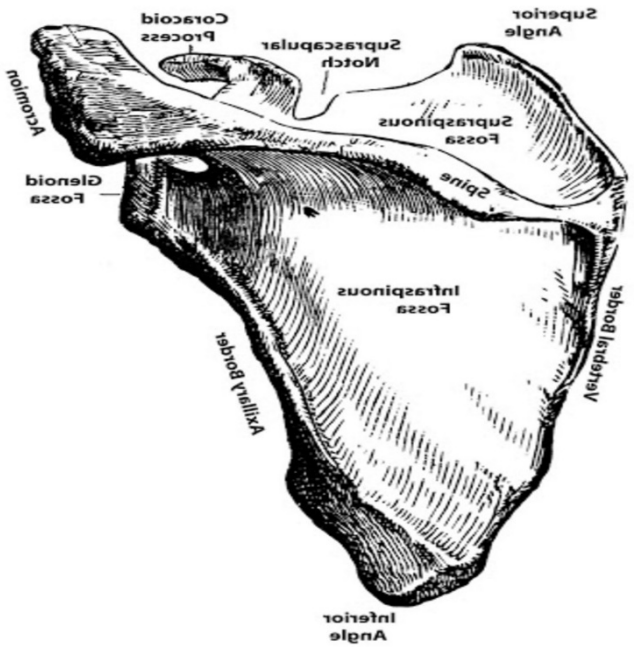
Tightness of
+ Iliopsoas
+ Rectus Femoris

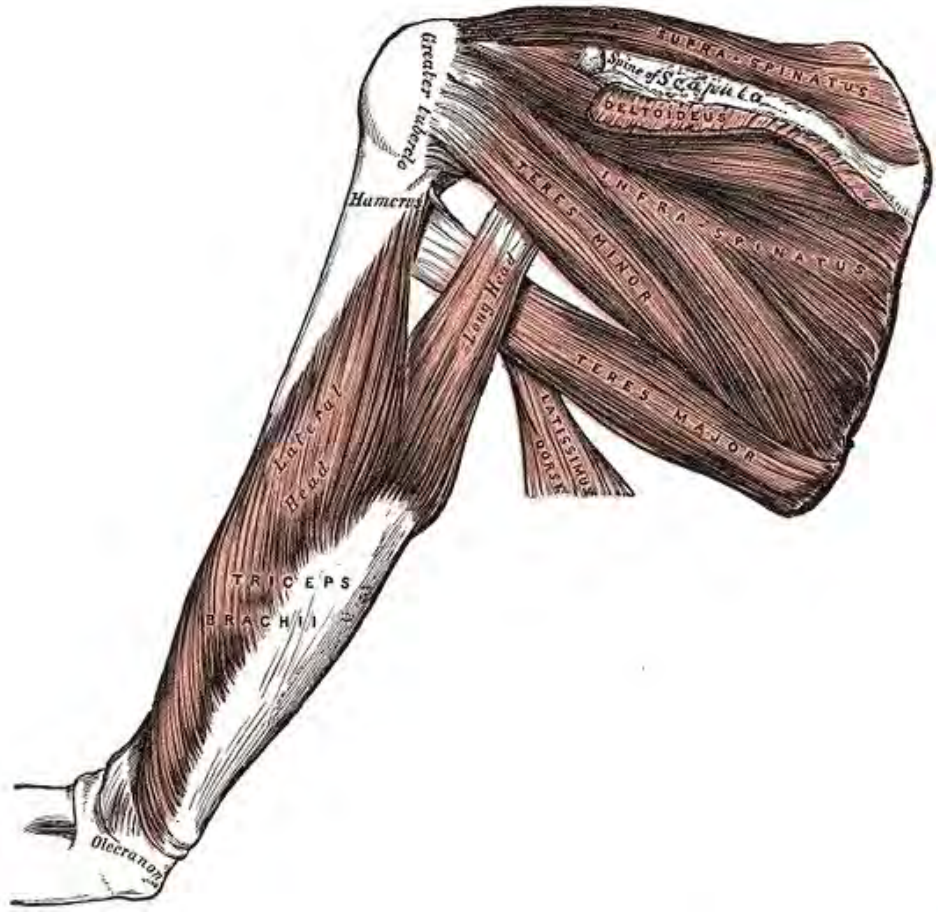
Exercise Selection

Exercise selection & choosing the right exercise

- The key is to ask yourself questions
  - What am I aiming to achieve with this exercise?
  - Is this exercise achieving the intended aim?

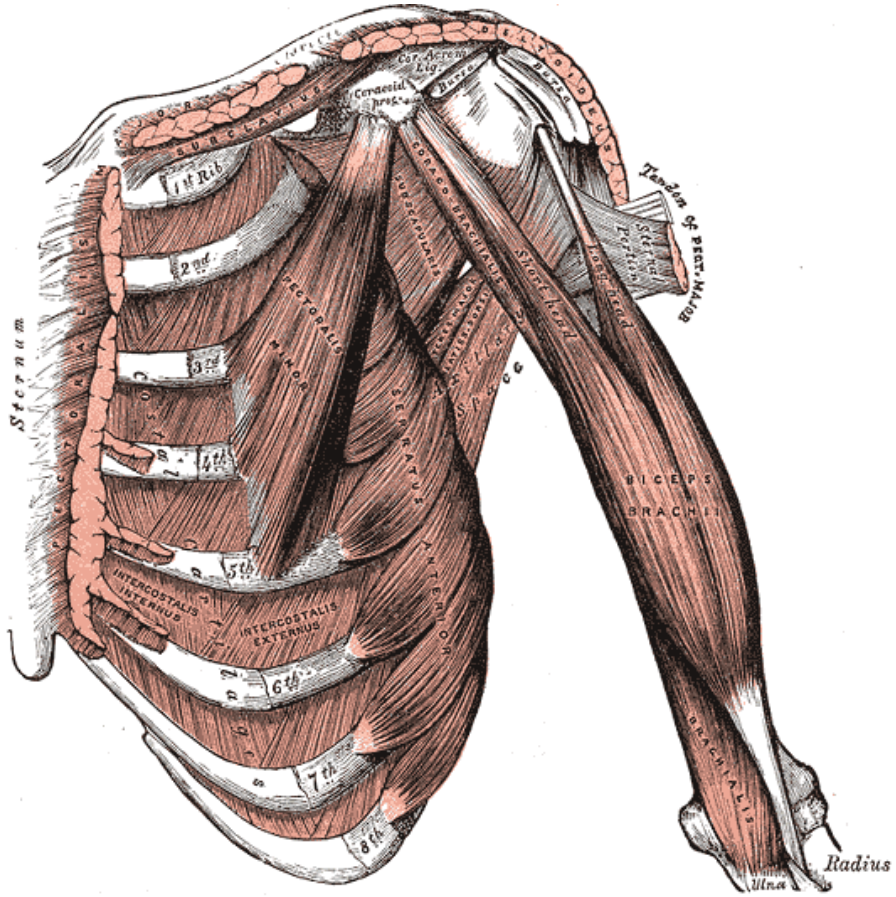
Exercise Selection - Anatomy





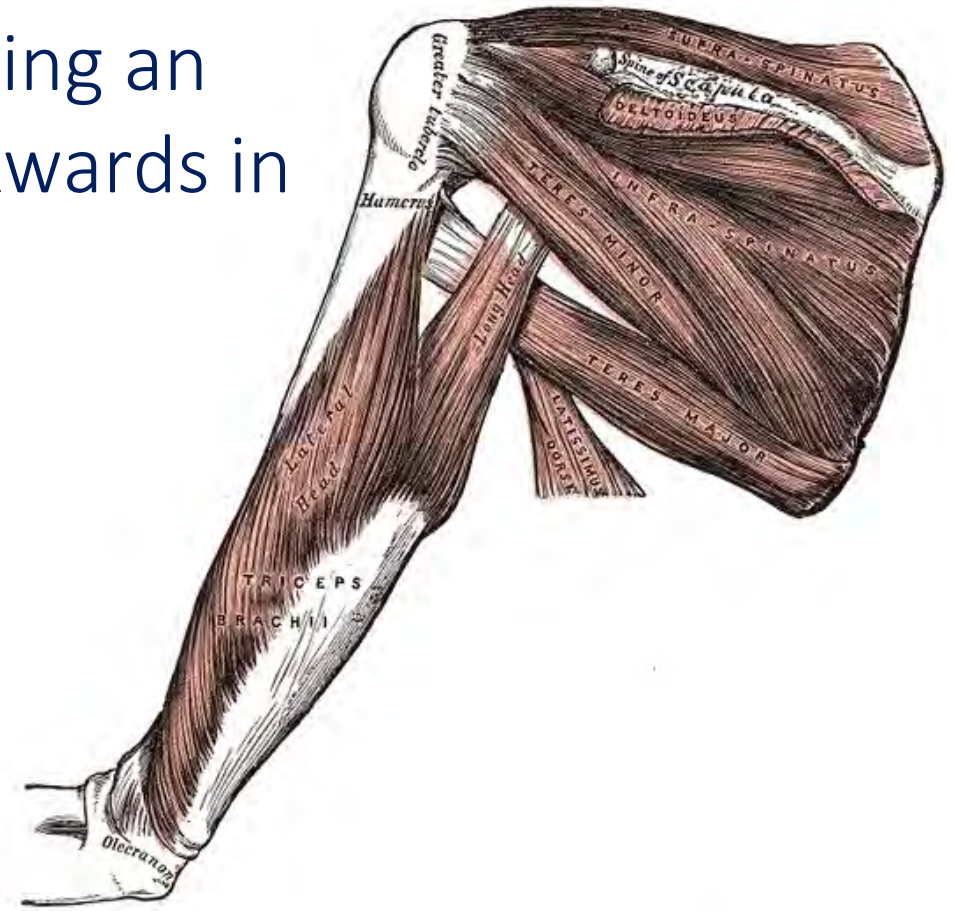
Exercise Selection - Anatomy

- Should the elbows move forward in a Biceps Curl?
- What are the origins of the Biceps?
- What three actions do the Biceps perform?



Exercise Selection - Anatomy

- Should the elbows move forward during an overhead Shoulder Extension or backwards in Pushdown?
- What are the origins of the Triceps?
- What three actions do the Triceps perform?



Exercise Selection - Anatomy

What exercises would you prescribe for tight Pecs?

What are the actions for the Pec Maj and Lats Dorsi?

Exercise Selection - Anatomy

What is the purpose of this stretch?

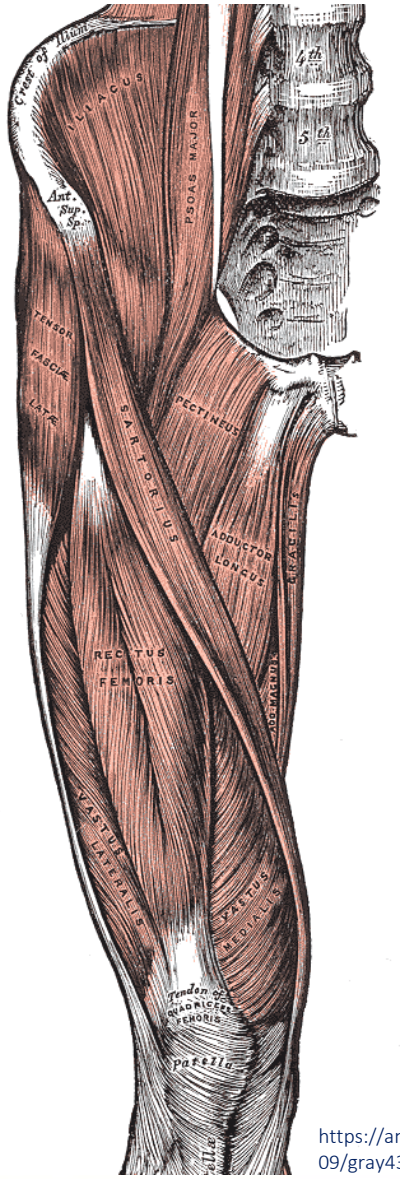
Exercise Selection - Anatomy

JAOA 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

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. *Journal of Osteopathic Medicine*, *108*(8), 379-390.



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

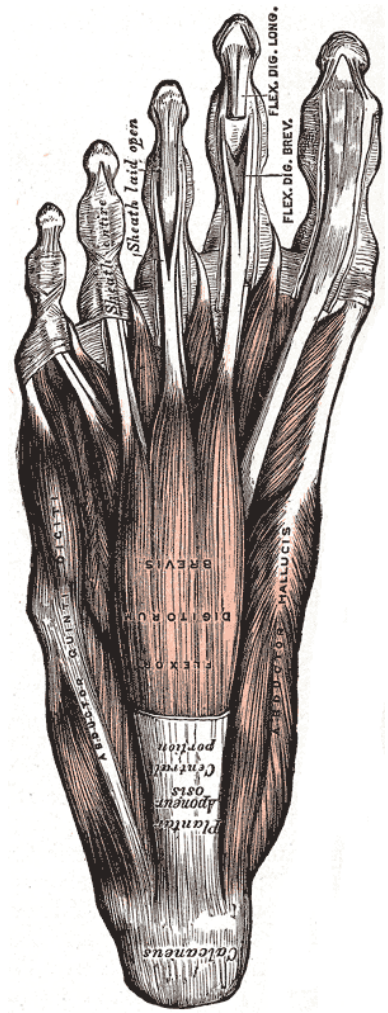
Exercise Selection - Anatomy

JAOA 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

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. *Journal of Osteopathic Medicine*, *108*(8), 379-390.



Exercise Selection - Anatomy

What is the purpose of this exercise?

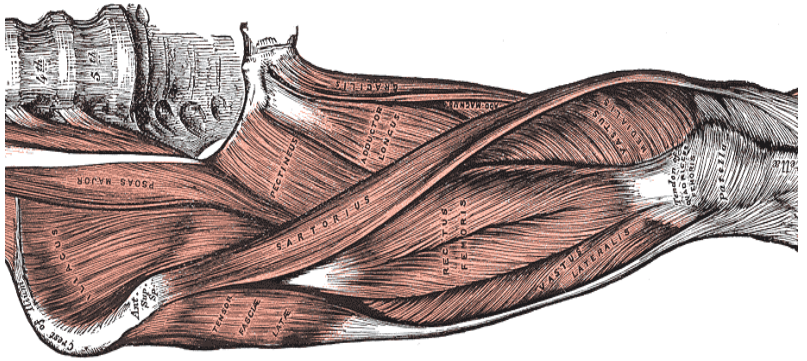
http://static1.squarespace.com/static/551035e3e4b0961711e870fe/t/551c230be4b0e383d17282e7/1427907340268/foam-roll.jpg?format=1500w

Exercise Selection - Anatomy

Are we effecting the ITB?

So why do it?

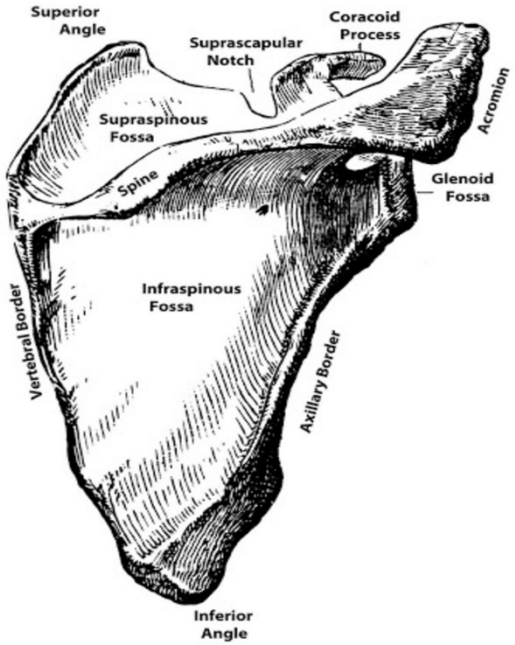
http://static1.squarespace.com/static/551035e3e4b0961711e870fe/t/551c230be4b0e383d17282e7/1427907340268/foam-roll.jpg?format=1500w

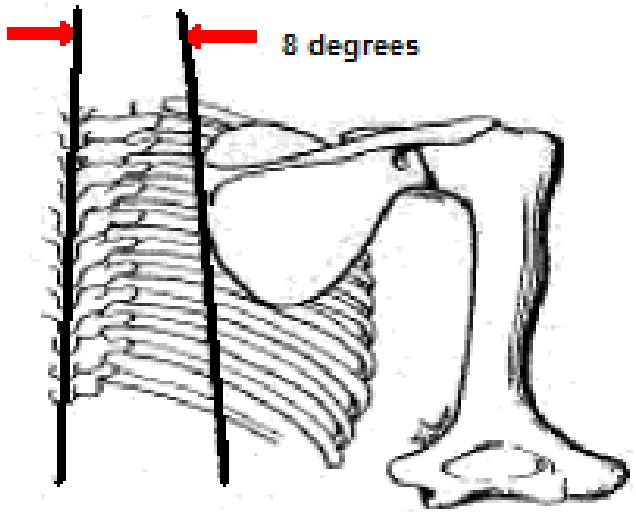


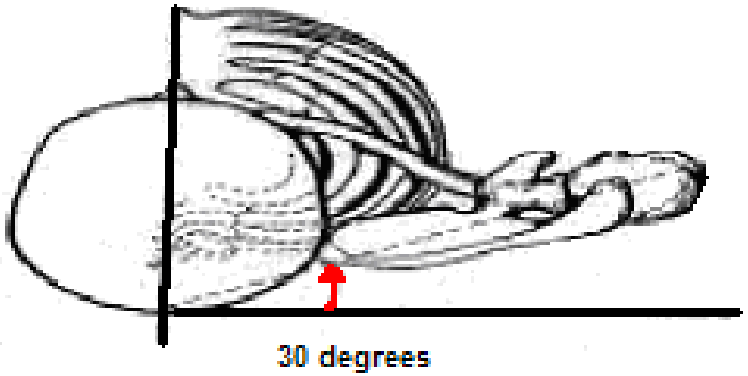
https://anytimeyoga.files.wordpress.com/2012/09/gray430.png

Exercise Selection - Anatomy

The Scapula

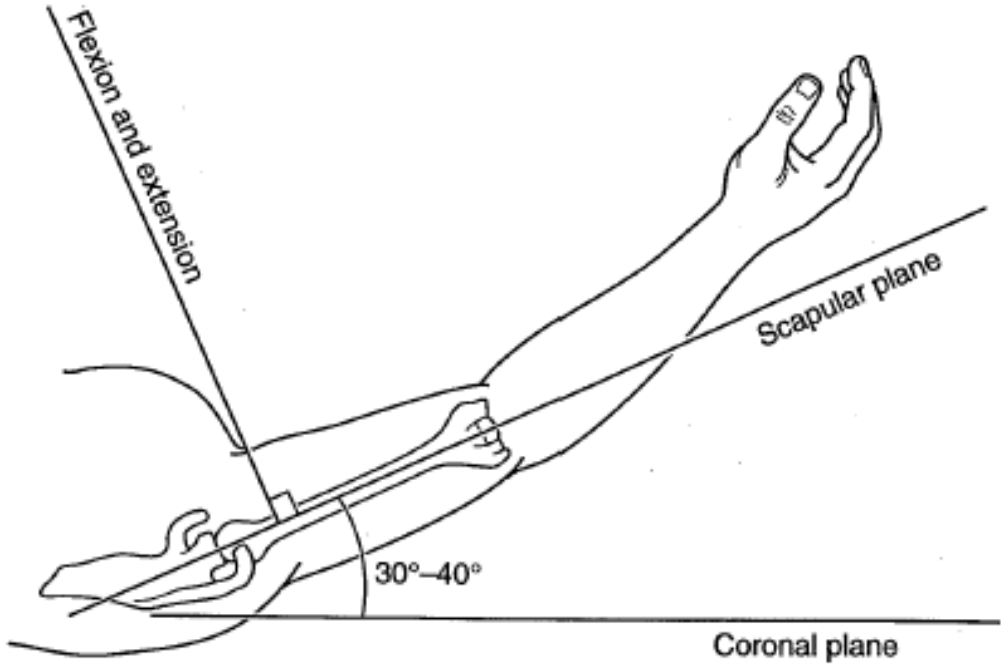






Exercise Selection - Anatomy

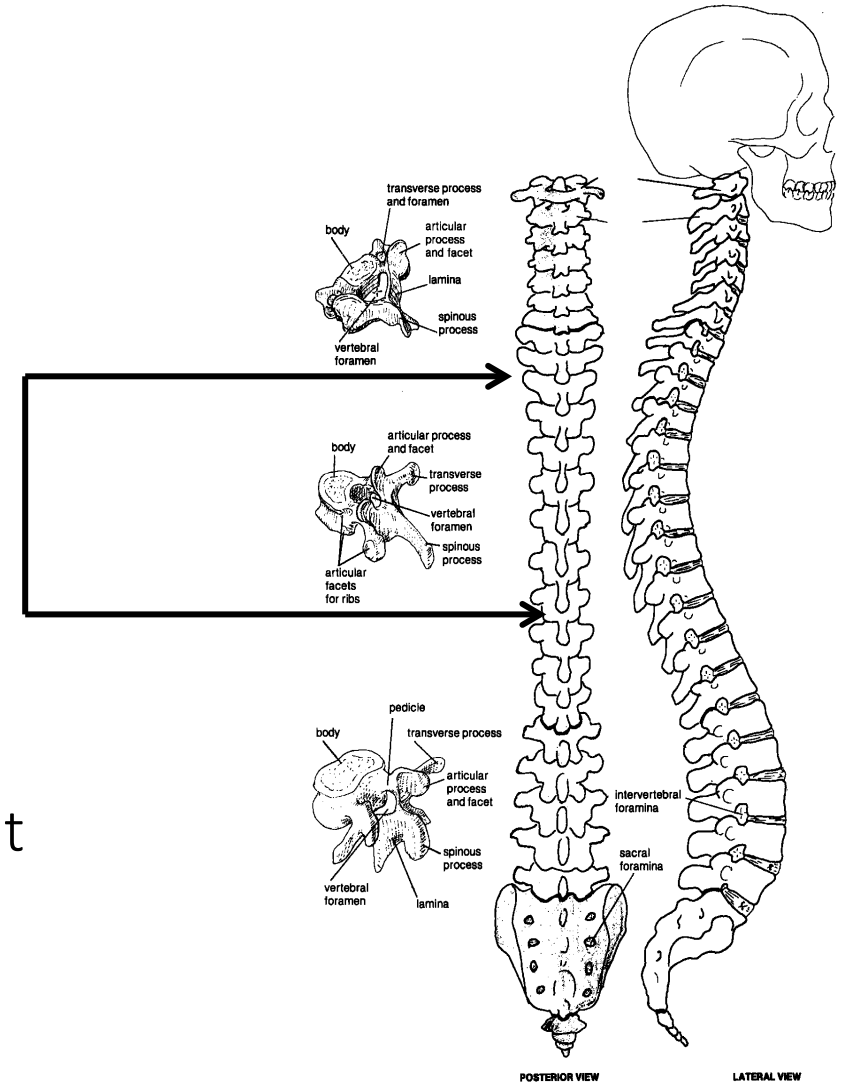
What is scaption and why us it important?



Exercise Selection - Anatomy

Segmented to allow movement

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

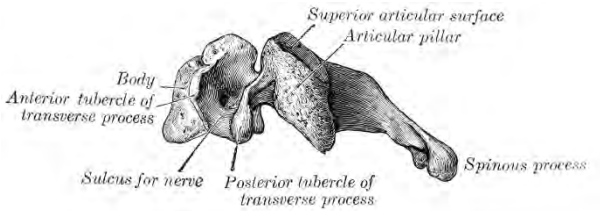


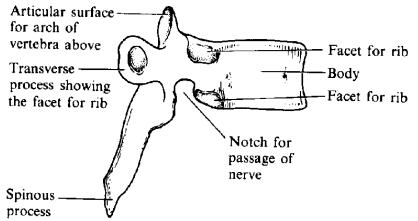
Exercise Selection - Anatomy

The Cervical Vertebrae
- Moderate F/E
- Good Rot

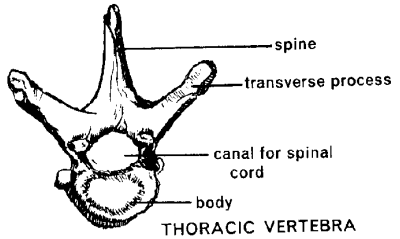
The Thoracic Vertebrae
- Limited F/E
- Limited Rot

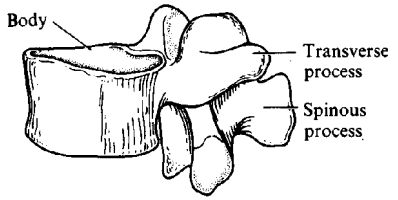
The Lumbar Vertebrae
- Good F/E
- Limited Rot





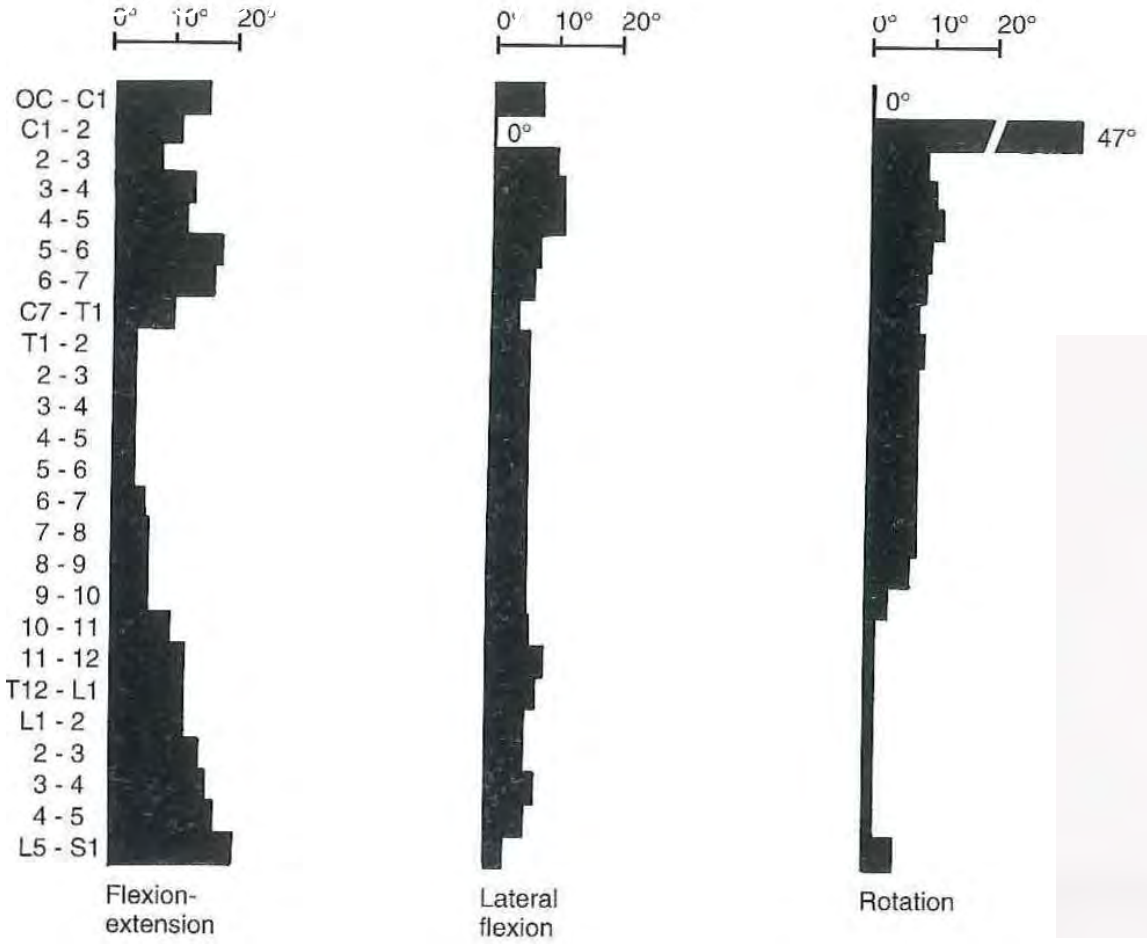
A typical thoracic vertebra (side view).





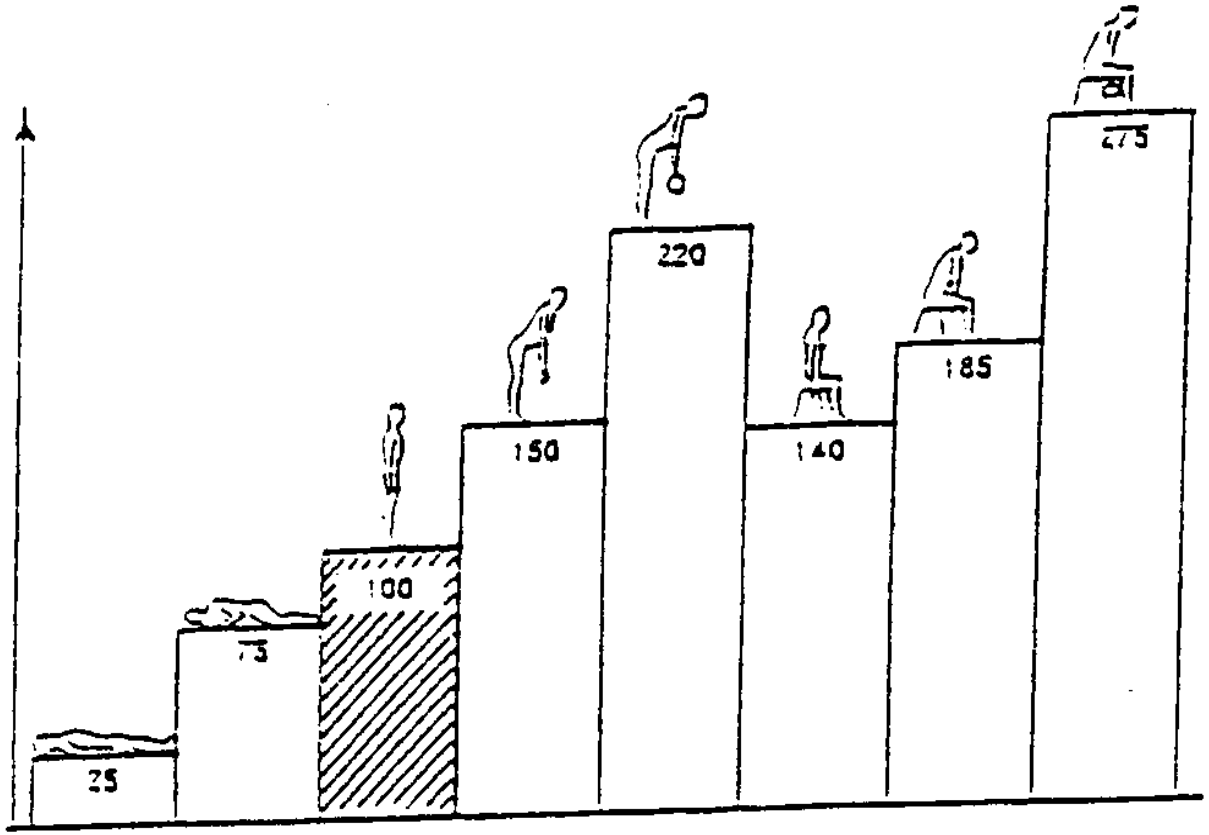
A lumbar vertebra.

Exercise Selection - Anatomy



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

Exercise Selection - Anatomy



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

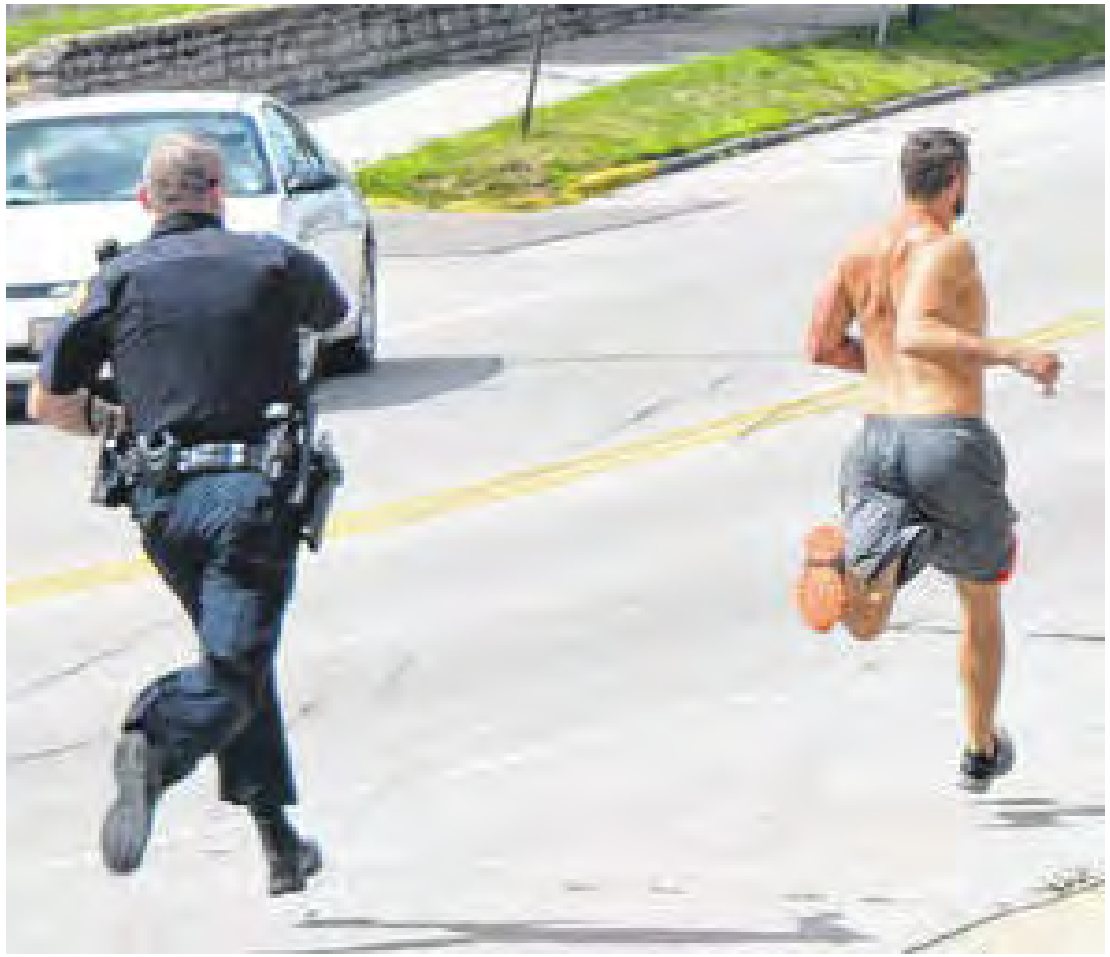
Exercise Selection - Anatomy

Exercise Selection - Anatomy

What exercises can you use to condition the hamstring?

What Ranges of Motion do these exercises move the hamstring through?

Exercise Selection - Anatomy



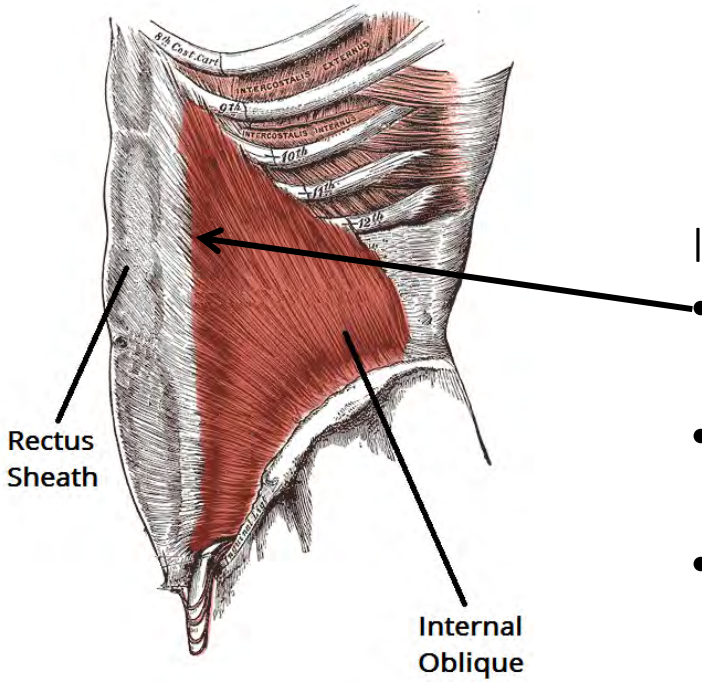
https://www.wnewsj.com/news/142125/breaking-wild-scene-downtown-with-car-crashing-entirely-into-cvs-wpd-foot-chase

1 JPAU

Exercise Selection - Anatomy

Rectus Abdominus (RA)

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



IO divides into 2

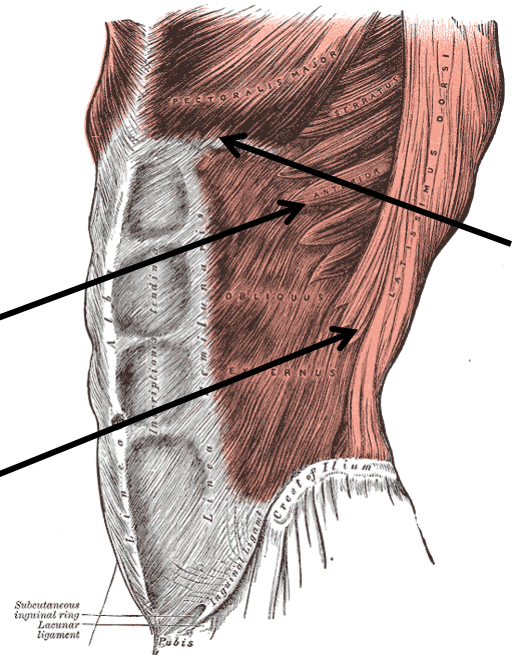
- Anterior sheath blends with EO to pass in front
- Posterior sheath with TA to pass behind
- All join again at the Linea Alba

Exercise Selection - 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

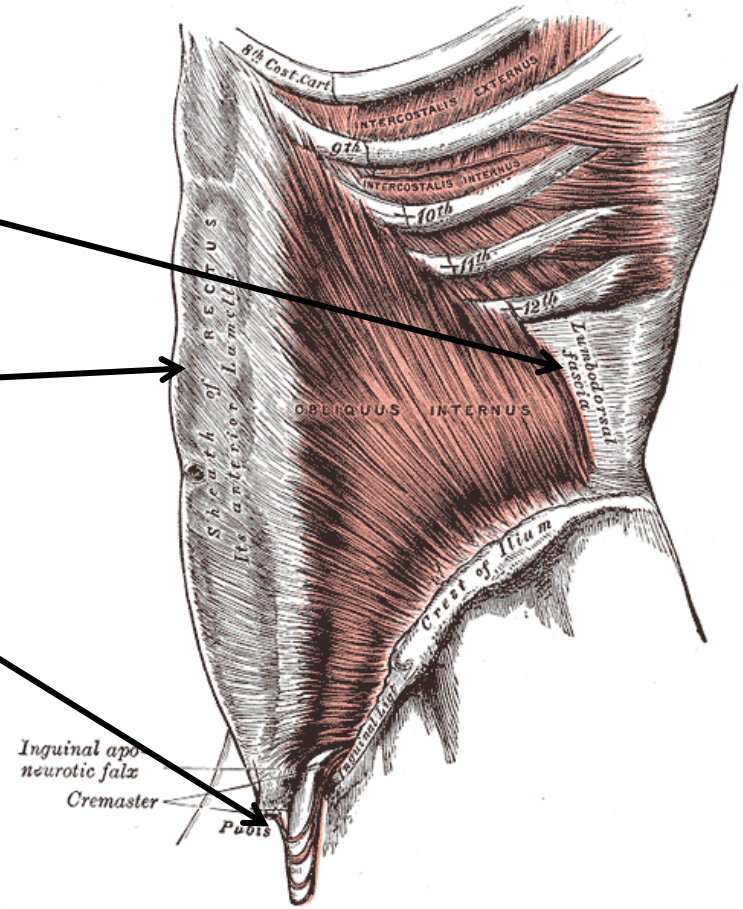
Exercise Selection - Anatomy

Internal Oblique (IO)

Attachments into the LDF and Iliac crest

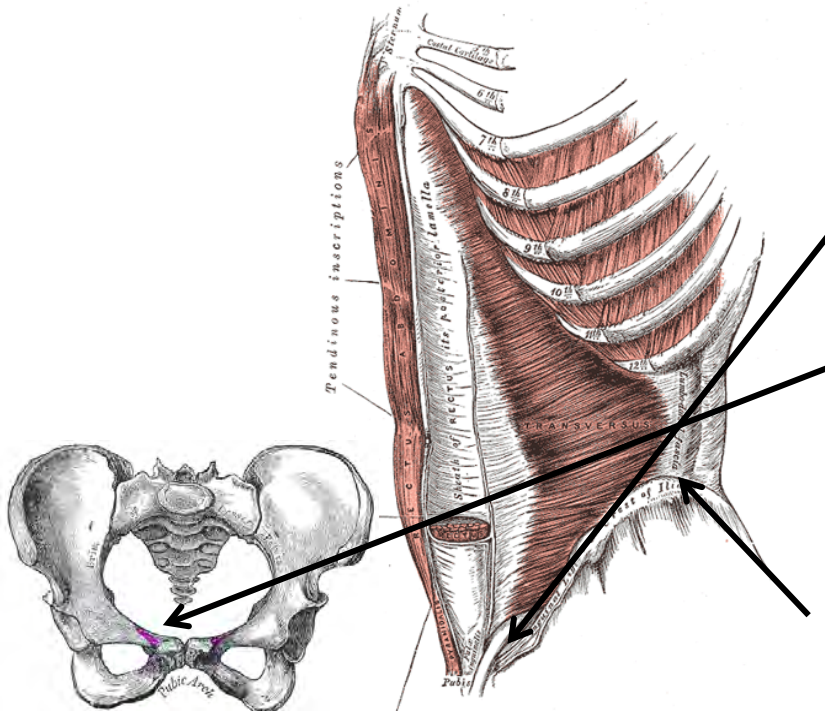
Attachments into the Linea Alba

Inserts conjointly with TrA into pubis and pectineal line



Exercise Selection - Anatomy

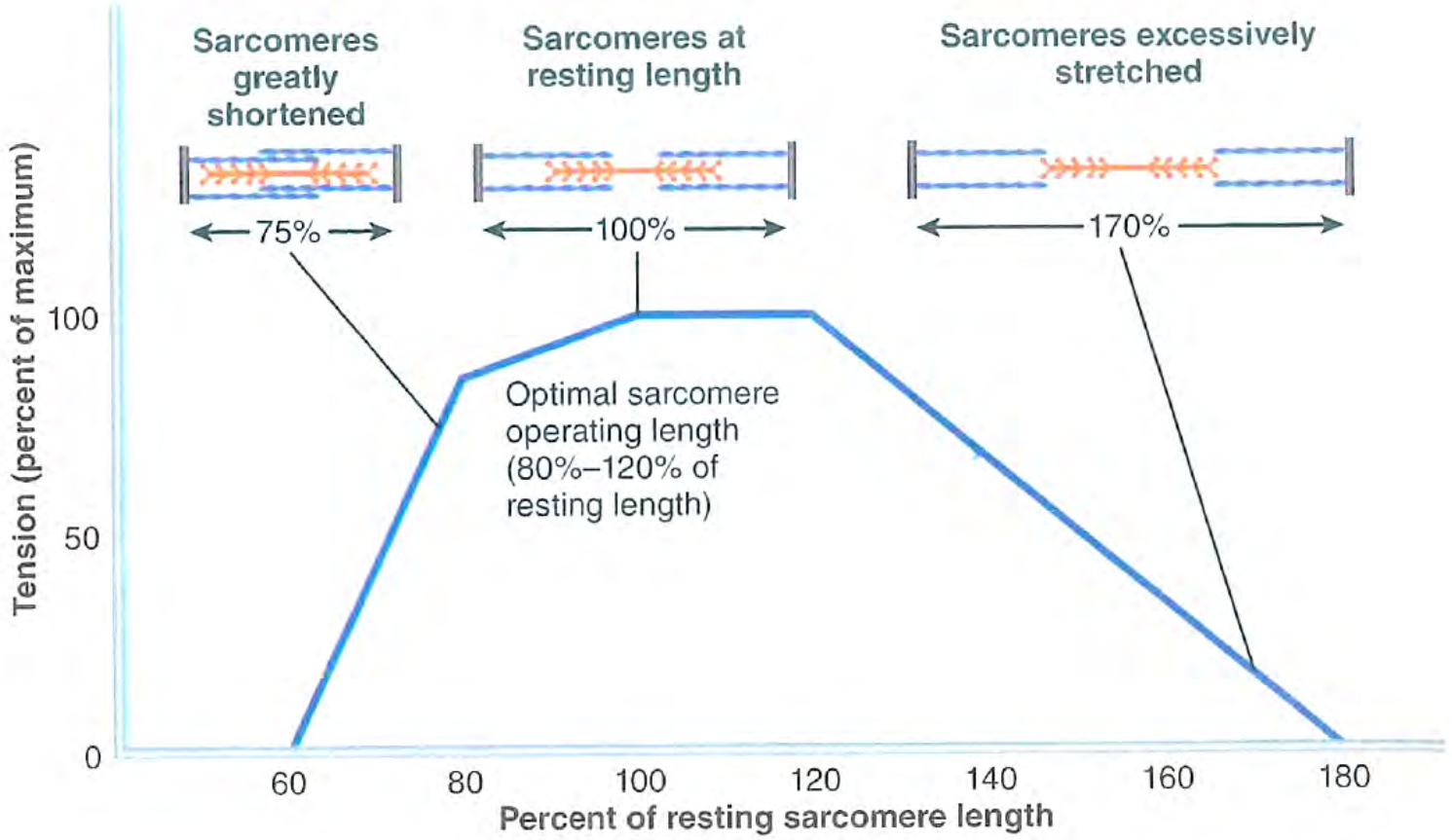
Transverse Abdominals (TA)



- 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

Exercise Selection - Physiology



Exercise Selection - Physiology

What is the purpose of this exercise?

https://s-media-cache-ak0.pinimg.com/216x146/87/f5/c1/87f5c

Exercise Selection - Physiology

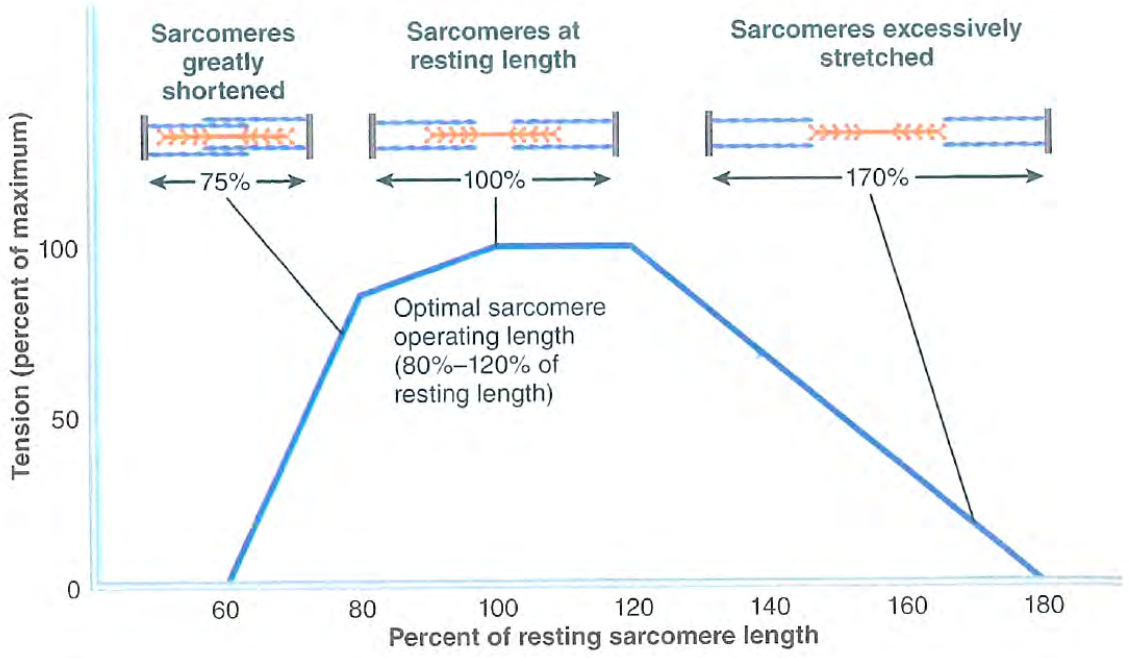
The Length-Tension Curve

- Joint position will influence which muscle takes up the most tension and receives the most stimulus.

https://s-media-cache-

Understanding the Physiology

- The Length-Tension Curve
  - A muscle's sarcomeres will develop most tension at between 90-110* of resting length.



Marieb, E. N., & Hoehn, K. (2019). Human anatomy & physiology. 11th Edition Pearson education, fig 9.19, pg. 339

Understanding the Physiology

The Length-Tension Curve

- It effects optimal loading for a muscles

http://www.bodybuilding.com/fun/2002/seatedcalfraise1.jpg

Understanding the Physiology

The Length-Tension Curve

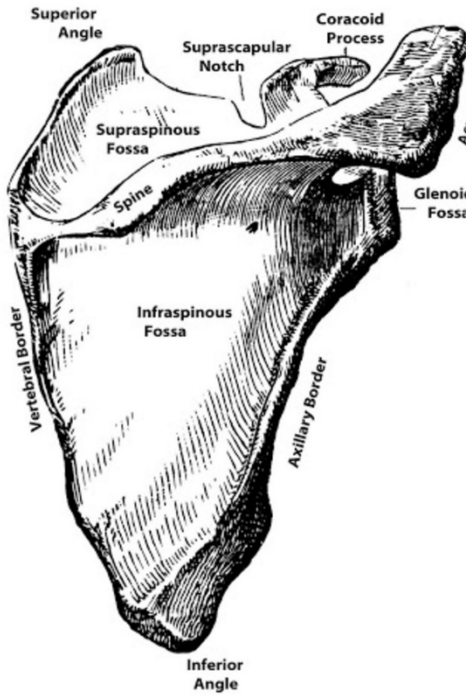
- It effects optimal loading for a muscles

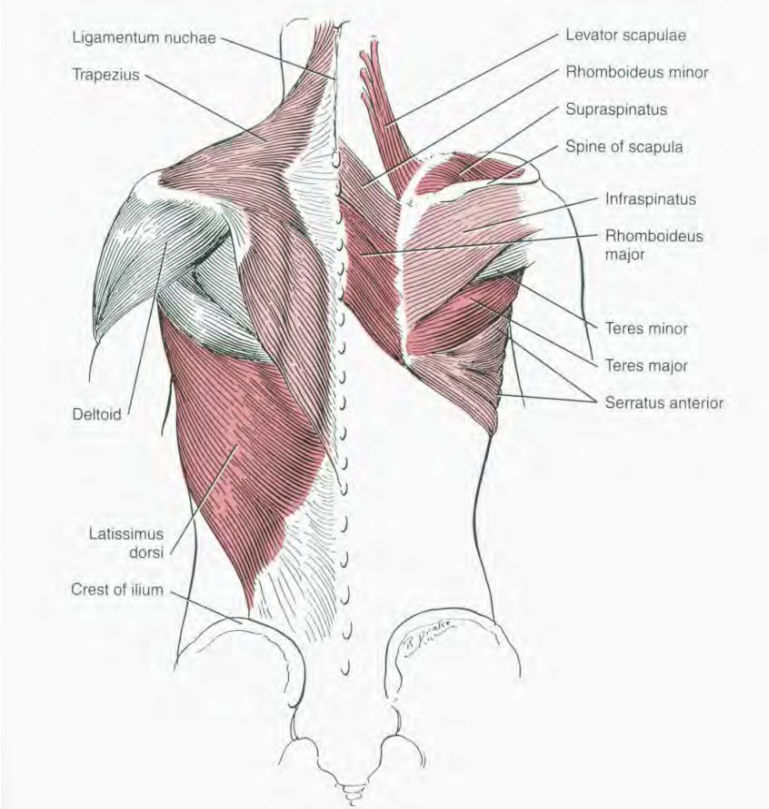
https://www.bodybuilding.com/content/leg-curls-done-light.html

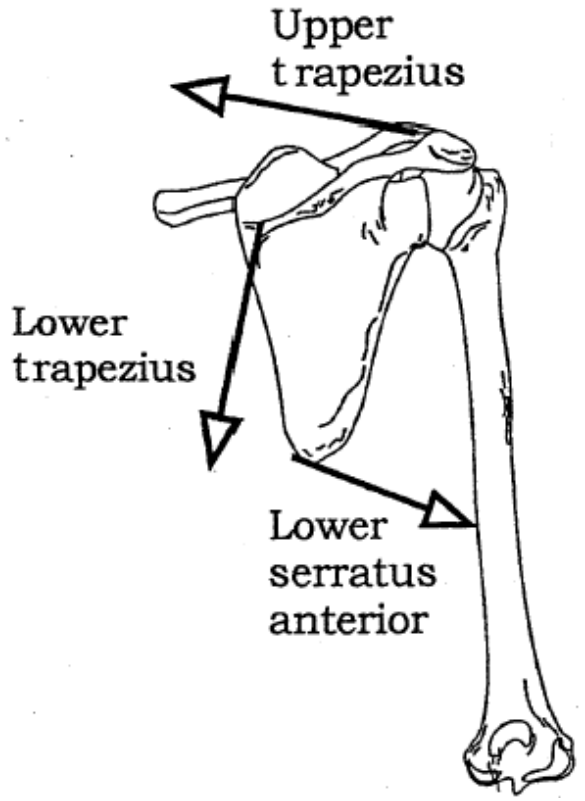
Understanding the Physiology

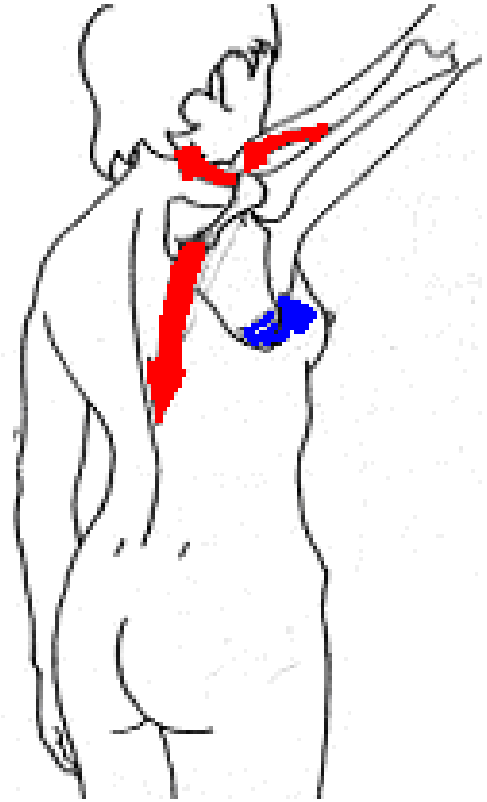
The Length-Tension Curve

- It effects optimal loading for a muscles



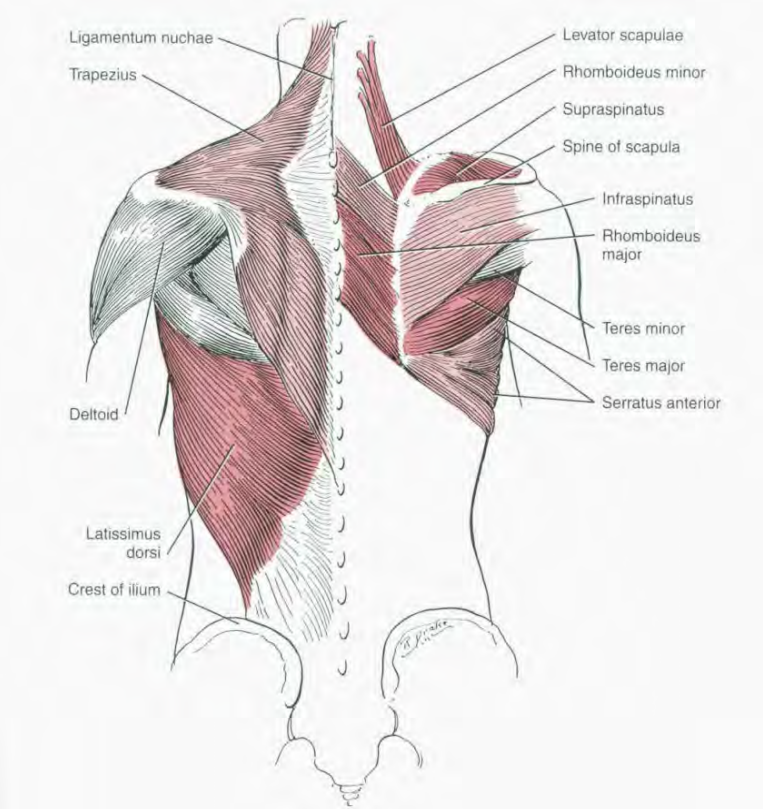




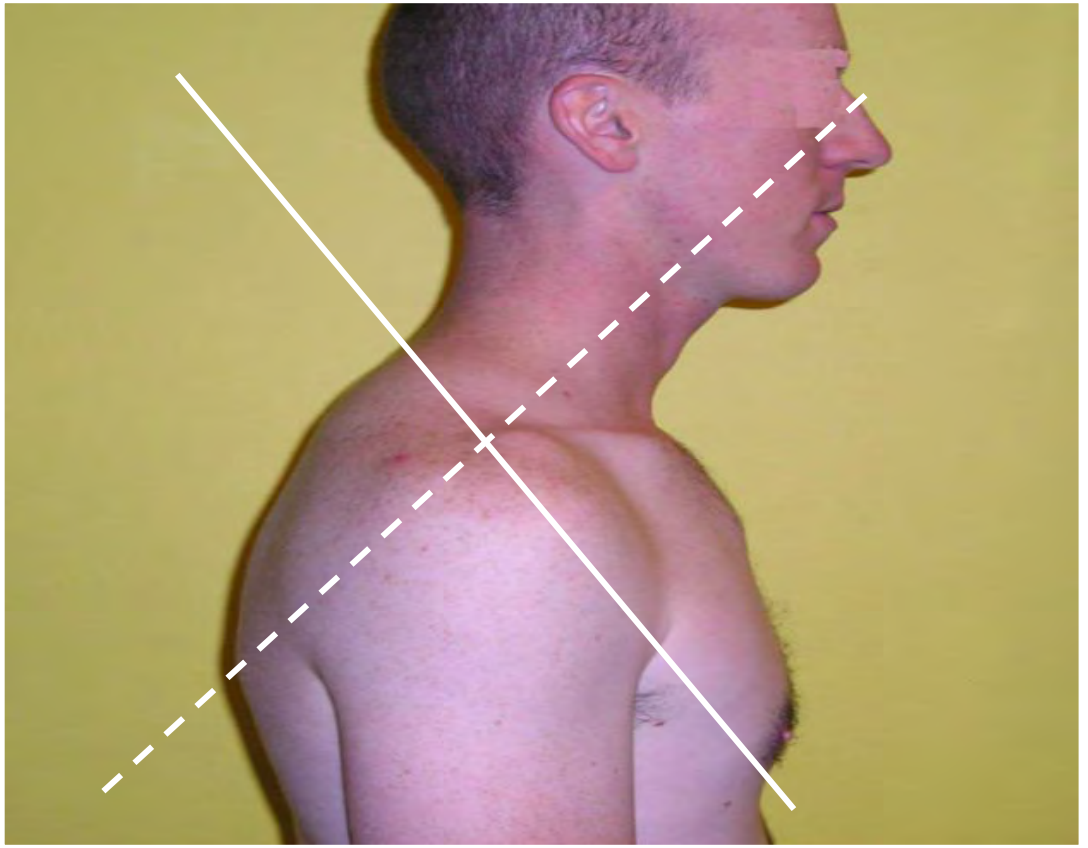


http://52bpijddwt-flywheel.netdna-ssl.com/wp-content/uploads/2013/03/shoulderposterior.gif

Understanding the Physiology

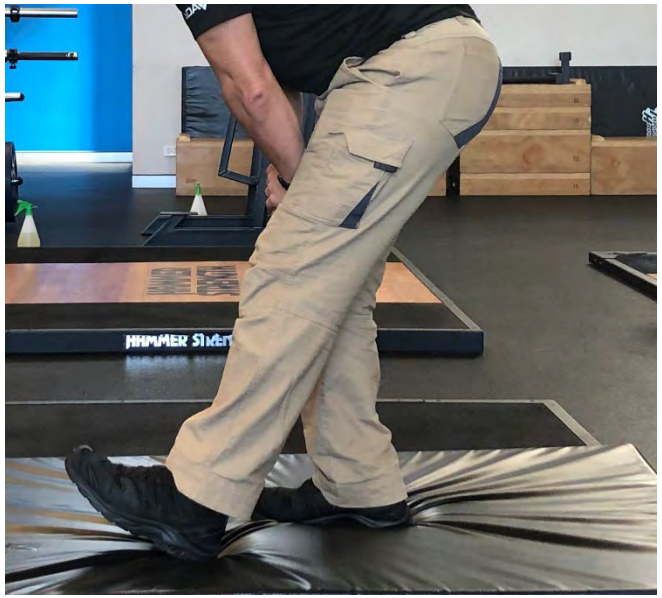


http://52bpijddwt-flywheel.netdna-ssl.com/wp-content/uploads/2013/03/shoulderposterior.gif



Understanding the Physiology

- Where is the muscle belly of the hamstrings?
- Which muscles are at optimal length?



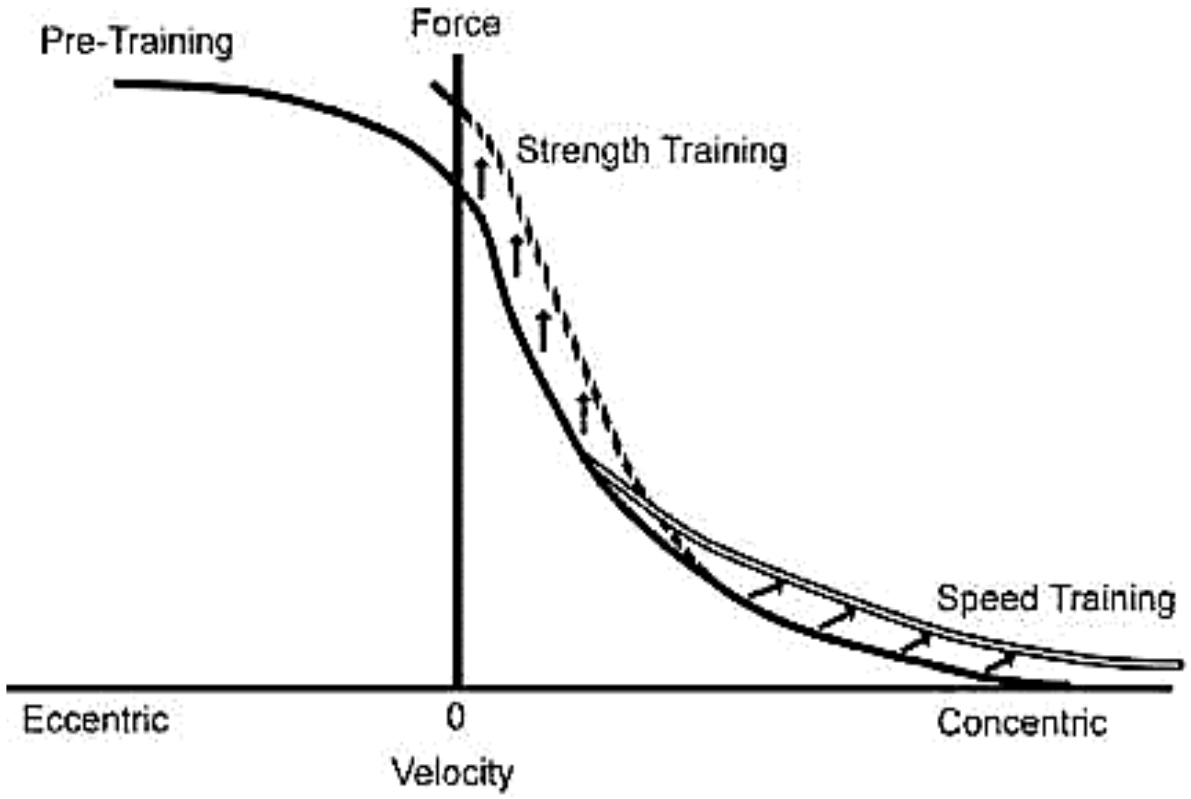
Understanding the Physiology

An effective stretch?

http://static1.squarespace.com/static/551035e3e4b0961711e870fe/t/551c230be4b0e383d17282e7/1427907340268/foam-roll.jpg?format=1500w

Understanding the Physiology

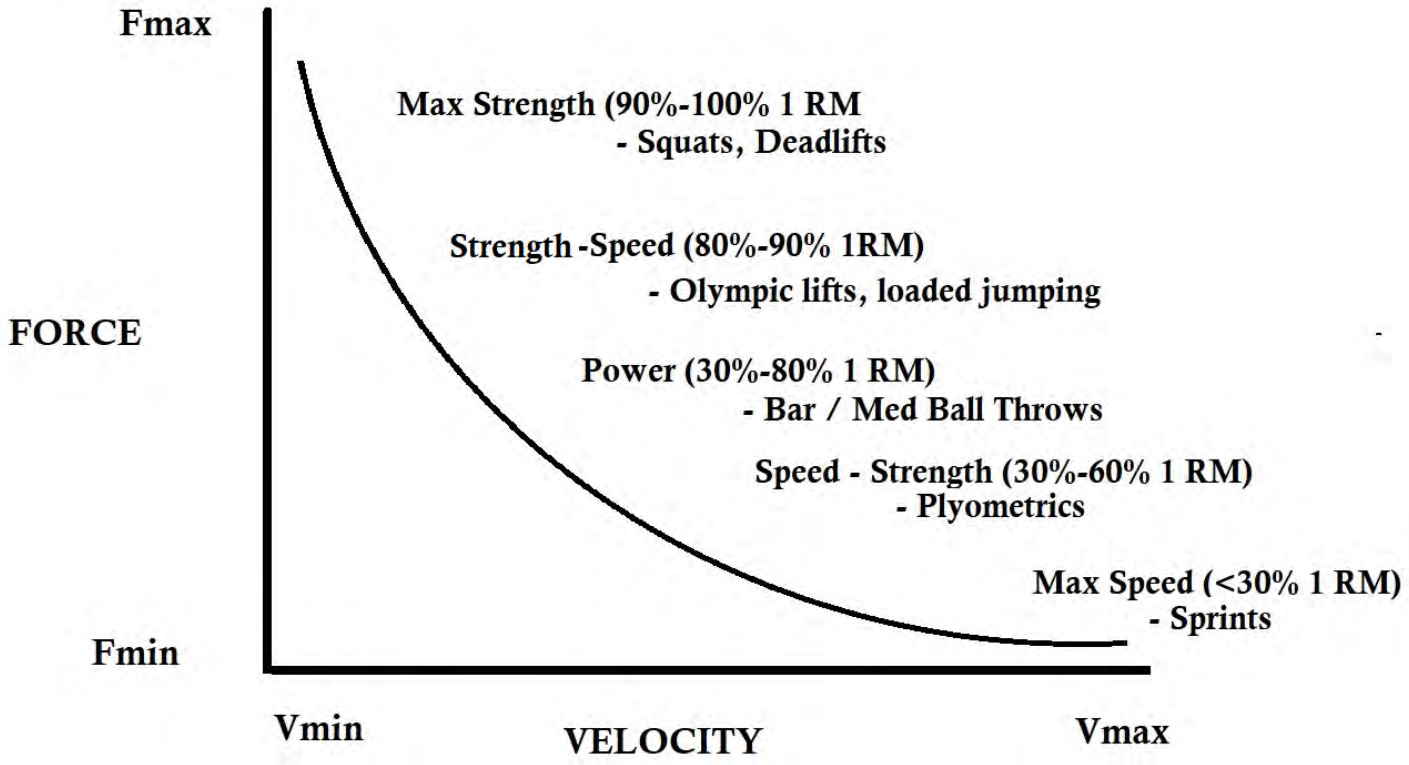
The Force Velocity Curve



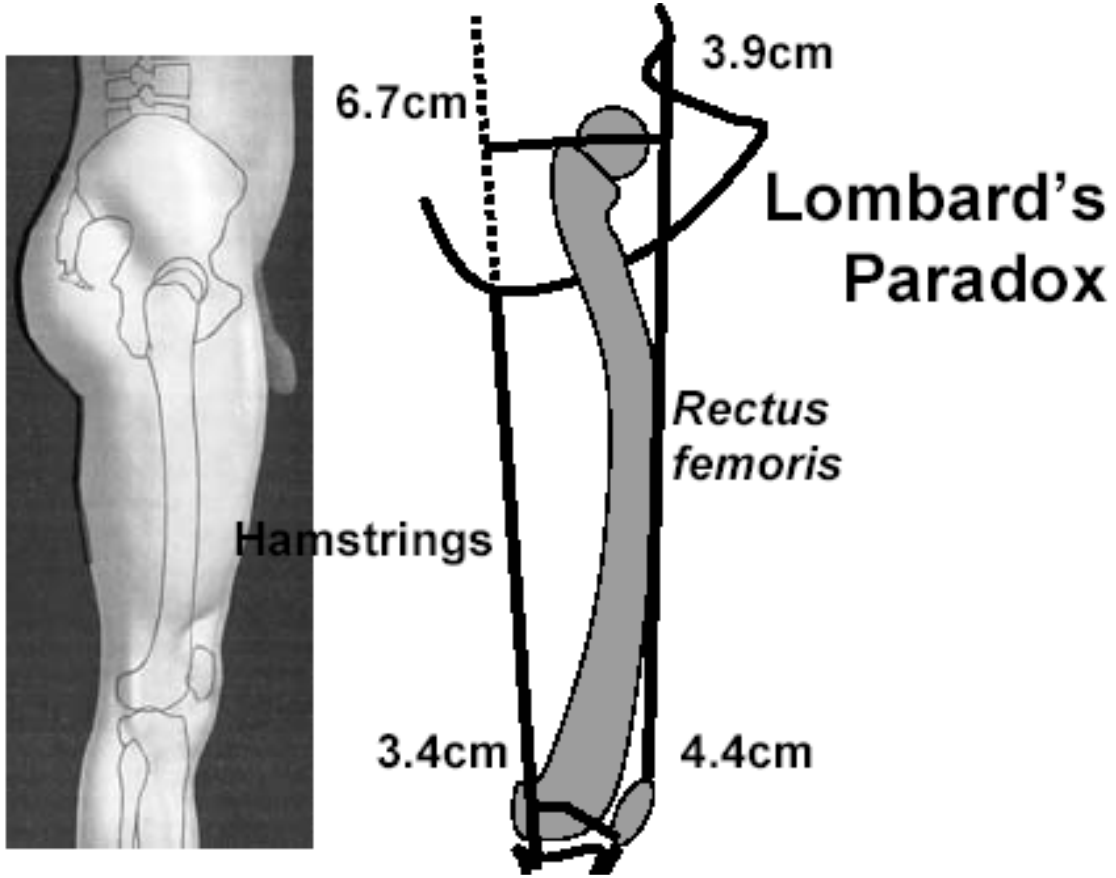
Kraemer, W. J., Fleck, S. J., & Deschenes, M. R. (2016). Exercise physiology: integrating theory and application. 2nd Edition. Lippincott Williams & Wilkins.

Understanding the Physiology

The Force Velocity Curve



Exercise Selection – Biomechanics



Exercise Selection – Biomechanics

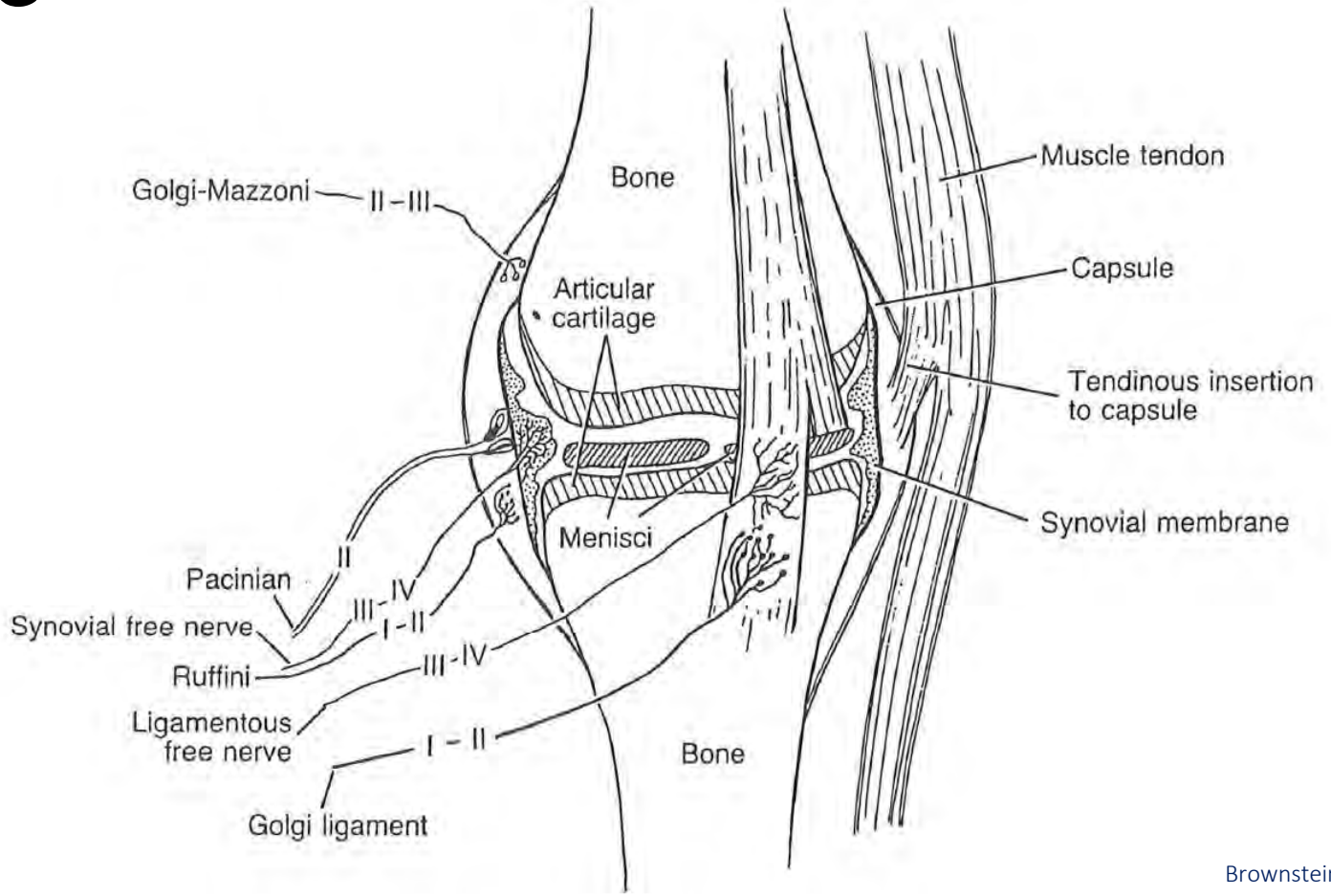
OKC vs CKC

CCK:

- Increased joint compressive forces
- Increased stability
- Decreased shear forces
- Decreased acceleration forces
- Stimulation of proprioceptors
- Better muscle synergistic patterns
- Proprioception, Joint Position Sense and Kinesthesia are vital to training and rehab

Understanding the Biomechanics

OKC vs CKC



Brownstein & Bronner (1997), Fig 2-1 p.50

Brownstein & Bronner (1997), Fig 2-1 p.50

Exercise Selection – Biomechanics

OKC vs CKC

OCK:

- Increased acceleration forces
- Increased joint distraction

Exercise Selection – Biomechanics

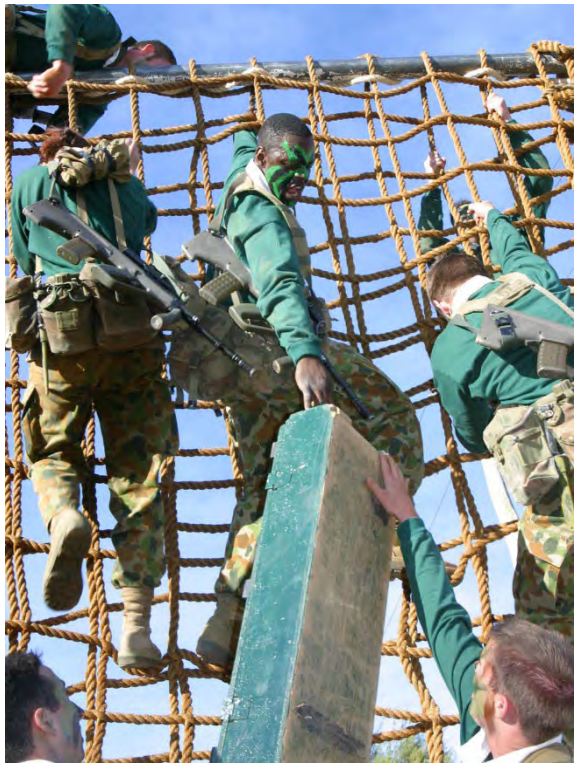
OCK v CKC

- Both OCK and CKC are important
- The question is when to use them as part of conditioning

Exercise Selection – Biomechanics

Pseudo KC

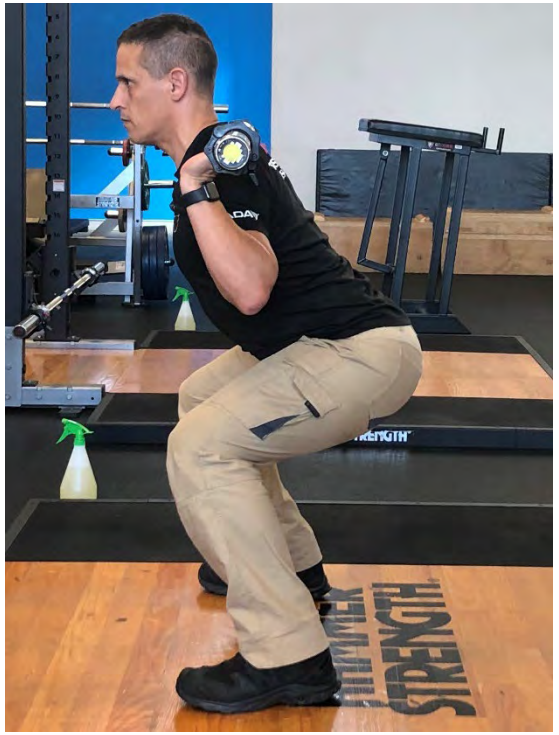
- Combines concepts of both OKC & CKC at once



Exercise Selection – Biomechanics

Lombard's Paradox

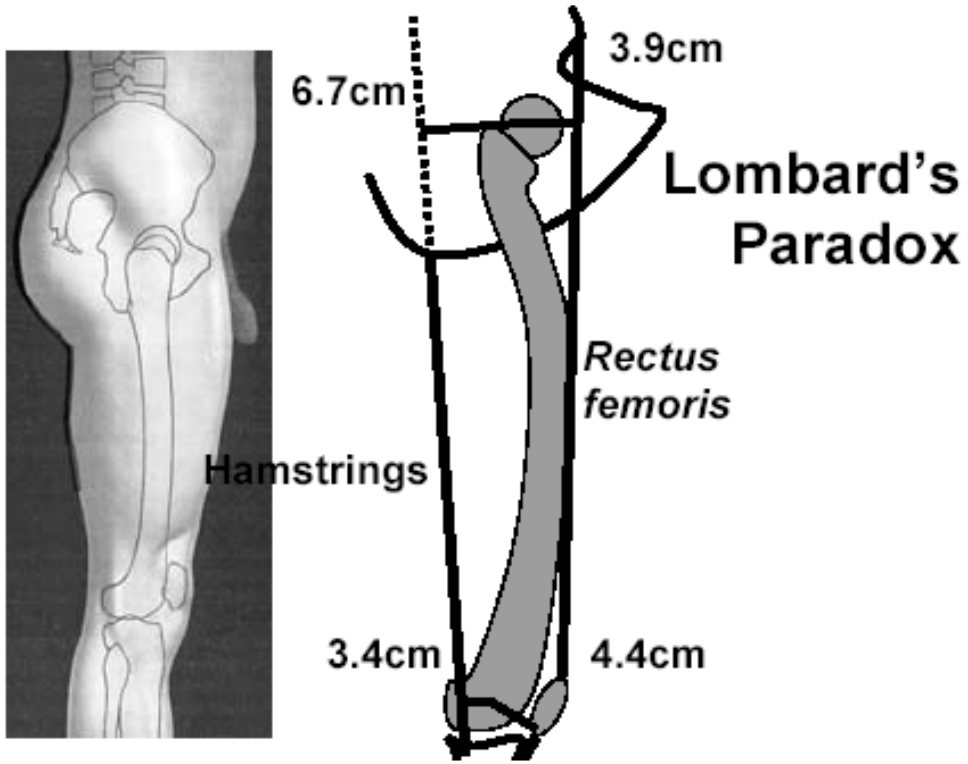
Hip	– Extension	– Glutes & Hamstrings
Knee	– Extension	– Quads

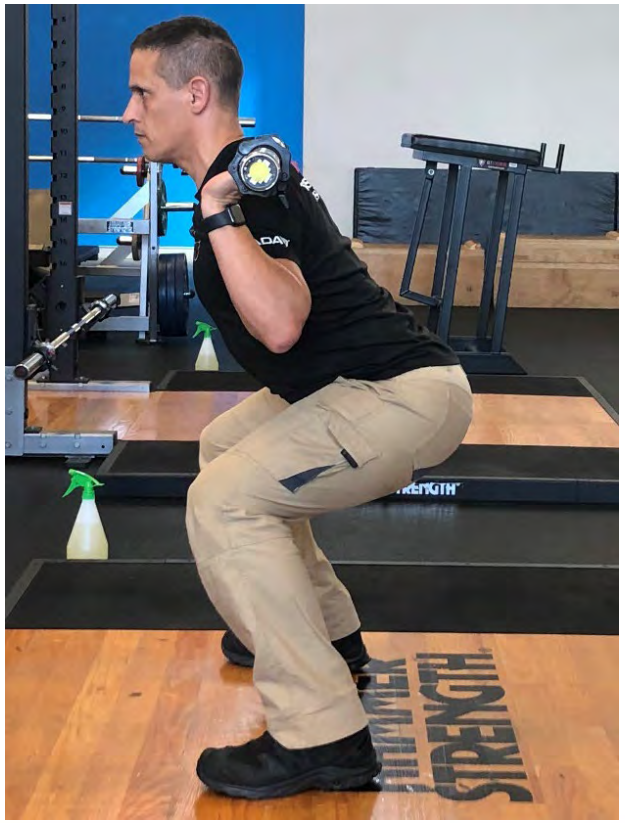


http://www.numetrex.com/our-pulse/wp-content/uploads/2014/07/squat.jpg

Exercise Selection – Biomechanics

Lombard's Paradox

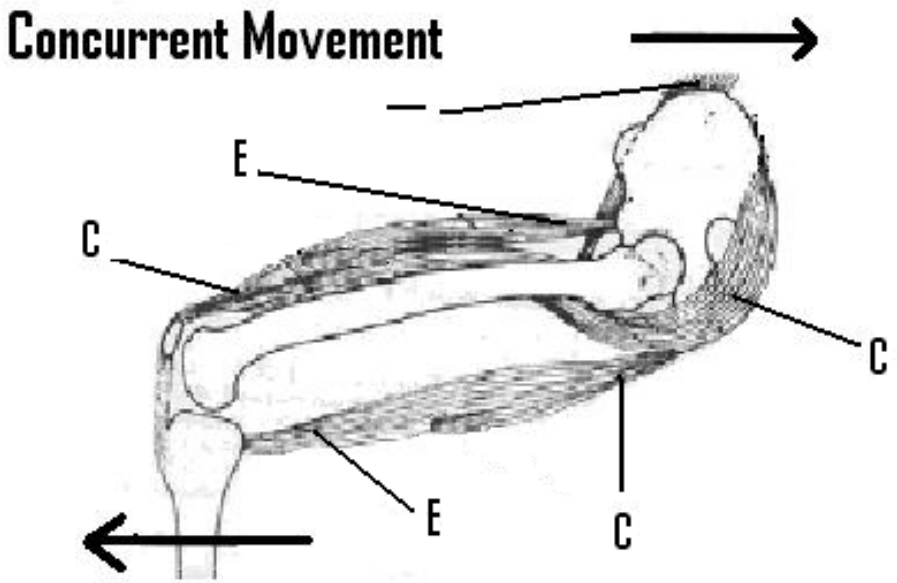


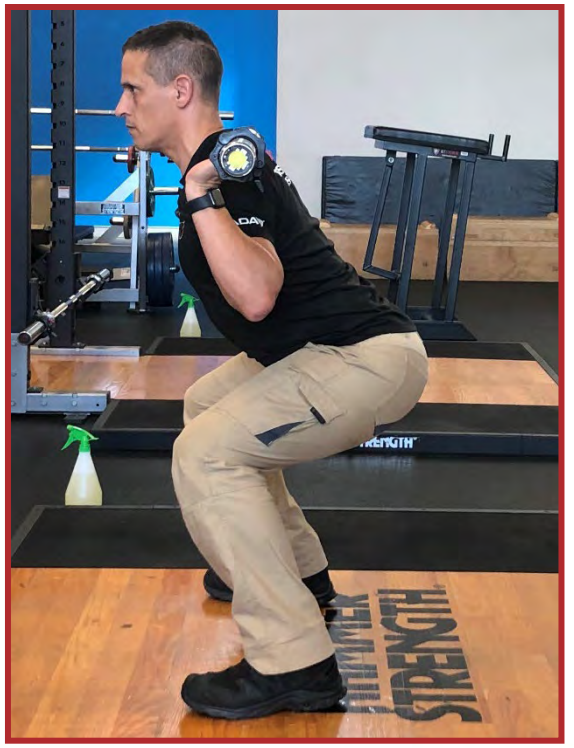


Understanding the Biomechanics

Complex Synergies – Shifts

- In a concurrent movement, the biarticular muscle is an agonist at one joint and an antagonist at another simultaneously





Exercise Selection – Biomechanics

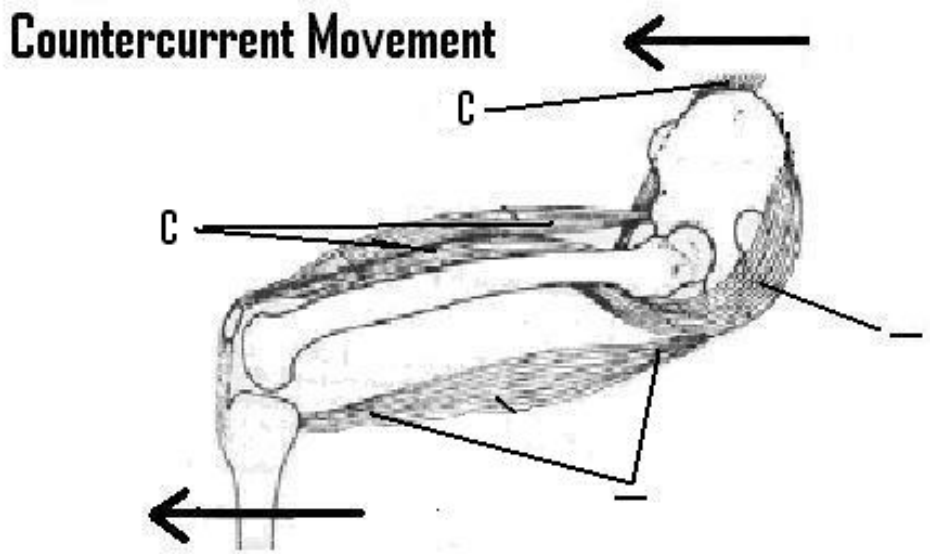
Hip	– Flexion	– Quads & Iliopsoas
Knee	– Extension	– Quads

http://www.numetros.com/our-pulse/wp-content/uploads/2014/07/squat.jpg

Understanding the Biomechanics

Complex Synergies – Shifts

- In a countercurrent movement, the biarticular muscle is an agonist at both joints simultaneously.



Complex Synergies – Shifts

- So which one do we train?



Exercise Selection – Biomechanics

Complex Synergies – Shifts

- So which one do we train?

Exercise Selection – Biomechanics

Complex Synergies – Shifts

- So which one do we train?

Correlation between outcome measures and performance in the victim drag and pack march performance tests.

Outcome measure	Victim drag	Pack march
Absolute bench	$r = 0.711$†	$r = -0.265$
Relative bench	$r = 0.531$†	$r = -0.330$*
Absolute squat	$r = 0.741$†	$r = -0.335$*
Relative squat	$r = 0.557$†	$r = -0.395$†
Absolute deadlift	$r = 0.747$†	$r = -0.219$
Relative deadlift	$r = 0.568$†	$r = -0.285$
Absolute pull-up	$r = 0.742$†	$r = -0.356$*
Relative pull-up	$r = 0.465$†	$r = -0.468$†

*Statistically significant at $p < 0.05$.
†Statistically significant at $p < 0.01$.

Orr, R. M., Robinson, J., Hasanki, K., Talaber, K. A., Schram, B., & Roberts, A. (2022). The relationship between strength measures and task performance in specialist tactical police. *Journal of Strength and Conditioning Research*, *36*(3), 757-762.

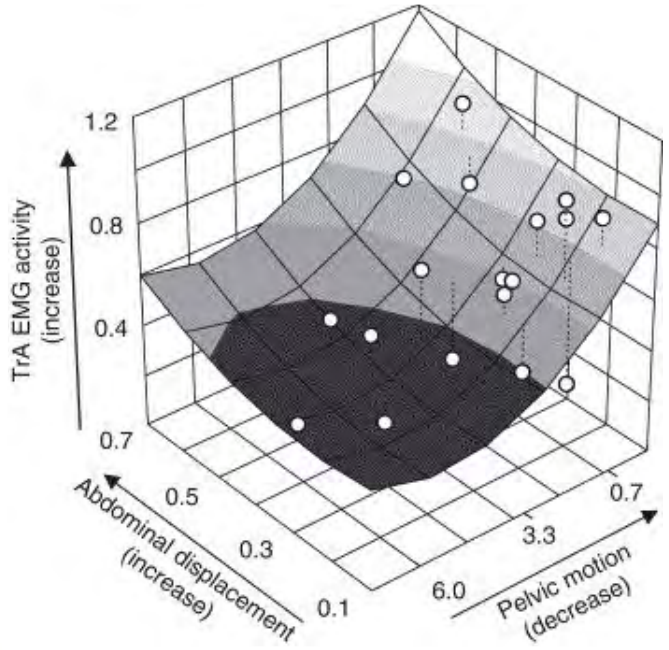
Robinson, J., Roberts, A., Irving, S., & Orr, R. (2018). Aerobic fitness is of greater importance than strength and power in the load carriage performance of specialist police. *International journal of exercise science*, *11*(4), 987.

Measure	Pack March 1	Pack March 2	Pack March
Pack March 1 (mins:sec)	1	.840**	.815**
Pack March 2 (mins:sec)	.840**	1	.881**
Pack March 3 (mins:sec)	.815**	.881**	1
Body Weight (kg)	.097	.010	.081
1 RM Bench Press (kg)	−.360*	−.318*	−.295*
Bench Ratio (%)	−.465**	−.365**	−.379**
1 RM Squat (kg)	−.401**	−.335*	−.316*
Squat Ratio (%)	−.500**	−.381**	−.396**
1 RM Deadlift (kg)	−.288*	−.248	−.215
Deadlift Ratio (%)	−.403**	−.294*	−.305*
1RM Pull-up (kg)	−.452**	−.439**	−.416**
Pull-up Ratio (%)	−.607**	−.512**	−.541**
Vertical Jump (cm)	−.501**	−.541**	−.523**

Exercise Selection - Biomechanics

For TrA alone – Discourage any movement of the upper abdominals, bracing of the abdominal walls or posterior tilting of the pelvis

(Urquhart, et al. 2006)



Exercise Selection - Biomechanics

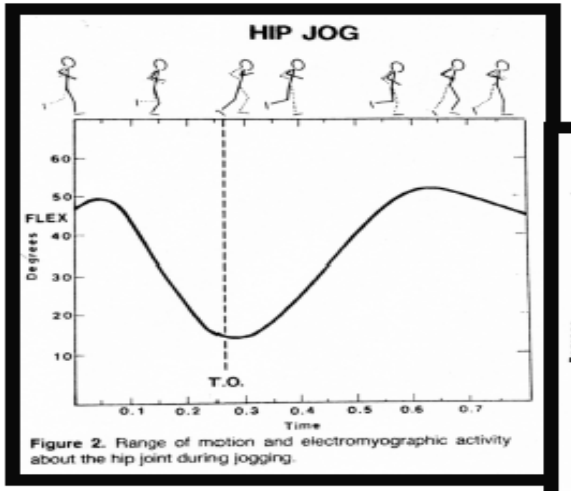


Figure 2. Range of motion and electromyographic activity about the hip joint during jogging.

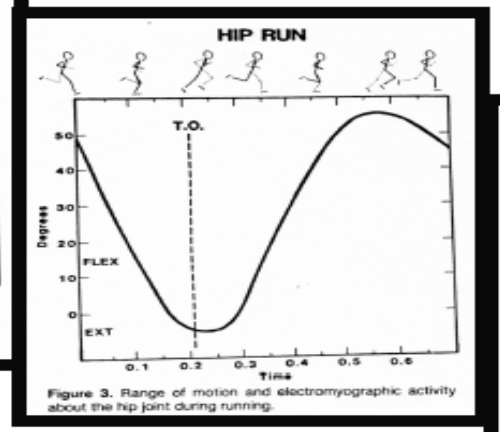


Figure 3. Range of motion and electromyographic activity about the hip joint during running.

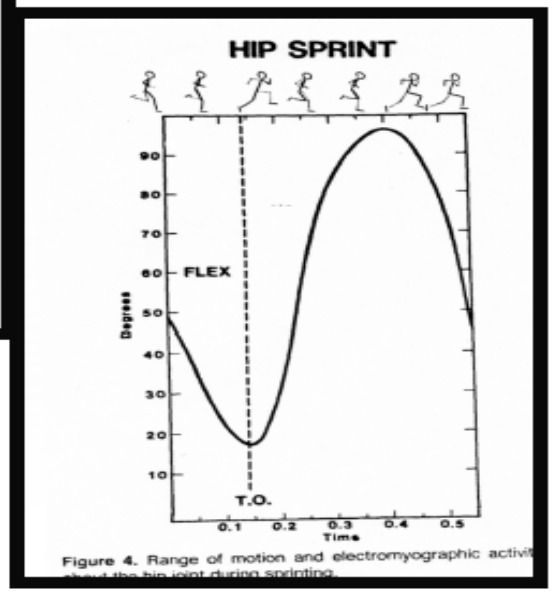


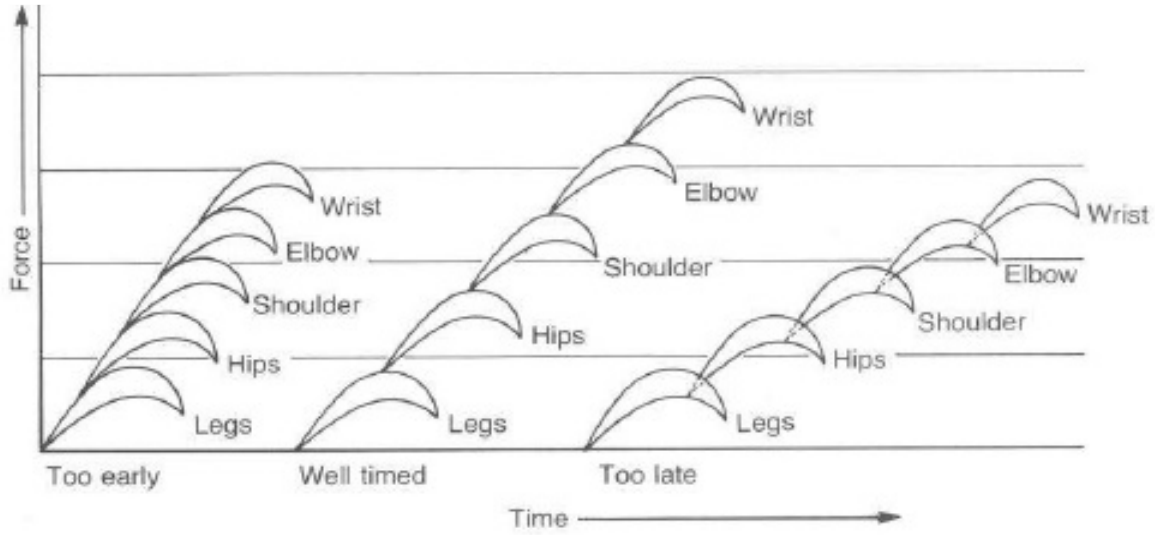
Figure 4. Range of motion and electromyographic activity about the hip joint during sprinting.

Mann et al, Comparative electromyography of the lower extremity in jogging, running and sprinting. Am. J. Sports Med. 1986;14:501-10.

Exercise Selection – Biomechanics

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



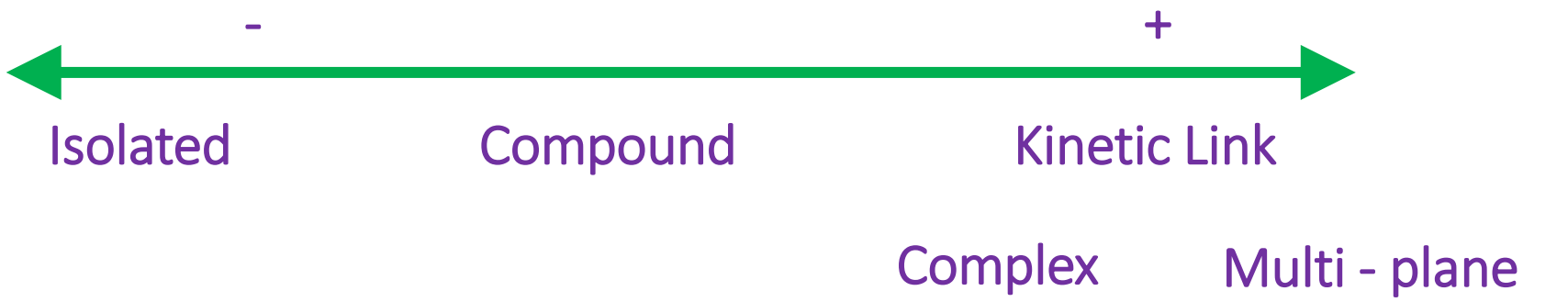
Elliott, B.C. Biomechanics in Sport in eds. Pyke, FS. Better Coaching, Australian Sports Commission, Figure 7-13, p.107

Exercise Selection – Motor Control

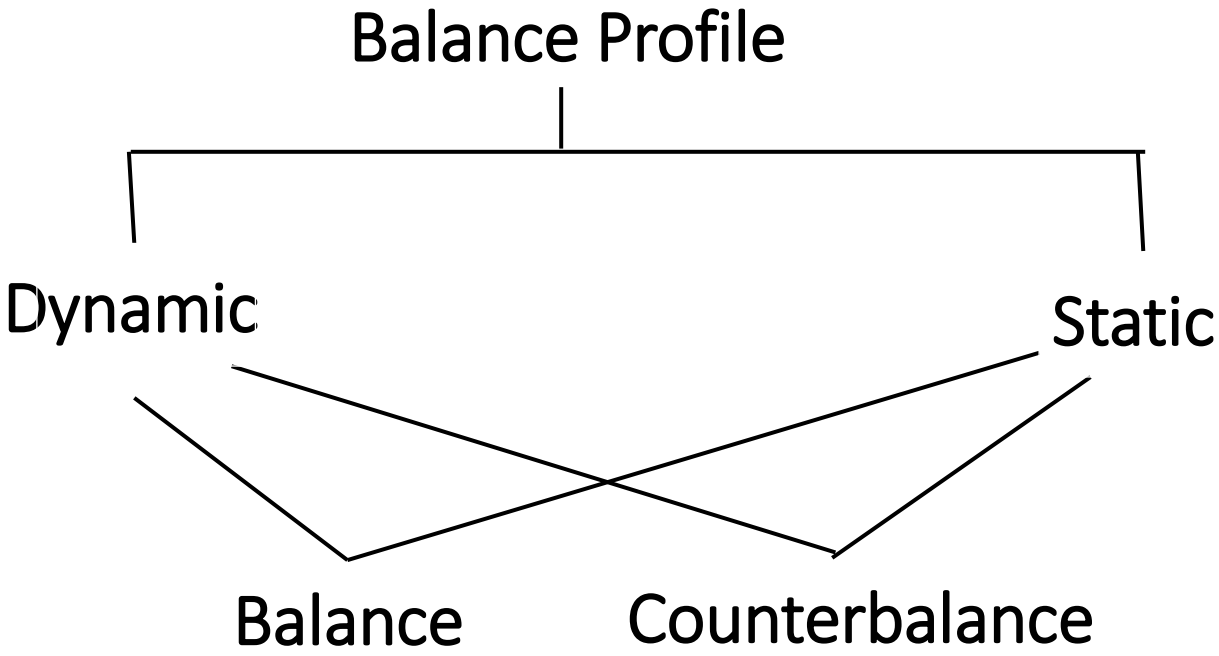
Exercise Selection – Motor Control

Synergy

- Coordination to muscles and muscle groups to achieve a MOVEMENT

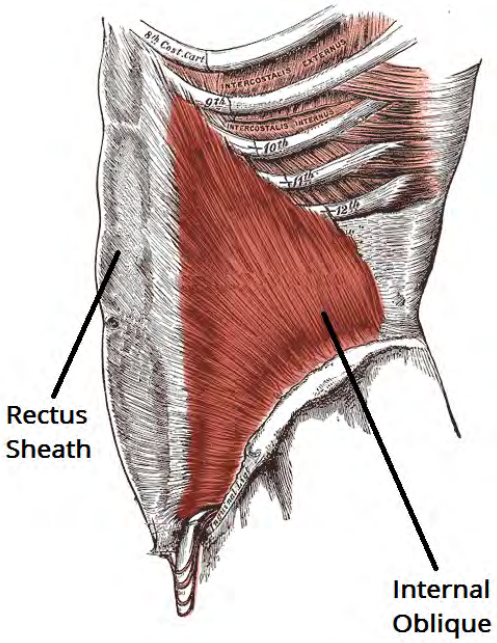


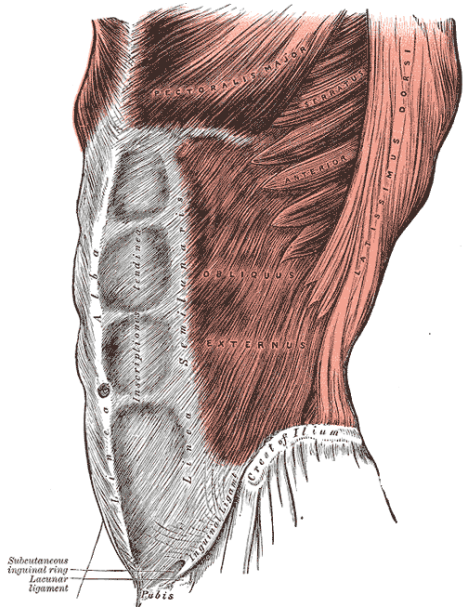
Exercise Selection – Motor Control

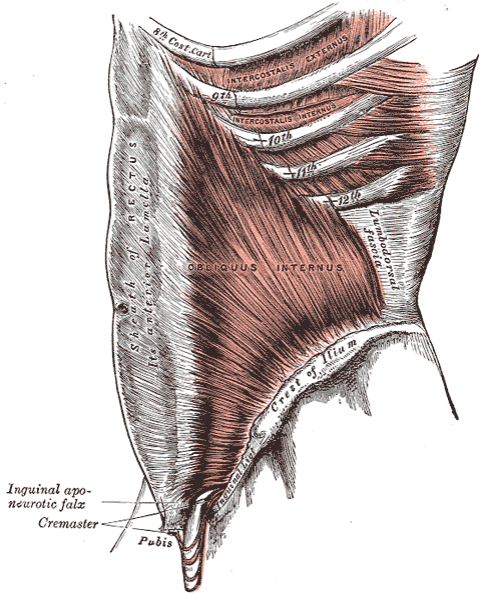


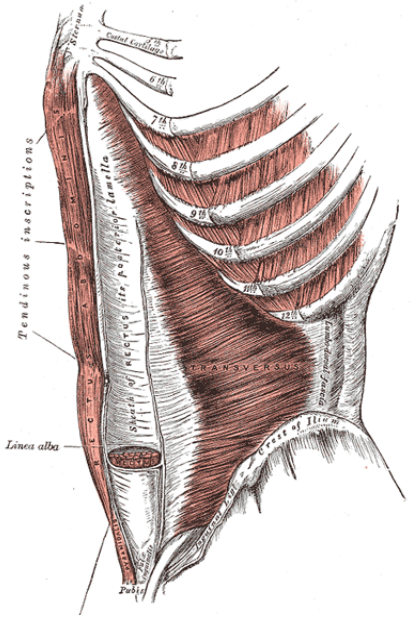
Exercise Selection – Motor Control

Exercise Selection – Motor Control

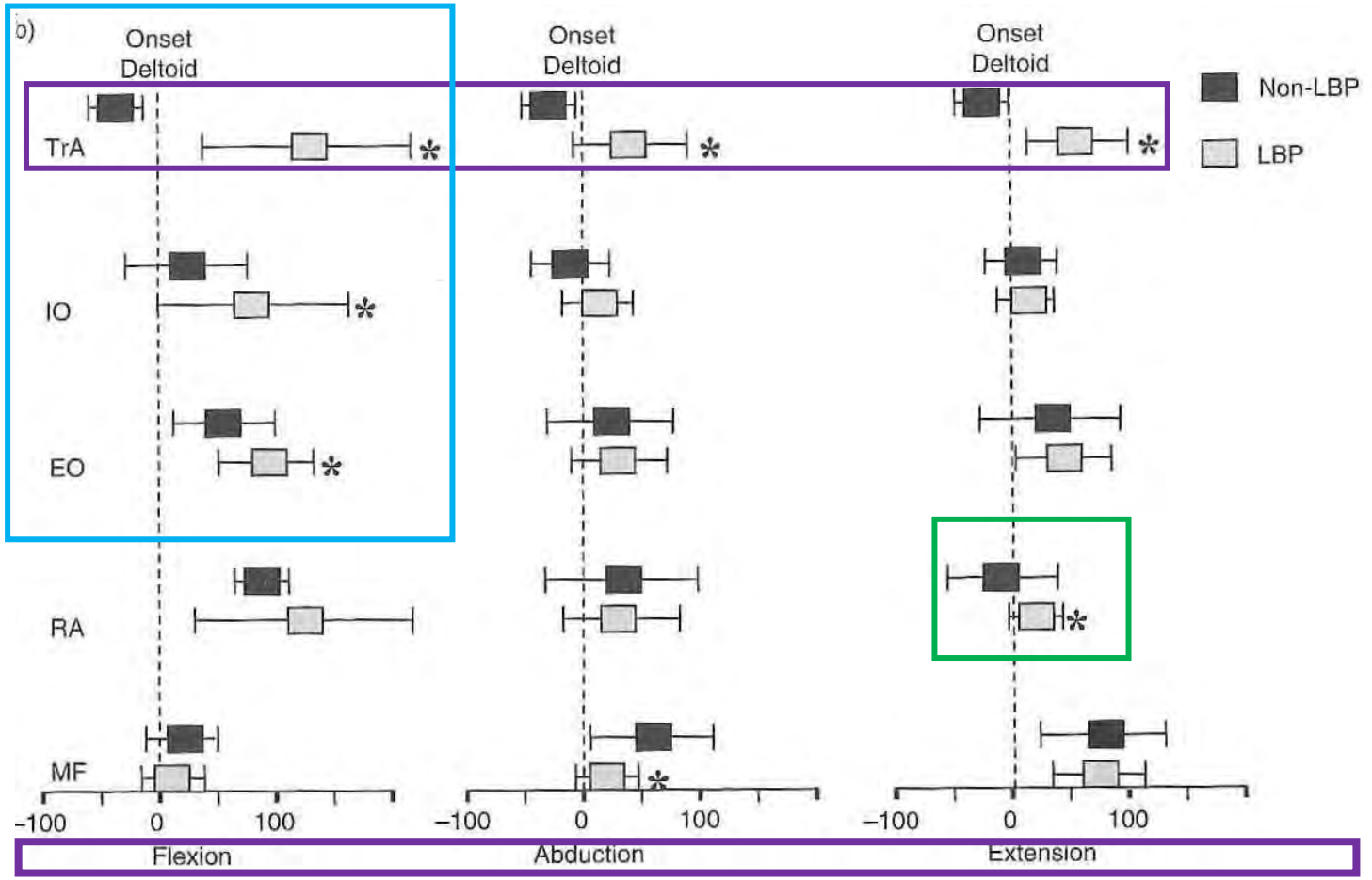








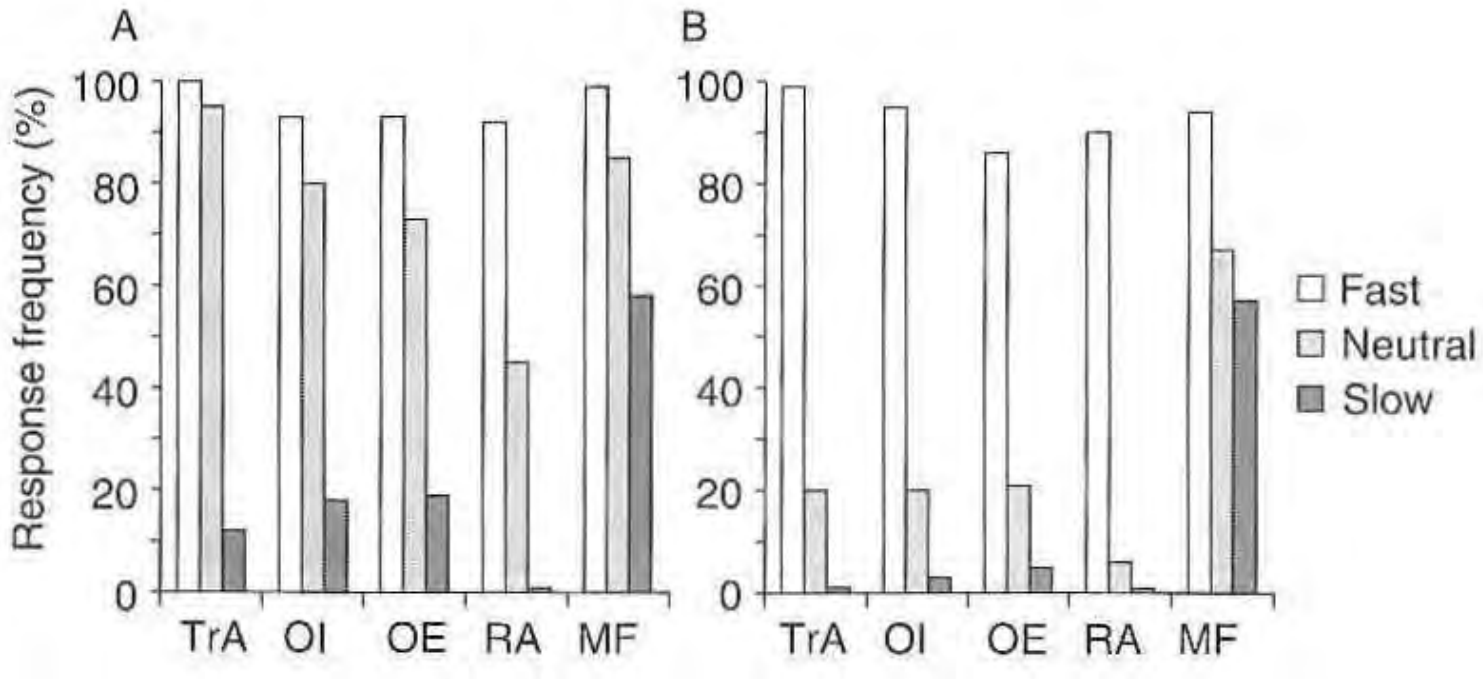
Exercise Selection – Motor Control



Hodges, P. W., & Richardson, C. A. (1996). Inefficient muscular stabilization of the lumbar spine associated with low back pain: a motor control evaluation of transversus abdominis. *Spine*, *21*(22), 2640-2650, Fig 6

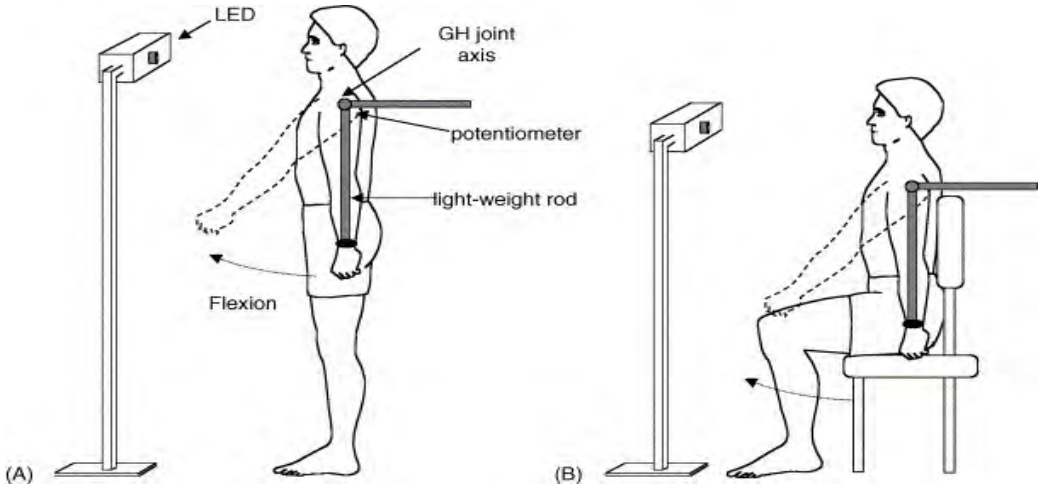
Exercise Selection – Motor Control

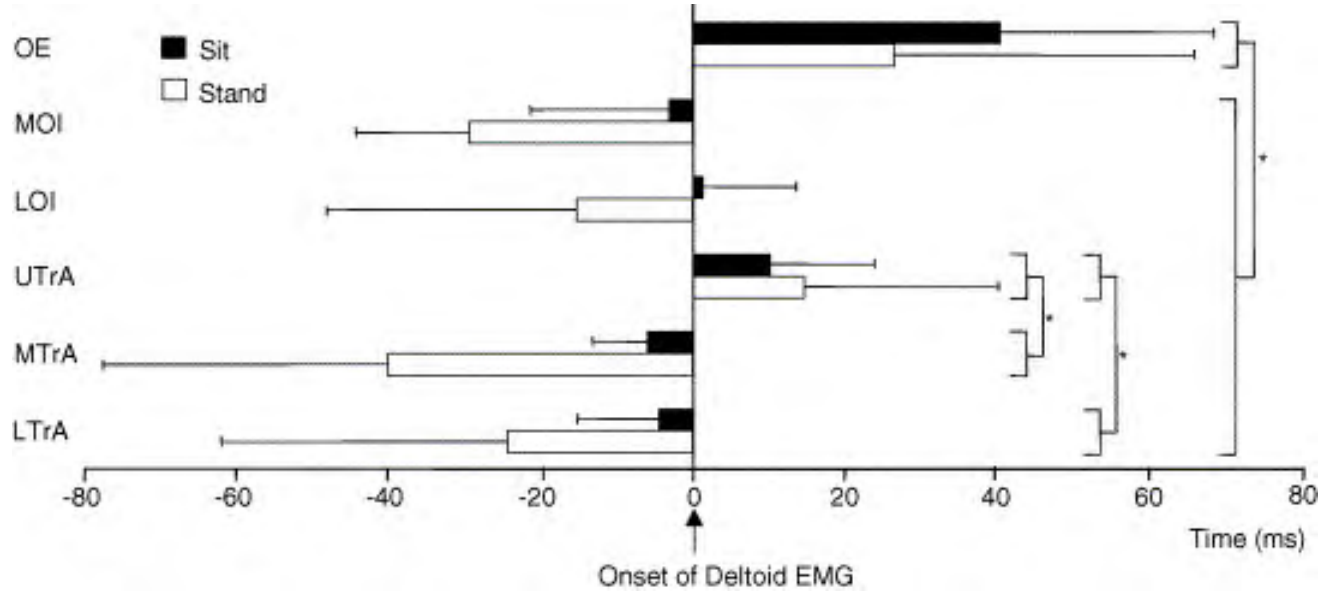
Research suggests that the problem is not one of strength or endurance but of motor control (Jull, et al., 1999)



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., Fig 5.5

Exercise Selection – Motor Control

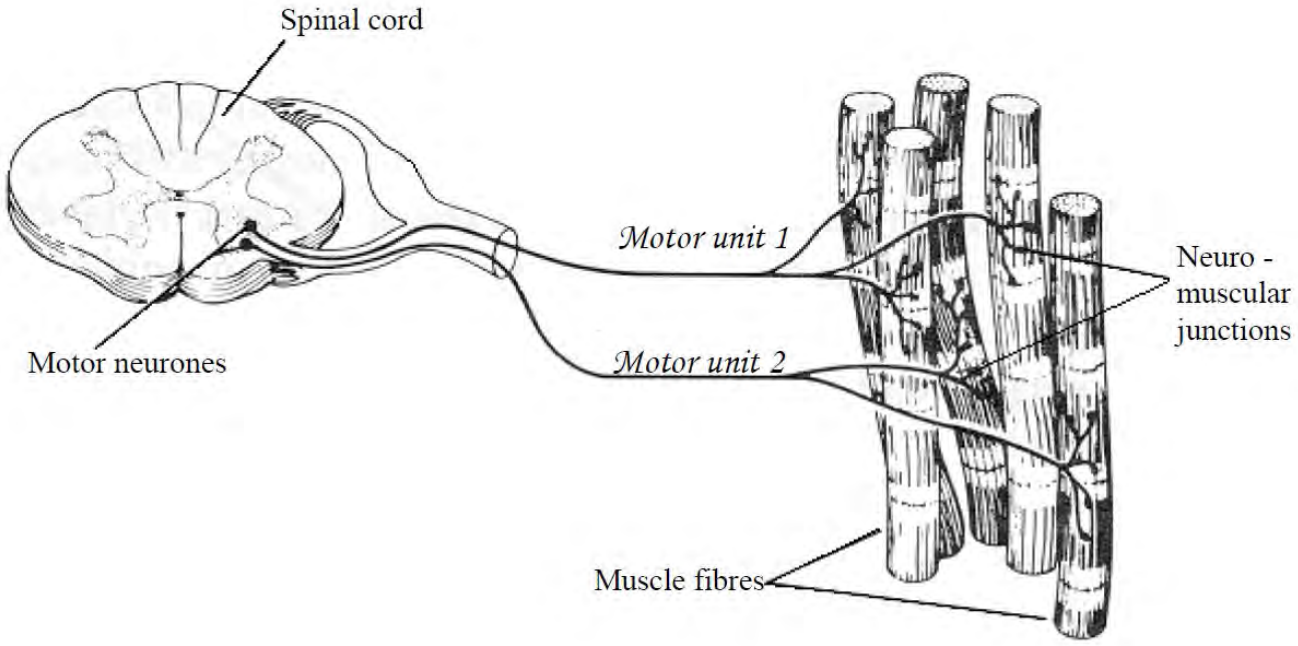


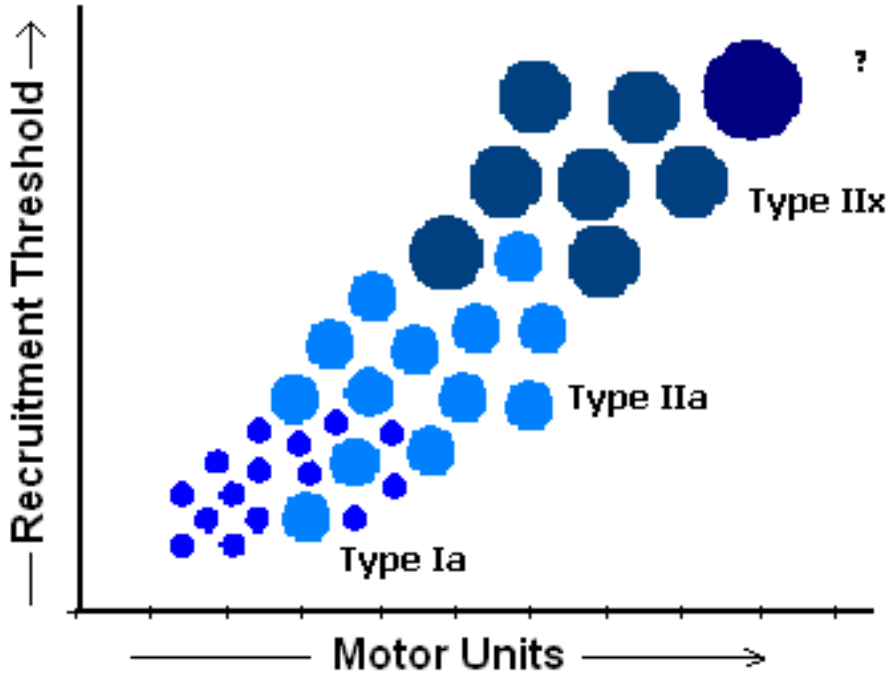


Urquhart, D. M., Hodges, P.W. & Story, I. H. (2004). Postural activity of the abdominal muscles varies between regions of these muscles and between body position. Gait & Posture, 22(2005), 295-301

Exercise Selection - Physiology

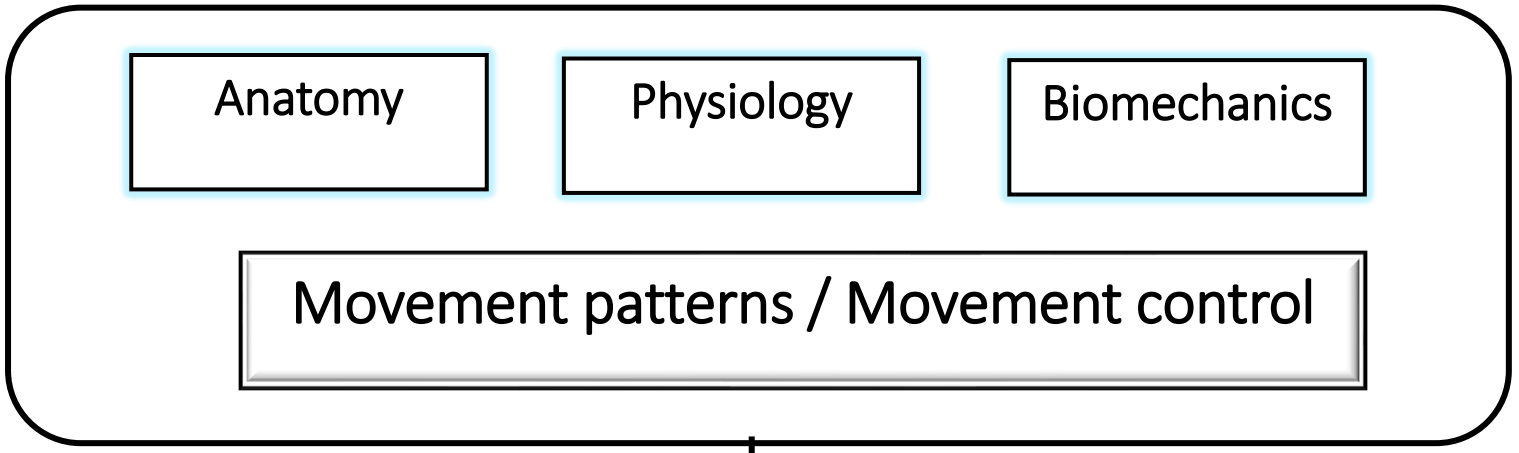
Motor Units and Motor Unit Summation





Summation

Summation


Anatomy
Physiology
Biomechanics
Movement patterns / Movement control
Conditioning Profile
Exercises
Program

Thank you






Questions?

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

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

NSCA®
NATIONAL STRENGTH AND CONDITIONING ASSOCIATION

2022 NSCA TACTICAL ANNUAL TRAINING

#NSCATactical22