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CHIROPRACTIC CONFERENCE

2019

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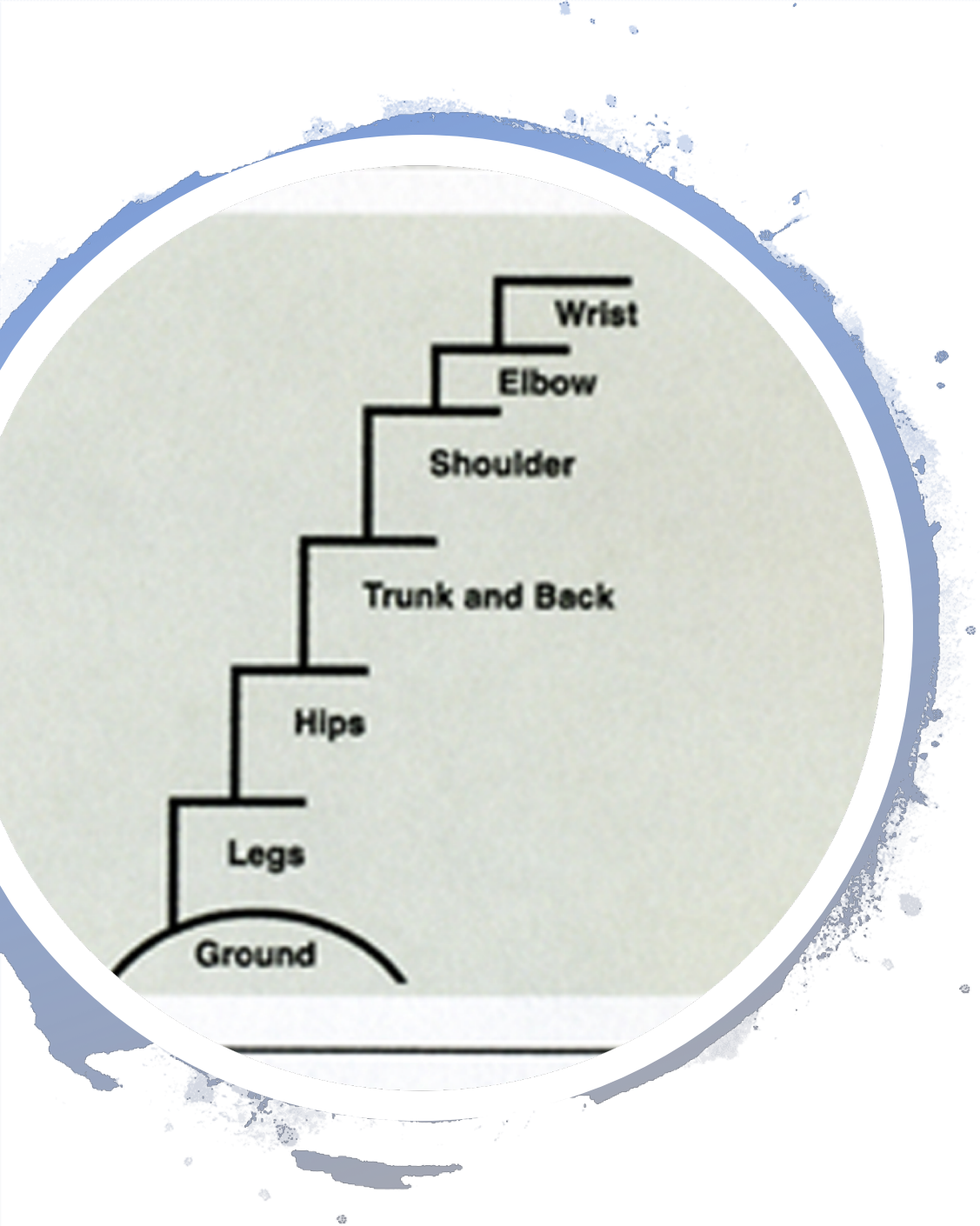
Connecting the dots

Structure, function, posture and movement

Neuromechanics and Global Assessment (GMA)

John Downes, DC

jdownes@life.edu

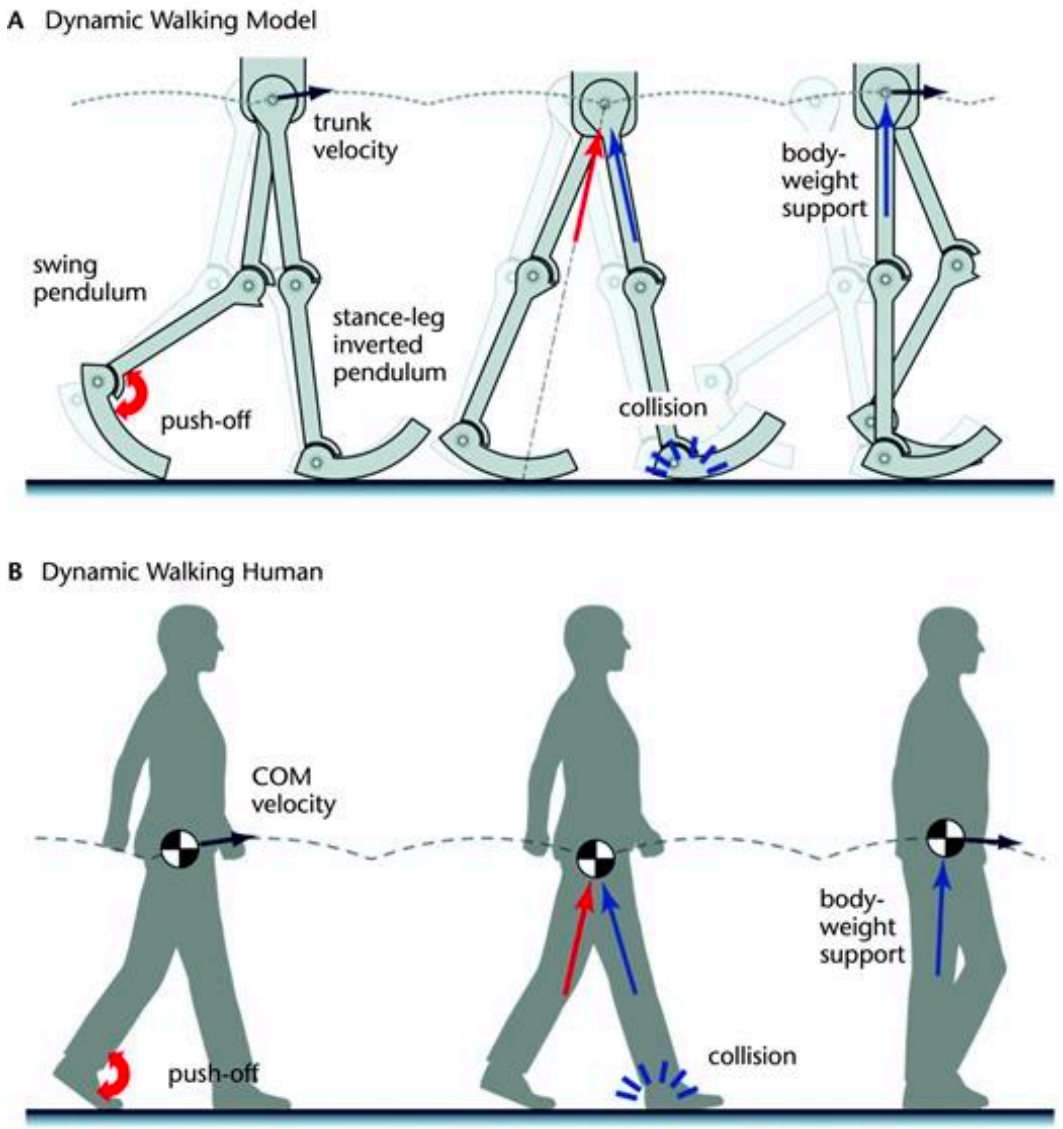


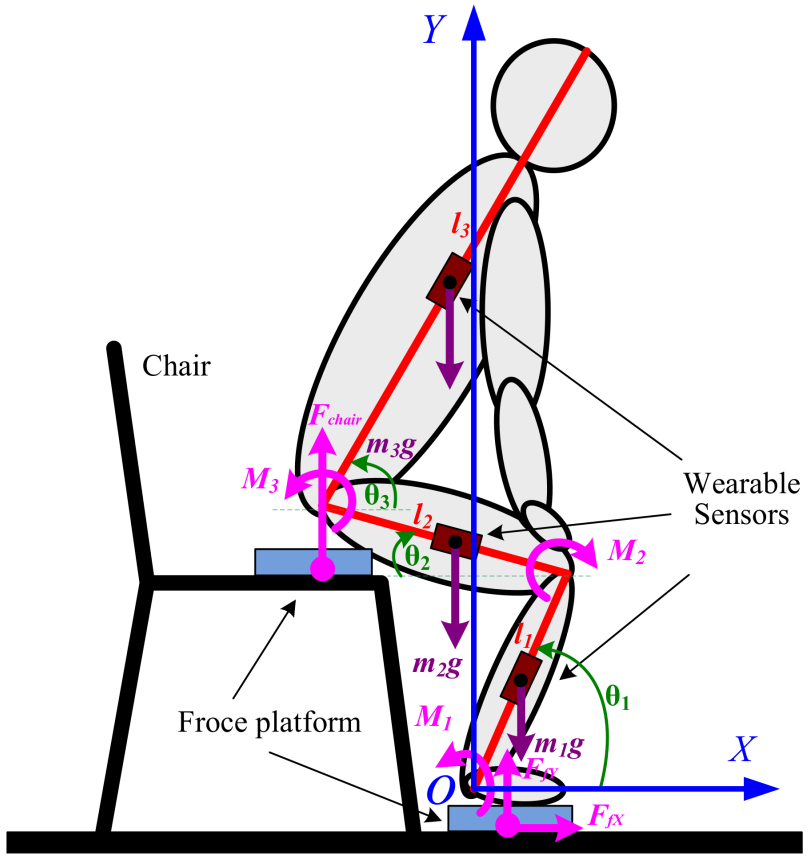
General Principles

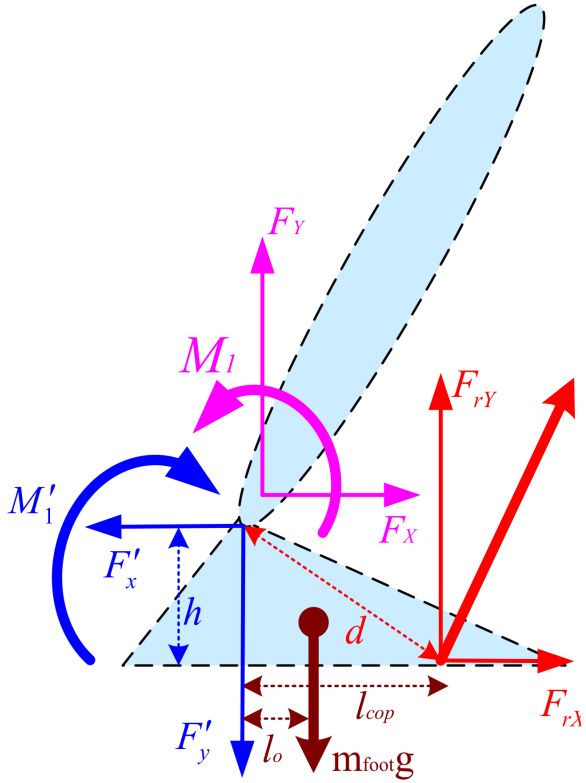
- GROUND REACTION FORCES INITIATE THROUGH FOOT STRIKE AND ARE TRANSMITTED UP THE KINETIC CHAIN
- EFFICIENCY OF FOOT STRIKE IS DETERMINED BY ‘CORE’ FOR NEUROMECHANICS OF THE LOWER KINETIC CHAIN
- IF ENERGY IS ABSORBED RATHER THAN DISTRIBUTED CALLOUSES AND STRESS FRACTURES OCCUR IN THE FEET AND UP THE KINETIC CHAIN

BASIC GAIT

- PUSH OFF AND HEEL STRIKE ARE THE TERMINAL AND INITIAL EVENTS IN GAIT
- It is a mechanical process to maintain COM
- Without pathology, gait is an unconscious behavior that becomes conscious when it fails to perform correctly





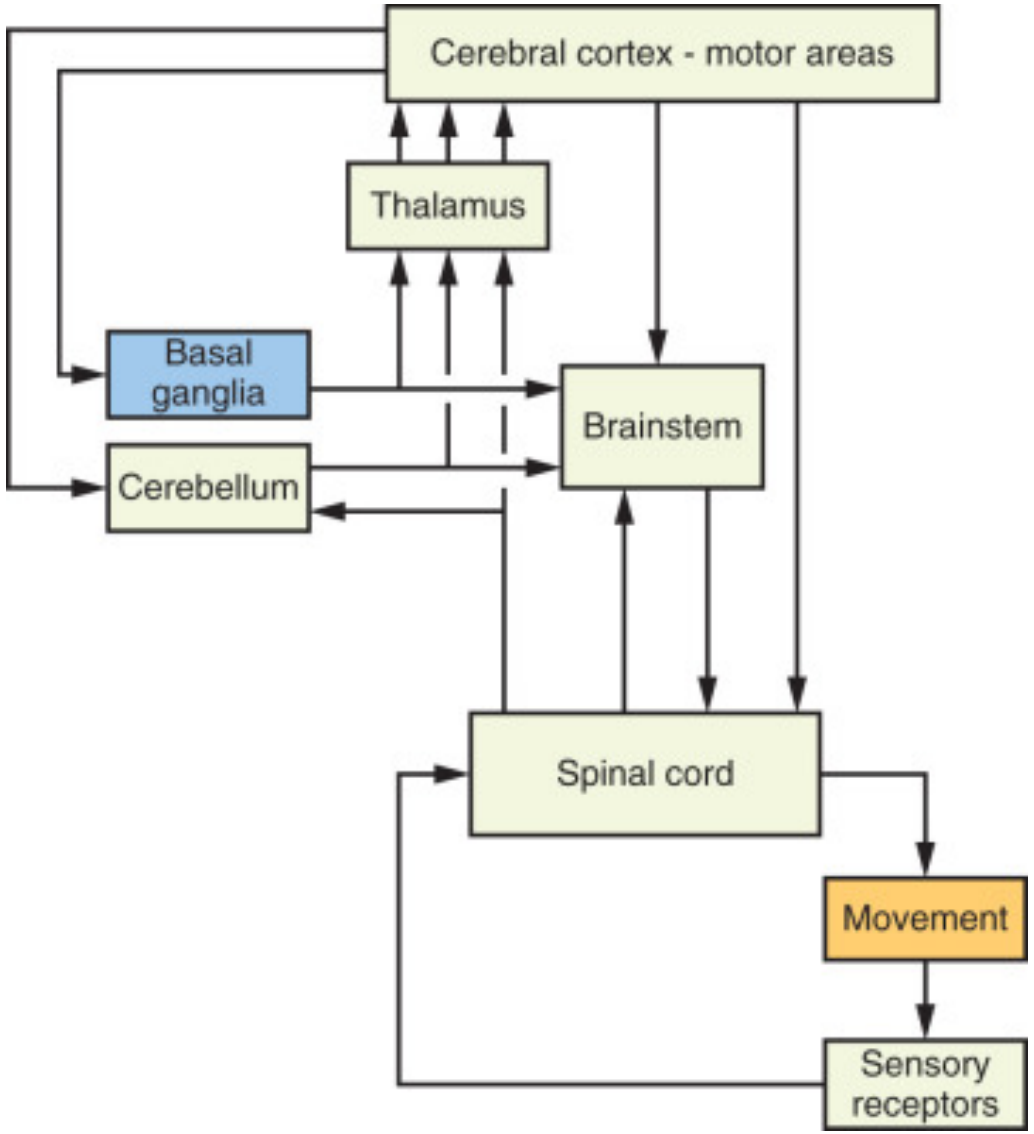


COMPLICATED BIOMECHANICS

- APAs (ANTICIPATORY POSTURAL ADAPTATIONS)
- APAs are FEEDFORWARD messaging 100+ms prior to movement to 75ms following joint loading
- CPAs (COMPENSATORY POSTURAL ADAPTATIONS)
- ~200 ms post movement
- CPAs are FEEDBACK messaging to modify original movement pattern

Neurology of Movement

Lower Extremity
Dsyfunction
When is it mechanical?
When is neuromechanical?



The Role of the Core Stability in Athletic Function

Kibler & Press

‘Core stability’ is the ability to control the position & motion of the trunk over the pelvis to allow optimum production

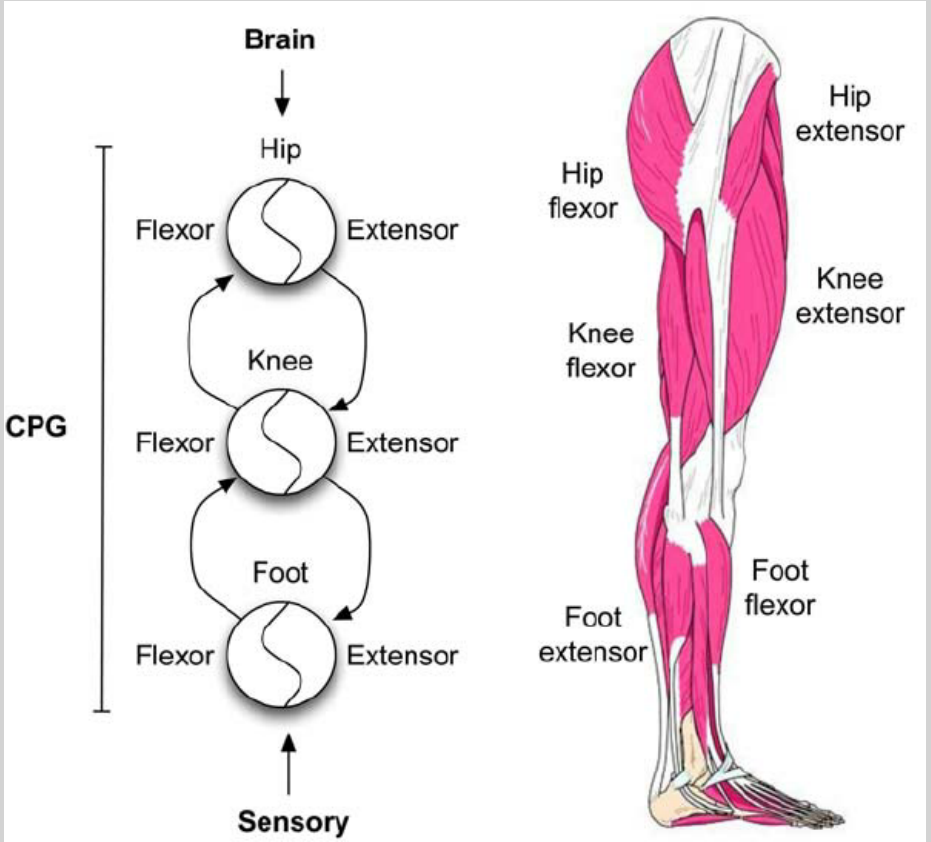
Core muscle activity is best understood as the pre-programmed integration of local, single-jt muscles and multi-jt muscles to provide stability and produce motion.

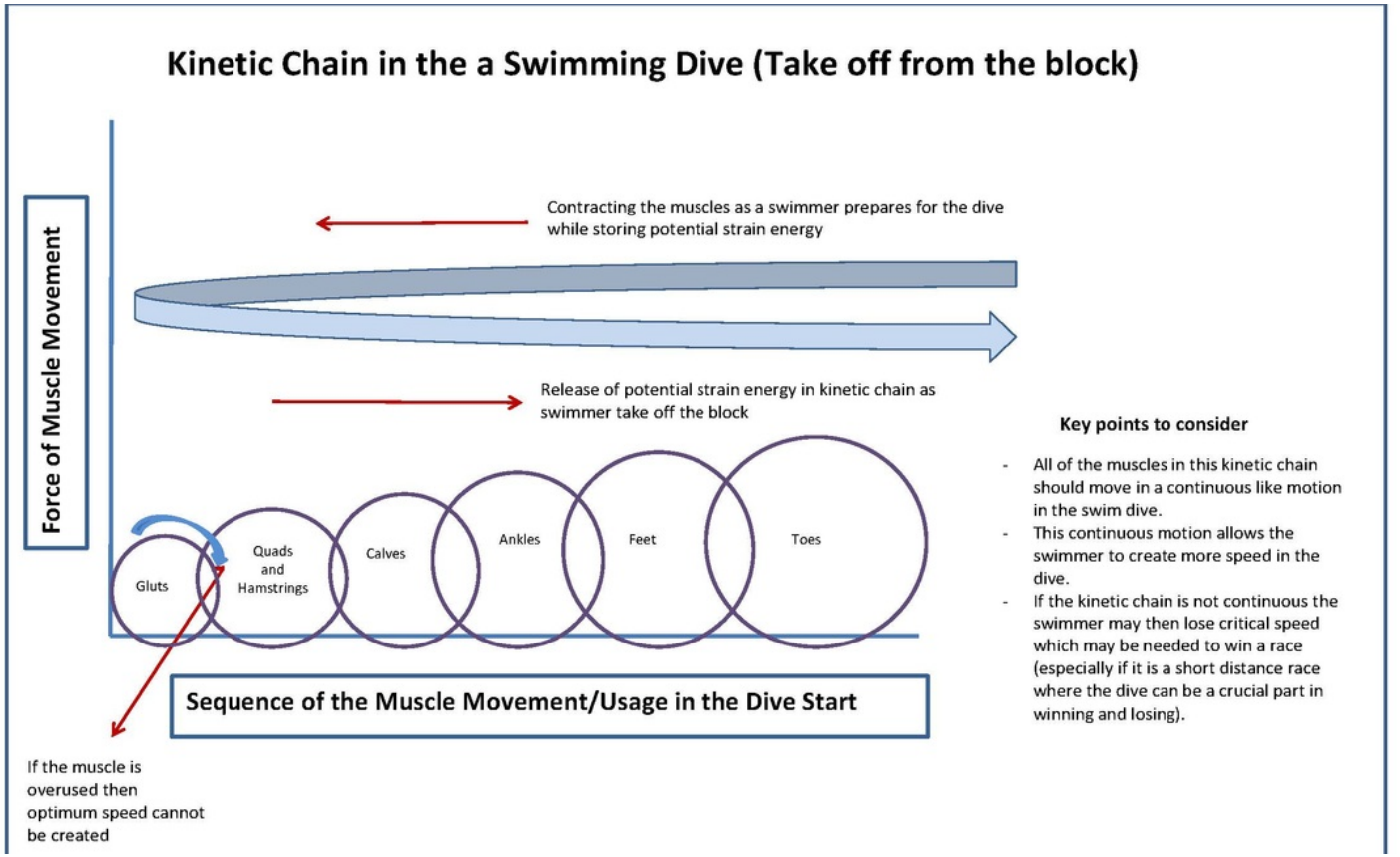
Proximal stability for distal mobility

The anchor for all extremities

Basic Neuromechanics

- The lower extremity is a series of oscillating flexor and extensor mechanisms. This oscillation is referred to as Central Pattern Generators (CPG) that is mediated by sensory input and supraspinal control.

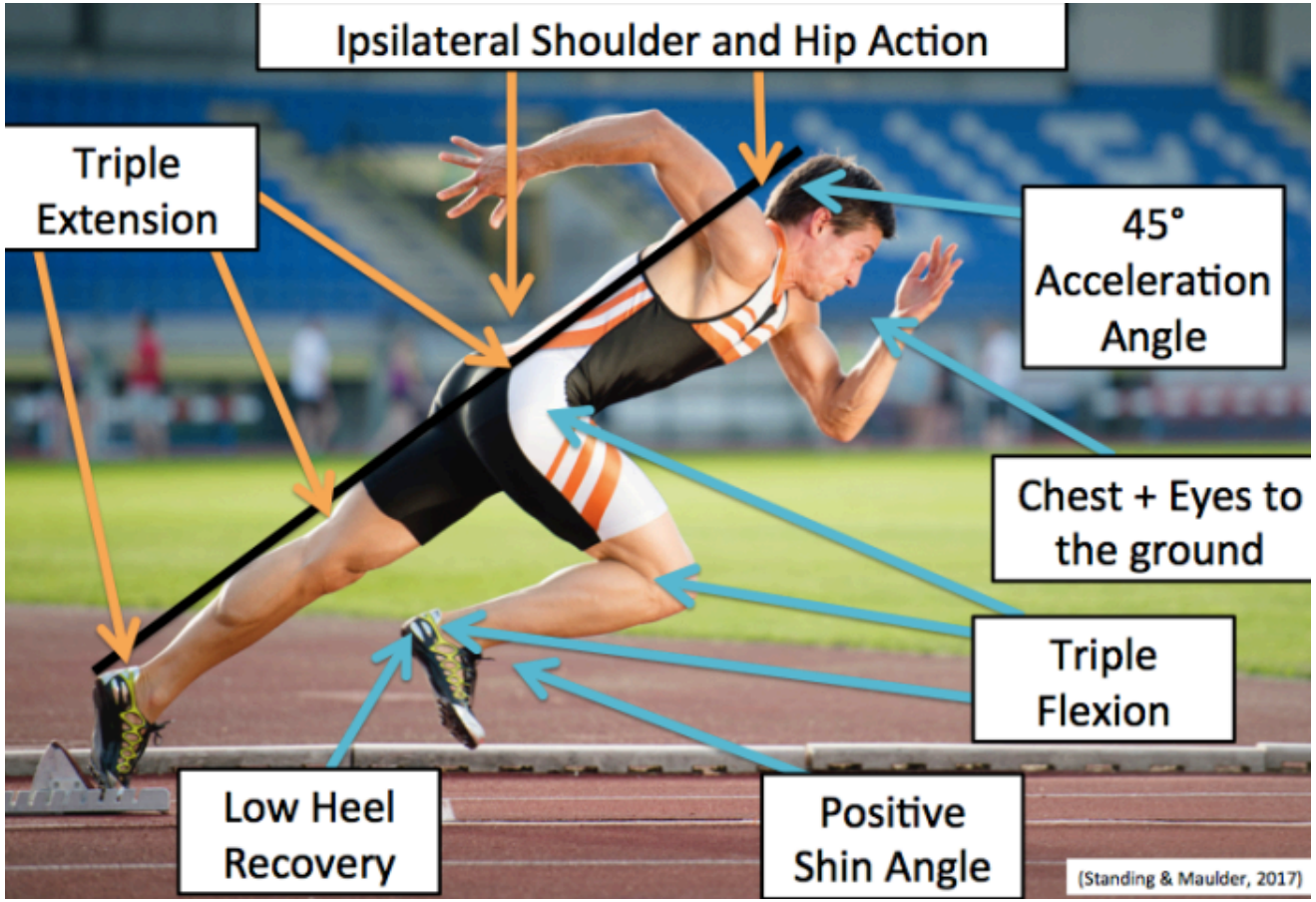




TASK EXECUTION

- SUMMATION OF EFFICIENCES OR DEFICIENCIES

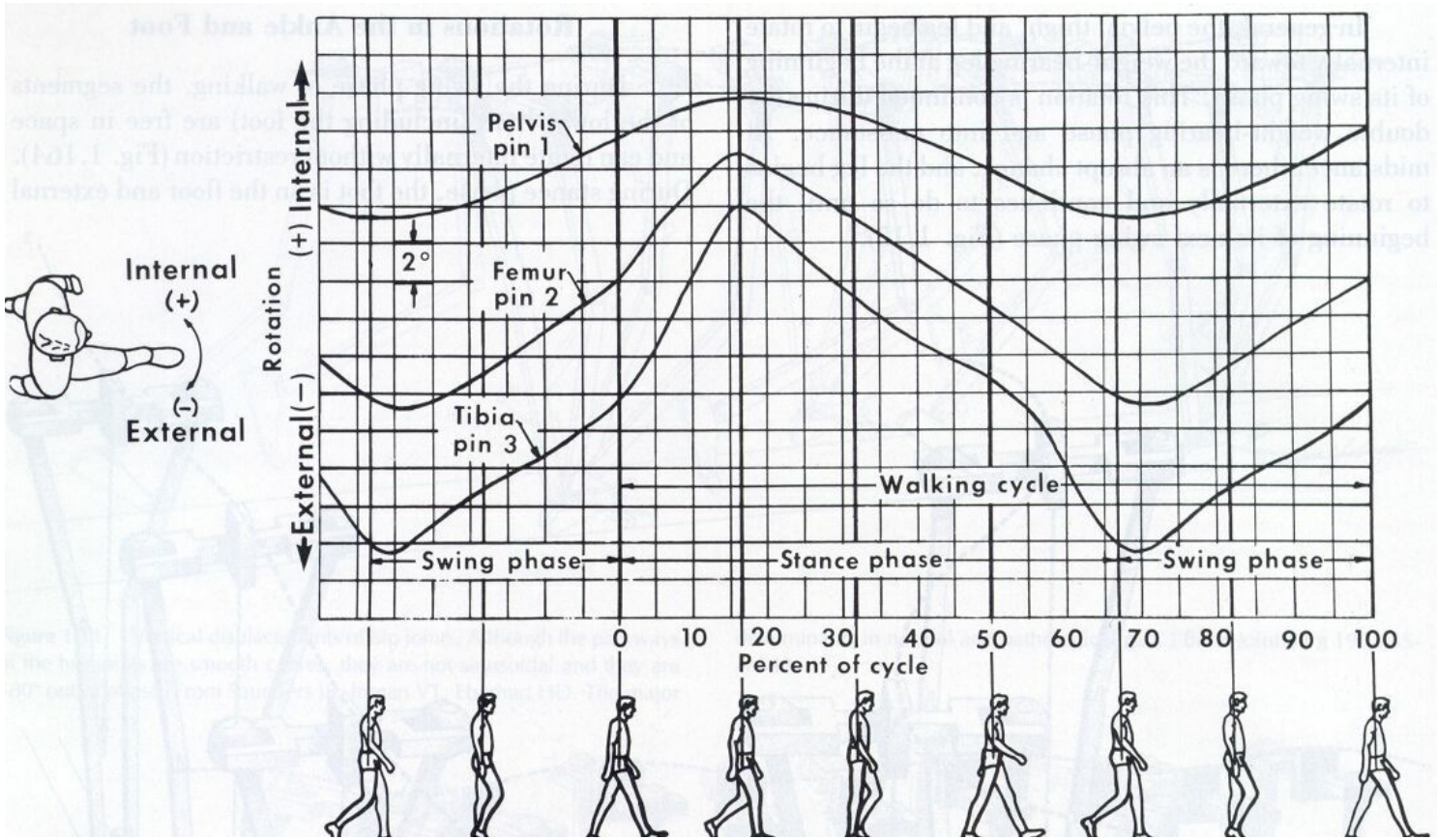
Sprinting technique – the details for APAs



- APAs can be visualized, but can the visualization over ride a corrupted system?
- Altered FFA is virtually undetectable to athletes and patients alike
- Substitutionary patterns are utilized to achieve the desired outcome
- Substitutionary patterns are always less efficient than the ideal

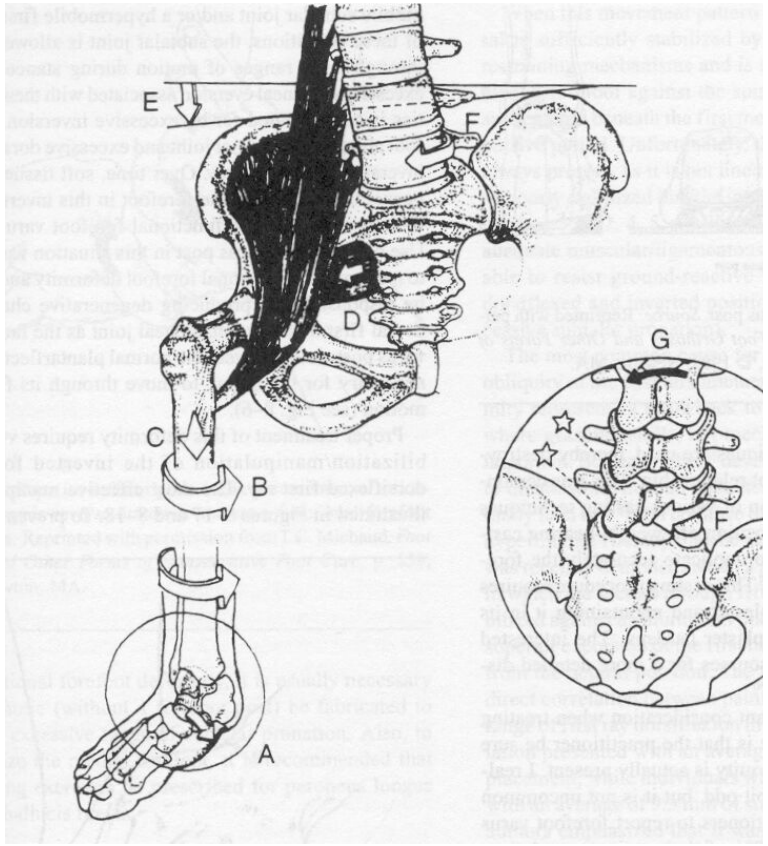
Who is going backwards?

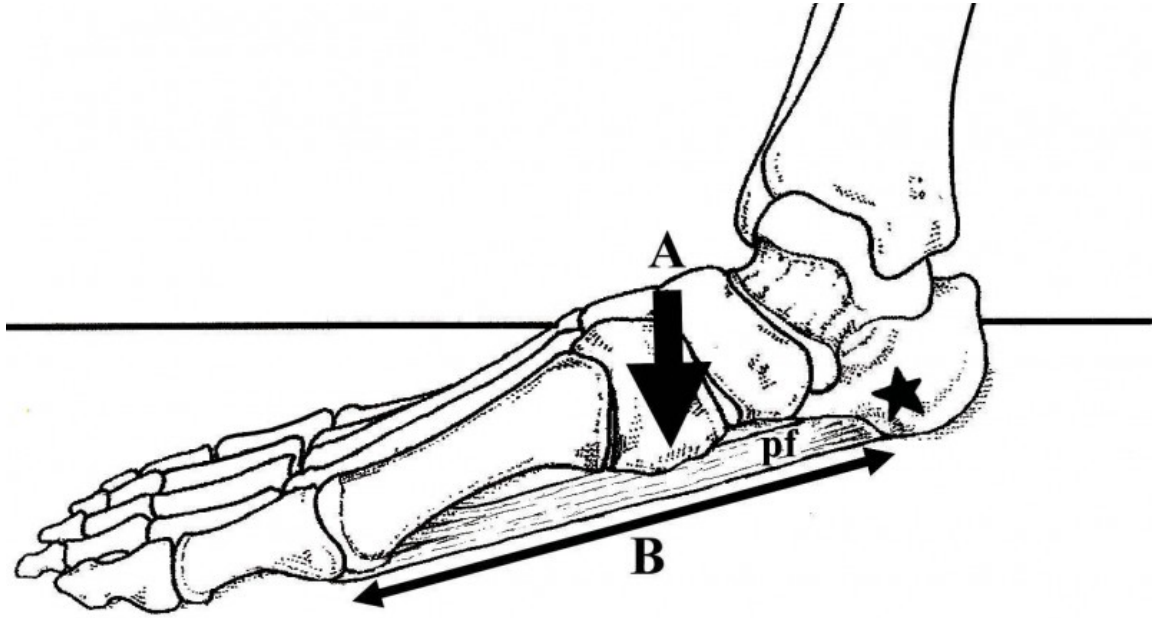
- Elastic / potential energy is stored in the muscles as they stiffen to keep the ankle in neutral position prior to push off
- Note the athlete on the left, the right ankle seems to be moving past neutral … is this decreased neuromuscular control? How can we tell? Could GMA be an indicator?



The Practical Details

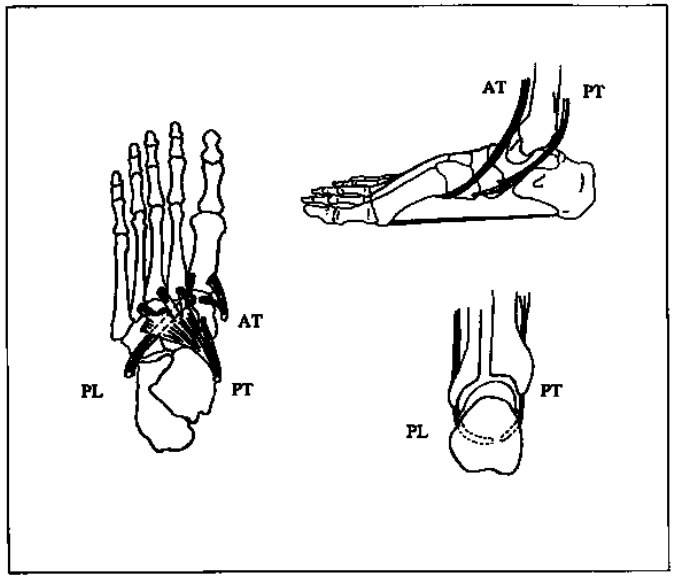
- Ambulation appears to be linear, but in reality there is inherent rotational components in every segment
- Tibial rotation is the greatest and deceleration is mitigated by eccentric Psoas activation
- Hyper-pronation increases eccentric loading of Psoas



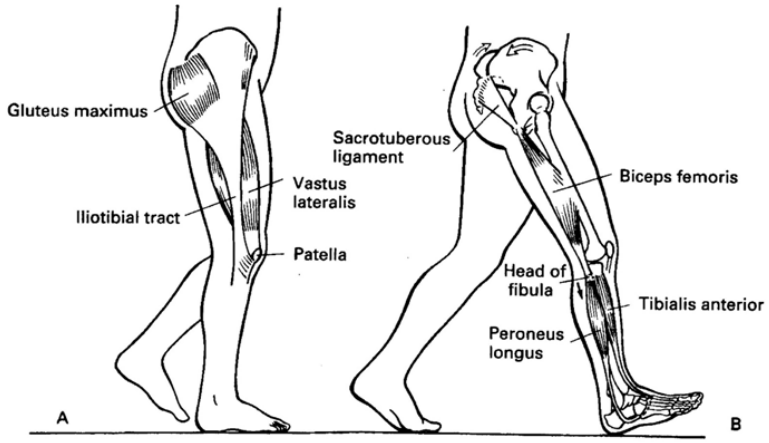


Mechanical linkage

Internal tibial rotation stops when navicular drop is stopped



From Hearon LE



From Vleeming et al 1997

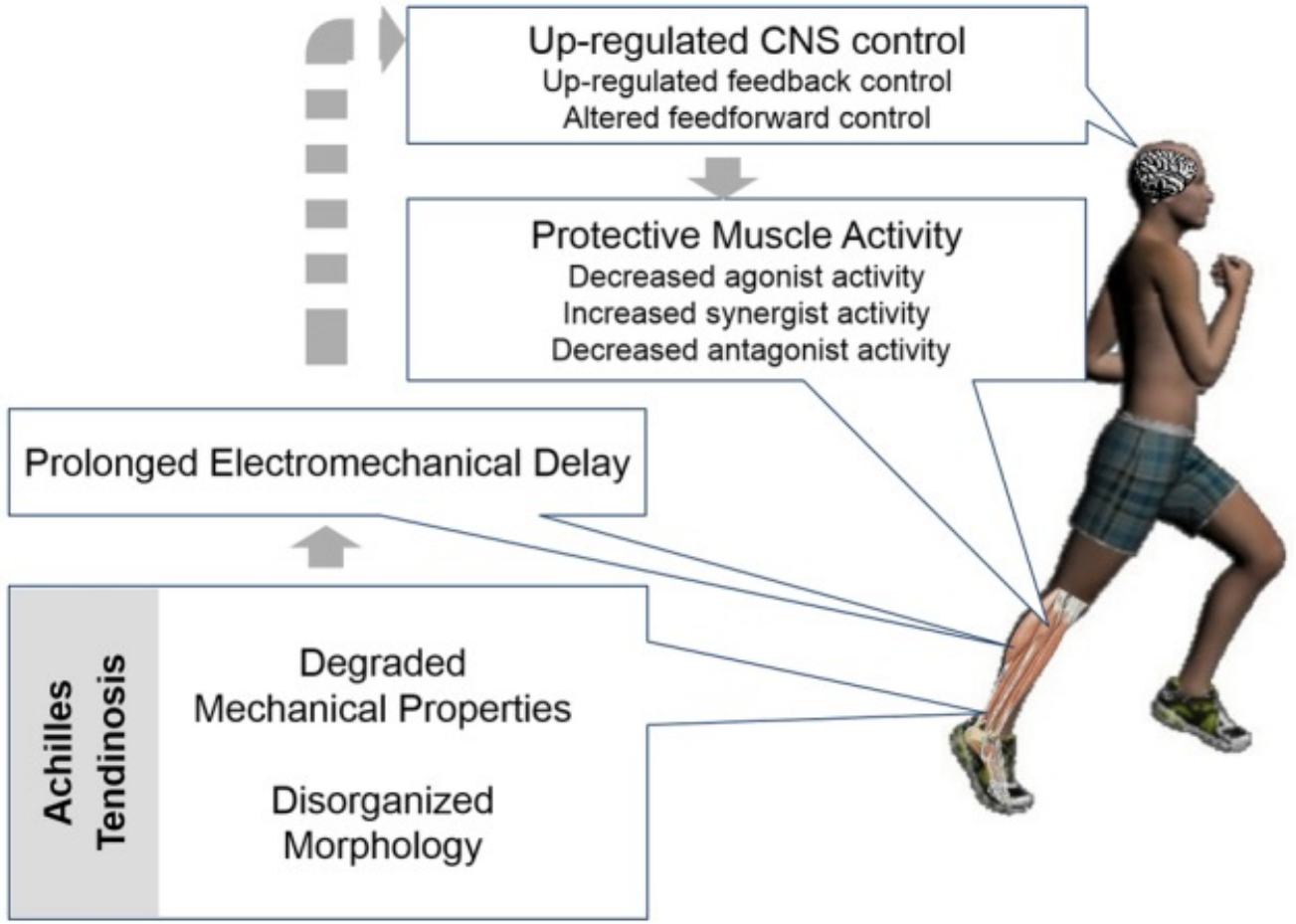
Lower sling

- Designed to lift and support the medial arch functionally through activation of Tibialis Anterior and Peroneus Longus
- If the arch cannot be maintained functionally via ‘short foot’
- Structural support may be necessary, e.g. orthotics

Foot and Ankle Mechanics

Adaptation / homeostasis

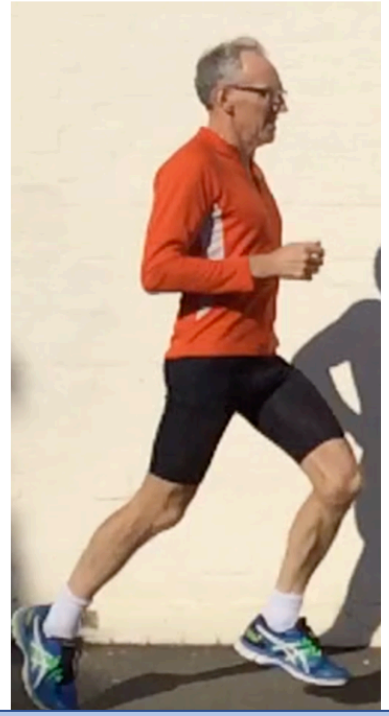
- This demonstrates how the body adapts through CNS signal modification
- It doesn't show how the process began



Neuromuscular

Delayed onset time and shorter duration of activation of Gluteus Medius and Maximus in people with AT

Reduced hip abduction, external rotation and extension isometric strength in people with AT



Kinematics and kinetics

↑ hip internal rotation at peak vGRF people with AT

↑ hip adduction impulse, hip peak external rotation and external rotati impulse in people with AT

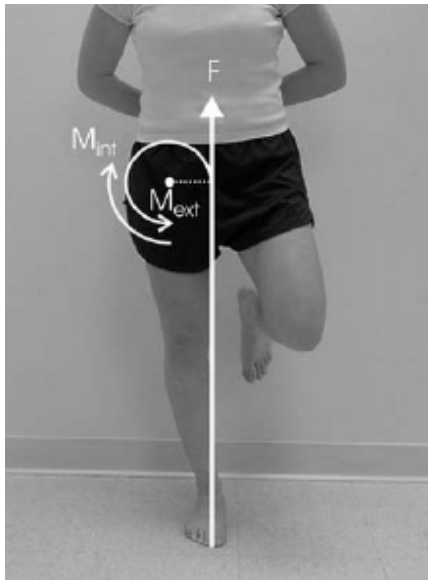
Hip biomechanics and Achilles tendinopathy

Modifications in the presence of altered motor control

- Delayed onset of activation of any muscle group is a result of altered FFA
- The question is what causes altered FFA?
- What does Panjabi think?
- What does GMA indicate?
- Both relate to altered or corrupted FFA.

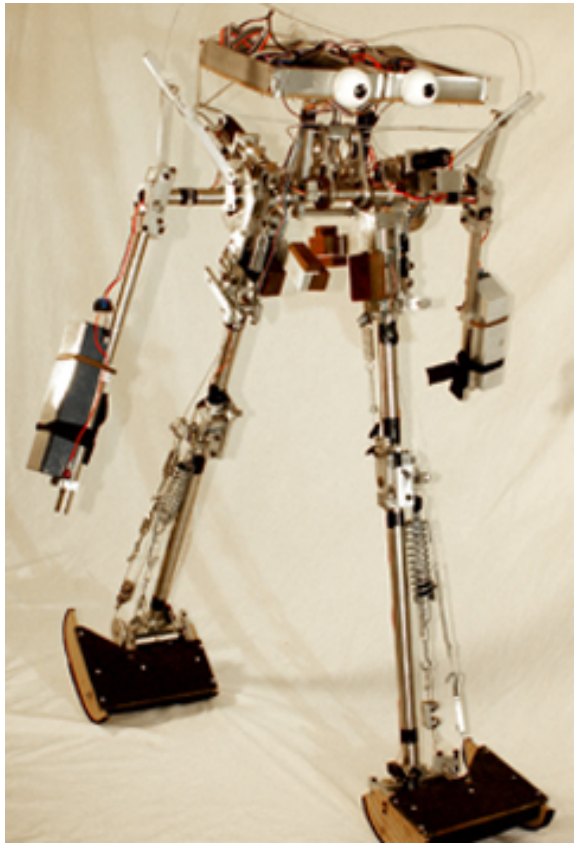
Effect of Lumbo-Pelvic-Hip Muscle Imbalance - From Wilson et al 2006, Kibler 2006

- ‘Corkscrewing’ – using hip rotators to stabilise the trunk over the planted leg in the presence of hip abductor weakness.
- Increased valgus moment in female athletes 6-10 times more susceptible to non-contact ACL ruptures



Lower Extremity Tasks

The half way point in any kinetic chain is most vulnerable to adaptive forces



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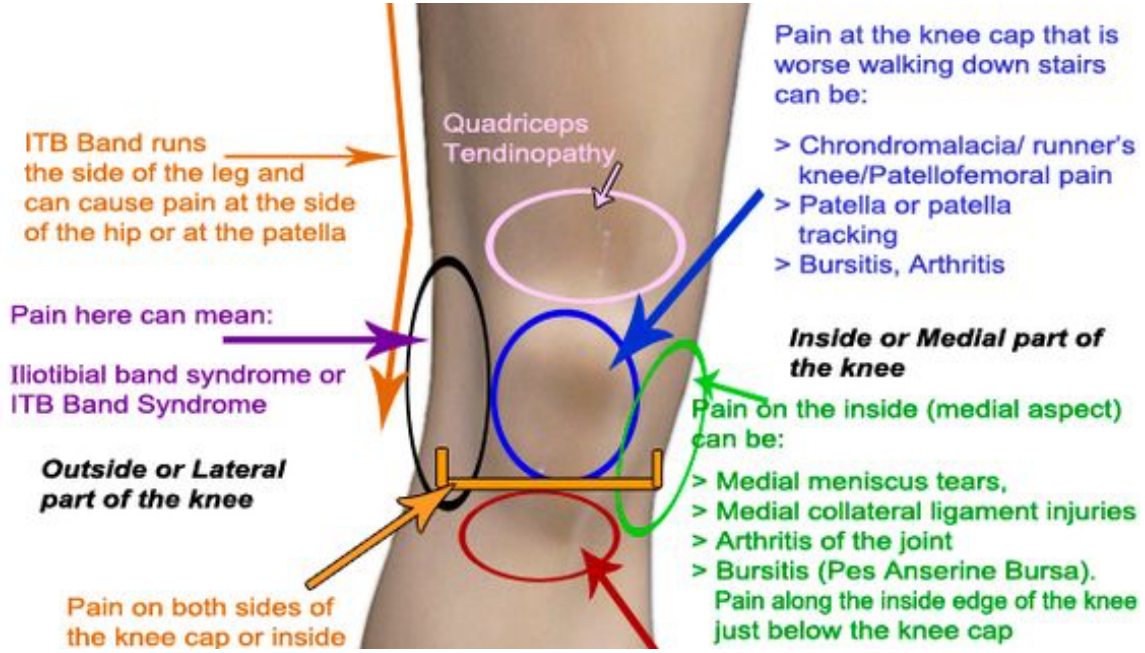
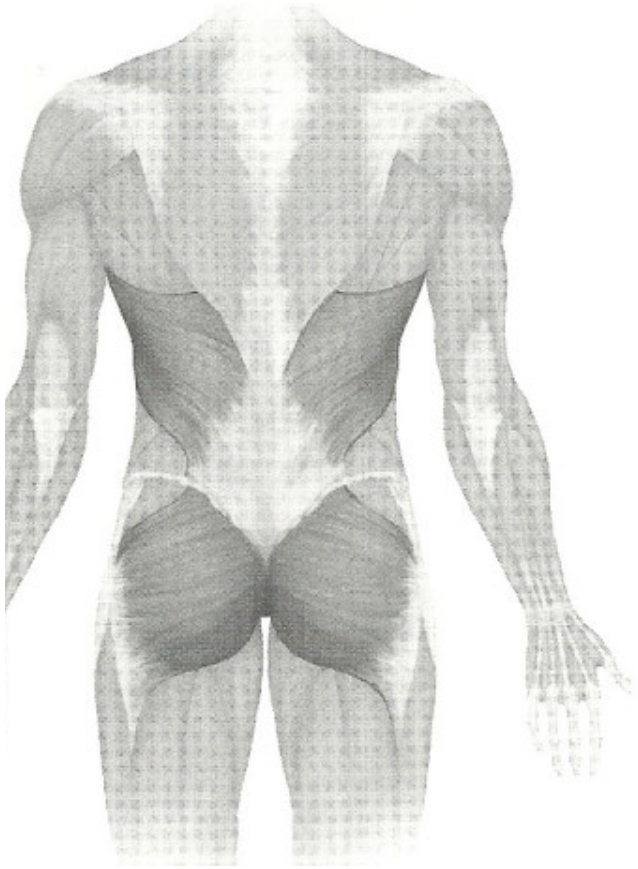
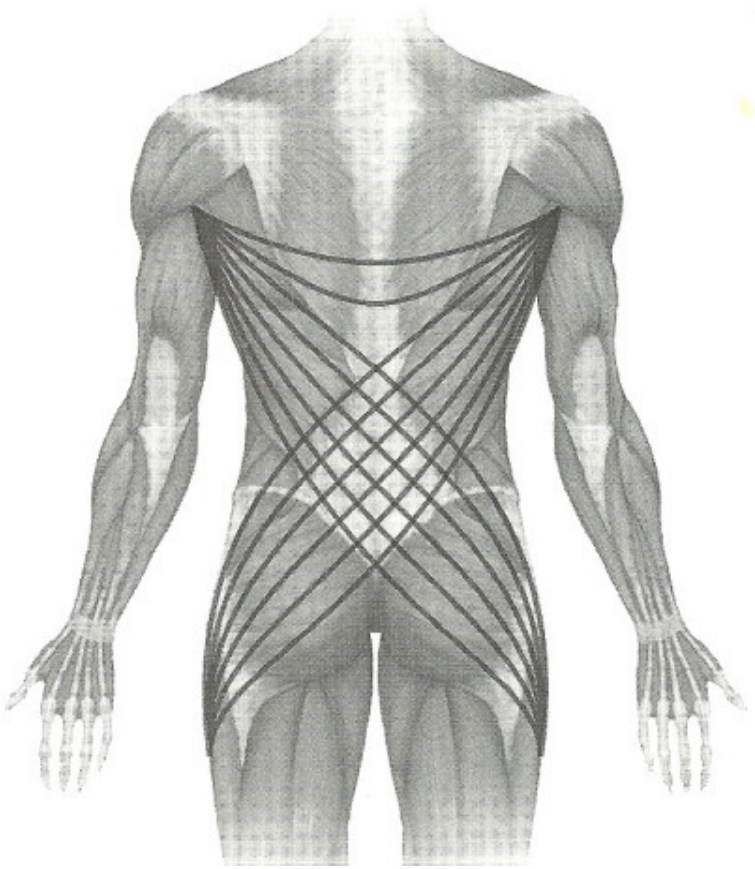
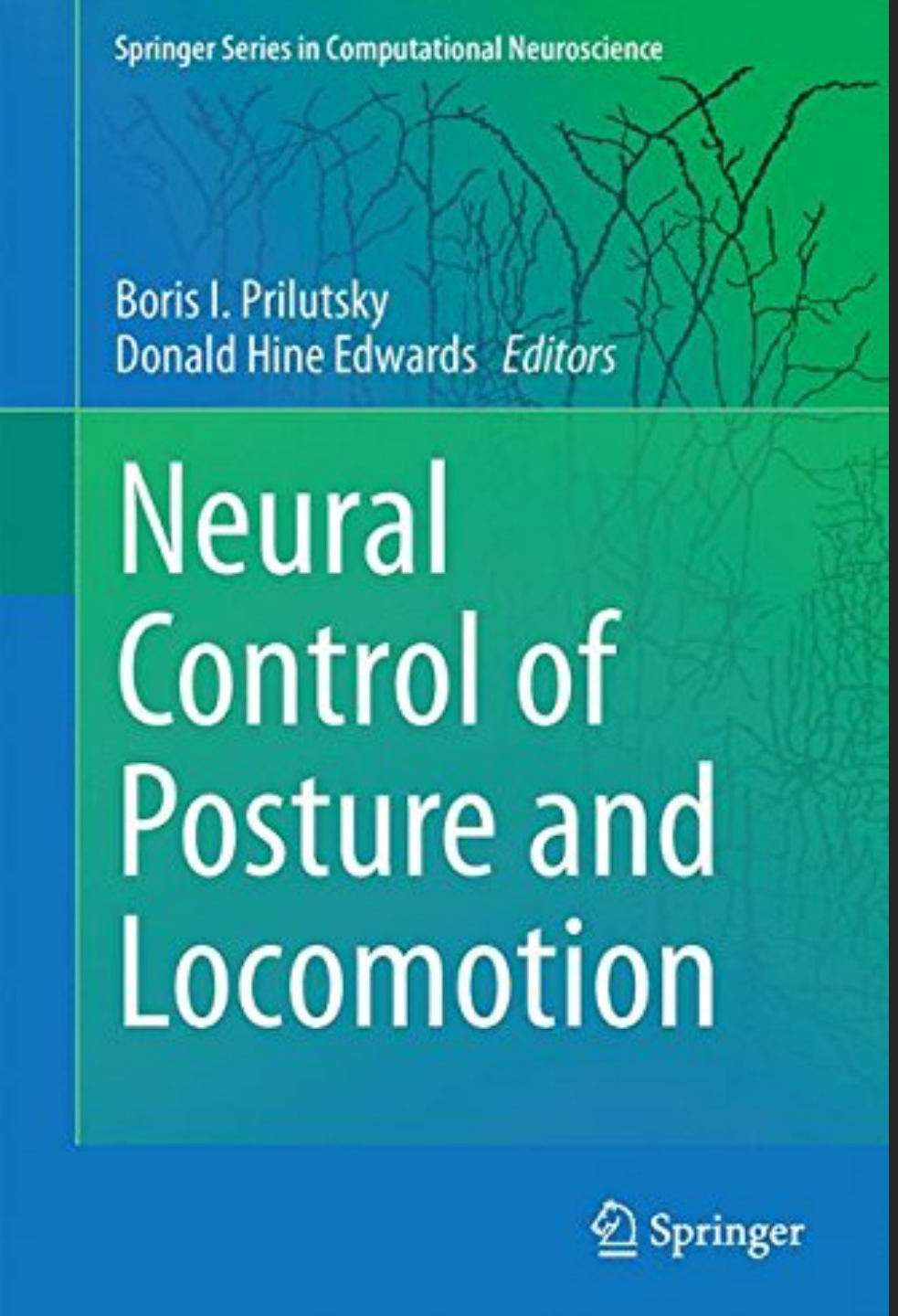






Back Slings

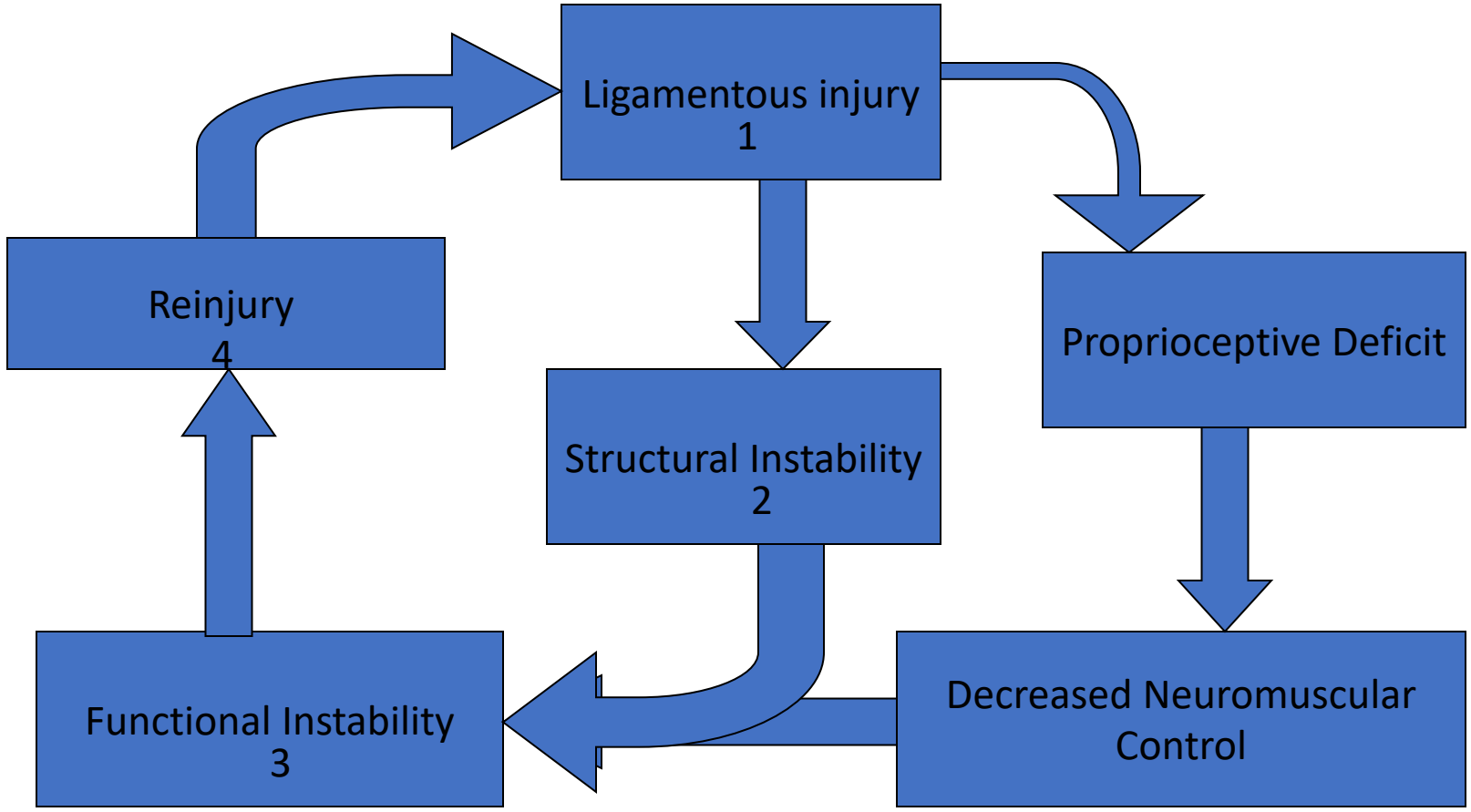
- The transfer of forces from lower extremity to upper are reflected in the thoracolumbar region
- Asymmetry in the glutes or posterior thorax maybe an indication of long standing sensorimotor disintegration, i.e. corrupted FFA and substitutionary muscle coupling patterns



FFA/FB>Neural Control>APAs/CPAs>Muscle Synergies>SAID

Task specificity and Neural Plasticity

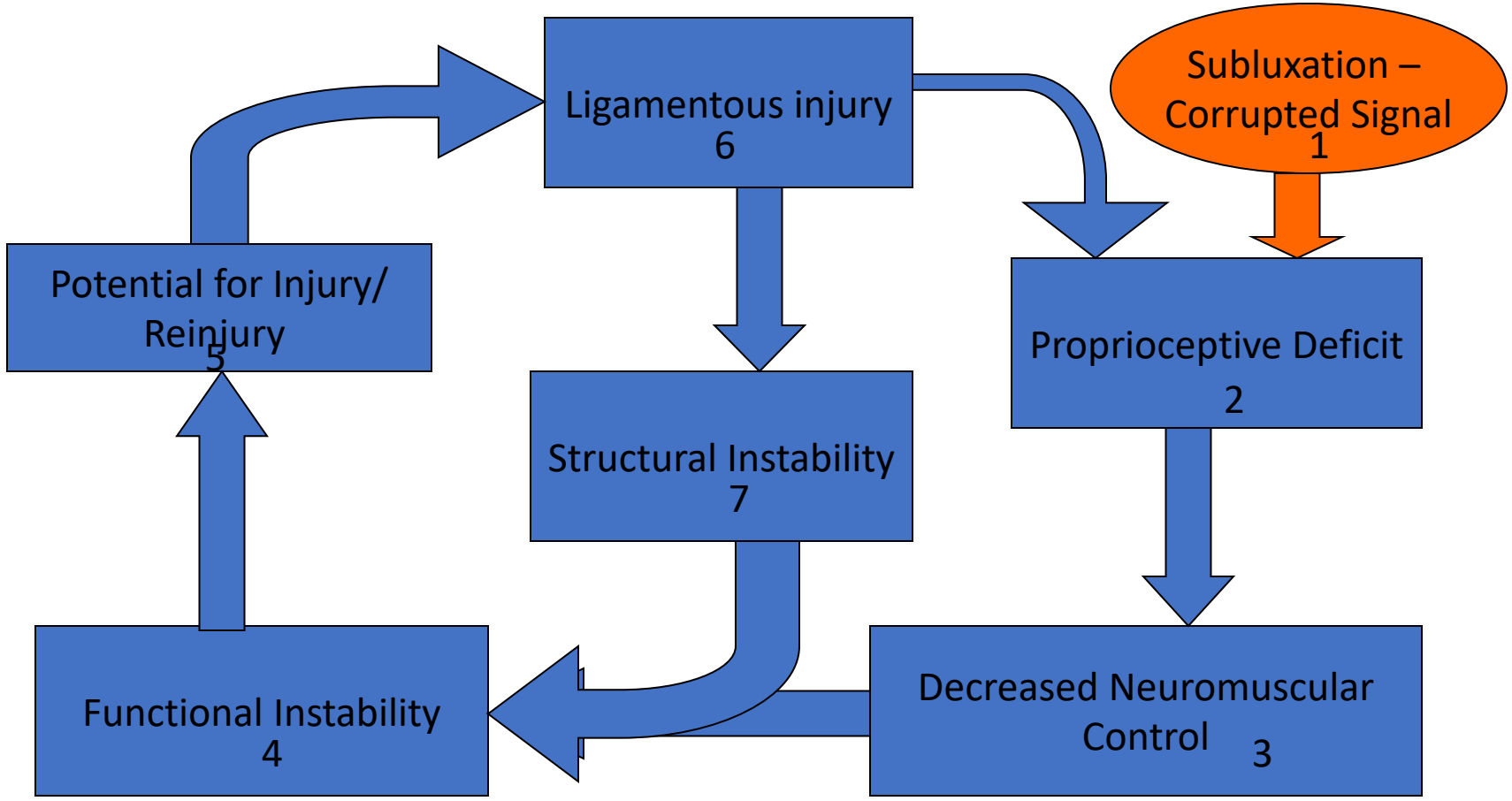
Cycle of Injury – Lephart,Fu,Scott



Mechanical Model

Neuromechanical Model

Cycle of Injury – Chiropractic / Neuromechanical Model Downes 2002

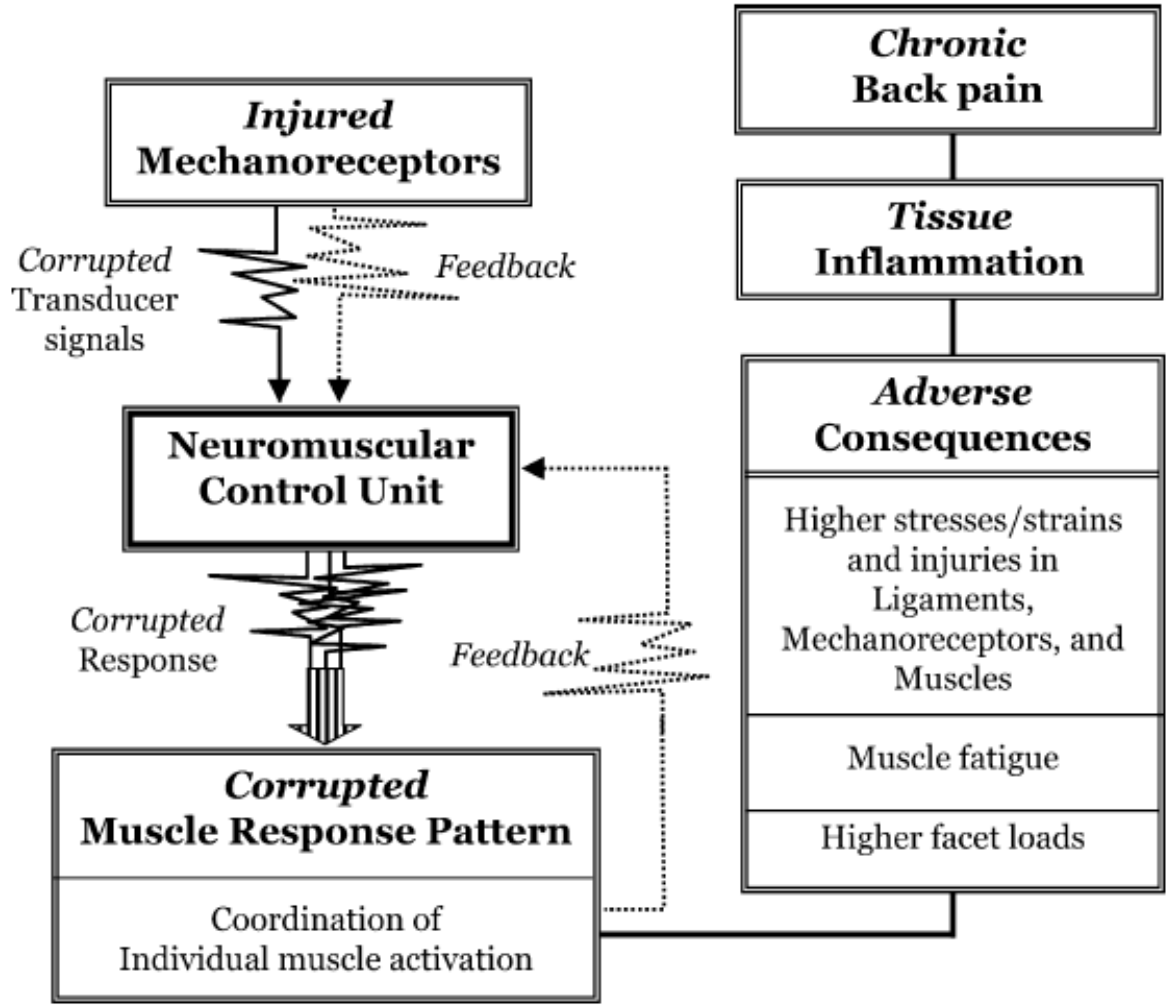


Mechanical Model

Neuromechanical Model

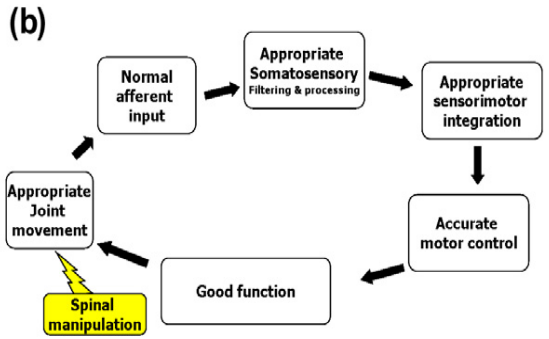
Subfailure Injury of Ligaments in the Spine

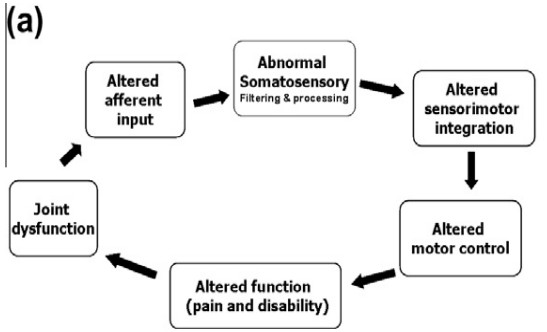
From Panjabi 2006



The Goal

- Demonstrate in a clinical setting a practical task to illustrate disordered sensorimotor integration / altered motor control
- Created by nerve interference and corrected by an adjustment
- The Global Assessment is comparative mirror image isometric testing utilizing the extremities as long lever challenges to the brain to replicate efficiencies.

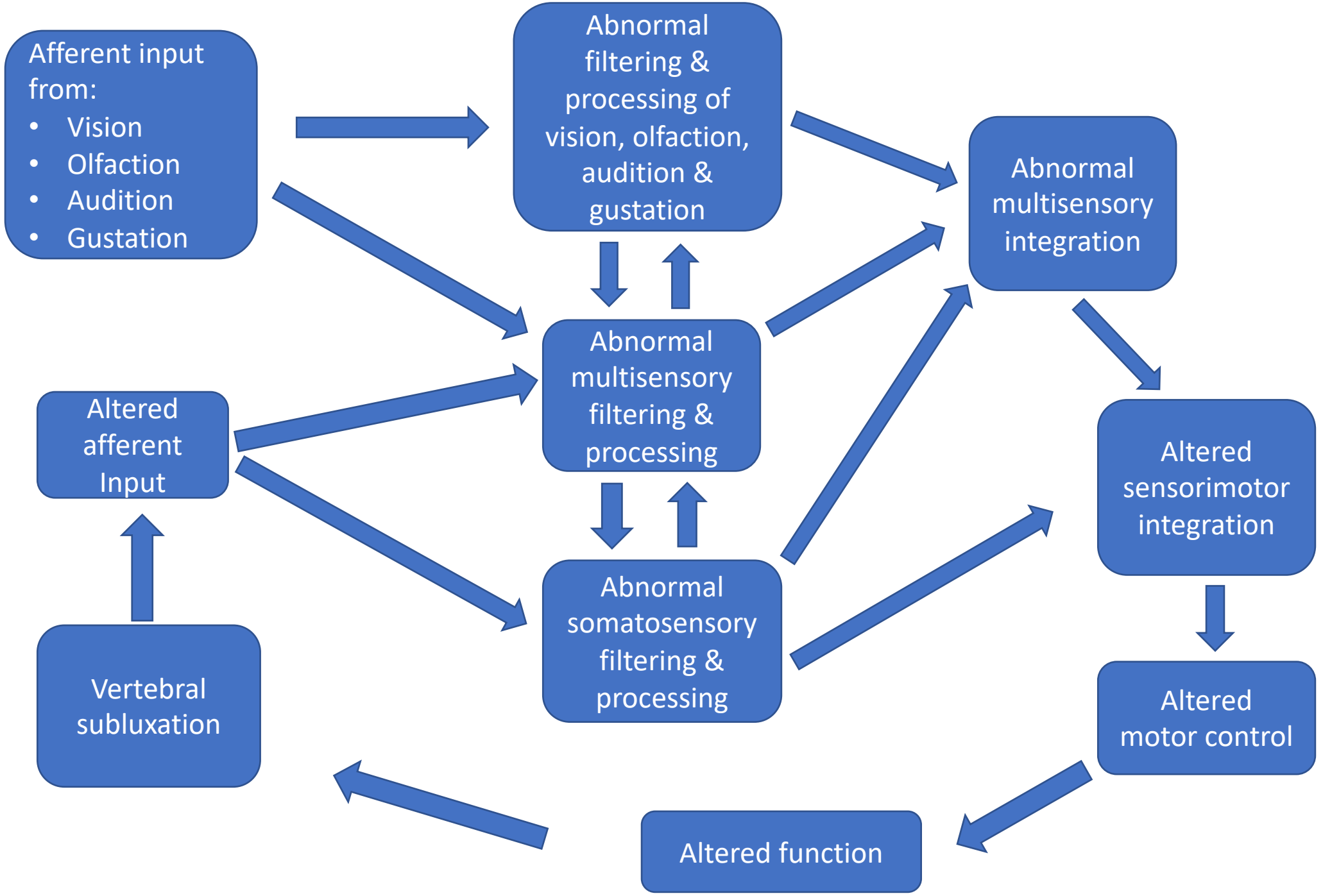




The role of spinal manipulation in addressing disordered sensorimotor integration and altered motor control

Heidi Haavik [a,1], Bernadette Murphy [b,*,2]

[a] *New Zealand College of Chiropractic, Auckland, New Zealand*
[b] *Faculty of Health Sciences, University of Ontario Institute of Technology, 2000 Simcoe St North, Oshawa, Ontario, Canada L1H 7K4*


Afferent input from:
• Vision
• Olfaction
• Audition
• Gustation
Abnormal filtering & processing of vision, olfaction, audition & gustation
Abnormal multisensory integration
Abnormal multisensory filtering & processing
Altered afferent Input
Abnormal somatosensory filtering & processing
Altered sensorimotor integration
Vertebral subluxation
Altered motor control
Altered function

K. Holt

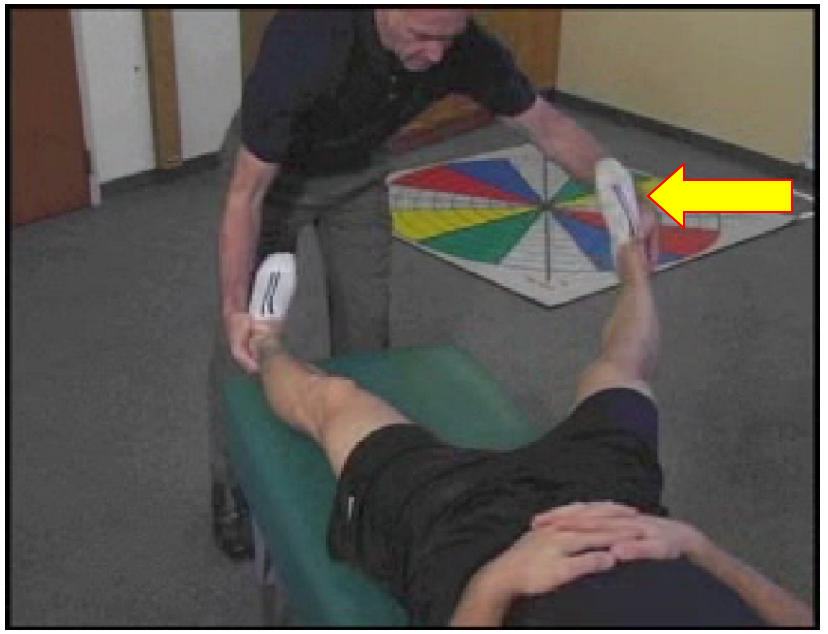
Presumption(s)

- An intact nervous system free of pathology or injury performs as a neutral conduit of signals.
- The mechanical indicators of techniques are a direct indicator of change in the nervous system.
- The changes in the horizontal stay changed in the vertical

Starting Point

The ankle that dorsiflexes the best is chosen as the preferred starting limb

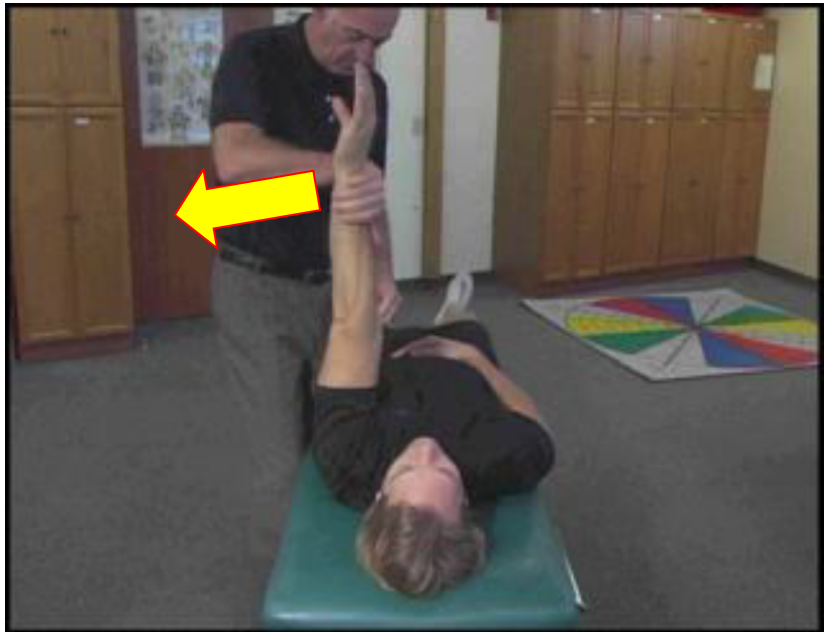
Abduction LE / LLNC



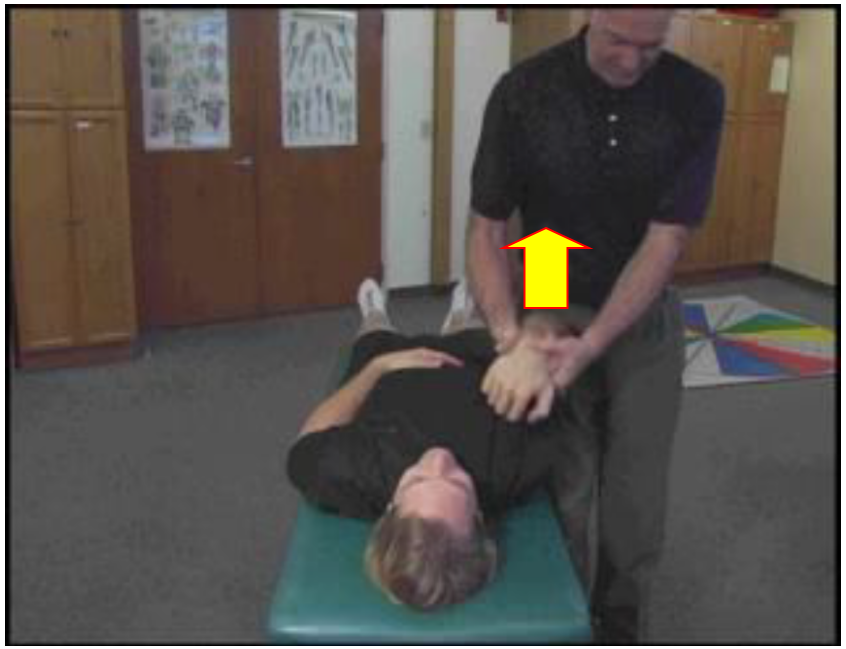
Abduction LE / LLNC Oblique

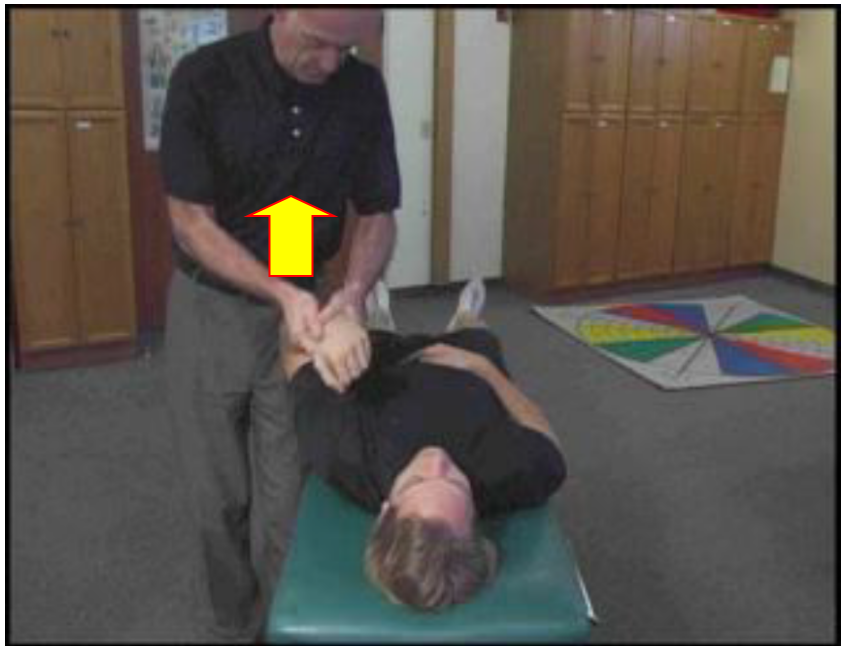
Adduction LE / LLNC Oblique

Adduction UE / LLNC Oblique

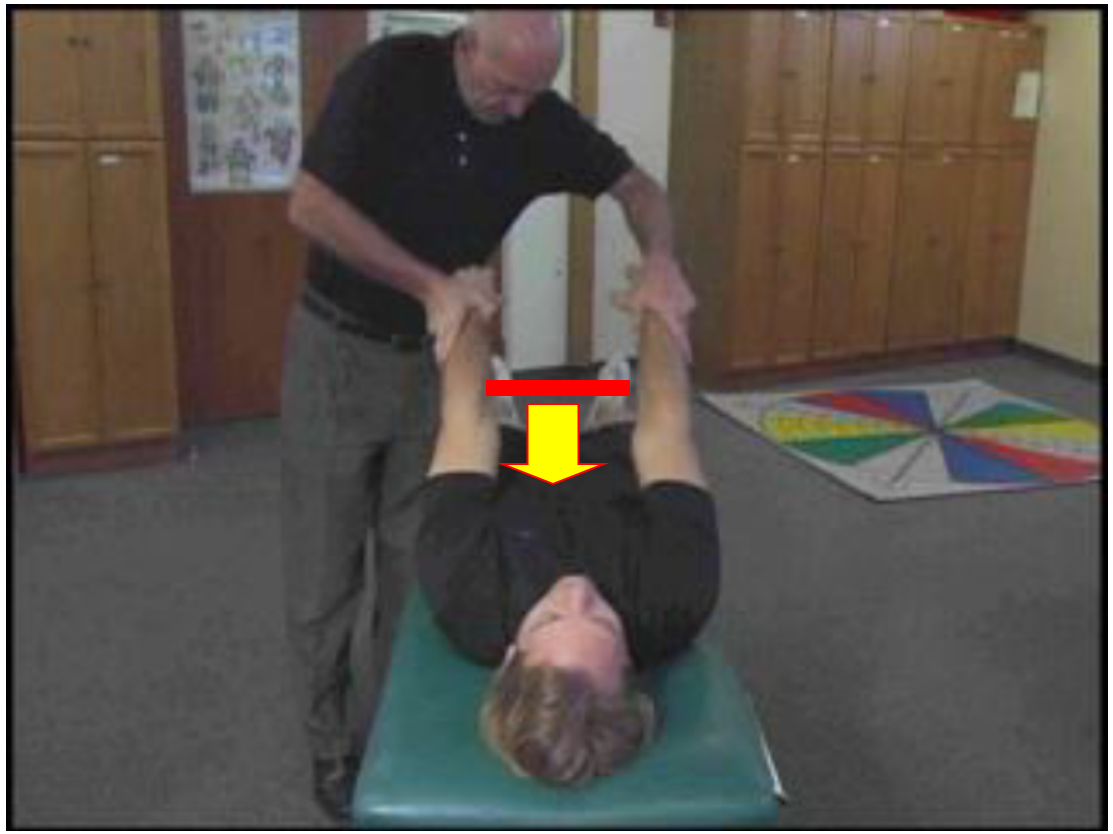


Scapular SLNC

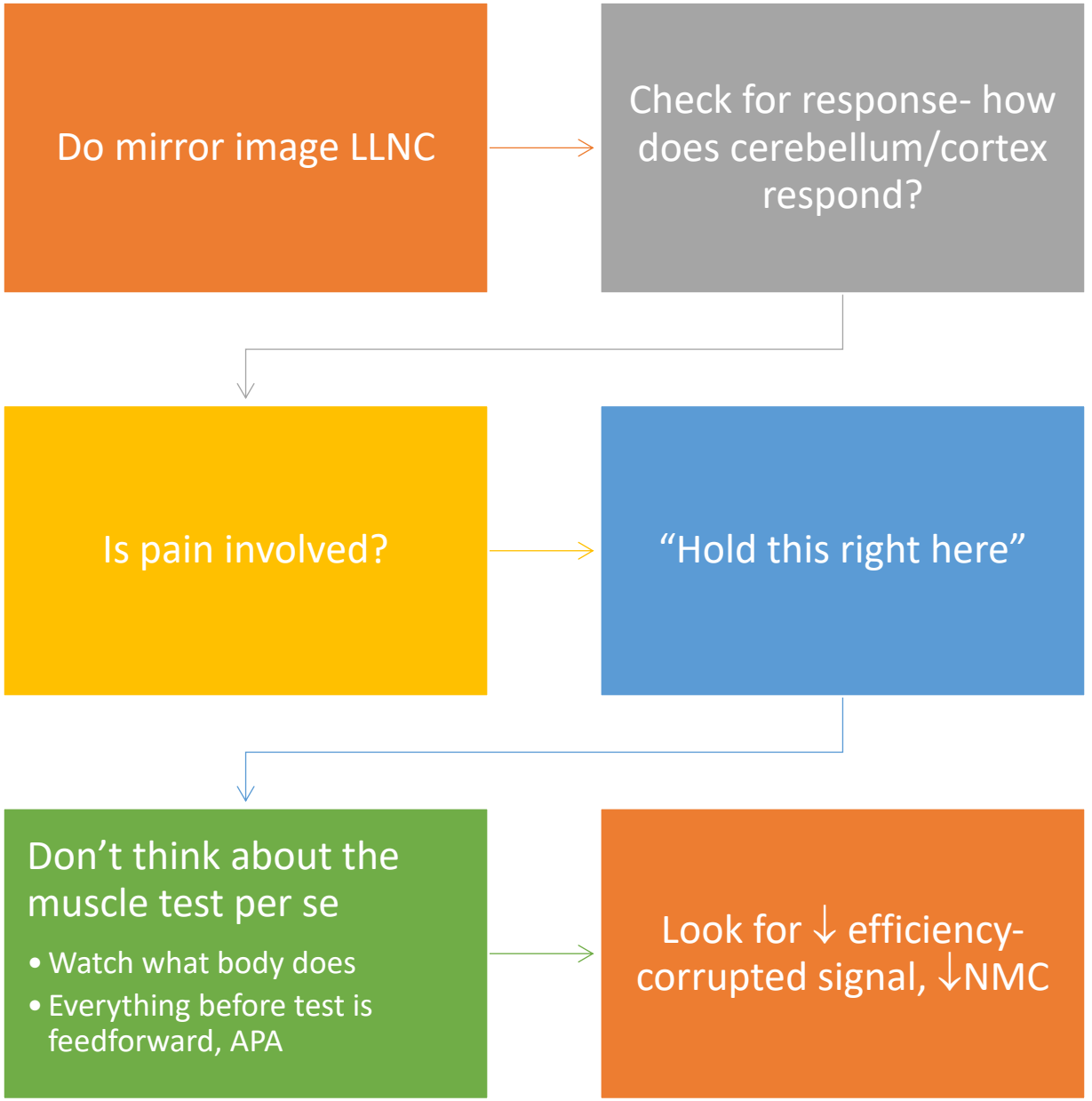




Flexion UE / LLNC



After Comparing Dorsiflexion



So what does it mean?

- If you find apparent inequality in the mirror image isometric tests … the patient has a neurological deficit
- If you find that there is a contralateral upper or lower extremity demonstrating a similar inequality … the patient has reciprocal limb syndrome RLS
- If you don’t find anything then there is no global imbalance … maybe …check head position

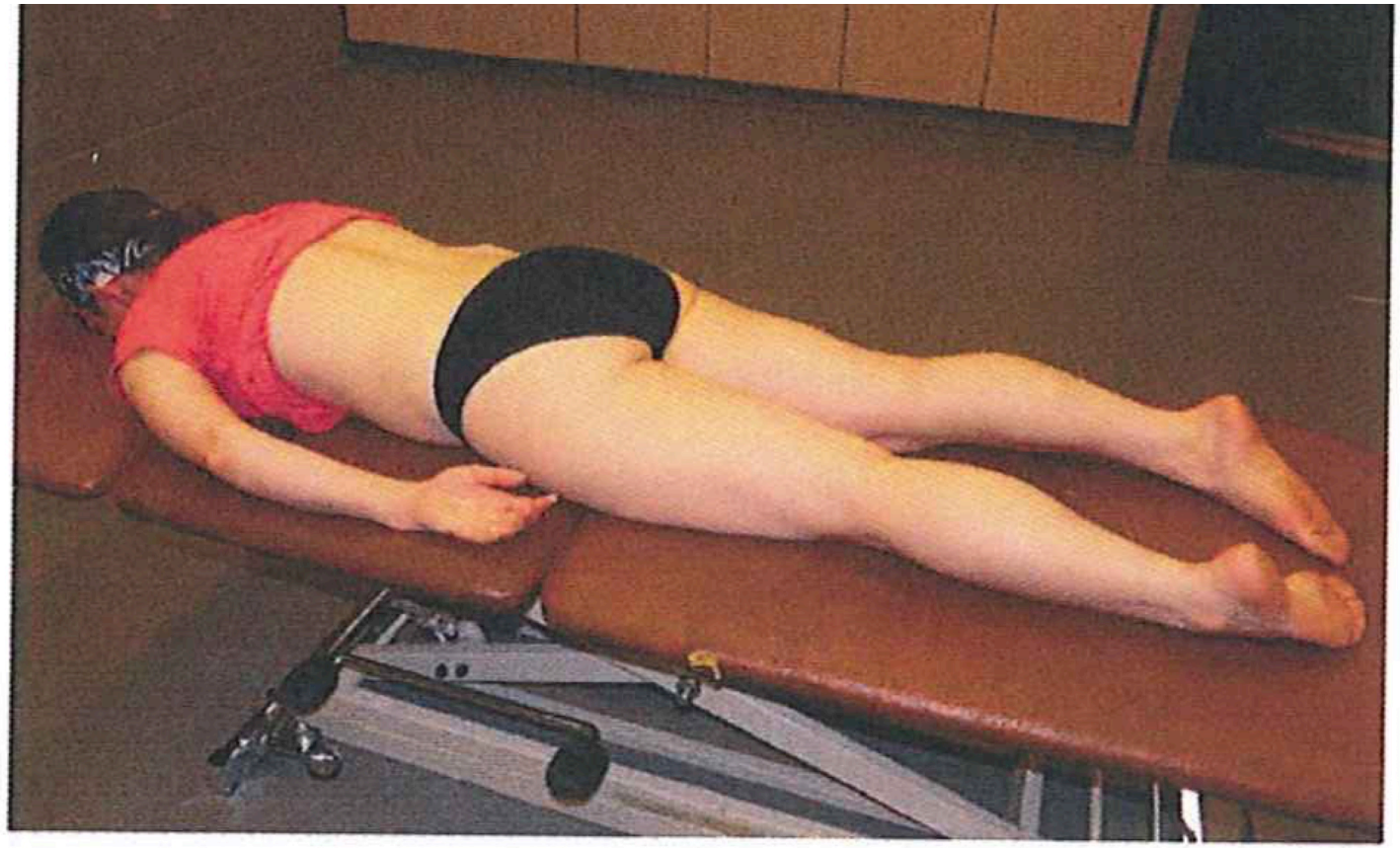
Theory of GPD

- Because it has nothing to do with pain the patient is not aware of its' presence.
- Because it appears to change the efficiencies within the NMS instantaneously the potential for injury may increase or decrease without perception.
- If you don't check for it pre and post you don't really know if a change has occurred.

Prevalence of GPD

Group / Team		Gender	Total	GPD Number		GPD Percentage	
				Y	N	Y	N
Non-athletes		Male	29	23	6	79.3%	20.7%
		Female	25	22	3	88.0%	12.0%
		Total	54	45	9	83.3%	16.7%
Athletes	Diving	Male	7	6	1	85.7%	14.3%
		Female	19	17	2	89.5%	10.5%
		Total	26	23	3	88.5%	11.5%
Track & Field		Male	14	10	4	71.4%	28.6%
		Female	9	8	1	88.9%	11.1%
		Total	23	18	5	78.3%	21.7%
	Total	Male	21	16	5	76.2%	23.8%
		Female	28	25	3	89.3%	10.7%
		Total	49	41	8	83.7%	16.3%
Total Subjects		Male	50	39	11	78.0%	22.0%
		Female	53	47	6	88.7%	11.3%
		Total	103	86	17	83.5%	16.5%

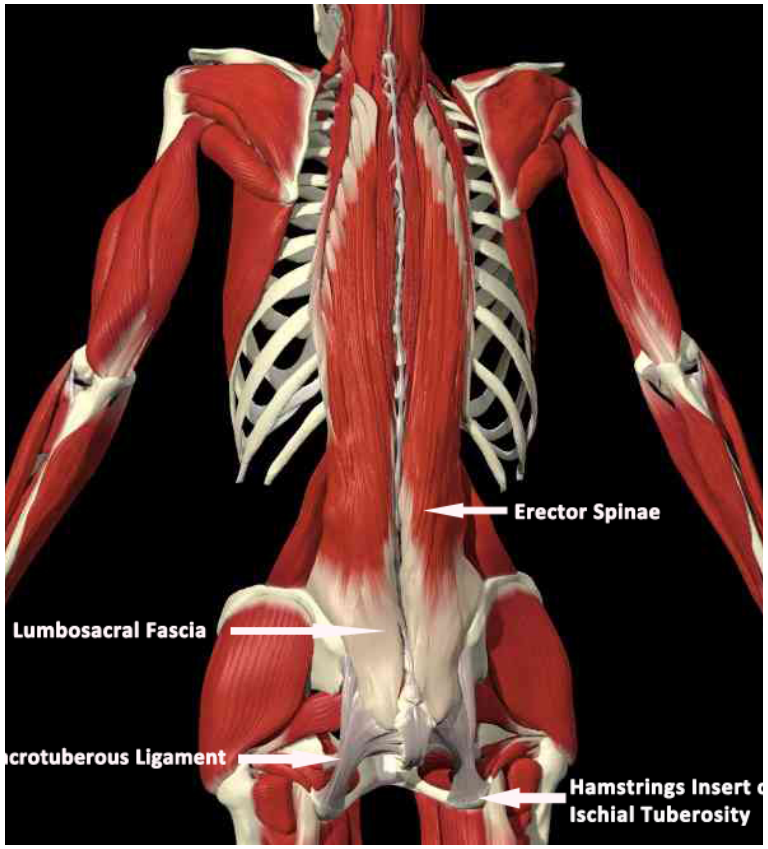
Accept then Verify

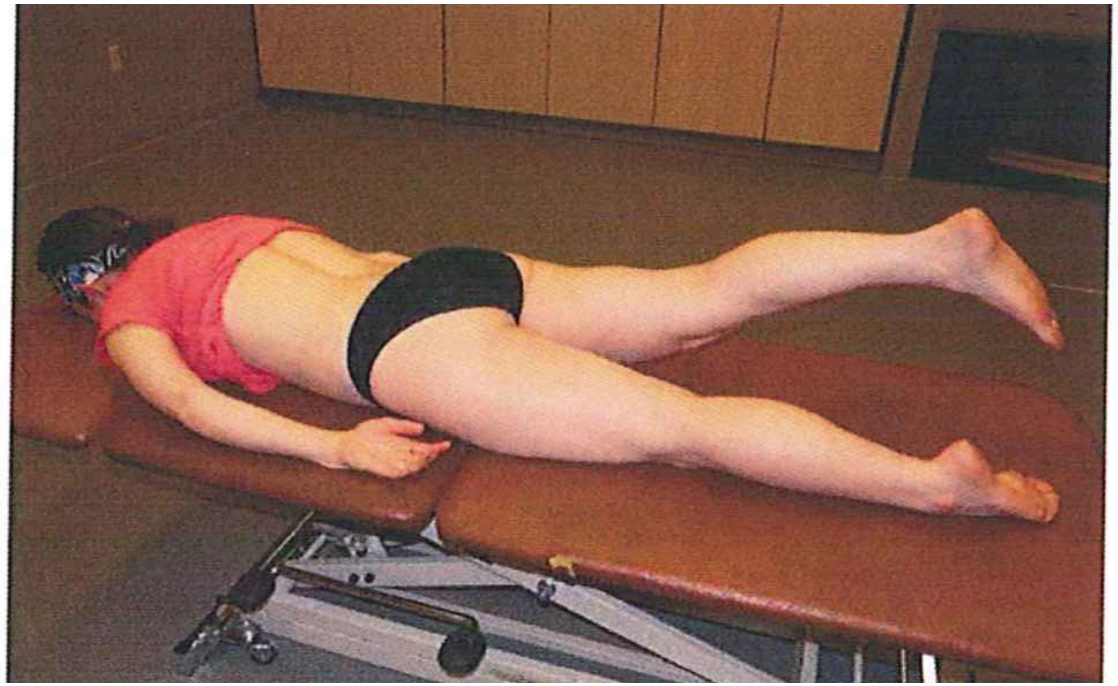


Prone Check for Ipsilateral Activation of Erector Spinae group

- An Investigation of Neck Muscle Activity in Asymptomatic Participants who show different lumbar spine motion patterns during prone hip extension

- Bruno Murphy 2011





Sensorimotor Disintegration Produces Substitutionary Muscle Coupling Patterns

Ipsilateral erector spinae activation (superficial core) with SI dysfunction

PRACTICAL APPLICATIONS

- When is a lower extremity dysfunction neuromechanical versus biomechnical
- SAID principles – what are your expectations following care?
- Our posture and movement are physical demonstrations of general adaptation syndrome (GAS) / Homeostasis
- GMA may prove to be a reliable surrogate to test the balance and symmetry of the nervous system at the most fundamental levels

CONCLUSIONS

Corrupted FFA (sensorimotor disintegration) creates altered neuromechanics

Altered neuromechanics can be demonstrated through decreased neuromuscular control and testing with GMA

Thank you for your attention

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