The Pelvic Equilibrium Theory

Part 2

Understanding the abnormal motion patterns associated with 'The Pelvic Equilibrium Theory' and Leg length Inequality.

Aims of this section

- To discuss the abnormal motion patterns associated with each pelvic adaption / pathway.
- To investigate some of the potential repetitive injuries associated with the theory.
- To select a delegate subject to & establish their pelvic adaption and associated motion patterns.
- There are potentially hundreds of multi-segmental interactions with pathomechanical adaptions. We will be looking at some of the known ones.

My injury

Leg length inequality & track athletics.

Long right leg:

Outdoor track ✓

Indoor track ✗

Longer left leg:

Outdoor track ✗

Indoor track ✓

England V USA 1985

3.57.88 min/secs. New British Indoor Record

Clinical MSK biomechanics is fundamentally about identifying the adaptive changes created by asymmetry in morphology.

Mainly the changes associated with Leg Length Inequality.

Why might adaptions occur?

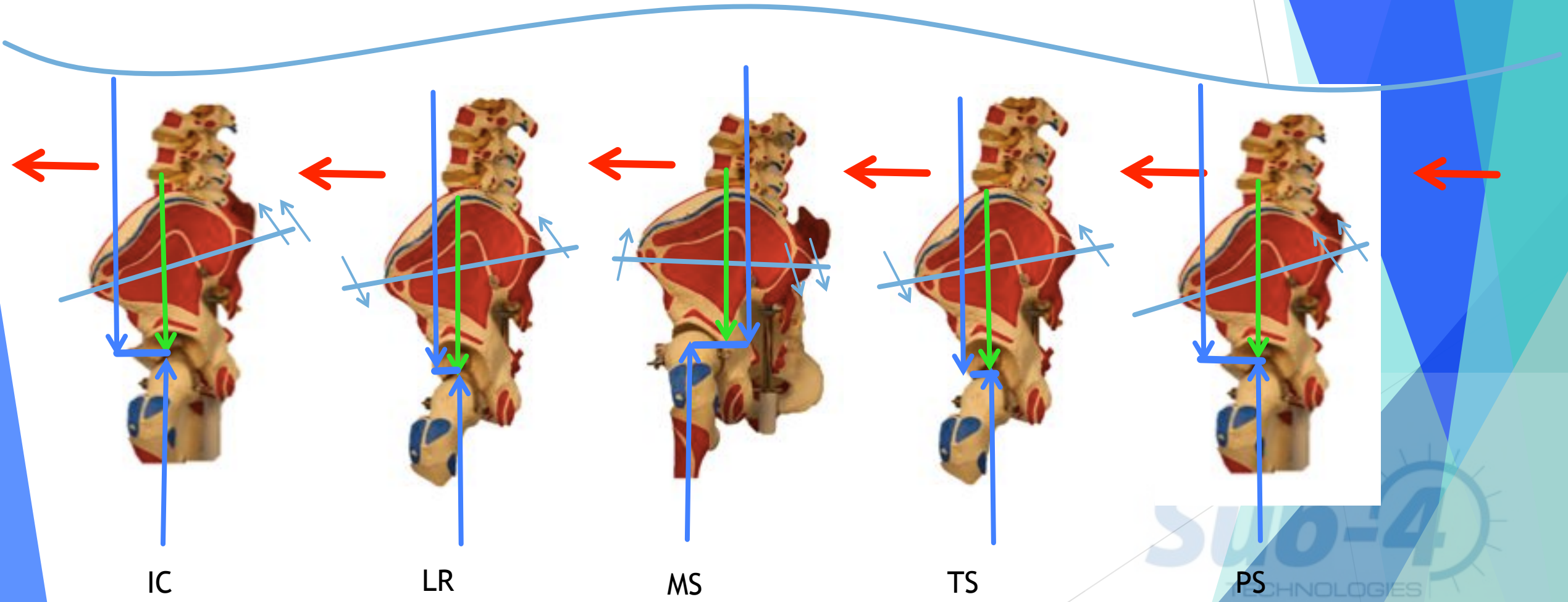
And how may they go on to create tissue stress.

There has to be a starting point.

Asymmetry – intrinsic / extrinsic

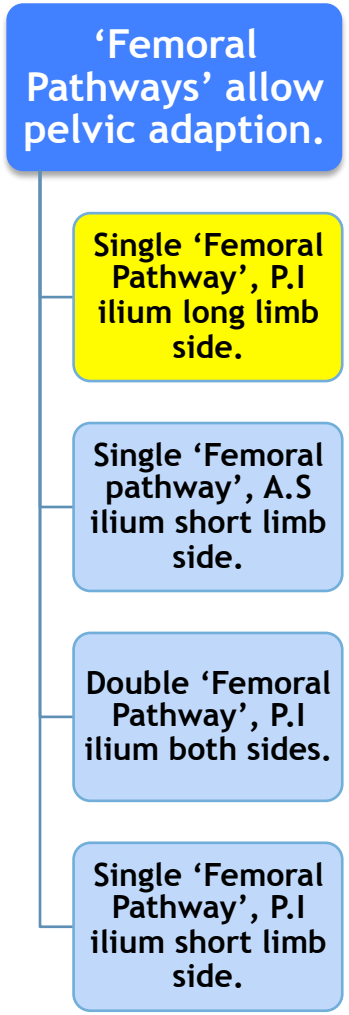
Geophysics

RARE but normal pelvic motion during gait.



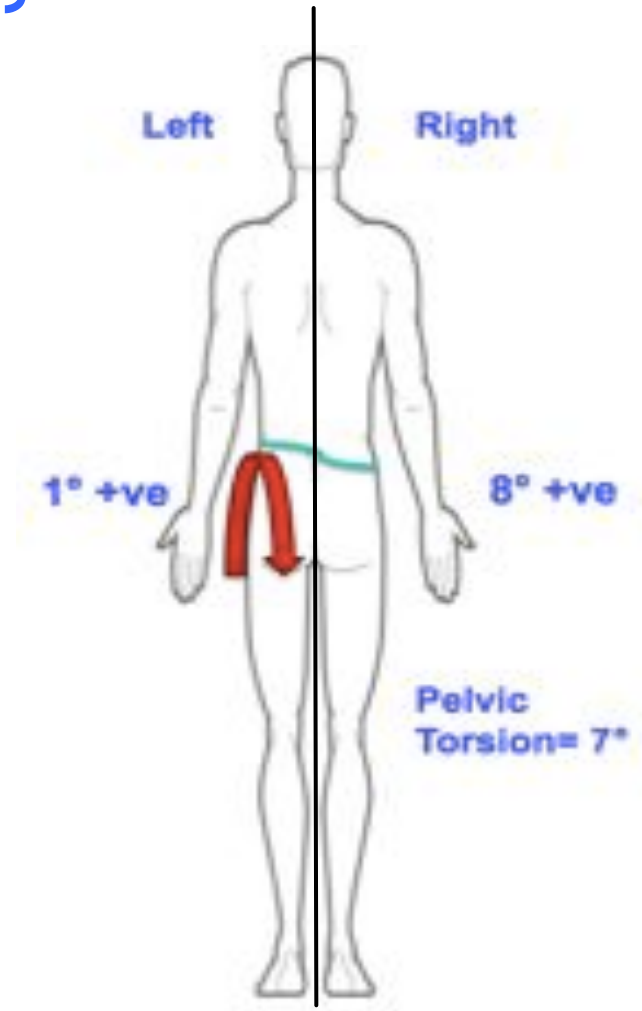
Single Femoral Pathway PI ilium – Long Side

- The Pelvic Equilibrium Theory describes the 4 pelvic adaptions.



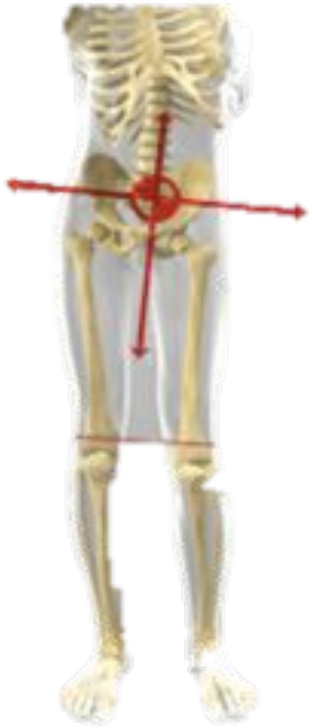
Single Femoral Pathway
PI ilium – Long Side

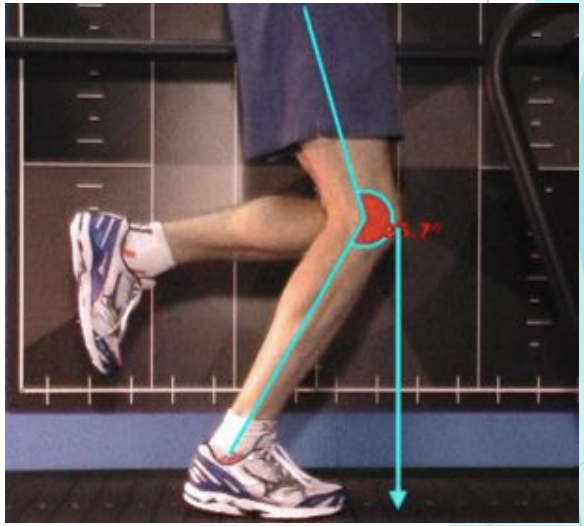
- Is the most common pelvic adaption.
- Often develops from a very early age.
- Easily identified / quantified / rectified.
- Can help to explain many repetitive injuries.
- In an advanced state with develop into the Double Femoral Pathway.
- Will create an oblique axis rotation across the sacrum.

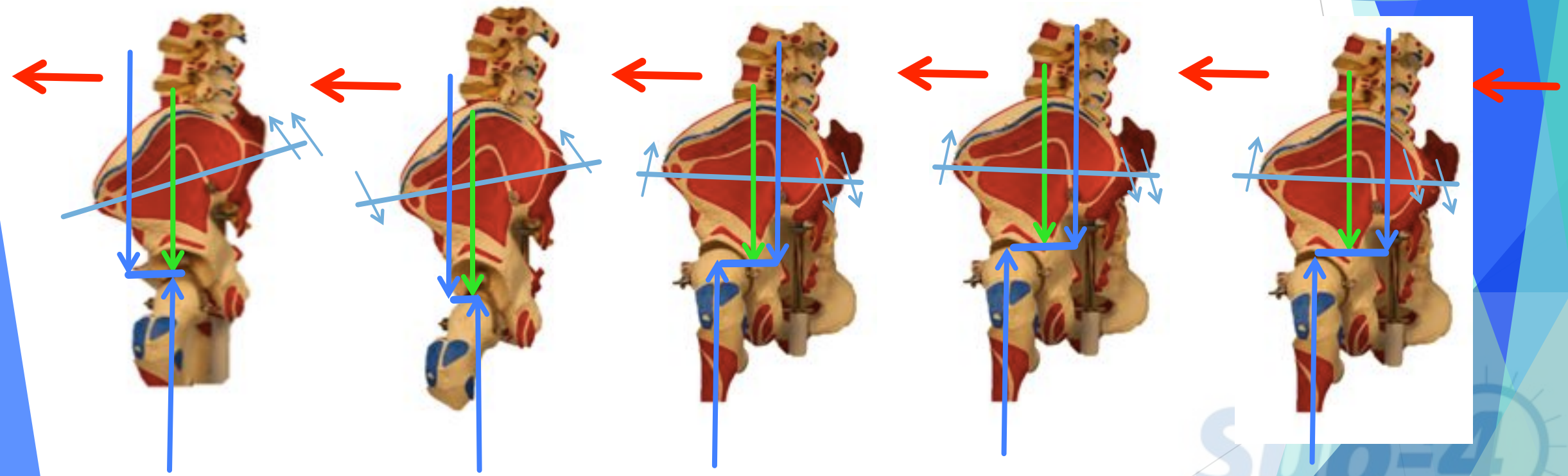


Associated Pathomechanics

1. Inc. GRF = Inc. force into the acetabulum (under the longer limb) i.e. increased time/pressure ratio from a longer contact phase than the contralateral side.
2. This creates a longer temporal window of force into the acetabulum on the ipsilateral.
3. This maintains the posterior rotation orientation of the innominate (PI ilium). Inc. pronatory moments in the foot, especially if coupled with a medially deviated STJ axis.
4. Therefore no re-anterior rotation occurs at heel lift. Sound familiar ?

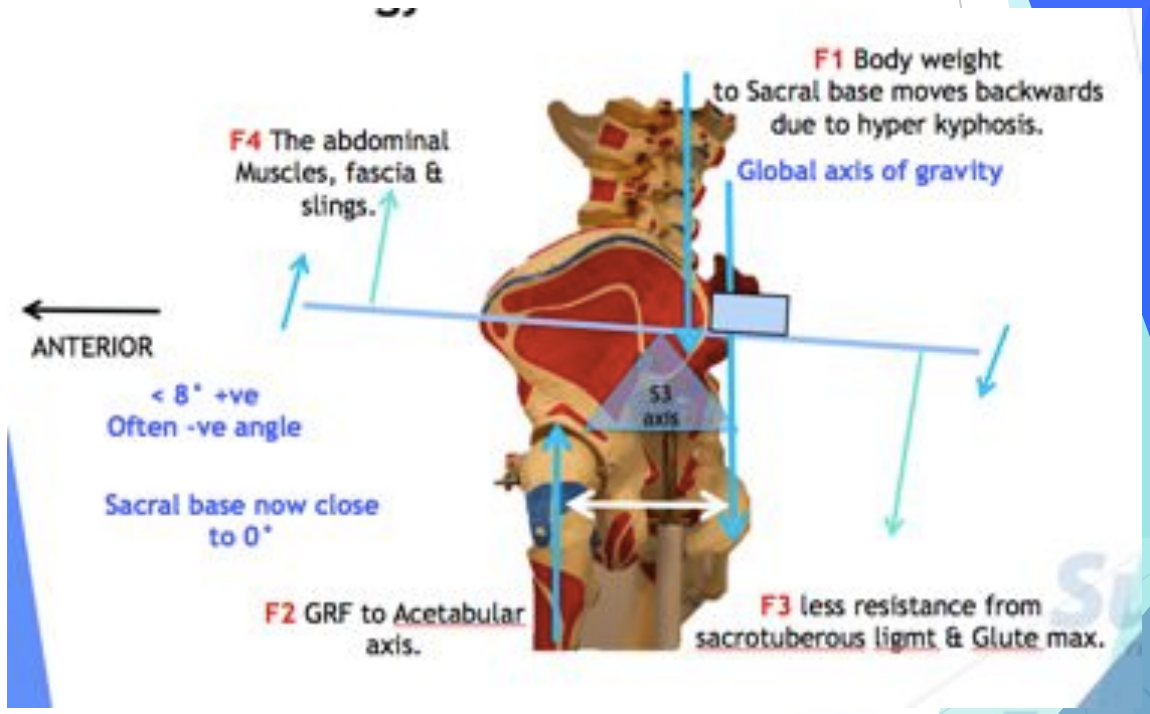





IC
LR
MS
TS
PS

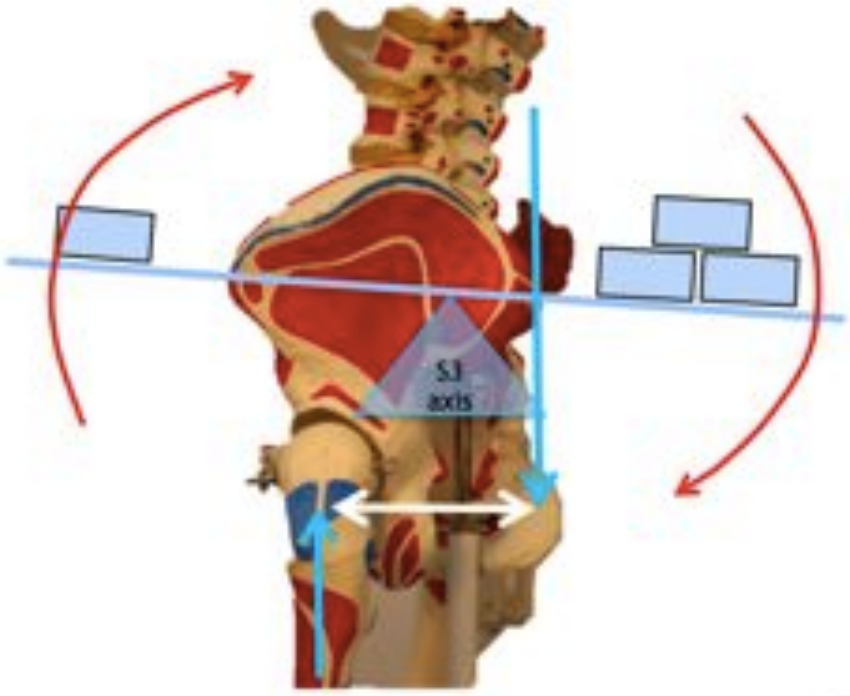
Associated Pathomechanics

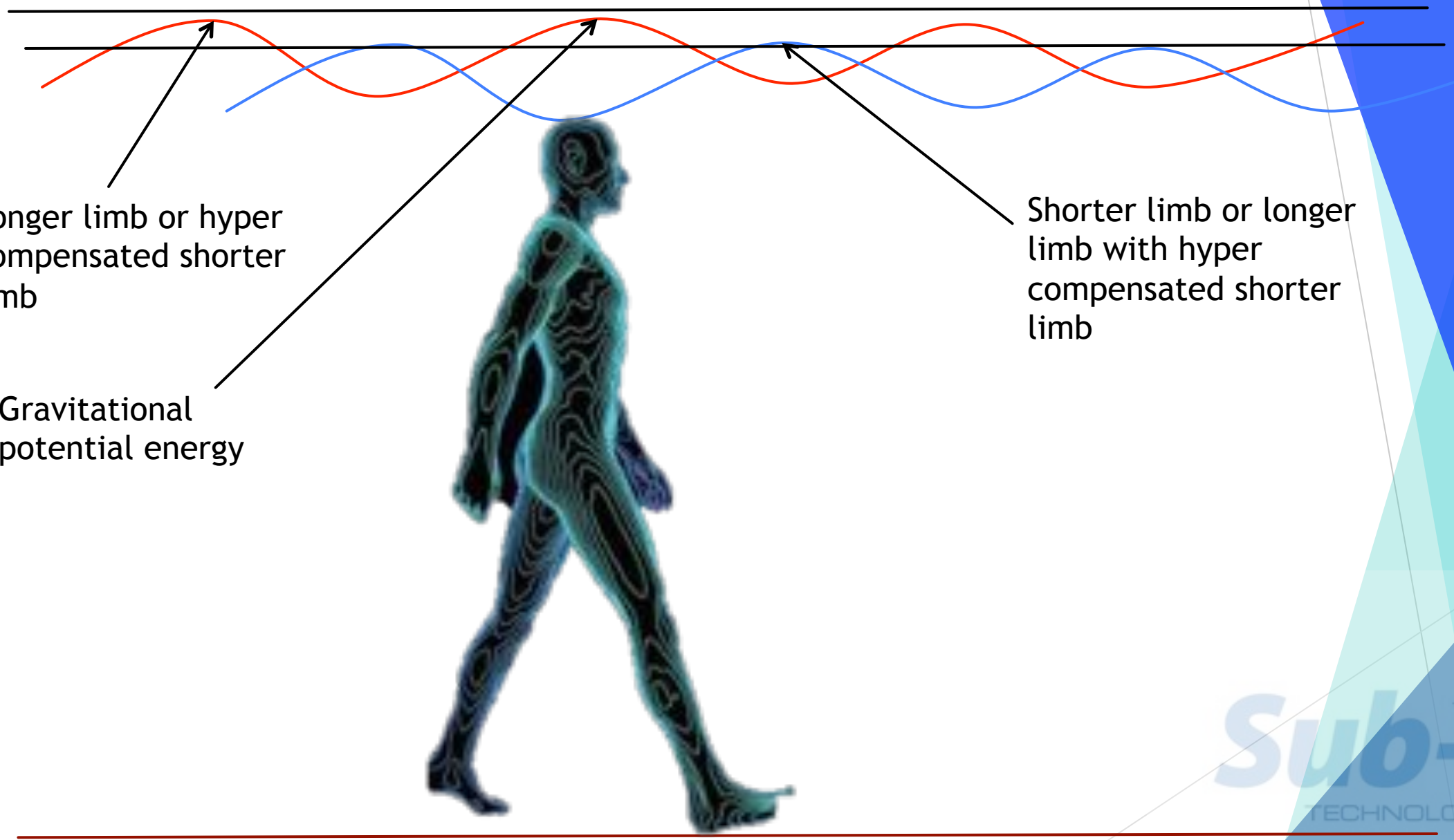
1. Therefore with a normal sacral base angle (30°)/normal sacral position , innominate angle (8 -10° +ve) it is possible to overcome the 'self balancing' mechanism of the pelvis very easily creating dysfunction and vulnerability.
2. This is because from IC to MS a window of 'weakness' opens for as long as the 'posterior rotational leverage arm' between the axes exist.
3. And it overcomes resistance from the numerous pelvic muscles and ligaments on the same side creating the PI ilium.
4. However, there is resistance on the contralateral side, and it remains normal.



Associated Pathomechanics

1. The acetabulum drops and internally rotates - internally rotating the femur, which internally rotates the lower limb.
2. The ipsilateral side of the pelvis drops to maintain cerebellovestibular balance. However, the innominate lengthens and measures longer lying supine (be aware!).
3. Depending on STJ axes this may increase time : pressure ratio per step delaying heel lift & increase pronatory moments.
4. = increased tissue stress = injury.




Longer limb or hyper compensated shorter limb
Gravitational potential energy
Shorter limb or longer limb with hyper compensated shorter limb

Adaptions.

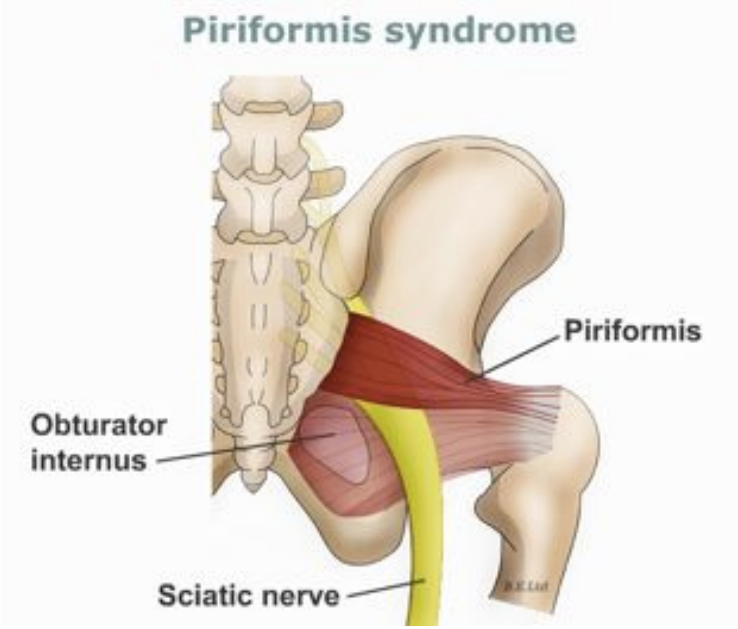
Sinusoidal curve disturbance

1. Vertical touch – no touch
2. Vertical touch – lateral shift
3. Complete loss of curve

Ipsilateral Injuries.

Piriformis sciatica

- PI ilium = under active gluteal muscles.
- Internal femoral rotation = excessive strain on piriformis muscle.
- Etc.

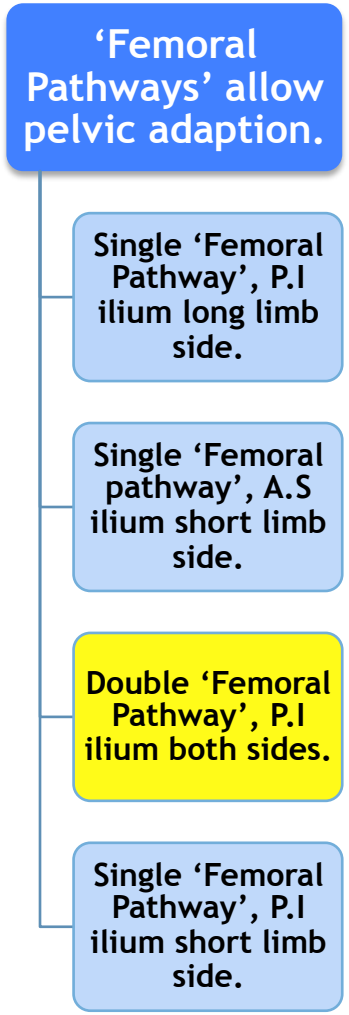


Non-specific lower back pain

- Ipsilateral PI ilium = oblique axis sacral dysfunction = posterior SIJ ligament strain = paraspinal dysfunction.
- Thoracolumbar fascia dysfunction.
- Superficial posterior back line.
- Posterior oblique sling dysfunction.
- Etc.

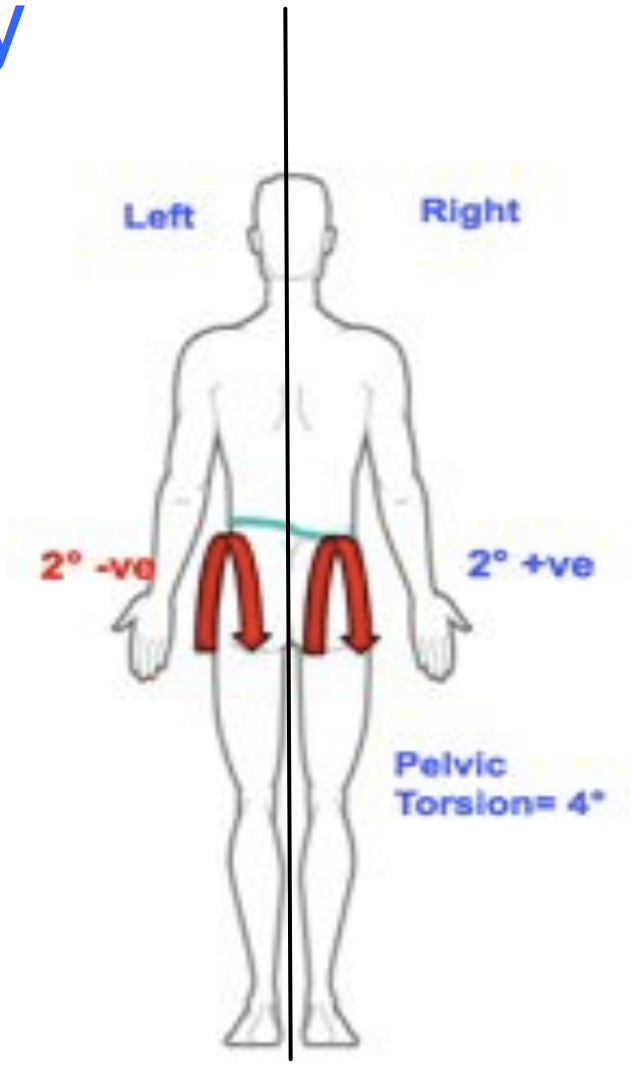
Double Femoral Pathway PI ilium – Both Sides

- The Pelvic Equilibrium Theory describes the 4 pelvic adaptions.

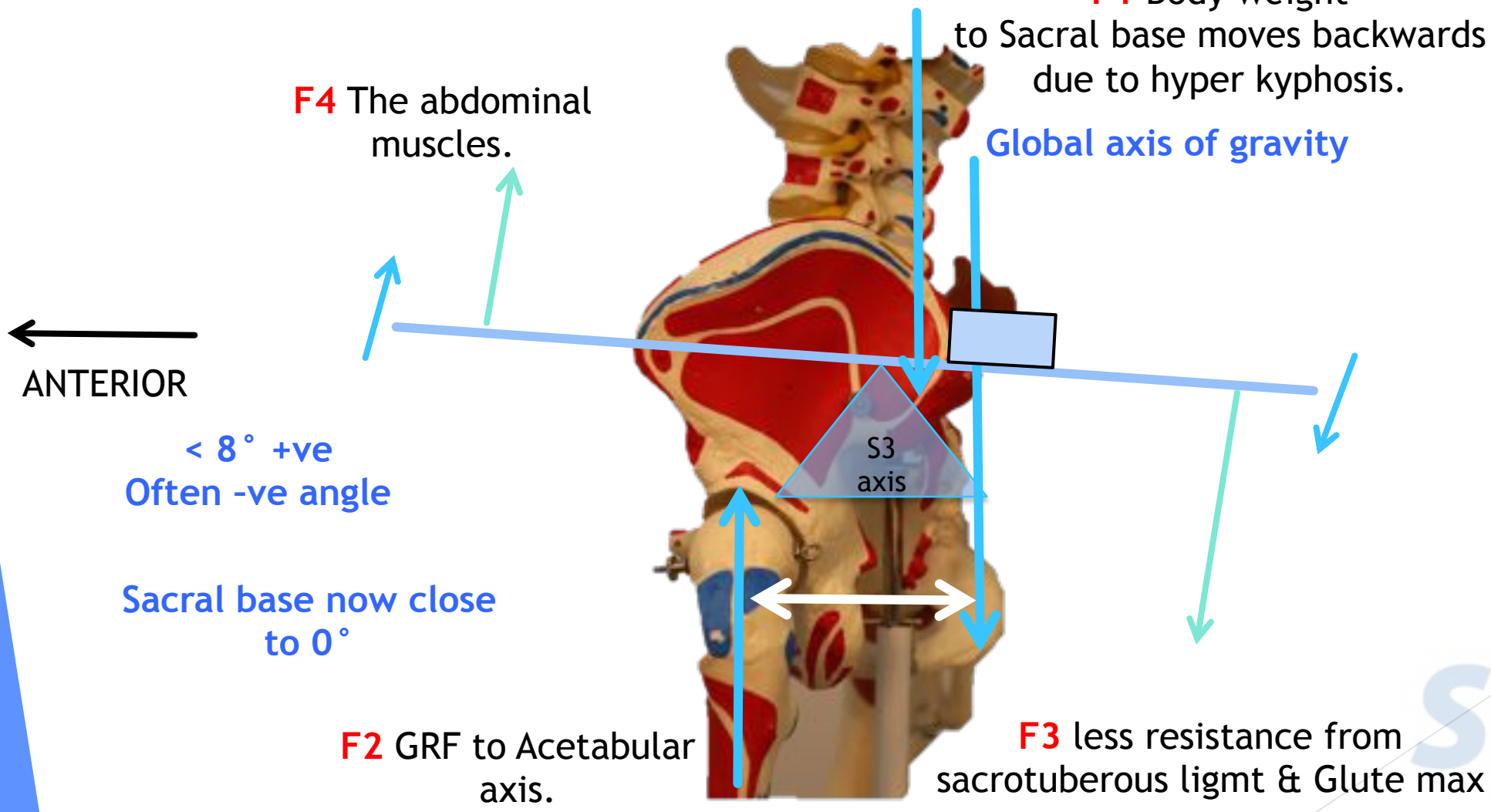


Double Femoral Pathway PI ilium – Both Sides.

- Occurs more in mainly endomorphs, but others too.
- Can only occur after a Single Femoral Pathway.
- Leading to a Double PI ilium.
- This creates a syndrome of full-kinetic chain dysfunction.
- ‘Seesaw effect’.

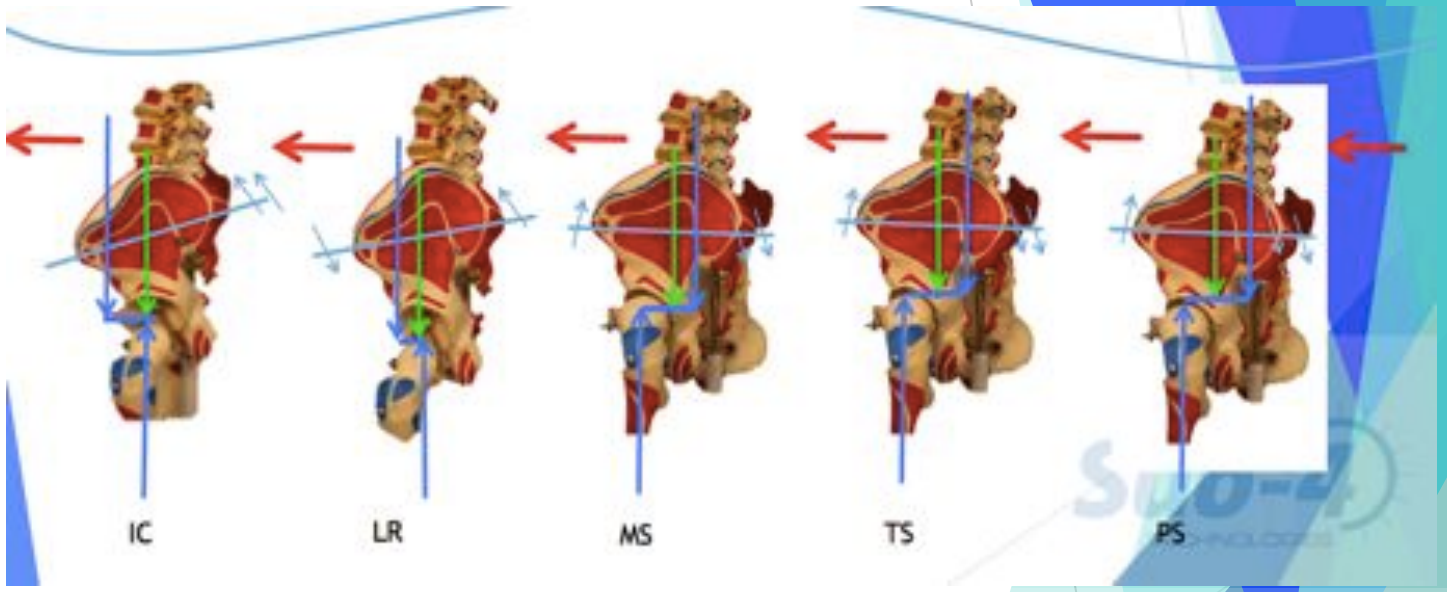


‘Seesaw’ analogy with a PI ilium both sides.



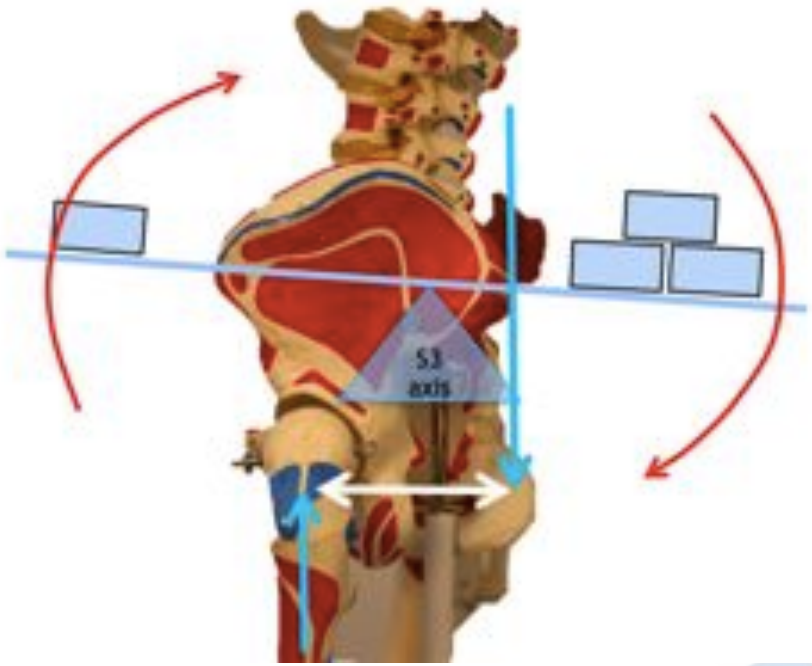
Associated Pathomechanics

1. Inc. GRF = Inc. force into the acetabulum (starts under the longer limb) i.e. increased time/pressure ratio from a longer contact phase than the contralateral side.
2. This creates a longer temporal window of force into the acetabulum on the ipsilateral.
3. This maintains the posterior rotation orientation of the innominate (PI ilium).
4. Over time if the force continues to be greater than resistance, then a 'Double PI ilium' occurs.



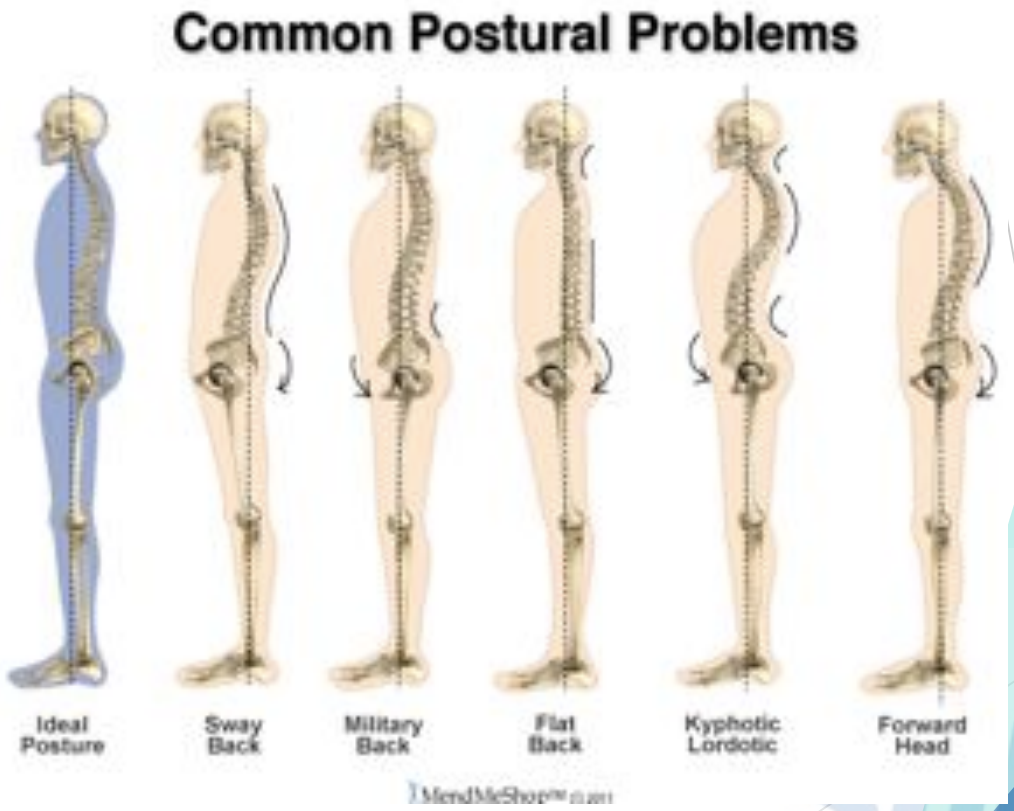
Associated Pathomechanics

1. The same (IC to MS) a window of ‘weakness’ opens for as long as the rotational leverage between the axes exist.
2. But this time:
    1. it overcomes resistance from the numerous pelvic muscles and ligaments on the ipsilateral side.
    2. Which creates an oblique axis across the sacrum, eventually forcing the contralateral side in a PI ilium.
    3. Once this occurs it can be a permanent postural anomaly.



Lumbosacral complex influence

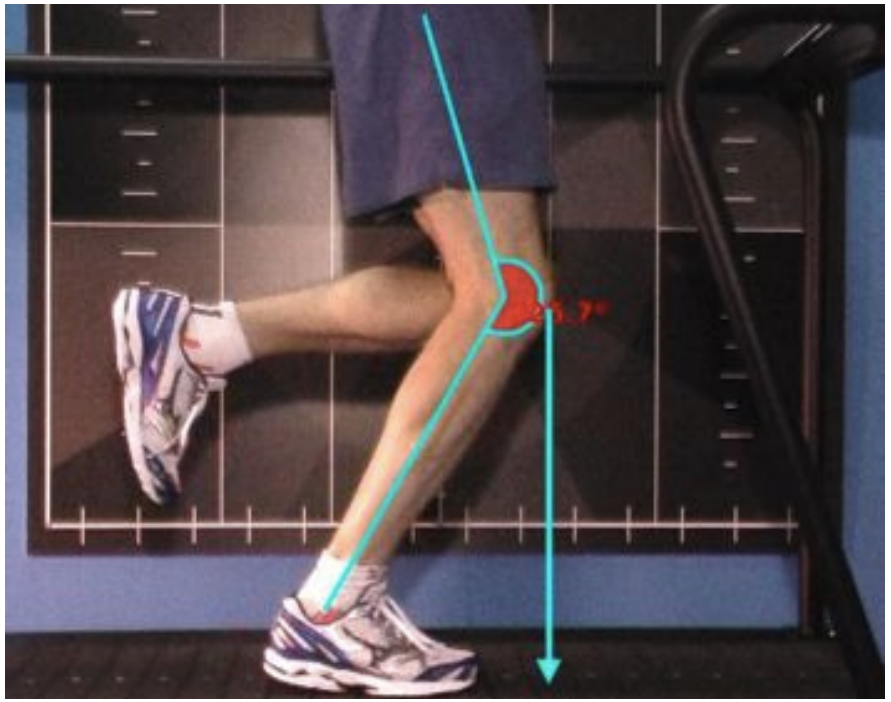
- Either the sacrum or the innominate is the major influencing factor over the lumbosacral complex
- The determining factor being whether there is a:
  - ‘Posterior rotational leverage arm’ which causes the innominate to be the dominant factor over the sacrum. Reducing muscle efficiency.
  - Or, a hyper flexed sacrum which prevents a posterior innominate adaption. However, facilitates the AS ilium orientation.



Bilateral adaptions.

Delayed heel lift

- Increased time : pressure integral



Counter-nutated sacrum

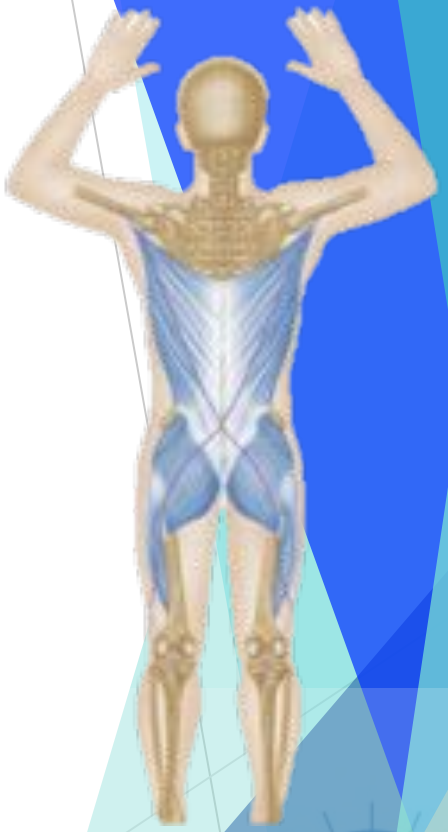
Bilateral injuries.

Delayed heel lift

- Achilles tendinosis
- Plantar heel pain
- PTTD
- MTSS
- Etc.

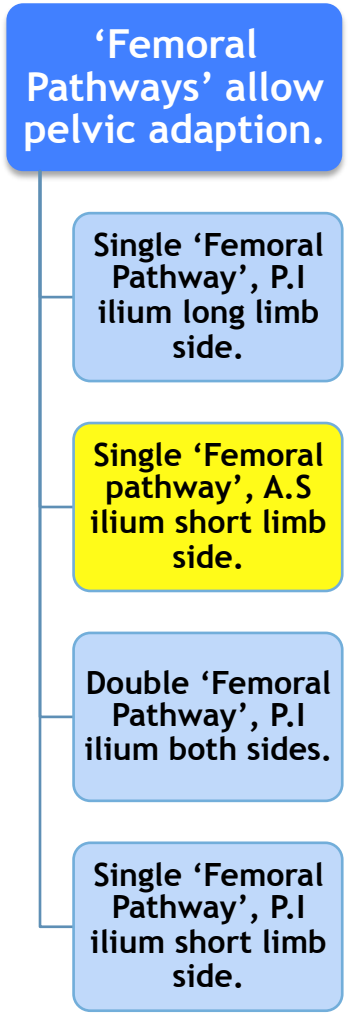
Counter-nutated sacrum

- Spinal extension
- Hypo lordosis / hyper kyphosis etc
- Paralumbar strain
- Myofascial strain
- Hamstring dysfunction
- Vertical height loss
- Long dorsal SIJ ligament strain
- Etc.



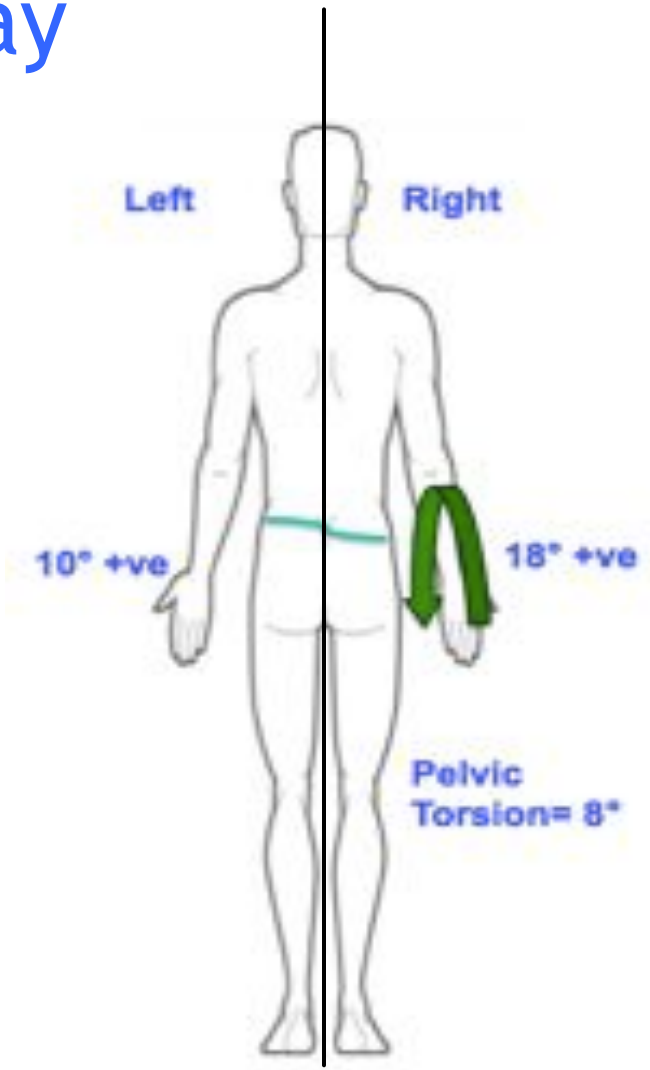
Single Femoral Pathway AS Ilium – Short Side

- The Pelvic Equilibrium Theory describes the 4 pelvic adaptions.



Single Femoral Pathway AS ilium – Short Side

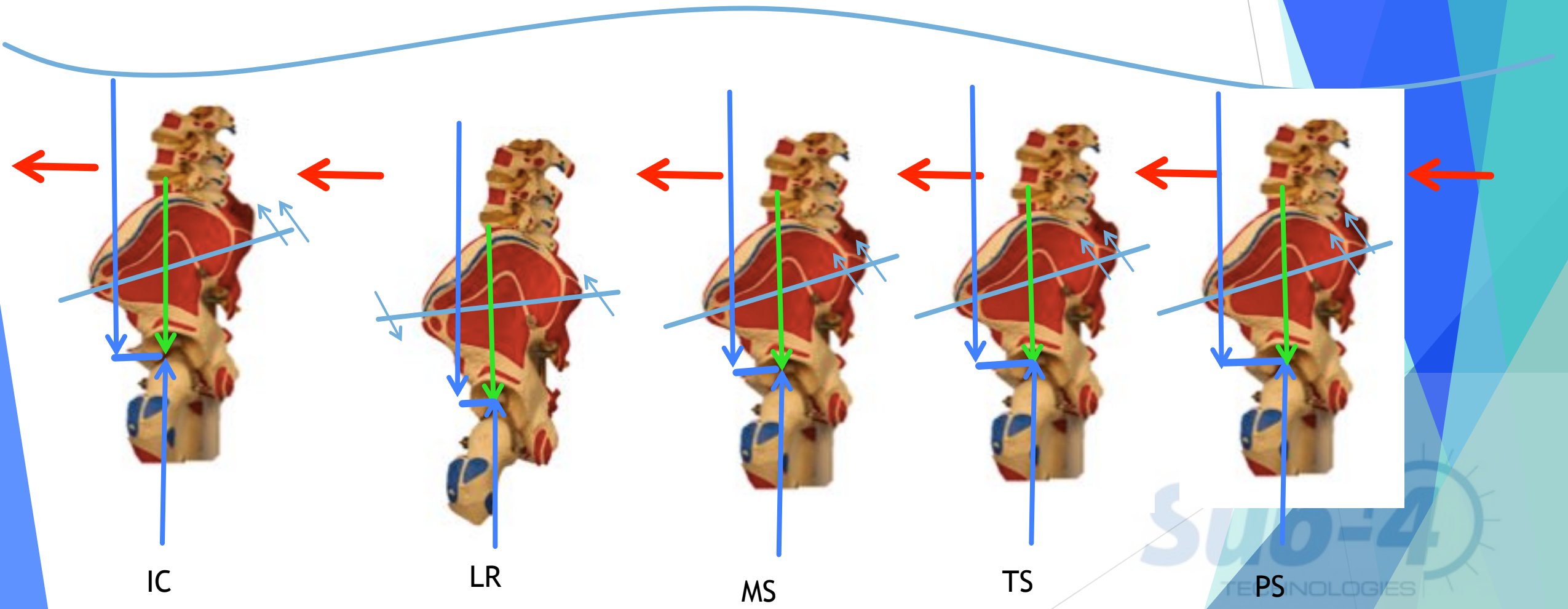
- Occurs more in mesomorphs and those with a anterior CoM and increased sacral flexion.
- Requires specific morphological characteristics to occur.
- i.e. increased innominate inclination.
- Powerful muscle groups which influence the sacral 2 axis.
- E.g. Gluteus maximus.
- Powerful legs which decrease the contact phase i.e. early heel lift.



Associated Pathomechanics

1. This adaption occurs because of the starting point of the sacrum and sacral base:
   1. Hyper flexed sacrum
   2. High sacral base angle
   3. > 10° +ve normal innominate angle

- Therefore can occur in the following body types:
- Natural athlete – long-term
- Pregnancy – worse for 9 month
- Forward displaced body mass – for the duration of the anterior CoM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PS

Associated Pathomechanics

1. The anterior displaced CoM along with a flexed sacrum & high sacral base angle moves descending forces forward.
2. This aligns the acetabular to sacral axes vertically eliminating the ‘posterior (-ve) rotational lever arm’, however creating an ‘anterior (+ve) rotational lever arm’.
3. Creating either a position of POWER or INSTABILITY especially on the shorter limb side if coupled with a laterally orientated STJ axis.

A posture of ‘power’ or ‘weakness’

‘Power’

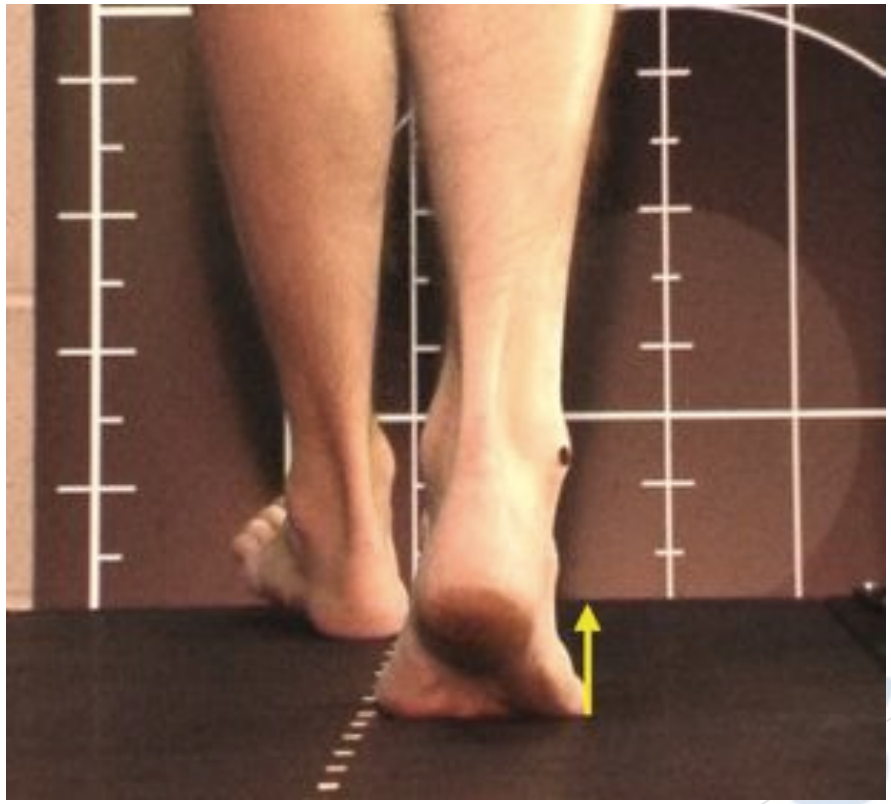
Because the morphology has NOT changed.
These are their normative values.

‘Weakness & Instability’

Because the morphology has changed from more normative values.

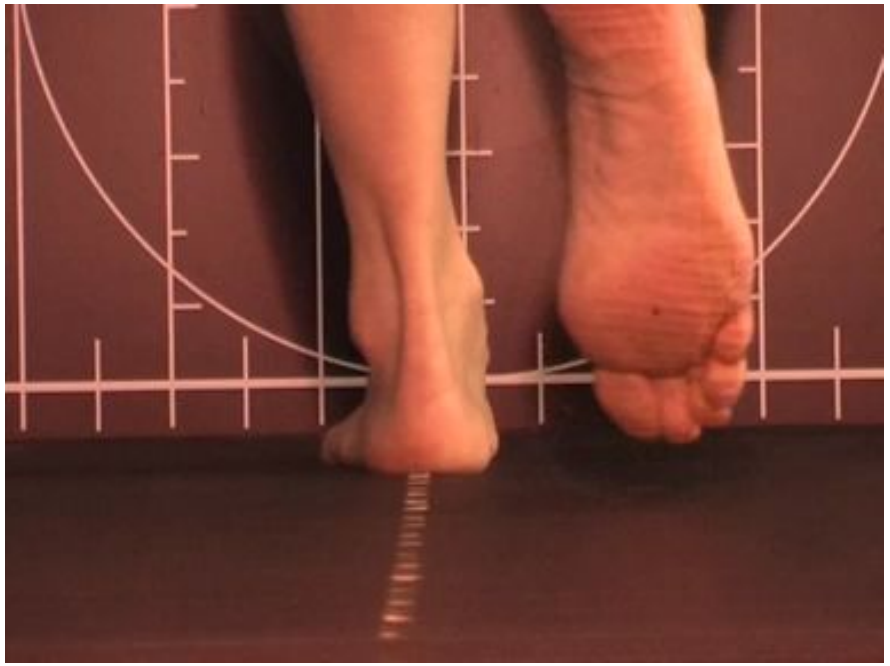
Associated Pathomechanics

1. The acetabulum raises and externally rotates - externally rotating the femur, which externally rotates the lower limb.
2. The ipsilateral side of the pelvis raises to maintain cerebellovestibular balance. However, the innominate shortens and measures shorter lying supine (be aware!).
3. Depending on STJ axes this may decrease time : pressure ratio per step creating and early heel lift & increase supinatory moments.
4. = increased tissue stress = injury.



Ipsilateral Adaptions.

Early heel lift



External acetabular rotation

Ipsilateral injuries.

Early heel lift

- Musculotendinous junction strain
- Plantar fascia strain
- Etc.

External acetabular rotation

- Sacrotuberous ligament strain
- Adductor strain
- Patellotendinosis
- Plantar flexed 1st ray /sesamoiditis
- 3rd to 5th MTP compression
- Lateral foot compression
- Lateral ankle inversion sprains
- Etc.

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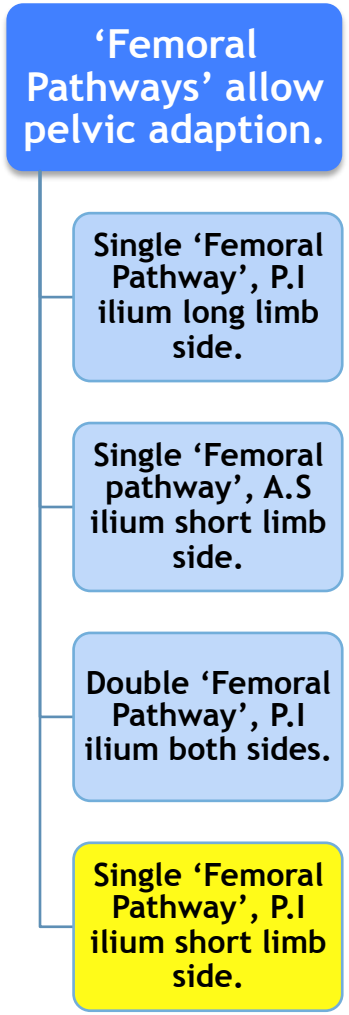
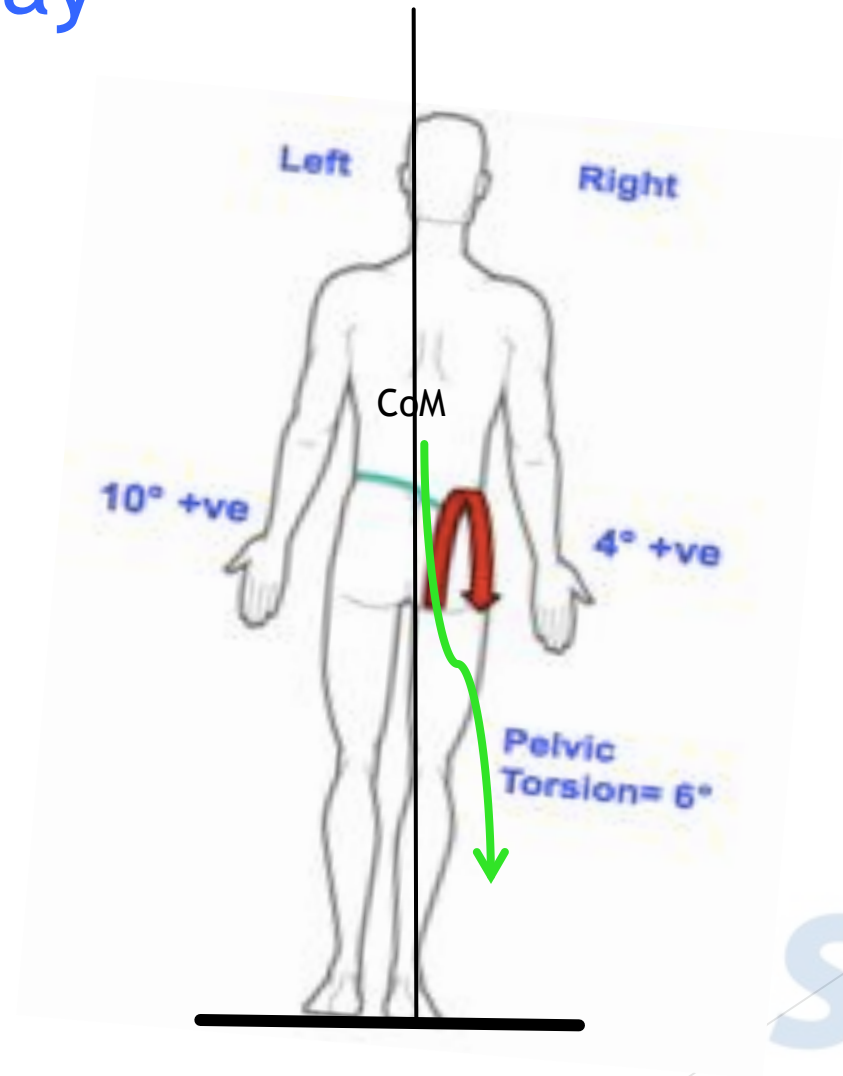


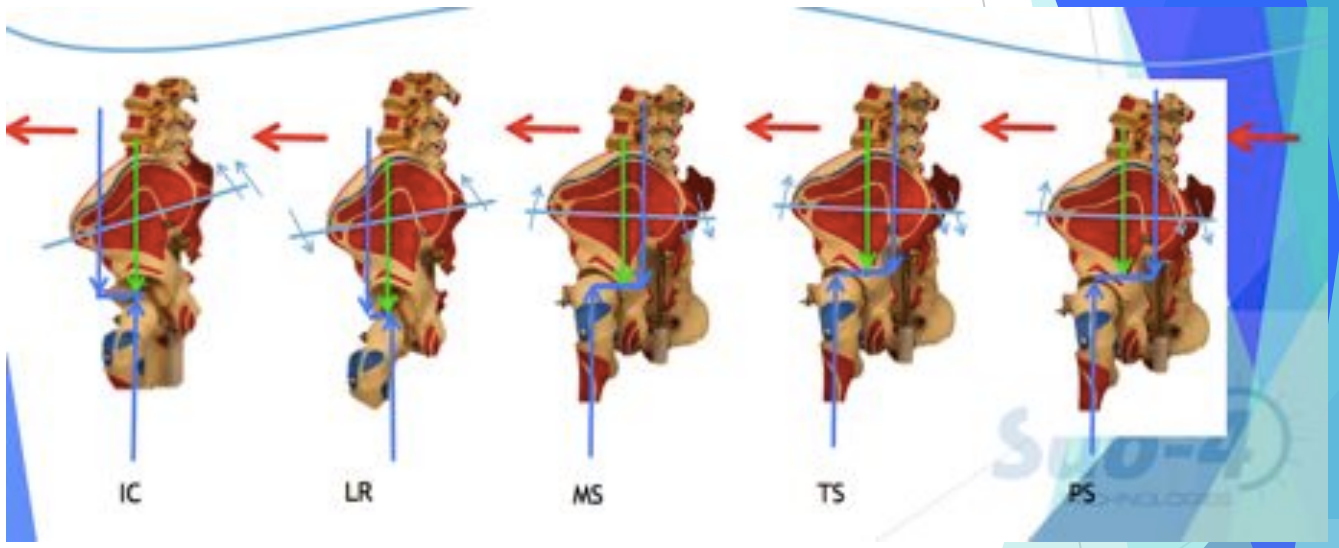
Single Femoral Pathway PI ilium – Short Side.

- Occurs more in those with high upper body mass ratio compared to the lower limb.
- With an excursion of the Body CoM to the short side.
- Occurs with increased flexion on the shorter-limb.
- Resistant to correction with foot raise therapy.



Associated Pathomechanics

1. Inc. GRF = Inc. force into the acetabulum (under the shorter limb due to a CoM drop) i.e. increased time/pressure ratio from a longer contact phase than the ipsilateral side.
2. This creates a longer temporal window of force into the acetabulum on the contralateral side.
3. This maintains the posterior rotation orientation of the innominate (PI ilium).
4. Therefore no re-anterior rotation occurs. Sound familiar ?



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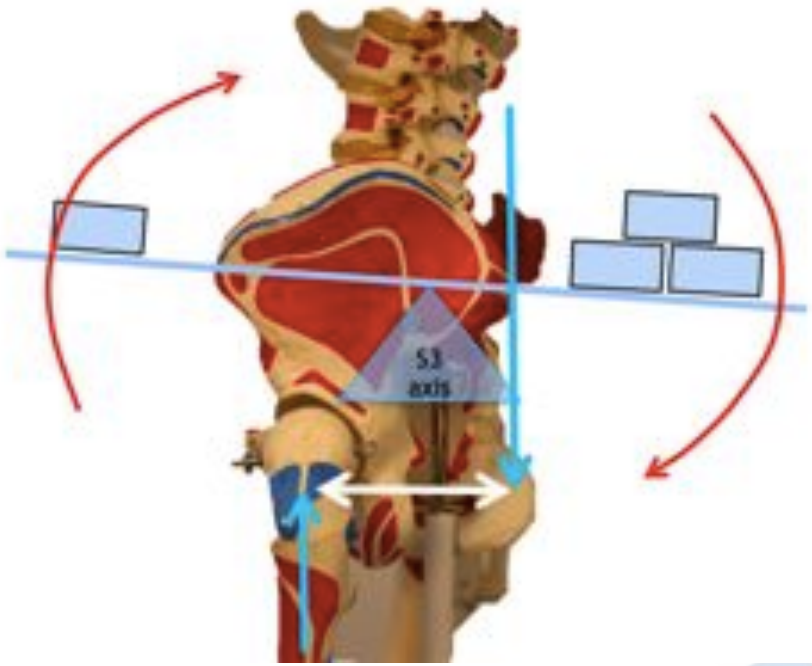

Ipsilateral adaptions.

CoM drop

- Delayed heel lift
- Increased time : pressure integral
- Delayed heel lift on the shorter limb side
- Plantar heel pain
- Rapid knee extension
- Shorter limb quad weakness
- Etc.

Lateral CoM excursion

- COP excursion to the lateral side
- Plantarflexed 1st ray
- 4th to 5th MTP junction compression
- Often rapid longitudinal axis MTJ pronation (medially deviated STJ axes)
- Etc.

Ipsilateral injuries.

CoM drop & excursion

- Plantar heel pain
- Patellar tendinosis
- Hip trauma
- LBP pain / SIJ pain
- Excessive pronation
- Etc.

Lateral CoM excursion

- Often lateral ankle inversion sprain (average to laterally deviated STJ axes)
- Tibial plateau trauma
- Unilateral quadriceps weakness
- Medial column collapse
- Etc.

Let me show you ?

A practical session.