‘The Pelvic Equilibrium Theory’

‘A new theory based on 27 years of clinical practice’.

Australia 2015

- England V USA 1985
- 3.57.88 min/secs. New British Indoor Record
Key points

1. Define a pelvic adaption theory based on experience.
2. Describe four pelvic adaptions.
3. Show you how to measure & quantify them using a new clinical protocol.
4. Demonstrate a DPI technique with high inter and intra rater reliability.
5. Show you how to classify a patient into 1 of the 4 pathways (adaptions).
What is the theory?

Definition.
The ‘Pelvic Equilibrium Theory’ focuses on the changes that occur around the innominate bones and sacrum and describes four pelvic adaptations based on the forces, which occur around the acetabular and sacral axes. The purpose of these four adaptations is to establish pelvic balance at the expense of symmetry, whilst attempting to maintain a stable upper body CoM.
Hypothesis: that all ambulant humans appear to demonstrate one of the four adaptions and that they may help to explain how injury patterns occur throughout the whole kinetic chain.

Background.
Ancient adaptions.
Ancient adaptive mechanisms
‘The Functional Pathways to injury’

- Our ancestors used a set number of adaptive mechanisms.
- Each of the adaptations were **SHORT-LIVED & CONSTANTLY CHANGING** as our ancestors moved around a natural world.
- The *extrinsic* natural environment was the main driver for these adaptations.
- Their aim was to achieve vestibular balance in the presence of **gravity**, **GRF** and **natural asymmetry** (internal & external).
- **PROBLEM** - we use a limited number of these adaptations for a much longer period of time for our **intrinsic asymmetry** E.g. Leg length inequality.
Major adaptions in the pelvis & lower limb

They allow joint adaption via:
- Changes in range magnitude
- Changes in acceleration
- Changes in vector quality
- Changes in temporal parameters

= INCREASED TISSUE STRESS
Pelvic adaptions

- The Pelvic Equilibrium Theory describes the 4 pelvic adaptions.

  ‘Femoral Pathways’ allow pelvic adaption.

  - Double ‘Femoral Pathway’, P.I ilium both sides.

(Cooperstein et al 2009)
The MSK adaptations create issues for modern living.

- The geophysics has **NOT** changed.
- Our adaptive capability has **NOT** changed.
- The need to establish ‘The essential T’ has **NOT** changed.
- What **HAS** changed is…

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[Diagram of the human skeleton with vectors labeled G and GRF]
Our under-foot environment. Concrete has high energy return.

- Now our natural *intrinsic* asymmetry becomes the main driver for adaption.
- We therefore use the same evolved adaptations to achieve the same end goal: *cerobellovestibular balance*.

- The difference is the duration (*temporal parameters*) of a single adaption.
- They can last for a much longer period of time.
Why?
**Instantaneous adaptations:** There is no plan for what happens after the adaption!

Natural surfaces constantly change as you move.
- Therefore adaptations are constantly changing.

Modern surfaces change less
- Therefore your adaptions change less.
Glossary
Pelvic torsion

This is one of the most important pieces of data obtained from an assessment. The future of clinical MSK will be based on pelvic mechanics.
Innominate orientation

+ve definition: +ve if above the reference line

-ve definition: -ve if blow the reference line
Normal innominate orientation

- 8 to 10 °+ve
- The pelvis appears to be more efficient when +ve.
- Athletes and stronger individuals tend to be more +ve.
- Pelvic inclination may influence / determine the type of repetitive injury.
- It may also determine adaptive mechanisms in the rest of the kinetic chain.
Innominate orientation

Anterior tilt / AS ilium:
- is always +ve
- (> 10 +ve)

Posterior / PI ilium can be both +ve & -ve definition

- (+ve if above the reference line)
- (-ve if below the reference line)
Vector quality in relation to the axes determines whether the sacrum or innominate are the dominant factor.

Femoral axis ($A_1$)

S3 axis ($A_2$)

Normal Innominate Inclination is 8 to 10° +ve.

Horizontal plane

GRF
‘Seesaw’ analogy with
Normal pelvic equilibrium

8 to 10° +ve.

Sacral base 30° +ve
‘Seesaw’ analogy with Normal pelvic equilibrium

Global axis of gravity (9 mm anterior of the centre of the femoral head. Vaz et al 2001).

ANTERIOR

8 to 10° +ve.

Sacral base 30° +ve
‘Seesaw’ analogy with Normal pelvic equilibrium

Global axis of gravity
(9 mm anterior of the centre of the femoral head. Vaz et al 2001).

F1 Body weight to Sacral base.

ANTERIOR

8 to 10° +ve.

Sacral base 30° +ve
‘Seesaw’ analogy with
Normal pelvic equilibrium

Global axis of gravity
(9 mm anterior of the centre of the femoral head. Vaz et al 2001).

F1 Body weight to Sacral base.

F2 GRF to Acetabular axis.

ANTERIOR

8 to 10° +ve.

Sacral base 30° +ve
‘Seesaw’ analogy with Normal pelvic equilibrium

Global axis of gravity (9 mm anterior of the centre of the femoral head. Vaz et al. 2001).

F1 Body weight to Sacral base.

F2 GRF to Acetabular axis.

F3 Resistance from sacrotuberous ligmt & Gluteus maximus.

F4 The abdominal Muscles, fascia & slings.

8 to 10° +ve.

Sacral base 30° +ve
Single Femoral Pathway
PI ilium - Long Side

- The Pelvic Equilibrium Theory describes the 4 pelvic adaption.

- Single 'Femoral Pathway', PI ilium long limb side.
- Single 'Femoral Pathway', AS ilium short limb side.
- Double 'Femoral Pathway', PI ilium both sides.
- Single 'Femoral Pathway', PI ilium short limb side.
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.
‘Seesaw’ analogy with a PI ilium

< 8° +ve
Often -ve angle

Sacral base now close to 0°
‘Seesaw’ analogy with a PI ilium

< 8° +ve
Often -ve angle

Sacral base now close to 0°
‘Seesaw’ analogy with a PI ilium

- Body weight to Sacral base moves backwards due to hyper kyphosis.
- Global axis of gravity

- < 8° +ve
- Often -ve angle

- Sacral base now close to 0°
‘Seesaw’ analogy with a PI ilium

F1 Body weight to Sacral base moves backwards due to hyper kyphosis.

Global axis of gravity

< 8° +ve
Often -ve angle

Sacral base now close to 0°

F2 GRF to Acetabular axis.
‘Seesaw’ analogy with a PI ilium

- **F1** Body weight to Sacral base moves backwards due to hyper kyphosis.
- **F2** GRF to Acetabular axis.
- **F3** less resistance from sacrotuberous ligmt & Gluteus maximus. More resistance from long dorsal SIJ ligament.
- **F4** The abdominal Muscles, fascia & slings.

< 8° +ve
Often -ve angle

Sacral base now close to 0°
Double Femoral Pathway
PI ilium - Both Sides

- The Pelvic Equilibrium Theory describes the 4 pelvic adaptations.

- Double ‘Femoral Pathway’, P.I ilium both sides.

(Cooperstein et al 2009)
Double Femoral Pathway
PI ilium - Both Sides.

- Occurs more in endomorphs.
- Can only occur after a Single Femoral Pathway.
- Occurs where the posterior rotational forces acting on a single innominate, overcomes resistance from the sacrum, and counter-nutation occurs, pulling the contralateral innominate posterior also.
- 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.

- **F1** Body weight to Sacral base moves backwards due to hyper kyphosis.
- **F2** GRF to Acetabular axis.
- **F3** Less resistance from sacrotuberous ligmt & Gluteus maximus. More resistance from long dorsal SIJ ligament.
- **F4** The abdominal muscles.

Sacral base now close to 0°

< 8° +ve
Often -ve angle
Single Femoral Pathway
AS Ilium - Short Side

The Pelvic Equilibrium Theory describes the 4 pelvic adaptions.

- Double ‘Femoral Pathway’, P.I ilium both sides.
Single Femoral Pathway
AS ilium - Short Side

- Occurs more in mesomorphs and those with an anterior CoM and inc. 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, quads, paralumbar muscles.
- Powerful legs which decrease the contact phase i.e. early heel lift.
‘Seesaw’ analogy with an AS ilium

>10° +ve
Often as high as 20° +ve
‘Seesaw’ analogy with an AS ilium

Global axis of gravity

>10° +ve
Often as high as 20° +ve
‘Seesaw’ analogy with an AS ilium

Global axis of gravity

F1 Body weight to Sacral base.

ANTERIOR

>10° +ve
Often as high as 20° +ve
‘Seesaw’ analogy with an AS ilium

- Global axis of gravity
- F1 Body weight to Sacral base.
- F2 GRF to Acetabular axis.

>10° +ve
Often as high as 20° +ve
‘Seesaw’ analogy with an AS ilium

Global axis of gravity

F1 Body weight to Sacral base.

F2 GRF to Acetabular axis.

F3 Resistance maintains however Glute max may now even facilitate the AS ilium.

F4 The abdominal Muscles, fascia & slings.

>10° +ve
Often as high as 20° +ve
Single Femoral Pathway
PI ilium - Short Side

- The Pelvic Equilibrium Theory describes the 4 pelvic adaptations.

- 'Femoral Pathways' allow pelvic adaption.
  - Single 'Femoral Pathway', PI ilium long limb side.
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(Cooperstein et al 2009)
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.
‘Seesaw’ analogy with a PI ilium short side.

F1 Body weight to Sacral base moves backwards due to hyper kyphosis.

Global axis of gravity

F2 GRF to Acetabular axis.

F3 less resistance from sacrotuberous ligmt & Gluteus maximus. More resistance from long dorsal SIJ ligament.

F4 The abdominal Muscles, fascia & slings.

ANTERIOR

< 8° +ve
Often -ve angle

Sacral base now close to 0°
How to find the pathway.
The ‘Pelvic Equilibrium Theory’ tells us that:

If your aim is to improve motion patterns and reduce injury risk, you should consider:

- understanding the global adaptive pathways
  &
- balancing the pelvis
Conclusion & future work.

- Pelvic adaptations are still widely misunderstood.
- It appears that all ambulant individuals may function around one of four pelvic positions.
- This new protocol may change our understanding of pelvic function.
- It may change how we treat pelvic, SIJ and spinal dysfunction.
- The relationship between pelvic motion and lower limb function requires further research.
- More reliability studies are required.
- This study has highlighted other areas of interest, that requires further research.
- Pelvic function has to be assessed as part of an MSK consultation.
- Not understanding the role of the pelvis in MSK repetitive injury may leave significant causative factors untreated.
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