Centre of Pressure Theory

- **Refer back to the second lecture of first semester on all the problems with the traditional or 'Root' based approach to foot biomechanics**
- **Refer back to the lectures on sagittal plane theory on the role of theory in informing clinical practice and the role of theory in understanding foot biomechanics**

- **What are some of the problems that a new approach needs to address?**

Classification proposed by Shearer based on the traditional approach
(Valmassey, 1996)

		Forefoot		
		Inverted	Perp	Everted
	Inverted	1	2	3
RF	Perpendic	4	5	6
	Everted	7	8	9

What are some of the problems with this classification?

- **They compare the foot to an idealised norm**
- **They look at the foot in stance**
- **They rely on measurements**
- **Do not account for rigidity of MTJ or joint axes variations**
- **Do not predict dynamic function**
- **Any others?**

- To solve some of these problems an approach has been put forward by Eric Fuller from the California College of Podiatric Medicine (CCPM), based on the following:
- "Pronation does not necessarily hurt - it's what stops it that hurts"
- It is the stress on the structure that stops pronation that is a problem - can we calculate that stress?
- It is essentially a further development of Kirby's work on the STJ axis

Principles that it is based on:

- The establishment of rotational equilibrium about joint axes of motions
- moment = force x distance
- to determine the moment from ground reaction forces you need to know the location of force and the location of the axis

Where is the location of force and the location of the axis?

- The axis is located by determining the position of the subtalar joint axis (Kirby)
- The location of force is found by determining where the centre of pressure (CoP) is located
- There are 3 possible combinations of the above - the CoP is lateral to the axis; the CoP is beneath the axis; the CoP is medial to the axis

CoP Lateral to the Axis

- Ground reaction forces will want to excessively pronate the foot
- The pronatory moment from GRF will need to be countered by a supinatory moment from internal to the foot
- What can provide this supinatory moment? :
  - 1) Plantar fascia
  - 2) Muscle (posterior tibial)
  - 3) Bone (sinus tarsi)

CoP Lateral to the Axis: The Plantar Fascia Foot

- Provides a supinatory moment via the windlass mechanism
- Pathology: plantar fasciitis; hallux limitus; hallux valgus (due to the imbalance of moments about the joint)
- Clinical observations: tight plantar fascia during static stance (palpate); some pronation is available as the STJ is not maximally pronated; there is a high medial forefoot loading or a low lateral loading

CoP Lateral to the Axis: The Muscle Foot

- The supinatory moment is provided by the posterior tibial muscle
- Related pathology: posterior tibial tendonitis and dysfunction (during stance, the tendon is tight and "pops" out from behind the medial malleolus
- Clinical observations: Forefoot loading is variable - get a high force on lateral column when the muscle is active; the plantar fascia is variable as the muscle is being used; STJ is not maximally pronated

CoP Lateral to the Axis: The Sinus Tarsi Foot

- The supination moment is provided by the osseous structures of the sinus tarsi
- Related pathology: sinus tarsi syndrome
- Clinical observations: no STJ pronation is available as the STJ is maximally deviated; the plantar fascia is 'slack'; there will be high lateral forefoot loading - it will be high on the medial side if the STJ axis is medially deviated

Other:

- Combination of the 3 types

CoP Beneath the Axis:

- This will be a balanced foot in rotational equilibrium
- No consistent related pathology - except possible lateral instability
- Clinical observations: even forefoot weight bearing (maybe higher on lateral); plantar fascia 'slack'; STJ pronation is available

CoP Medial to the Axis:

- Rare
- Very unstable laterally
- Recurrent ankle sprains
- Peroneal tendonitis
- Clubfoot

Clinical Observations:

- Is the STJ maximally pronated?
- Location of forefoot force
- Palpate arch/plantar fascia
- Palpate posterior tibial tendon

Advantages Of This Classification System

- Does not require a heel bisection or measurements
- Ease of predicting pathology - pathology correlates with physical findings
- Easier to teach
- Treatment is aimed at reducing the stress on anatomical structure (the tissue stress model)

Where do we go next with this approach?

References

- Fuller (1999) - in manual