



Department of

• **PODIATRY** •

La Trobe University

Podiatric Biomechanics

Tissue Stress Model & Other Theories: B

The Tissue Stress Model in the Literature

- McPoil TG & Hunt GC: *Evaluation and Management of Foot and Ankle Disorders: Present Problems and Future Directions*. JOSPT 21(6)381-388 1995 (in course manual)
- McPoil TG & Hunt GC: *An Evaluation and Treatment Paradigm for the Future*. In Hunt GC & McPoil (eds): *Physical Therapy of the Foot and Ankle* 2nd Ed 1997. Churchill Livingstone
- Citations only include - Payne, 1997 & 1998 and Menz 1997 - **Why so few?**

The Tissue Stress Model

- McPoil and Hunt, in their two papers on the tissue stress model, start by discussing some of the problems with the traditional/classical approach to foot biomechanics
- They then provide what they refer to as an overuse injury model based on excessive tissue stress
- However the model does not necessarily 'grow' out of the critique

Principles it is based on:

- excessive stress can occur to the various tissues
- the goal is to reduce tissues stress to a tolerable level
- need to determine if the symptoms reported are mechanical or nonmechanical in nature

Protocol for Evaluation and Management

- 1) Identify the involved tissues being stressed based on symptoms and other subjective information obtained from the history
- 2) The application of various stresses to the involved tissues in an attempt to replicate symptoms through the use of non-weightbearing and weightbearing tests as well as palpation

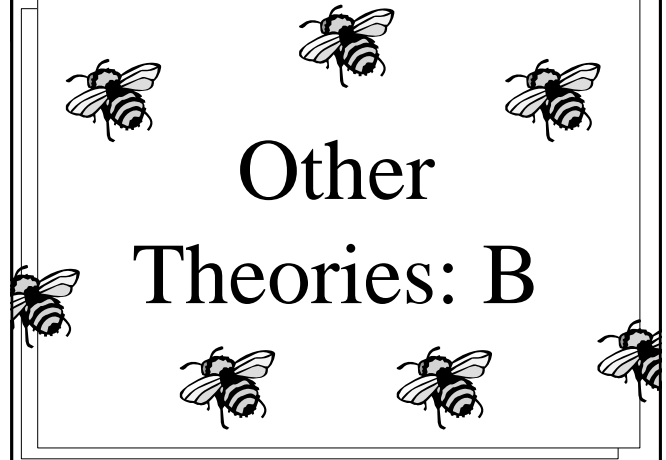
- 3) Based on the findings of the evaluation, determine if the patient's complaint is related to excessive mechanical loading of tissues or if it is a non-mechanical problem. If it is determined that the patient's complaint is caused by excessive mechanical loading of tissues, then ascertain whether the patient's problem is related to:
 - a) excessive foot pronation
 - b) lack of foot mobility
 - c) limitation in flexibility
 - d) decrease in muscle strength
 - (any others?)

- 4) A management protocol that emphasizes;
 - a) Reducing tissue stress to a tolerable level through rest, activity modification, footwear and/or orthoses
 - b) Healing the involved tissues through medications and physical therapeutic mechanisms
 - c) The restoration of lower extremity flexibility and muscle strength
 - d) A plan for the gradual resumption of activity
- **Is this consistent with the approach put forward by Fuller?**

Example: Plantar fasciitis

- 1. What are the symptoms that the patient will complain of?
- 2. What is the key point in the history that indicates that it is of mechanical origin?
- 3. What are the weightbearing and non-weightbearing tests?
- 4. What are the key points in the management protocol based on the tissue stress model?
- 5. What are the purposes of the orthoses in this model?

Is this an alternative model or a protocol that puts orthoses management in the appropriate place in the management of patients?



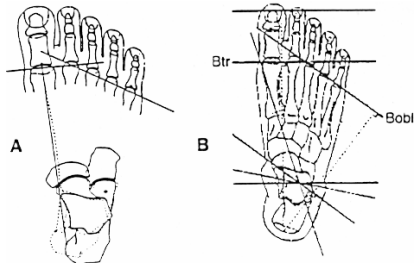
Can we integrate it all and make clinical decisions?

- Will there ever be one theory or many theories?
- abnormal function in any body plane can interfere with function
- so must we assess alignment and function in all three body planes
- Prior (unpublished, 1998) has suggested an approach based on this:

Transverse Plane

For normal function need:

- A sufficient low gear axis angle in relation to the long axis of the foot and angle of gait to allow supination at heel lift
- A sufficient high gear axis angle in relation to the long axis of the foot and the angle of gait to allow transfer and facilitate the windlass effect
- The angle of gait and the angle of the high gear axis should be of the same magnitude in relation to the long axis of the foot to allow this axis to function in the line of progression
- The axis of the subtalar joint in relation to the sagittal plane should pass through the first and second interspace



The perpendicular bisections of each axis show the longer radial arm from the heel to the transverse axis (Btr) versus the shorter radial arm to the oblique axis (Bobl). The greater the radial arm length, the greater the ability to develop greater thrust, hence high versus low gear push. Once the medial arm becomes engaged by weight shift to the transverse axis, it causes the 'closed packing' of the calcaneo-cuboid joint and secondary tarsal and midtarsal joint stability. (FBM, 1979)

Frontal Plane

For normal function need:

- The NCSP will be slightly inverted
- STJ eversion occurs at heel strike
- STJ remains everted while calcaneus unweights
- STJ inversion at heel lift to accommodate external limb rotation, to assist ankle joint plantarflexion and facilitate sagittal plane motion
- Adequate forefoot to rearfoot alignment to facilitate axes transfer

Sagittal Plane

For normal function need:

- Adequate first MPJ and ankle ROM
- Equal limb length
- At heel strike the ankle must plantarflex
- During midstance the ankle must dorsiflex
- Must be a transfer from the low gear to high gear axis just prior to heel off
- Following heel lift the ankle must plantarflex, the first MPJ must dorsiflex with first ray plantarflexion



Confused ?