Foot mechanics & low back pain

Department of
• PODIATRY •
La Trobe University

Adam Bird

Outline

- Epidemiology of LBP
- Diagnosis & risk factors
- LBP in pregnancy
- Basic spinal function
- How might the foot affect the lower back?
- Clinical studies
- Treatment
- Summary

References

- Bird AR & Payne CB. (1999). Foot function and low back pain: a review of the literature. *The Foot*. 9: 175-180
- Minkowsky I & Minkowsky R. (1996). The spine, an integral part of the lower extremity. In: Valmassy RL (ed.) *Clinical biomechanics of the lower extremities*. CV Mosby, St. Louis, Chapter 4
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Epidemiology of LBP

- Epidemic since WWII
- Point prevalence in the US: 5.6%
  (Loney & Stratford, 1999)
- 60-85% lifetime incidence in Westernised countries
- Largest grouping of non-fatal injuries in WorkCover(Vic): A$410 million
  (WorkCover Statistical Report, 1997-1998)
- After the common cold, problems caused by low back pain are the most frequent cause of lost work days in adults under the age of 45
- Proper functioning of the lower back is required for almost all activities of daily living

Background to LBP

- Natural history characterised by variability & change
- Hard to research
- Diagnosis difficult - 70% cases described as 'non-specific' or 'miscellaneous'
  (Hart et al., 1995)
- Bed rest vs. continuing light activity
- Do 'functional restoration' programs work? (Teasell & Harth, 1996)

Specific Dx via...

- Plain X-ray
  - Will show OA and bone disease, but not soft tissues like lumbar disks and nerves
- CT or MRI required for soft tissue imaging
  - Multifidus?
- ? Bone scan to assess bone activity
- ? EMG/NCS to determine if spinal condition has caused nerve or spinal damage

Risk factors include:

- Increased age (influenced injury, influenced discomfort and symptoms)
- Smoking
- Previous hx of LBP
- Years of employment and seniority
  - Younger employees higher incidence - more manual handling?
    - Not as developed motor control?
    - …

Risk factors…

- Anthropometry
- Exposure factors (lifting, bending…)
- Psychological and psychosocial (stressful life events, job satisfaction…)

(Ferguson & Marras, 1997)

LBP in pregnancy

- 76% of 200 subjects reported back pain
  - 48% @ 24 weeks gestation highest prevalence rate
  - 30% reported great difficulties with normal activities
  - Hormone related (relaxin?)
  - Foetal pressure on lumbosacral nerve roots?
  - Biomechanical malalignment?

(Kristiansson et al, 1996)

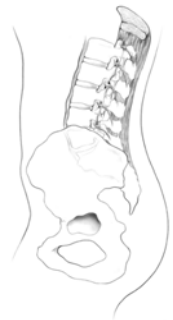
Low back pain (LBP)…

- As mentioned, only in 20-30% of cases is a specific anatomical diagnosis made
  - disk herniation
    - Abnormal protrusion - may impinge on nerve roots
  - spinal stenosis
    - 'narrowing' of the VC
  - spondyloarthrosis
    - Osteoarthritis of the spine

LBP…

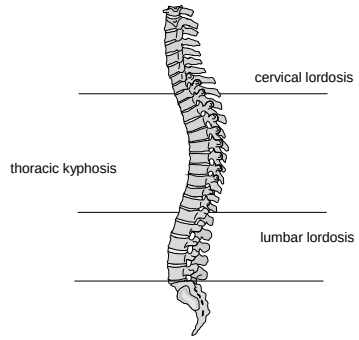
- all other cases are termed 'idiopathic'
- 500+ theories regarding the aetiology of LBP!
- however, there is increasing evidence that **faulty foot mechanics** may be at least a contributing factor in the development of LBP

Spinal Anatomy



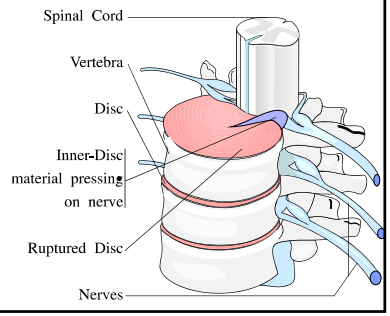
Spinal function

- 7 cervical, 12 thoracic, 5 lumbar 'true' vertebrae separated by IV disks
- 5 sacral and 4 coccygeal 'pseudo' vertebrae, fused
- the neutral spine is comprised of 3 curves which contribute to shock attenuation: cervical and lumbar lordosis (sway back), thoracic kyphosis (hunch back)



Spinal function

Spinal function



Spinal function...

- due to the lumbar lordosis, there is a constant anterior shear force at the lumbosacral joint (L5-S1), the most stressed spinal joint
- posterior facet joints (zygoapophyseal) bear 10-40% of the total load and control spinal motion
- the sacro-iliac joint is slightly moveable, and is involved in a movement called nutation (*latin* - 'nodding'), in which the sacrum moves forward and backward with bending of the trunk

How might the foot be related to the lower back?

Theoretical mechanisms

Footwear heel height

- Increase plantar pressures
  (Mandato & Nester, 1999)
- Increase knee joint compressive forces
  (Kerrigan et al., 1998)
- Lead to changes in the lower back?

QuickTime™ and a Photo - JPEG decompressor are needed to see this picture.

Inadequate shock absorption

- Voloshin & Wosk (1985)
  - Viscoelastic insoles, n = 382
  - 'rapid & surprisingly significant improvement' (in 80% participants, 12/12)
  - Control group 45% improvement

Inadequate shock absorption

- Ogon et al. (1999)
- Link between arch height and impact loading in the lower spine?
- Running, n=12, over force platform with accelerometer attached
- 'high arch' = intrinsically better shock absorbing'?
- High arch protective for the lower back?
- Why counterintuitive result?

XS foot pronation factors

- Similar underlying framework
  - Internal limb rotation
  - Anteriolateral pelvic tilt
  - Strain iliopsoas, piriformis, gluteus maximus
  - Rotation of affected lumbar vertebral bodies
  - Functional lumbar scoliosis
  - … develop LBP?

QuickTime™ and a Animation decompressor are needed to see this picture.

(Botte, 1981, Minkowsky², 1996, Michaud, 1997)

Forefoot varus

- Rothbart et al. (1995)
  - 202 of 208 participants had a 'forefoot varus' ≥ 16mm
  - Measured with 'Biovector™'
  - Proprietary orthosis design - big medial wedge
  - 80% participants reported at least a 50% decrease in their LBP

Functional LLD

- Unilateral excessive foot pronation = functional shortening of limb
  (Sanner et al., 1981)
- Primarily clinical folklore
- Single case study
  (Blake & Fettig, 1983)

Sagittal plane blockade

- Ability of sagittal plane pivots of the foot to function effectively
  (Payne & Dananberg, 1997)
- Particulary the 1st MTPJ
- Functional hallux limitus = not normal dynamic function of 1st MTPJ
- Number of theoretical sequelae of FHL

- Midstance phase gait cycle - weightbearing limb starting to extend at hip joint
- With a sagittal plane block, this motion is impeded...

- Biceps femoris attaches to sacrotuberous ligament, which in turn attaches to the sacral base...

Posterior view of the pelvis

FHL & LBP

- a lack of b.femoris contraction is thought to stop normal nutation and '**self-bracing**' of the SIJ during midstance/propulsion phases of the gait cycle
- Repetitive abnormal loading ⇒ LBP?
- Clinical study - 32 participants CLBP, end-stage conservative Tx, Rx orthoses to facilitate sagittal plane motion
  (Dananberg & Guiliano, 1999)

FHL & LBP

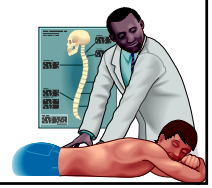
- Questionnaire pre, 1+6 mths post tx
- Twice improvement over not having orthoses

Discussion

- Which factors are more important?
- Still lack of basic science connecting the foot and the back
- Difficulty of 'gold standard' clinical trials
- How to classify and diagnose?
- Natural hx one of variability & change
- Pain interpretation
  - Some measures have been shown to have some reliability & validity
    (Hudson-Cook, 1989, Stratford et al., 1994, Kopec et al., 1995)

Treatment

- lift therapy for LLD
- orthoses for XS pronation/FHL?
- shock absorbing insoles / shoes for cavus foot type?
- Chiro/Osteo/manip Physio adjustment of secondary subluxations in spine and sacroiliac joint



Summary

- Importance of lower extremity biomechanics in the development of CLBP
- Foot orthoses have shown to be successful in a number of studies … but can they then cause harm?
- Still no clear protocol for Mx