Biomechanics of Running: From footwear to form

Kristian O’Connor, PhD
Why are footwear and form important?

- Running Performance
- Injury Risk
Running velocity at lactate threshold is most important!
Two ways to change running speed...

- Increase Stride length
- Increase Stride rate
  - ~150 steps/minute at jogging pace
Is there an optimum SL/SR combination?

- Yes, but it is based on a number of factors individualized to the runner

Cavanagh & Williams (1982)

College of Health Sciences
Department of Kinesiology
What is good running form?

• Not good...
  – [http://www.youtube.com/watch?v=rfaztVg4k aA](http://www.youtube.com/watch?v=rfaztVg4k aA)

• Good...
  – [http://www.youtube.com/watch?v=9jJ7bWJf p64](http://www.youtube.com/watch?v=9jJ7bWJf p64)
Should I change my running style?

- “Good Form Running”? 
- “Chi Running”? 
- “POSE Running”? 

NO evidence of better economy or reduced injury risk
Some basic running tips

• Slight forward lean is okay (10-13°)
• Avoid excessive vertical oscillation
  • More oscillation relates to greater metabolic cost
• Avoid under- and over-striding...
  • Weak or no relationship between SL and leg length (height)
• Ignore advice in popular literature to dramatically change your running style!
Shoe weight affects energy cost
However, running barefoot may cost more energy than wearing shoes

Franz et al. (2012)
Injury: What is the role of the shoe?

• Cushioning

• Support

• Both
**Running Shoe Anatomy**

- **Shape of Shoe**
  - Straight-lasted shoe
  - Curved-lasted shoe

- **Shoe Construction**
  - Board
  - Slip
  - Combination

- **Type of Midsole**
  - Dual-density midsole
  - Single-density midsole

---

College of Health Sciences
Department of Kinesiology
• Each company has its own cushioning/stability technology
  – Air, Grid, Gel, etc.
• Each company uses its own last (shape)
  – Try them all on!
  – Within a category of shoe, buy the shoe that is most comfortable.
Cushioning

• Heel Contact – No shoes
• Heel Contact – Shod
• Forefoot contact
Traditional Prescription

**Static/Dynamic Factors**
- Flat foot/ “overpronator”; flexible foot
- Neutral foot
- High-arched foot/ “supinator”; rigid foot

**Recommended Shoe Category**
- Stability (+) --- Motion Control
- Cushioned/Neutral --- Stability
- Cushioned/Neutral

College of Health Sciences
Department of Kinesiology
Further Consideration

- What is the current footwear?
- What are the structural influences?
  - Static
  - Dynamic
  - Anthropometric
- How will the shoes be used?
  - Volume
  - Intensity
  - Goals
Training Programs

• The 10% Rule
  – Avoid increasing weekly mileage >10% of the previous week’s total

• Mileage progression
  – Training mileage plateaus should be built into the program