Are we closer to understanding the role of the ankle in pedalling?

Andy Brooke BSc, MA, MRes, PhD candidate

CYCLOLOGIC

INTERNATIONAL BIKE FITTING INSTITUTE

NOTTINGHAM TRENT UNIVERSITY

MOTION METRIQ

BIKE FITTER SUPPLY

CYCLOLOGIC EDUCATION

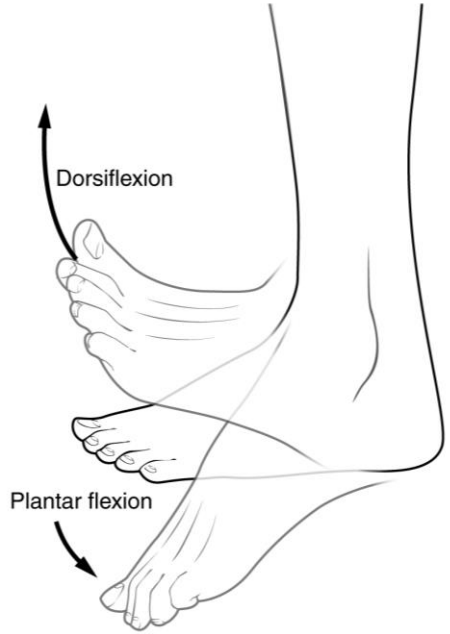
Commercial interests and affiliations

A trip down memory lane

- Toe up/toe down
  - “You can win 5 tours either way”

Terminology

- Plantarflexion/dorsiflexion
  - Flexed vs flexion
    - absolute position vs direction of movement

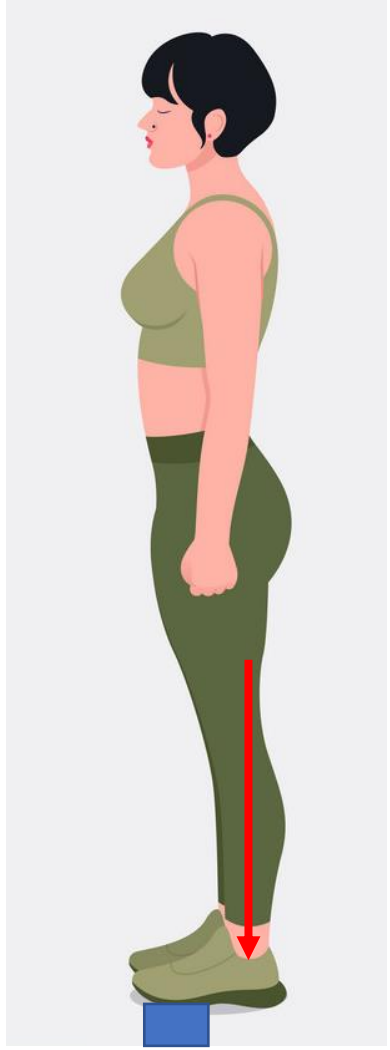


Pedal reaction forces

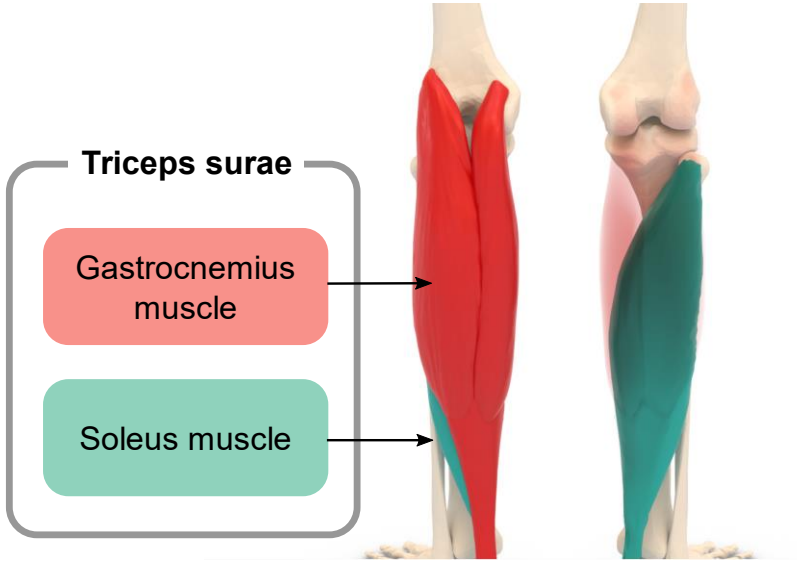
- Every force has an equal and opposite
  - In both magnitude and direction

Stabilising the ankle

- Similar to a calf raise on a block
- Without a stable ankle, the ankle collapses and shifts into dorsiflexion
  - Ankle absorbs force in this case
- Direction of movement more important than absolute position



Resisting pedal reaction forces

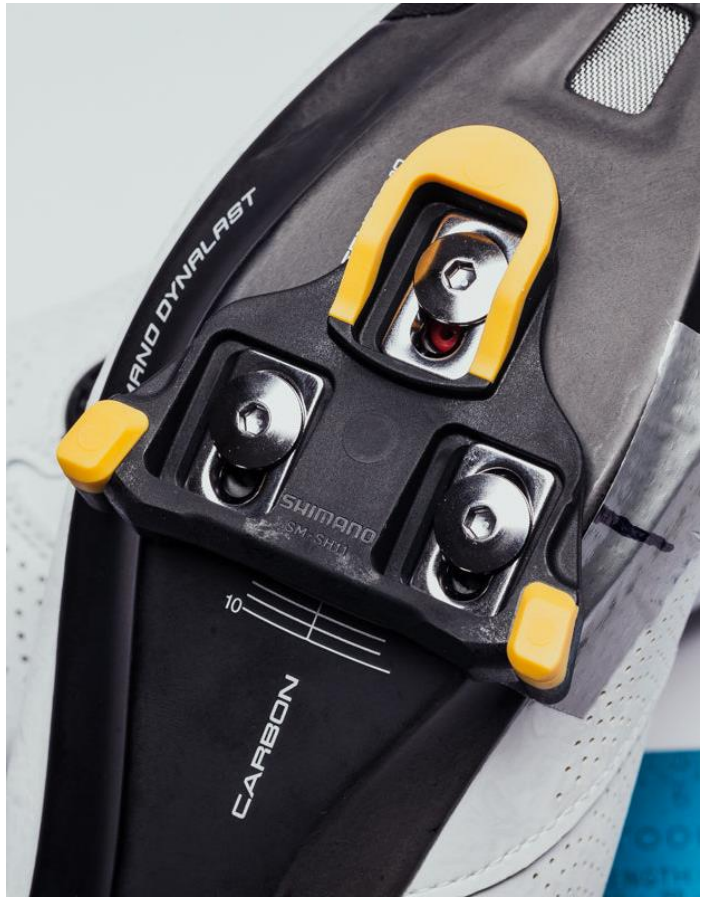


- Take-home: Soleus is king
  - Bent knee calf raises

- Are Joint Torque Models Limited by an Assumption of Monoarticularity? (Lewis et al, 2012)
  - Biarticular components contribute 31% of total force
  - 40 deg knee bend reduces that to 19%
  - ~100 deg knee bend common at start of power phase

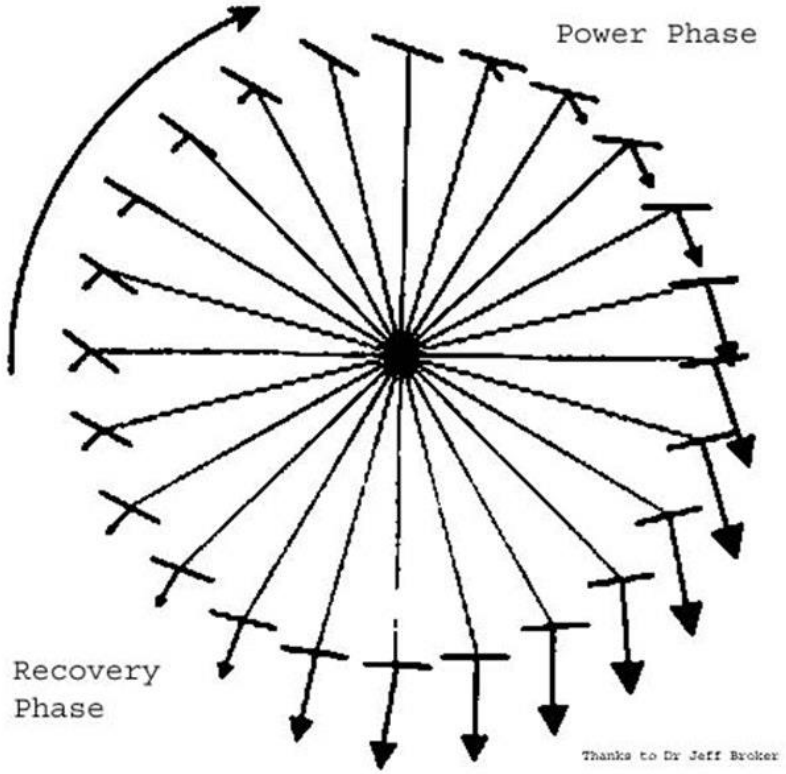
Pedal reaction forces and cleat position

- Moving the cleats back reduces the length of the lever arm
  - Can reduce required muscle activation to overcome pedal reaction forces (Van Sickle & Hull, 2007; Gregor et al., 1987; Mademli, et al., 2009)



Pedal force effectiveness

- Sinθ
- θ = angle of force application
- 90º = 100%
- 0 and 180 = 0%



Pedal reaction force effectiveness

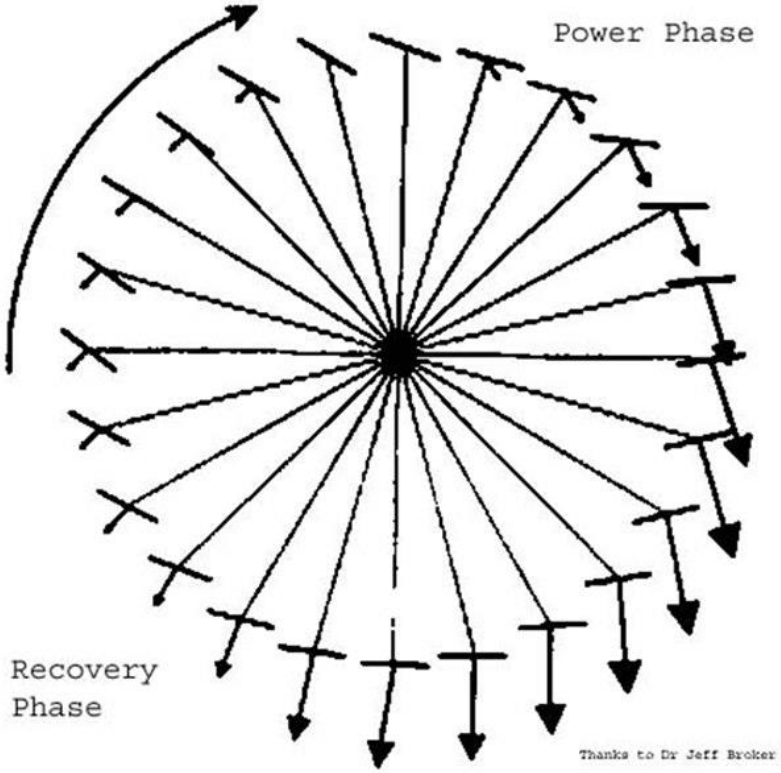
- Sinθ
- Rearward position
  - 140 deg = 64.3%
- Forward position
  - 130 deg = 76.6%

Pedal reaction force effectiveness

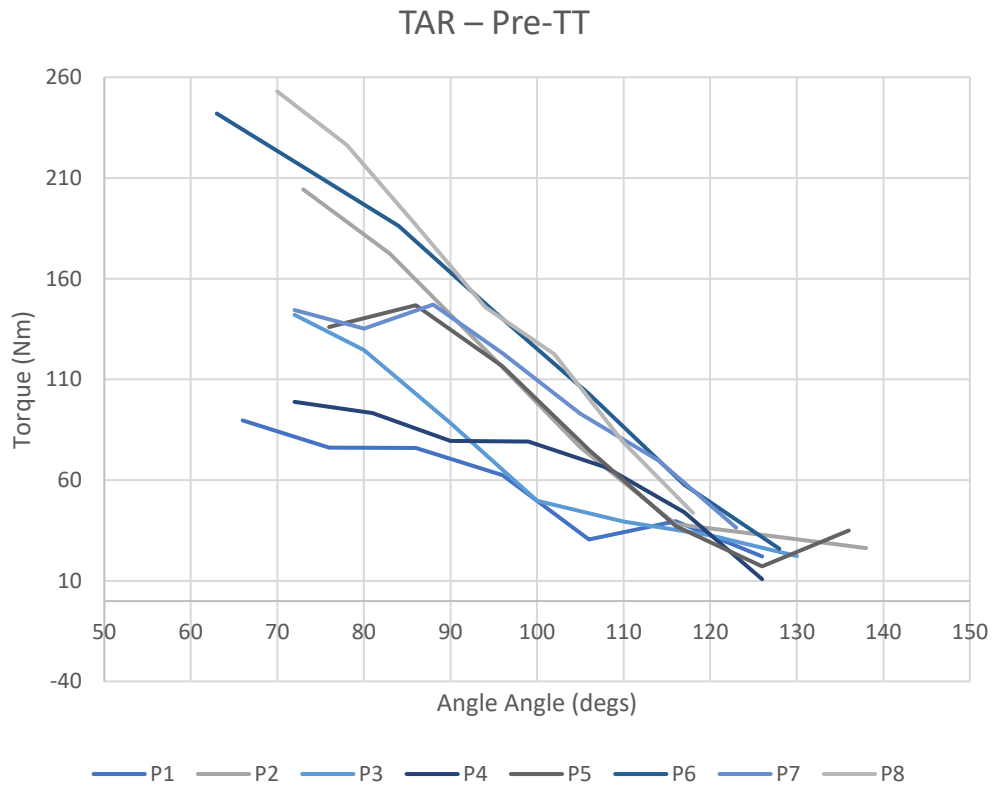
- What if PF increases?
- Rearward position
  - 155 deg = 42.3%
- Forward position
  - 147 deg = 54.5%

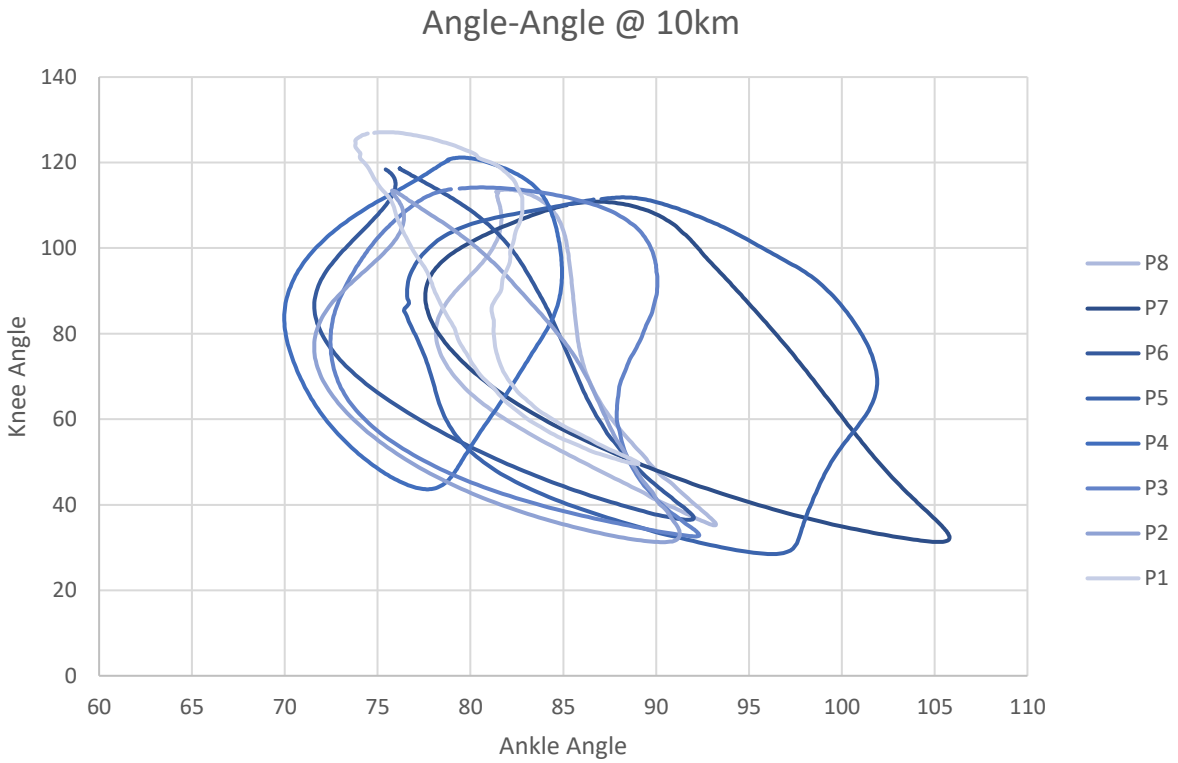
…while applying forward force

- 170 deg = 17.4%
- 163 deg = 29.2%



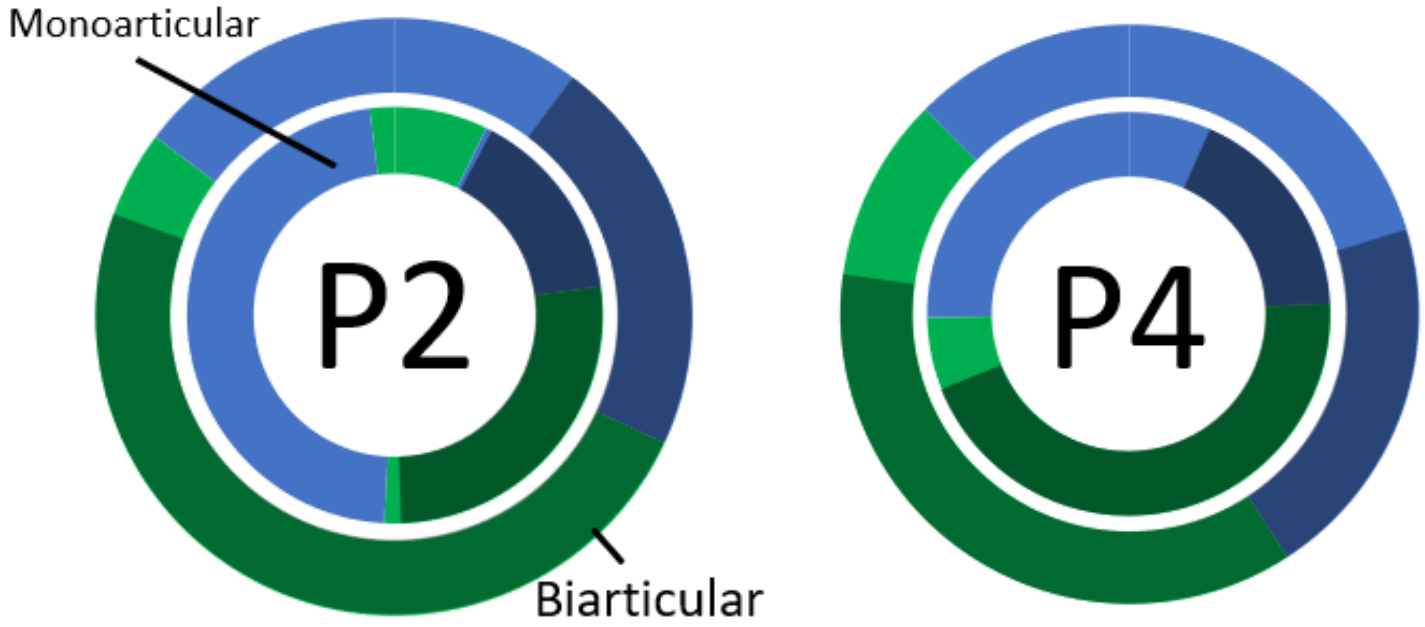
Individual variability





Individual variability

PF strength,
relative strength,
cleat position,
technique (learnt and natural),
calf as a pump
RoM



Head of Biomechanics
abrooke@cyclologic.com

President
andy@ibfi-certification.com