Variation in the rotational profile of the lower limb in industrial era modern humans

Jessica S. Wollmann*, Michelle E. Cameron, & Bence Viola
Department of Anthropology, University of Toronto
*j.wollmann@mail.utoronto.ca

What is the rotational profile of the lower limb?

- The combined torsion of the femur and tibia, and talar neck angle[1,2]
- Affects mobility of the hip, rotation of the knees, and angle of the foot (Fig. 1)[1-7]
- Two key points:
  - Partially controlled by genetics[8,9]
  - Partially developmentally plastic[10,11]
- Potential sources of variation include:
  - Age[4,6,12,13]
  - Sex[5,13-16]
  - Body mass[17]
  - Bone length[13]
  - Activity[10,18,19] or postural behaviour[11,20]
- Other considerations:
  - Right/left Symmetry[1,6,7,20]
  - Correlations between measures in an individual[1,2,14,21,22]

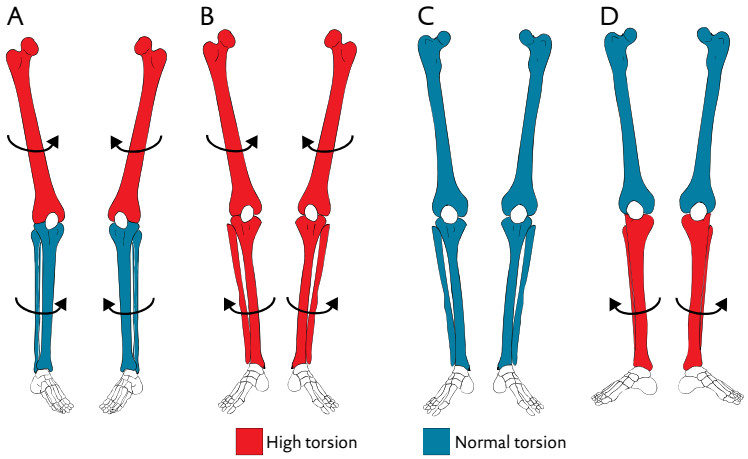

Figure 1. Positional variations in the rotational profile of the lower limb. **A)** High femoral anteversion and normal tibial torsion, resulting in an internal rotation of both the knees and the feet. **B)** High femoral anteversion and high tibial torsion, resulting in an internal rotation of the knees, but normal rotation of the foot. **C)** Normal femoral anteversion and normal tibial torsion. **D)** Normal femoral anteversion and high tibial torsion, resulting in an external rotation of the feet.

Methods

- Bilateral data from 45 adult (avg. age: 43.1 yrs.; range: 18-60 yrs.) industrial era individuals from the J.C.B. Grant Collection at the University of Toronto
- All measurements directly from skeleton or from photos
- Variables: age, sex, body mass, bone length, right/left symmetry, and intraindividual correlations

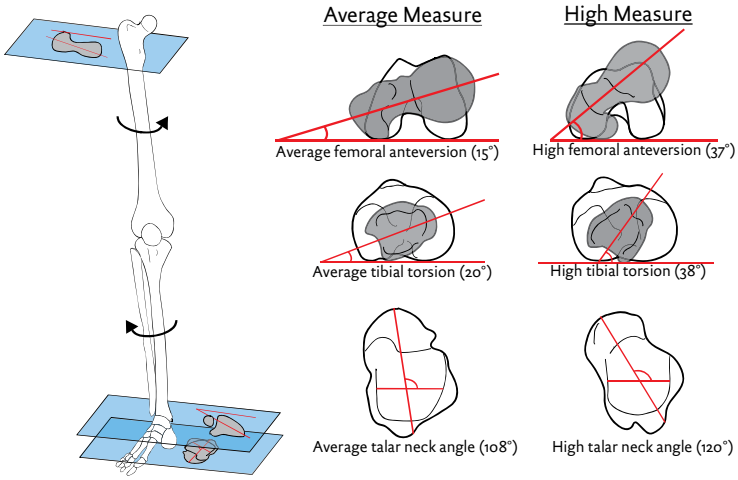

Figure 2. The rotational profile of the lower limb, with averages and examples of high measures for each variable. Left figure adapted from Grisch & Dreher, 2019[23]

Hypotheses

- Age, body mass, and bone length will not be correlated with any measure of the rotational profile
- Males and females will not have significant differences in the rotational profile
- The right and left leg will be reasonably symmetric
- Femoral anteversion and tibial torsion will be correlated, as will tibial torsion and talar neck angle. Femoral anteversion will not correlate with talar neck angle

Results

- Tibial torsion negatively correlated with age ($r = -0.21$, $p = .05$) and body mass ($r = -0.26$, $p = .012$)
- No correlations with bone length for the femur or tibia
- No differences between males and females in any measure (Fig. 3)
- High correlations between right and left legs for all measures (Fig. 4)
- No correlation between femoral anteversion and tibial torsion. Tibial torsion and talar neck angle were positively, but weakly, correlated ($r = 0.21$, $p = .046$), as were femoral anteversion and talar neck angle ($r = 0.23$, $p = .028$)

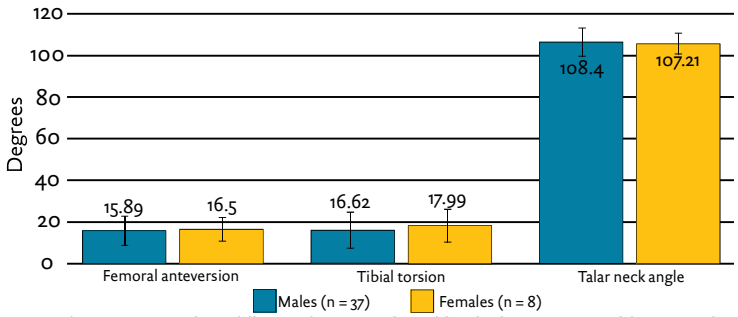

Figure 3. There were no significant differences between males and females for any measure of the rotational profile.

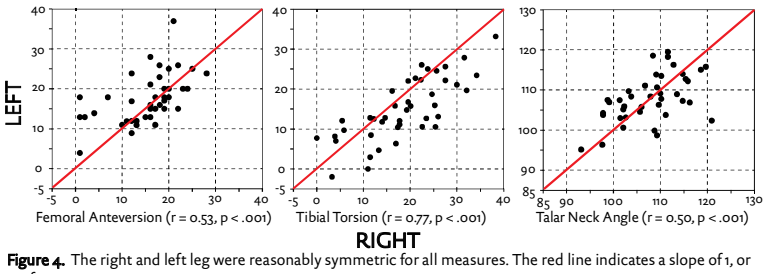

Figure 4. The right and left leg were reasonably symmetric for all measures. The red line indicates a slope of 1, or perfect symmetry.

Discussion and Conclusions

- No substantial differences between males and females
- Age, body mass, and bone length likely do not affect the rotational profile
- Right and left legs are reasonably symmetric - evaluating one side of the body only can sufficiently capture variation in the rotational profile
- Some covariation between tibia and talus, and femur and talus - potentially indicating some shared aspects of the loading enviornment
- Future studies will explore variance and the effects of activity and postural behaviour

Acknowledgements

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Scan the QR code to find references and download a PDF copy of the poster.