Knee biomechanics in 214 runners with and without heightened risk of post-traumatic knee osteoarthritis

Danilo De Oliveira Silva[1], Kay M Crossley[1], Prasanna Sritharan[1], Matthew G King[1], Melissa Haberfield[1], Joshua Hill[1], Fernanda Serighelli[1], Brody McCarthy[1], Richard Johnston[1], Michael Girdwood[1], Paula Pappalardo[1], Thomas West[1], Gustavo Telles[1], Benjamin F Mentiplay[1]

[1]La Trobe Sport and Exercise Medicine Research Centre, La Trobe University, Melbourne, Victoria, Australia

Email: D.DeOliveiraSilva@latrobe.edu.au

Summary

We aimed to compare sagittal plane knee angles and moments in runners with and without a history of knee surgery (heightened risk of post-traumatic knee osteoarthritis). Analysing 214 runners, we observed no significant differences between runners with and without a history of knee surgery for both sagittal plane knee angles and moments. Future longitudinal research is needed to explore how running biomechanics may impact the development of post-traumatic knee osteoarthritis in post-surgical runners.

Introduction

Adults who have sustained a traumatic knee injury have a 4-6-fold increased risk of developing post-traumatic knee osteoarthritis compared to non-injured adults [1]. Following a traumatic knee injury (and subsequent surgery), running is a common physical activity of choice given the perception that running is a 'safer' form of sport participation. While studies have shown that altered walking biomechanics relate to future osteoarthritis onset and progression in older adults [2], less is known about running biomechanics in younger adults with a history of knee surgery, which may provide as an important modifiable predictor of future post-traumatic knee osteoarthritis risk. Prior to exploring longitudinal associations between running biomechanics and future onset or progression of post-traumatic knee osteoarthritis, exploring whether running biomechanics are different in those following knee surgery for a traumatic knee injury compared to controls is warranted. Therefore, we aimed to compare sagittal plane knee joint angles and moments during running between runners with and without a history of knee surgery.

Methods

This study used baseline data from the TRajectory of knee heaLth in runners (TRAIL) prospective cohort study [3]. We included 214 runners, 108 with a history of knee surgery (55 males, 53 females; average 10 years post-surgery, 60% anterior cruciate ligament reconstruction) and 106 without (52 males, 54 females). All participants underwent biomechanical assessment during overground running (3-3.5 m/s) at the La Trobe University Gait Laboratory. Kinematic and kinetic data were recorded via a 10-camera 3D motion capture system (VICON Motion Systems Ltd, sampling at 200Hz) and two force plates embedded in the laboratory floor (AMTI, sampling at 1000Hz), respectively. A biomechanical model was created in OpenSim 4.3 to examine the entire stride cycle. For each running trial (n = 8 per participant), inverse kinematics were used to generate sagittal plane knee angles, while inverse dynamics were used to generate knee joint moments for the surgical limb (surgical group) and a randomly selected limb of the controls. Comparisons between participants with and without a history of knee surgery was split by sex, given the known differences in running biomechanics between males and females. Differences between groups were explored using t-tests via statistical parametric mapping with alpha set at 0.05.

Results and Discussion

No significant differences (p>0.05) were observed in sagittal plane knee angles or moments during running between runners with and without a history of knee surgery, for both males and females (Figure 1). The knee joint moment was slightly lower during the stance phase for females with a history of surgery compared to females without a history of surgery. However, this difference was not statistically significant.

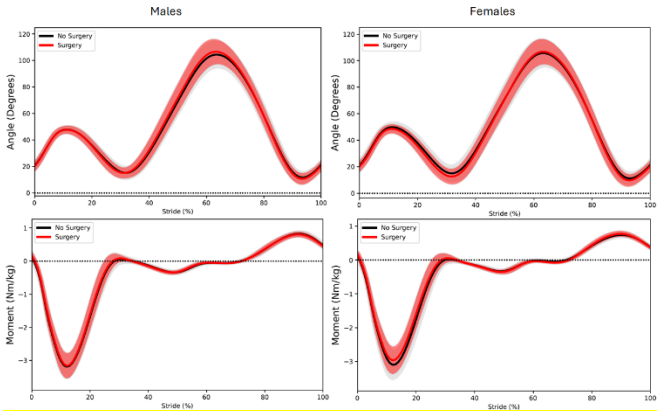

Figure 1: Differences between sagittal plane knee angles (top row) and moments (bottom row) during running between runners with (red) and without (black) a history of knee surgery, split for males (left column) and females (right column).

Conclusions

There were no differences in sagittal plane knee angles or moments during running between runners with and without a history of knee surgery. Future longitudinal research should explore how running biomechanics may influence the onset and progression of post-traumatic knee osteoarthritis.

References

[1] Poulsen E et al. (2019) *Br J Sports Med*, **53**: 1454-1463.
[2] D'Souza N et al. (2022) *OAC*, **30**: 381-394.
[3] De Oliveira Silva D et al. (2023) *BMJ Open*, **13:**e068040