Are ankle and tibial kinematics associated with medial tibial stress syndrome development?

Joshua P.M. Mattock[1], Julie R. Steele[1], Karen J. Mickle[2]
[1]Biomechanics Research Laboratory, University of Wollongong, Wollongong, Australia
[2]Applied Sports Science and Exercise Testing Laboratory, University of Newcastle, Newcastle, Australia
Email: jmattock@uow.edu.au

Summary

This case-control and case study investigated whether ankle and tibial kinematics were associated with medial tibial stress syndrome (MTSS) development. The limbs of long-distance runners with MTSS and the bilateral baseline kinematics of a case study were compared to those of asymptomatic long-distance runners. The findings of this study suggest that reduced ankle plantarflexion may be associated with MTSS development.

Introduction

MTSS, one of the most prevalent running injuries, is associated with repeated tibial bending, causing tibial loading above its remodeling capacity at the posteromedial tibial border [1,2]. Greater rearfoot eversion and tibial varus angle are reported to be associated with MTSS development [3]. However, although kinematic peaks and mean values of these variables have been analyzed, no continuous analysis of ankle and tibial joint angles across the stance phase has been conducted, and prospective studies are lacking. Therefore, we aimed to (i) determine whether stance phase ankle and tibial kinematics during running differed between MTSS symptomatic and asymptomatic long-distance runners and (ii) present a prospective case study of a runner who developed MTSS to determine the role of these variables in MTSS development.

Methods

Eleven MTSS symptomatic long-distance runners (8 female; age=32.9±9.2 years; mass=68.3±6.3 kg; height=172±5.1 cm) were matched with 11 asymptomatic controls (8 female; age=32.5±9.4 years; mass=66.1±6.2 kg; height=170±6.8 cm) based on age, height, limb dominance, and training load. This provided 11 symptomatic and 11 control limbs. After prospective monitoring, a male (age=26.3 years; mass=78.8 kg; height=191.5 cm) developed bilateral MTSS. 3D motion capture and pressure-measuring insoles monitored stance phase 3D ankle and tibial kinematics while participants ran on a treadmill. Statistical parametric mapping of multiple independent *t*-tests determined whether a significant difference existed in kinematics between the MTSS symptomatic and control limbs ($p<0.05$). Descriptive analyses of the mean kinematic trajectories and 95% confidence intervals were conducted for baseline data from the left and right limbs of the case study and control limbs.

Results and Discussion

No significant differences were found in 3D kinematics of the ankle and tibia between MTSS symptomatic and asymptomatic controls. Compared to the control limbs, the case study limbs displayed inconsistent findings between the left and right limbs for most joints and planes. However, non-overlapping 95% confidence intervals suggest that the case study displayed greater ankle dorsiflexion later in the stance phase and reduced plantar flexion bilaterally compared to the control limbs (Figure 1). We speculate that this reduced plantar flexion could be associated with reduced ankle plantar flexion strength and endurance, contributing to an impaired ability to resist tibial bending moments during the propulsive phase [4]. Potentially, greater plantar flexor force could facilitate posterior tibial bending to reduce tensile loading at the posterior medial tibia and lessen the risk of MTSS.

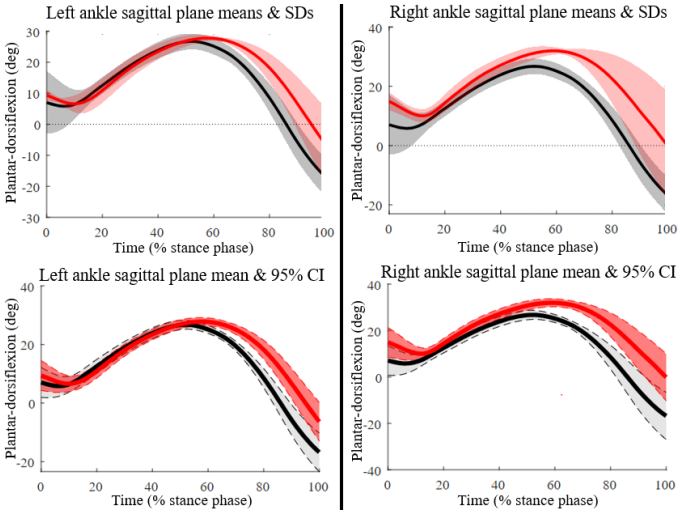

Figure 1: Sagittal plane ankle motion, mean, standard deviation (SD), and 95% confidence interval (CI) trajectories. Control limbs (mean = black line, SD and 95% CI grey), case study limbs (mean = red line, SD & 95% CI shaded red).

Conclusions

Greater ankle dorsiflexion and reduced plantar flexion displayed by the case study might be associated with MTSS development. However, further prospective studies are required to substantiate these findings.

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References

[1] Mulvad B et al. (2018). *Plos One*, 13(10).
[2] Moen MH et al. (2009). *Sports Med*, **39**(7), 523-546.
[3] Becker J et al. (2017). *Am J Sports Med*, **25**(11), 2615-21.
[4] Mattock JM et al. (2024). *J Athl Train*, **59**(11) 1095-99.