Title: An exploratory investigation of patellofemoral joint loadings during directional lunges in badminton

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Background: Anterior knee pain is a commonly documented musculoskeletal disorder among badminton players. However, current biomechanical studies of badminton lunges mainly report kinetic profiles in the lower extremity with few investigations of in-vivo loadings. The objective of this study was to evaluate tissue loadings in the patellofemoral joint via musculoskeletal modelling and Finite Element simulation.

Methods: The collected marker trajectories, ground reaction force and muscle activation data were used for musculoskeletal modelling to compute knee joint angles and quadricep muscle forces. These parameters were then set as boundary conditions and loads for a quasistatic simulation using the Abaqus Explicit solver.

Results & Discussion: Simulations revealed that the left-forward (LF) and backward lunges showed greater contact pressure (14.98–29.61%) and von Mises stress (14.17–32.02%) than the right-forward and backward lunges; while, loadings in the left-backward lunge were greater than the left-forward lunge by 13–14%. Specifically, the stress in the chondral layer was greater than the contact interface, particularly in the patellar cartilage. These findings suggest that right-side dominant badminton players load higher in the right patellofemoral joint during left-side (backhand) lunges.

Conclusions: Knowledge of these tissue loadings may provide implications for the training of badminton footwork, such as musculature development, to reduce cartilage loading accumulation, and prevent anterior knee pain.