Supplementary File 4: PhysioFIRST hip biomechanics assessment and calculation.

As outlined, hip biomechanics will be a secondary outcome of the study. Forty participants (20 per group) will undergo a baseline (pre-intervention) and 6-month follow-up (post-intervention) biomechanical assessment at the La Trobe University Gait Laboratory.

Experimental data collection: Participants will be required to change into a pair of running shorts, running singlet, and a pair of Teva Original-Universal sandals (Deckers Brands, Goleta, CA) to allow adequate exposure of bony landmarks for accurate marker placement. Forty-nine small (14 mm) spherical reflective markers (B & L Engineering, Albion, Australia) will be placed on the participant's body utilising a previously published protocol [1]. In summary, for the upper body and trunk, marker locations are on the C7 spinous process, acromioclavicular joints, lateral epicondyle of the humerus, and the posterior joint line of the wrists. A thermoplastic plate with four markers is affixed to the pelvis of the participant using a belt at the height of the posterior superior iliac spine, with two additional markers placed on the anterior superior iliac spines. For the lower limbs and feet, markers will be placed on the medial and lateral femoral condyles, medial and lateral malleoli, 5^{th} and 1^{st} metatarsal heads, and the great toes. Four additional segment tracking markers are placed on each thigh (two anterior, two lateral), three on the shank (two anterior, one lateral), and two on the midfoot (one superior, one lateral) [1]. Such marker locations are consistent with previously published biomechanics studies in hip pain [2-4].

Marker trajectories will be collected using a ten camera opto-reflective motion capture system (Vicon Motion Systems Ltd, Oxford, UK) sampling at 100 Hz. Ground reaction force (GRF) data will be collected using two 600mm*400mm force plates in series (Advanced Mechanical Technology, Watertown, MA) and one 1200mm*600mm force plate (for running only) (Advanced Mechanical Technology, Watertown, MA) mounted in the laboratory floor. GRF data will be sampled at 1000 Hz. Marker trajectories and GRF data will be recorded concurrently using Vicon Nexsus version 2.8 (Vicon Motion Systems Ltd, Oxford, UK).

Functional task data collection: Prior to data collection of the functional tasks, a static calibration trial will be captured, with the participant standing in an upright neutral posture, with their arms out to the side, to calculate anthropometric properties and lower limb joint centres. Following this, participants will complete four functional tasks for biomechanical data collection; walking, single-leg squats, the Y-balance test, and running.

- Walking: participants will be instructed to walk along a 10-metre walkway through the capture volume of the cameras at a comfortable self-selected speed.
- Single-leg squat: Participants will complete 10 (5 each leg) single-leg squats on the force plates in time with a metronome at 60 beats per minute. Participants will be instructed to maintain a stationary single-leg stance for two beats, descend for two beats, ascend for two beats and maintain a stationary single-leg stance for a final two beats. A maximal depth indicator will be located 10 cm behind the participant and set to a height whereby the end of the descent phase corresponds to 60 degrees knee flexion (calculated via the use of a hydraulic plinth and goniometer during participant setup).
- Y-balance test: participants will complete six y-balance tests (three each limb) within the capture volume of the cameras as per standard protocol [5].
- Running: participants will be instructed to run along a 20-metre walkway through the capture volume of the cameras (utilising the larger force plate) at speed between 3 and 3.5 m/s (calculated using timing gates placed 5 m apart inside the capture volume). Verbal

feedback will be given to the participants to speed up or slow down after each trial until the prescribed speed is obtained.

Hip joint kinematics and kinetics: A seven-segment (pelvis, left/right thigh, left/right shank, left/right foot) customised biomechanical model will be generated in Vicon BodyBuilder 3.6.4 (Vicon Motion Systems Ltd, Oxford, UK). This model will utilise previously defined anatomical co-ordinate systems by Schache and Baker [6]. The hip joint centre will be defined according to Harrington, Zavatsky, Lawson, Yuan, & Theologis [7] and a dynamic optimisation approach will be used to determine the knee flexion and extension axis [8]. Pelvis angles will be calculated in reference to the lab (global) co-ordinate system utilising the Cardan sequence recommended by Baker [9]. Hip joint angles will be calculated using a joint co-ordinate system convention [10], with a standard inverse dynamic method used to calculate external joint moments [6]. External joint moments will be reported in the same non-orthogonal joint co-ordinate system as the calculated hip, knee, and ankle angles [6]. Joint moments will be normalised to body mass and reported as Newton metres per kilogram (Nm/kg) for analysis.

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