**REVISED FULBRIGHT STUDY**

**Motivation:**

Pivoting after landing from height is a frequent and necessary manoeuvre undertaken during many sports, such as contesting for a mark during Australian Rules Football (AFL) and heading the ball in soccer. However, for individuals with femoroacetabular impingement (FAI) syndrome, this manoeuvre may exacerbate symptoms such as pain. Despite increasing knowledge of the aetiology and natural history of FAI syndrome, the impact of FAI syndrome on human biomechanics during dynamic “everyday” weightbearing tasks is poorly understood.

Despite increasing knowledge of the aetiology of femoroacetabular impingement syndrome, the impact of FAIS on human biomechanics during dynamic “everyday” weightbearing tasks is poorly understood. Individuals with FAIS typically experience pain when the hip is simultaneously flexed, abducted/adducted and externally/internally rotated (FABER/FADIR). The step-down-and-pivot task requires coordination of movement in all three planes and activates both pain modes, and to my knowledge, has not been extensively studied in the context of FAIS. Biomechanical analysis of tasks that involve these movements can provide valuable insight into the natural history of this condition, and will contribute to evidence-based clinical approaches to its treatment.

**Objective 1:**

To compare and explain differences in kinematic and kinetic patterns during a step-down-and-pivot task (1) between individuals with FAIS and healthy controls; (2) across levels of severity of hip/groin pain; and (3) between different modes of pain (FABER/FADIR/both).

Primary outcome measures: group differences in lower-limb joint angles, joint moments

Method: OpenSim IK and ID

Analysis: SPM

**Objective 2:**

To explore “muscle function” in individuals with FAIS during the step-down-and-pivot task, i.e., to quantify differences in muscular coordination of centre-of-mass accelerations: (1) compared to healthy controls; (2) across levels of severity of hip/groin pain; and (3) between different modes of pain (FABER/FADIR/both).

Primary outcome measures: group differences in muscle activation patterns, induced accelerations

Method: OpenSim CMC and induced accelerations

Analysis: SPM

Additional development: Implement the pseudoinverse-based GRF-decomposition approach by Lin et al. (https://doi.org/10.1002/cnm.1396) as a Python package using the OpenSim API. This method was previously implemented by Dr Tim Dorn (NMBL & University of Melbourne) as an OpenSim 3.2 plug-in, which is now obsolete.

**Spare-time personal development**

Develop Moco-based predictive musculoskeletal simulations of the pivot phase only of the step-down-and-pivot task with penalisation to simulate FABER/FADIR/both pain modes at the hip. Compare simulated optimal movement patterns and muscular coordination to those actually found from Objectives 1 and 2. This is revisits my 2019 Visiting Scholar goals, to use Moco to simulate deep squats using FAIS, which were not achieved due to limitations on muscle moment arms about the knee in full flexion.