

Arthritis Australia Lay Project Report

Title: Feasibility of movement retraining in a natural environment for self-management of hip osteoarthritis

Funded by: Arthritis Australia, Gladys Irene Benjamin Estate

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Overview

Suboptimal mechanical loading contributes to hip osteoarthritis (OA) progression. Articular loading is necessary for cartilage remodelling, though abnormal loading (insufficient, excessive, or concentrated) can drive cartilage degeneration. We have previously proven that abnormal hip loading is a key marker of hip OA severity and can be improved with laboratory-based movement retraining. To make this intervention accessible outside the lab, we developed Smarti-Shorts. Smarti-Shorts is a wearable garment we co-designed with consumers that monitors hip loading during daily activities in a natural environment. In this proof-of-concept study, we assessed the validity of Smarti-Shorts to measure hip biomechanics when people with hip OA walked using nine walking modifications.

To achieve our aim, we used Smarti-Shorts in combination with artificial intelligence (neural network) to estimate hip biomechanics and compared its accuracy to gold-standard laboratory measurement and modelling methods. A female participant with hip OA attended two laboratory sessions where they walked on an instrumented treadmill wearing custom Smarti-Shorts. The shorts were equipped with sensors (textile electrodes and inertial measurement units) embedded in the shorts' fabric. The participant walked using nine gait modifications while receiving real-time visual biofeedback of a personalised target to a monitor in front of the treadmill.

What problems did you try to solve, or gaps in knowledge did you try to fill?

Conservative non-drug interventions recommended for management (e.g., exercise, weight loss) are much less effective for hip OA compared to knee OA. These poor treatment outcomes are because mechanical targets for the treatment of hip OA are not well defined, not personalised, and not measurable outside the lab. Our consumer co-design focus groups confirmed a need for a novel, effective therapeutic alternative to joint replacement surgery and current conservative management options.

Movement retraining delivered via Smarti-Shorts has potential to disrupt the harmful underloading of hip cartilage associated with hip OA and will close a critical gap in therapeutic options for patients. A portable, cost-effective, ultra-personalised technology, like Smarti-Shorts, will ensure people with hip OA can access the right treatment, every day, in any environment, including those in remote communities. Smarti-Shorts could solve a key

blockage in the research-translation pipeline hampering out-of-lab implementation of effective movement retraining for treatment of hip OA.

What did you discover during the course of the grant?

We showed that Smarti-Shorts, in combination with our developed neural network, can measure hip loading accurately during nine different gait modifications compared to gold standard laboratory measurement. Importantly, we showed Smarti-Shorts can detect small changes in hip motion and loading that occur during gait retraining interventions which are highly relevant to cartilage health and adaption.

Have the findings of the research already benefited people with musculoskeletal disease?

We have actively collaborated with people with hip OA across all stages of this work to ensure the Smarti-Shorts concept, design, and movement retraining intervention align with their needs and preferences. Findings from this study provide essential data for us to move towards a feasibility trial in people with hip OA, which we are hopeful will result in symptom relief and long-term benefit for cartilage health.

How might the findings inform further research to help sufferers in the future?

Findings from this study provide essential validation data needed to undertake a feasibility trial in people with hip OA. We are hopeful that a feasibility trial will generate pilot data evidencing feasibility of Smarti-Shorts for reducing symptoms in people with hip OA. Results could be used to inform the future clinical trials necessary to update clinical practice and policy, as appropriate, for management of hip OA.

Are you planning to continue the research?

Yes. We have been awarded additional funding to explore the perspectives of clinicians on the acceptability and feasibility of integrating Smarti-Shorts into their treatment plans. We also have an accompanying mobile application under development. We have applied for funding to update the design of Smarti-Shorts to include sensor-embedded real-time feedback during walking, and to conduct a feasibility trial.